



## Standard Recovery Diodes (MAGN-A-PAK Power Modules), 250 A to 320 A

**MAGN-A-PAK****FEATURES**

- High voltage
- Electrically isolated base plate
- 3000 V<sub>RMS</sub> 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](http://www.vishay.com/doc?99912)

**RoHS**  
COMPLIANT**PRIMARY CHARACTERISTICS**

|                       |                                                                        |
|-----------------------|------------------------------------------------------------------------|
| I <sub>F(AV)</sub>    | 250 A to 320 A                                                         |
| Type                  | Modules - diode, high voltage                                          |
| Package               | MAGN-A-PAK                                                             |
| Circuit configuration | Two diodes doubler circuit,<br>two diodes common cathode, single diode |

**DESCRIPTION / APPLICATIONS**

This VS-VSK series of MAGN-A-PAKs uses high voltage power diodes in two 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 and the single diode module can be used in conjunction with the thyristor modules as a freewheel diode.

These modules are intended for general purpose applications such as battery chargers, welders and plating equipment and where high voltage and high current are required (motor drives, etc.)

**MAJOR RATINGS AND CHARACTERISTICS**

| SYMBOL              | CHARACTERISTICS | VSK.250..   | VSK.270..   | VSK.320..   | UNITS              |
|---------------------|-----------------|-------------|-------------|-------------|--------------------|
| I <sub>F(AV)</sub>  |                 | 250         | 270         | 320         | A                  |
|                     | T <sub>C</sub>  | 100         | 100         | 100         | °C                 |
| I <sub>F(RMS)</sub> |                 | 393         | 424         | 502         | A                  |
| I <sub>FSM</sub>    | 50 Hz           | 7015        | 8920        | 10 110      |                    |
|                     | 60 Hz           | 7345        | 9430        | 10 580      |                    |
| I <sup>2</sup> t    | 50 Hz           | 246         | 398         | 511         | kA <sup>2</sup> s  |
|                     | 60 Hz           | 225         | 363         | 466         |                    |
| I <sup>2</sup> √t   |                 | 2460        | 3980        | 5110        | kA <sup>2</sup> √s |
| V <sub>RRM</sub>    |                 | 400 to 2000 | 400 to 3000 | 400 to 2000 | V                  |
| T <sub>J</sub>      |                 | -40 to +150 |             |             | °C                 |



## ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS                        |              |                                                          |                                                              |                                   |
|----------------------------------------|--------------|----------------------------------------------------------|--------------------------------------------------------------|-----------------------------------|
| TYPE NUMBER                            | VOLTAGE CODE | $V_{RRM}$ , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE<br>V | $V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | $I_{RRM}$ MAXIMUM AT 150 °C<br>mA |
| VS-VSK.270<br>VS-VSK.320               | 04           | 400                                                      | 500                                                          | 50                                |
| VS-VSK.250<br>VS-VSK.270<br>VS-VSK.320 | 08           | 800                                                      | 900                                                          |                                   |
|                                        | 12           | 1200                                                     | 1300                                                         |                                   |
|                                        | 16           | 1600                                                     | 1700                                                         |                                   |
|                                        | 20           | 2000                                                     | 2100                                                         |                                   |
| VS-VSK.270                             | 30           | 3000                                                     | 3100                                                         |                                   |

| FORWARD CONDUCTION                                            |                     |                                                                                                                                                                                                                       |                                      |                                                                          |         |         |         |                    |
|---------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------|---------|---------|---------|--------------------|
| PARAMETER                                                     | SYMBOL              | TEST CONDITIONS                                                                                                                                                                                                       |                                      |                                                                          | VALUES  |         |         | UNITS              |
|                                                               |                     |                                                                                                                                                                                                                       |                                      |                                                                          | VSK.250 | VSK.270 | VSK.320 |                    |
| Maximum average forward current at case temperature           | I <sub>F(AV)</sub>  | 180° conduction, half sine wave                                                                                                                                                                                       |                                      |                                                                          | 250     | 270     | 320     | A                  |
|                                                               |                     |                                                                                                                                                                                                                       |                                      |                                                                          | 100     | 100     | 100     | °C                 |
| Maximum RMS forward current                                   | I <sub>F(RMS)</sub> | As AC switch                                                                                                                                                                                                          |                                      |                                                                          | 393     | 424     | 502     | A                  |
| Maximum peak, one-cycle forward, non-repetitive surge current | I <sub>FSM</sub>    | t = 10 ms                                                                                                                                                                                                             | No voltage reappplied                | Sinusoidal half wave, initial<br>T <sub>J</sub> = T <sub>J</sub> maximum | 7015    | 8920    | 10 110  |                    |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                            |                                      |                                                                          | 7345    | 9340    | 10 580  |                    |
|                                                               |                     | t = 10 ms                                                                                                                                                                                                             | 100 %<br>V <sub>RRM</sub> reappplied |                                                                          | 5900    | 7500    | 8500    |                    |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                            |                                      |                                                                          | 6180    | 7850    | 8900    |                    |
| Maximum I <sup>2</sup> t for fusing                           | I <sup>2</sup> t    | t = 10 ms                                                                                                                                                                                                             | No voltage reappplied                |                                                                          | 246     | 398     | 511     | kA <sup>2</sup> s  |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                            |                                      |                                                                          | 225     | 363     | 466     |                    |
|                                                               |                     | t = 10 ms                                                                                                                                                                                                             | 100 %<br>V <sub>RRM</sub> reappplied |                                                                          | 174     | 281     | 361     |                    |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                                            |                                      |                                                                          | 159     | 257     | 330     |                    |
| Maximum I <sup>2</sup> √t for fusing                          | I <sup>2</sup> √t   | t = 0.1 ms to 10 ms, no voltage reappplied                                                                                                                                                                            |                                      |                                                                          | 2460    | 3980    | 5110    | kA <sup>2</sup> √s |
| Low level value of threshold voltage                          | V <sub>F(TO)1</sub> | (16.7 % × π × I <sub>F(AV)</sub> ) < I < π × I <sub>F(AV)</sub> ,<br>T <sub>J</sub> = T <sub>J</sub> maximum                                                                                                          |                                      |                                                                          | 0.79    | 0.74    | 0.69    | V                  |
| High level value of threshold voltage                         | V <sub>F(TO)2</sub> | (I > π × I <sub>F(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                                                                                                                                |                                      |                                                                          | 0.92    | 0.87    | 0.86    |                    |
| Low level forward slope resistance                            | r <sub>f1</sub>     | (16.7 % × π × I <sub>F(AV)</sub> ) < I < π × I <sub>F(AV)</sub> ,<br>T <sub>J</sub> = T <sub>J</sub> maximum                                                                                                          |                                      |                                                                          | 0.63    | 0.94    | 0.59    | mΩ                 |
| High level forward slope resistance                           | r <sub>f2</sub>     | (I > π × I <sub>F(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                                                                                                                                |                                      |                                                                          | 0.49    | 0.81    | 0.44    |                    |
| Maximum forward voltage drop                                  | V <sub>FM</sub>     | I <sub>FM</sub> = π × I <sub>F(AV)</sub> , T <sub>J</sub> = T <sub>J</sub> maximum, 180° conduction<br>Average power = V <sub>F(TO)</sub> × I <sub>F(AV)</sub> + r <sub>f</sub> × (I <sub>F(RMS)</sub> ) <sup>2</sup> |                                      |                                                                          | 1.29    | 1.48    | 1.28    | V                  |

| BLOCKING                             |           |                                                        |        |       |
|--------------------------------------|-----------|--------------------------------------------------------|--------|-------|
| PARAMETER                            | SYMBOL    | TEST CONDITIONS                                        | VALUES | UNITS |
| Maximum peak reverse leakage current | $I_{RRM}$ | $T_J = 150$ °C                                         | 50     | mA    |
| RMS insulation voltage               | $V_{INS}$ | 50 Hz, circuit to base, all terminals shorted, t = 1 s | 3000   | V     |



| THERMAL AND MECHANICAL SPECIFICATIONS                     |                        |                                   |                                                                                                                                                |             |         |         |       |
|-----------------------------------------------------------|------------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------|---------|-------|
| PARAMETER                                                 |                        | SYMBOL                            | TEST CONDITIONS                                                                                                                                | VALUES      |         |         | UNITS |
|                                                           |                        |                                   |                                                                                                                                                | VSK.250     | VSK.270 | VSK.320 |       |
| Maximum junction operating and storage temperature range  |                        | T <sub>J</sub> , T <sub>Stg</sub> |                                                                                                                                                | -40 to +150 |         |         | °C    |
| Maximum thermal resistance, junction to case per junction |                        | R <sub>thJC</sub>                 | DC operation                                                                                                                                   | 0.16        | 0.125   | 0.125   | K/W   |
| Maximum resistance, case to heat sink per module          |                        | R <sub>thCS</sub>                 | Mounting surface flat, smooth and greased                                                                                                      | 0.035       |         |         |       |
| Mounting torque<br>± 10 %                                 | MAGN-A-PAK to heatsink |                                   | A mounting compound is recommended and the torque should be rechecked after a period of about 3 hours to allow for the spread of the compound. | 4 to 6      |         |         | Nm    |
|                                                           | Busbar to MAGN-A-PAK   |                                   |                                                                                                                                                |             |         |         |       |
| Approximate weight                                        |                        |                                   |                                                                                                                                                | 800         |         |         | g     |
|                                                           |                        |                                   |                                                                                                                                                | 30          |         |         | oz.   |
| Case style                                                |                        |                                   |                                                                                                                                                | MAGN-A-PAK  |         |         |       |

| ΔR CONDUCTION PER JUNCTION |                                                    |       |       |       |       |                                                     |       |       |       |       |       |
|----------------------------|----------------------------------------------------|-------|-------|-------|-------|-----------------------------------------------------|-------|-------|-------|-------|-------|
| DEVICE                     | SINUSOIDAL CONDUCTION<br>AT T <sub>J</sub> MAXIMUM |       |       |       |       | RECTANGULAR CONDUCTION<br>AT T <sub>J</sub> MAXIMUM |       |       |       |       | UNITS |
|                            | 180°                                               | 120°  | 90°   | 60°   | 30°   | 180°                                                | 120°  | 90°   | 60°   | 30°   |       |
| VSK.250                    | 0.009                                              | 0.010 | 0.014 | 0.020 | 0.032 | 0.007                                               | 0.011 | 0.015 | 0.021 | 0.033 | K/W   |
| VSK.270                    | 0.008                                              | 0.012 | 0.014 | 0.020 | 0.032 | 0.007                                               | 0.011 | 0.015 | 0.020 | 0.033 |       |
| VSK.320                    | 0.008                                              | 0.010 | 0.013 | 0.020 | 0.032 | 0.007                                               | 0.011 | 0.015 | 0.020 | 0.033 |       |

## Note

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

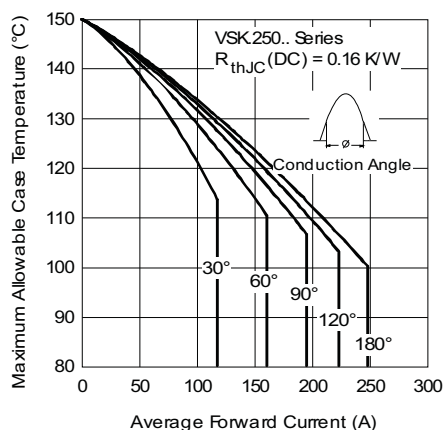


Fig. 1 - Current Ratings Characteristics

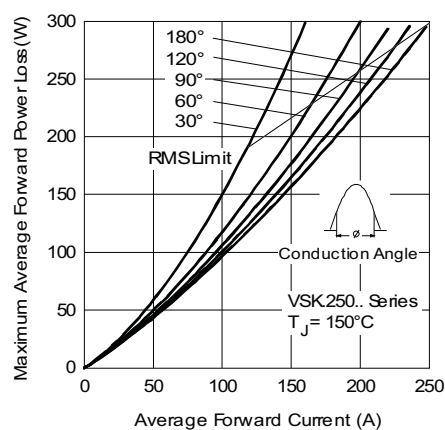


Fig. 3 - Forward Power Loss Characteristics

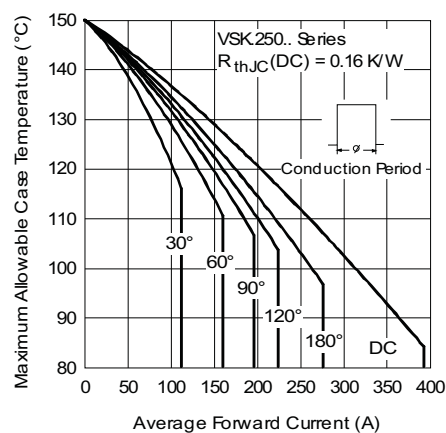


Fig. 2 - Current Ratings Characteristics

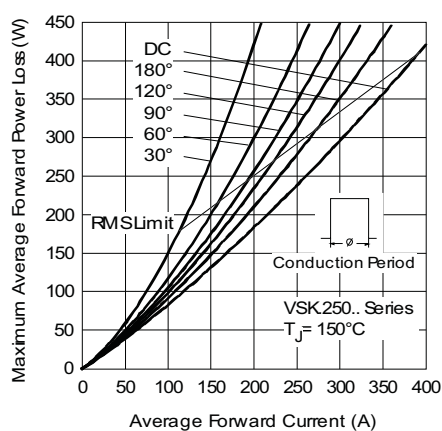


Fig. 4 - Forward Power Loss Characteristics

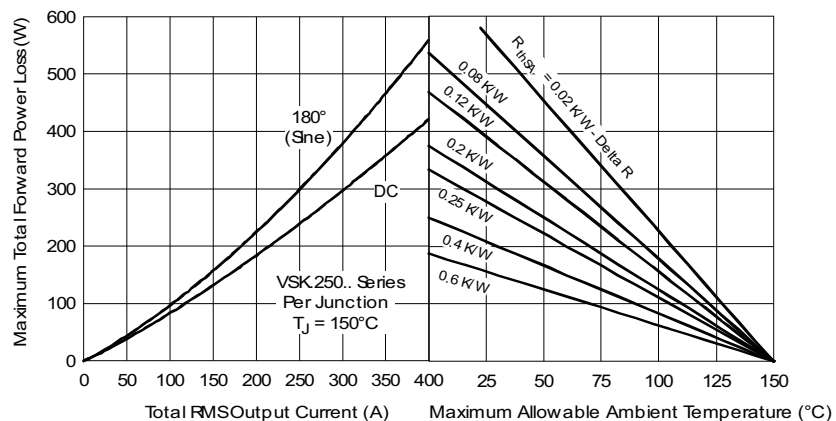


Fig. 5 - Forward Power Loss Characteristics

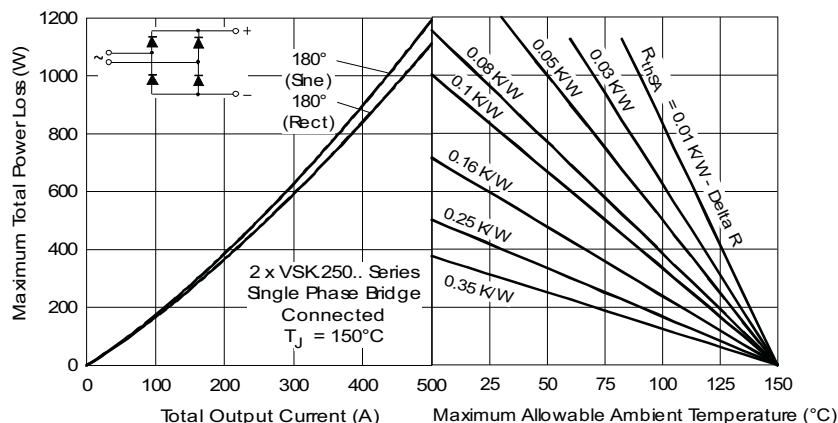


Fig. 6 - Forward Power Loss Characteristics

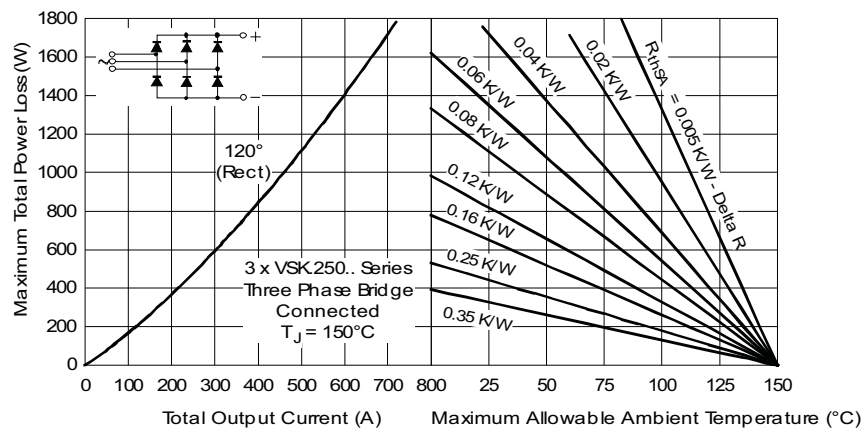


Fig. 7 - Forward Power Loss Characteristics

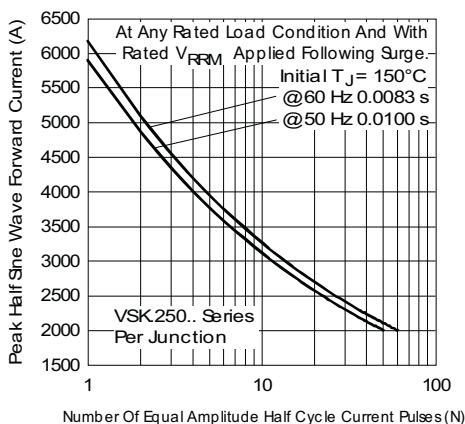


Fig. 8 - Maximum Non-Repetitive Surge Current

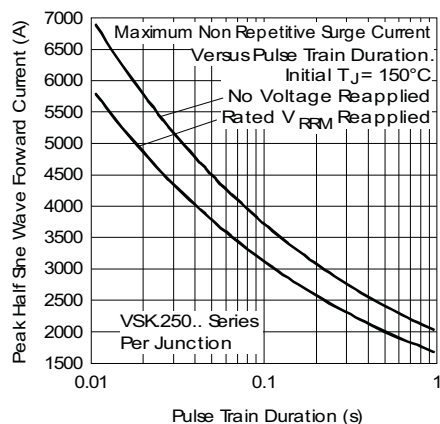


Fig. 9 - Maximum Non-Repetitive Surge Current

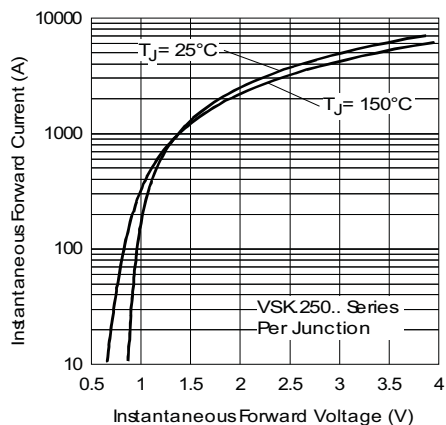


Fig. 10 - Forward Voltage Drop Characteristics

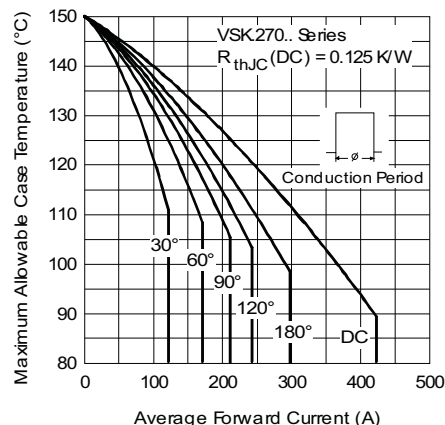


Fig. 13 - Current Ratings Characteristics

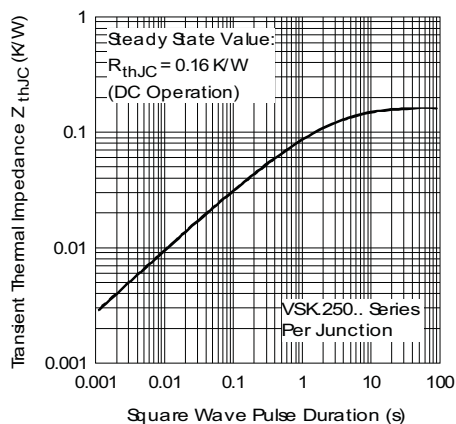


Fig. 11 - Thermal Impedance  $Z_{thJC}$  Characteristics

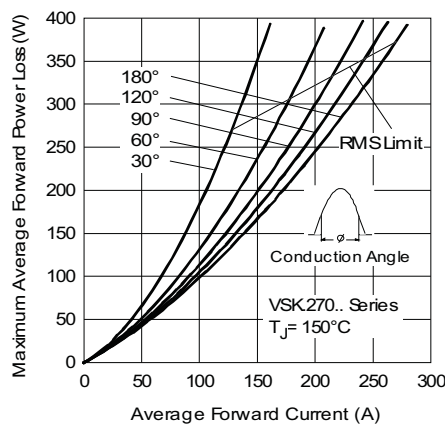


Fig. 14 - Forward Power Loss Characteristics

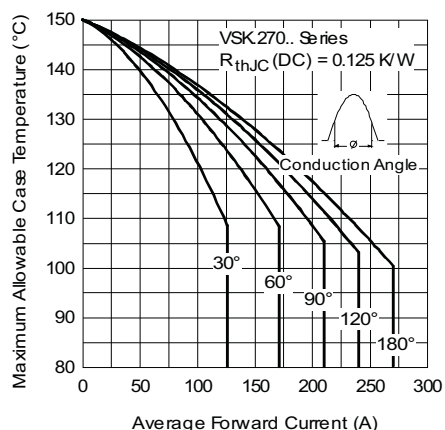


Fig. 12 - Current Ratings Characteristics

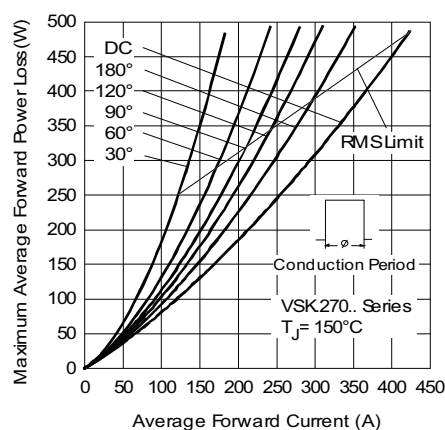


Fig. 15 - Forward Power Loss Characteristics

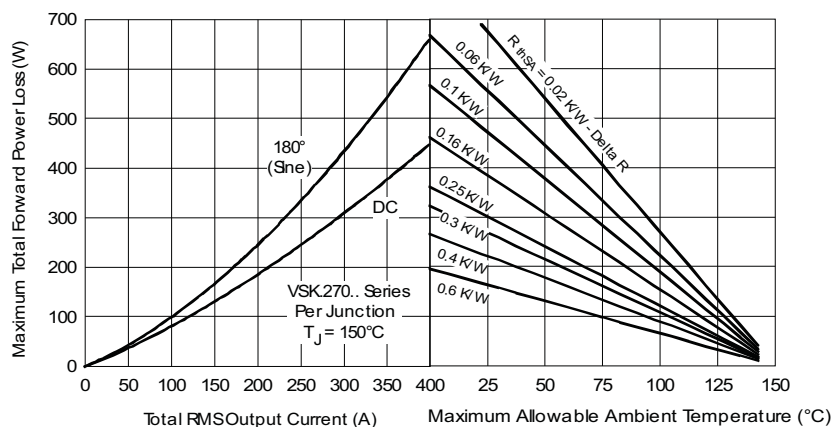


Fig. 16 - Forward Power Loss Characteristics

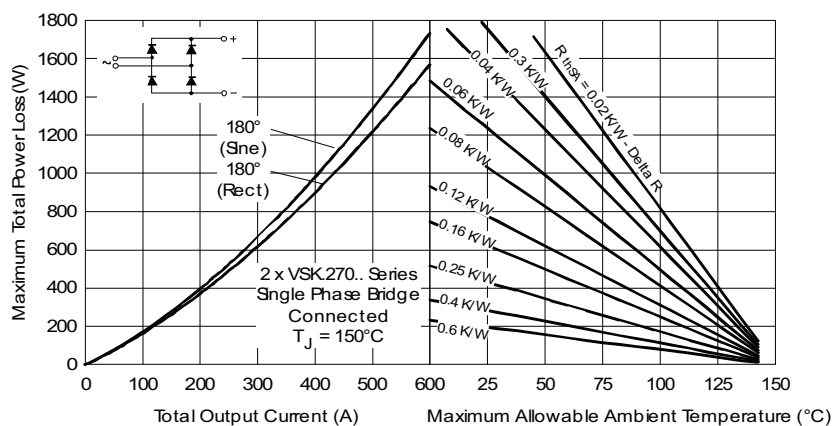


Fig. 17 - Forward Power Loss Characteristics

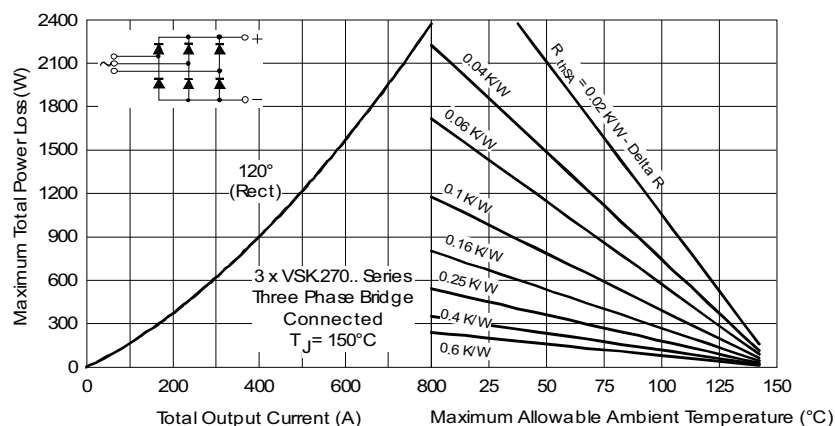


Fig. 18 - Forward Power Loss Characteristics

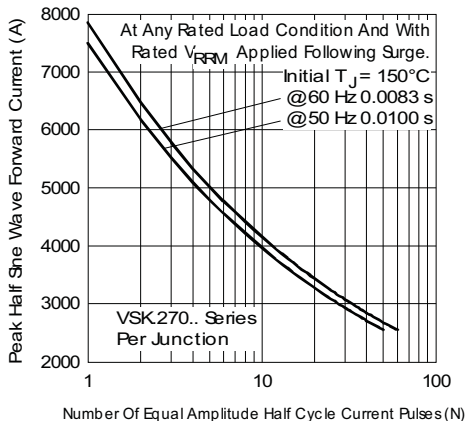


Fig. 19 - Maximum Non-Repetitive Surge Current

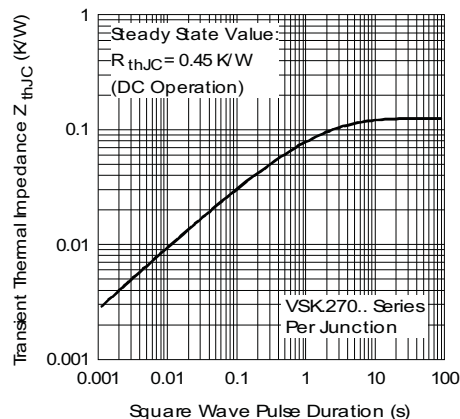


Fig. 22 - Thermal Impedance  $Z_{thJC}$  Characteristics

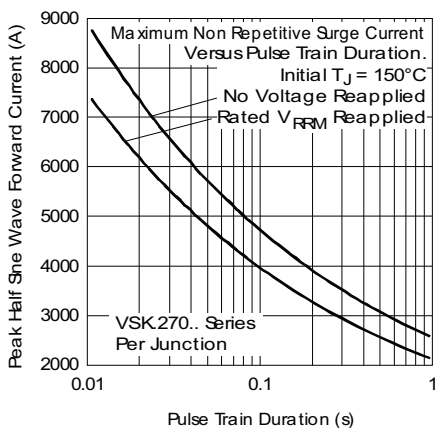


Fig. 20 - Maximum Non-Repetitive Surge Current

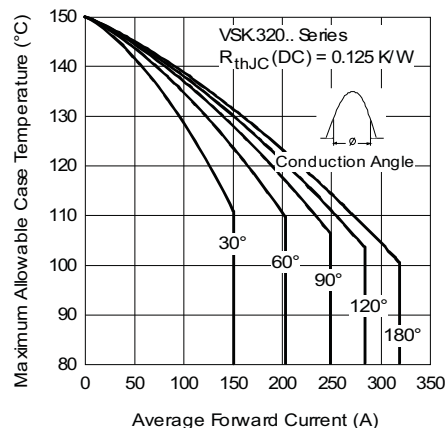


Fig. 23 - Current Ratings Characteristics

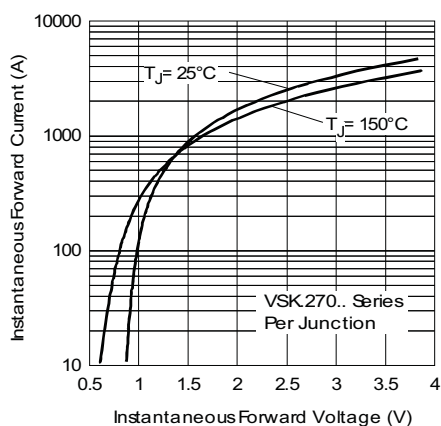


Fig. 21 - Forward Voltage Drop Characteristics

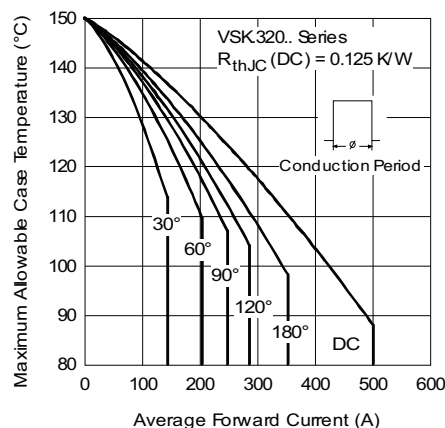


Fig. 24 - Current Ratings Characteristics

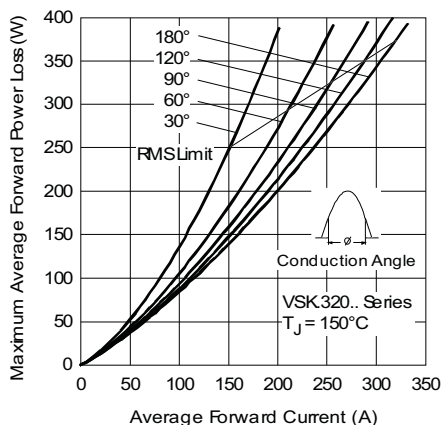


Fig. 25 - Forward Power Loss Characteristics

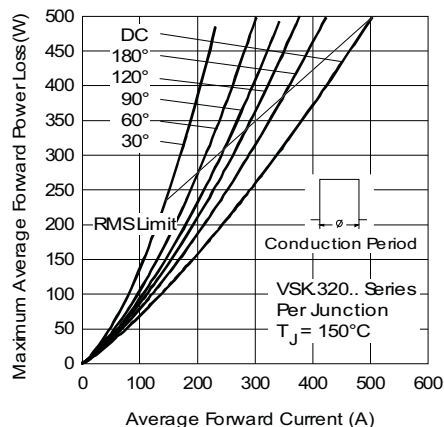


Fig. 26 - Forward Power Loss Characteristics

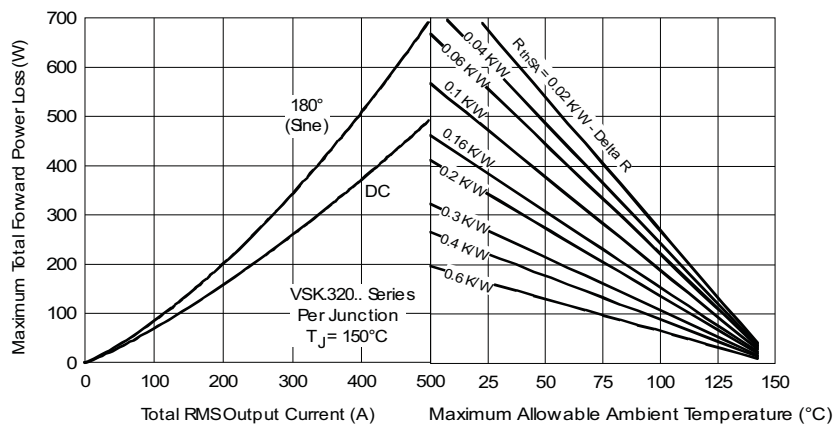


Fig. 27 - Forward Power Loss Characteristics

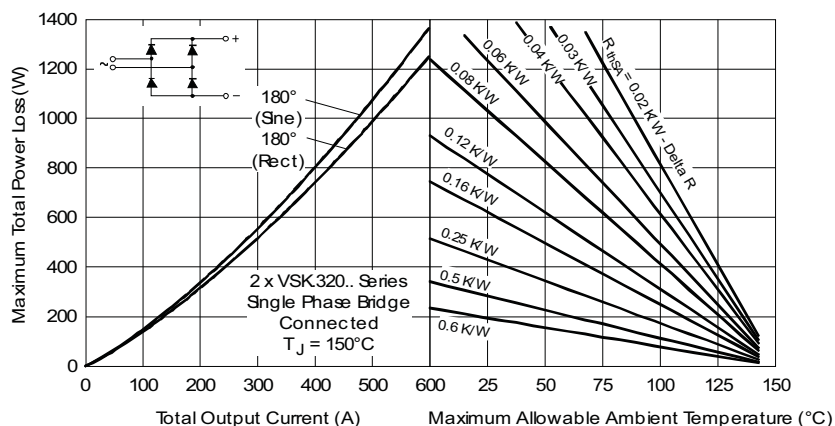


Fig. 28 - Forward Power Loss Characteristics

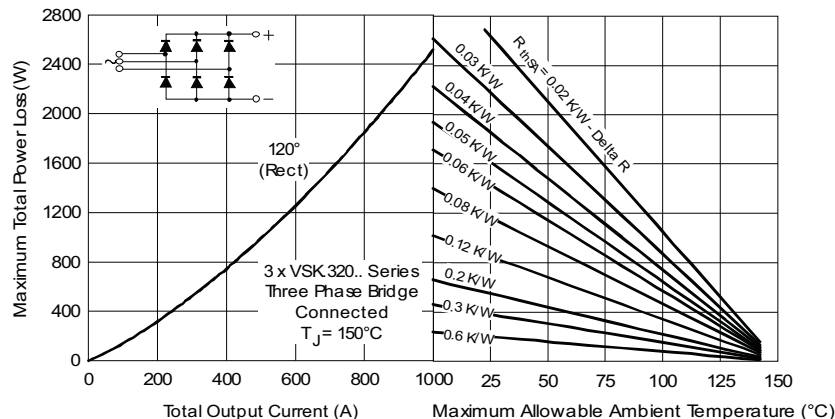


Fig. 29 - Forward Power Loss Characteristics

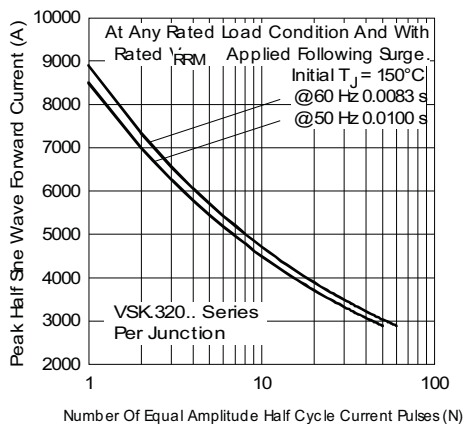


Fig. 30 - Maximum Non-Repetitive Surge Current

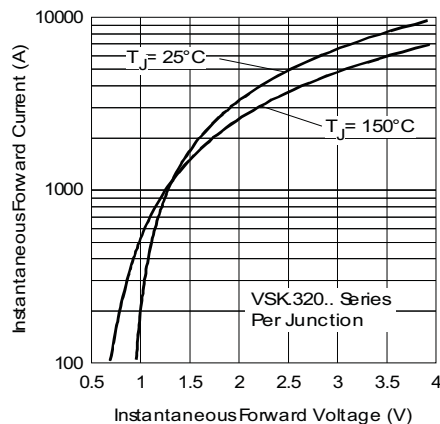


Fig. 32 - Forward Voltage Drop Characteristics

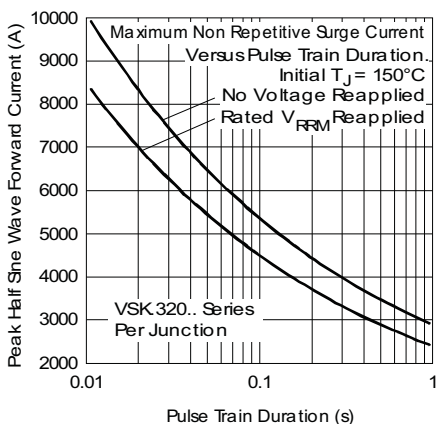


Fig. 31 - Maximum Non-Repetitive Surge Current

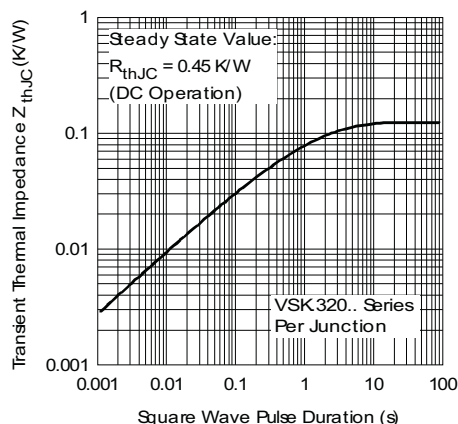


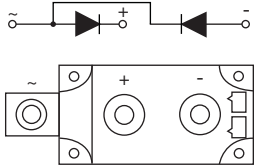
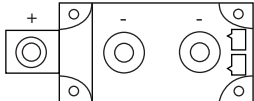
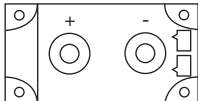
Fig. 33 - Thermal Impedance  $Z_{thJC}$  Characteristics



## ORDERING INFORMATION TABLE

| Device code | VS-VS | KD | 320 | - | 24 | PbF |
|-------------|-------|----|-----|---|----|-----|
|             | 1     | 2  | 3   |   | 4  | 5   |

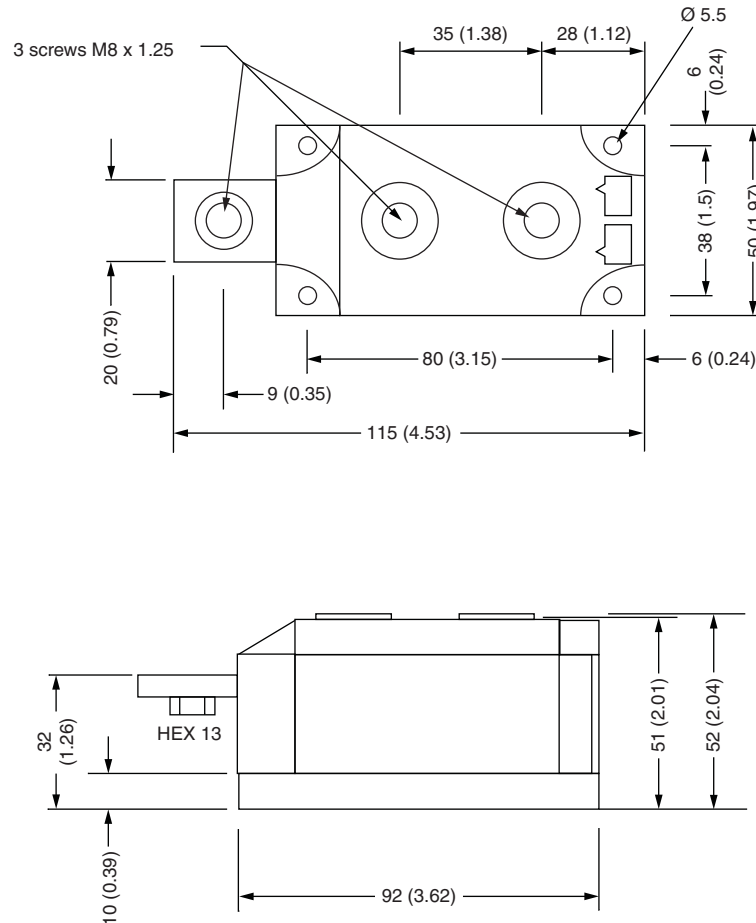
- 1** - Vishay Semiconductors product
- 2** - Circuit configuration (see Circuit Configuration table)
- 3** - Current rating:  $I_{F(AV)}$  rounded
- 4** - Voltage code  $\times 100 = V_{RRM}$  (see Voltage Ratings table)
- 5** - Lead (Pb)-free

| CIRCUIT CONFIGURATION      |                            |                                                                                                             |
|----------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------|
| CIRCUIT DESCRIPTION        | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING                                                                                             |
| Two diodes doubler circuit | KD                         | <p><b>VSKD...</b></p>   |
| Two diodes common cathode  | KC                         | <p><b>VSKC...</b></p>  |
| Single diode               | KE                         | <p><b>VSKE...</b></p>  |

| LINKS TO RELATED DOCUMENTS |                                                                        |
|----------------------------|------------------------------------------------------------------------|
| Dimensions                 | <a href="http://www.vishay.com/doc?95086">www.vishay.com/doc?95086</a> |

## 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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