

## Fast Recovery Diodes, 250 A (MAGN-A-PAK Power Modules)



MAGN-A-PAK

### FEATURES

- Fast recovery time characteristics
- Electrically isolated base plate
- Industrial standard package
- Simplified mechanical designs, rapid assembly
- High surge capability
- Large creepage distances
- 3000 V<sub>RMS</sub> isolating voltage
- UL approved file E78996 
- Compliant to RoHS Directive 2002/95/EC
- Designed and qualified for industrial level



**RoHS**  
COMPLIANT

### PRODUCT SUMMARY

|                    |                       |
|--------------------|-----------------------|
| I <sub>F(AV)</sub> | 250 A                 |
| Type               | Modules - Diode, Fast |

### DESCRIPTION

The VSK.L240 Series of MAGN-A-PAKs uses fast recovery power diodes in four basic configurations. The semiconductors are electrically isolated from the metal base, allowing common heatsinks and compact assemblies to be built. Application includes power supplies, battery chargers, welders, motor controls and general industrial current rectification. These modules are intended for those applications where fast recovery characteristics are required.

### MAJOR RATINGS AND CHARACTERISTICS

| SYMBOL              | CHARACTERISTICS | VSK.L240    |      | UNITS              |
|---------------------|-----------------|-------------|------|--------------------|
|                     |                 | S10/S20     | S30  |                    |
| I <sub>F(AV)</sub>  |                 | 250         | 240  | A                  |
|                     | T <sub>C</sub>  | 100         | 100  | °C                 |
| I <sub>F(RMS)</sub> |                 | 392         | 377  | A                  |
| I <sub>FSM</sub>    | 50 Hz           | 8000        | 7500 |                    |
|                     | 60 Hz           | 8400        | 7850 |                    |
| I <sup>2</sup> t    | 50 Hz           | 322         | 280  | kA <sup>2</sup> s  |
|                     | 60 Hz           | 294         | 256  |                    |
| I <sup>2</sup> √t   |                 | 3220        | 2800 | kA <sup>2</sup> √s |
| V <sub>RRM</sub>    | Range           | 600 to 2500 |      | V                  |
| T <sub>J</sub>      | Range           | - 40 to 150 |      | °C                 |



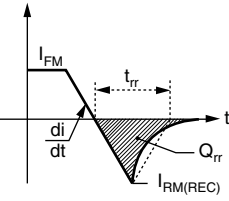
## ELECTRICAL SPECIFICATIONS

| VOLTAGE RATINGS |              |                      |                                                                 |                                                                     |                                          |
|-----------------|--------------|----------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------|
| TYPE NUMBER     | VOLTAGE CODE | t <sub>rr</sub> CODE | V <sub>RRM</sub> , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE<br>V | V <sub>RSM</sub> , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE<br>V | I <sub>RRM</sub> MAXIMUM AT 150 °C<br>mA |
| VSK.L240        | 06           | S10                  | 600                                                             | 700                                                                 | 50                                       |
|                 | 10           | S10                  | 1000                                                            | 1100                                                                |                                          |
|                 | 12           | S20                  | 1200                                                            | 1300                                                                |                                          |
|                 | 14           | S20                  | 1400                                                            | 1500                                                                |                                          |
|                 | 20           | S30                  | 2000                                                            | 2100                                                                |                                          |
|                 | 25           | S30                  | 2500                                                            | 2600                                                                |                                          |

| FORWARD CONDUCTION                                            |                     |                                                                                                                                                                                            |                                  |                                                                       |          |      |                   |                    |
|---------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------------------------------------|----------|------|-------------------|--------------------|
| PARAMETER                                                     | SYMBOL              | TEST CONDITIONS                                                                                                                                                                            |                                  |                                                                       | VSK.L240 |      | UNITS             |                    |
|                                                               |                     |                                                                                                                                                                                            |                                  |                                                                       | S10/S20  | S30  |                   |                    |
| Maximum average forward current at case temperature           | I <sub>F(AV)</sub>  | 180° conduction, half sine wave                                                                                                                                                            |                                  |                                                                       | 250      | 240  | A                 |                    |
|                                                               |                     |                                                                                                                                                                                            |                                  |                                                                       | 100      | 100  | °C                |                    |
| Maximum RMS forward current                                   | I <sub>F(RMS)</sub> | As AC switch                                                                                                                                                                               |                                  |                                                                       | 392      | 377  | A                 |                    |
| Maximum peak, one-cycle forward non-repetitive, surge current | I <sub>FSM</sub>    | t = 10 ms                                                                                                                                                                                  | No voltage reapplied             | Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum | 8000     | 7500 |                   |                    |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                 |                                  |                                                                       | 8400     | 7850 |                   |                    |
|                                                               |                     | t = 10 ms                                                                                                                                                                                  | 100 % V <sub>RRM</sub> reapplied |                                                                       | 6750     | 6300 |                   |                    |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                 |                                  |                                                                       | 7100     | 6600 |                   |                    |
| Maximum I <sup>2</sup> t for fusing                           | I <sup>2</sup> t    | t = 10 ms                                                                                                                                                                                  | No voltage reapplied             |                                                                       | 322      | 280  | kA <sup>2</sup> s |                    |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                 |                                  |                                                                       | 294      | 256  |                   |                    |
|                                                               |                     | t = 10 ms                                                                                                                                                                                  | 100 % V <sub>RRM</sub> reapplied |                                                                       | 228      | 198  |                   |                    |
|                                                               |                     | t = 8.3 ms                                                                                                                                                                                 |                                  |                                                                       | 208      | 181  |                   |                    |
| Maximum I <sup>2</sup> √t for fusing                          | I <sup>2</sup> √t   | t = 0.1 ms to 10 ms, no voltage reapplied                                                                                                                                                  |                                  |                                                                       | 3220     | 2800 |                   | 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> ), T <sub>J</sub> = T <sub>J</sub> maximum                                                                                   |                                  |                                                                       | 0.98     | 0.98 | 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                                                                                                                     |                                  |                                                                       | 1.31     | 1.31 |                   |                    |
| Low level value of forward slope resistance                   | r <sub>f1</sub>     | (16.7 % × π × I <sub>F(AV)</sub> < I < π × I <sub>F(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                                                                   |                                  |                                                                       | 0.75     | 0.97 | mΩ                |                    |
| High level value of forward slope resistance                  | r <sub>f2</sub>     | (I > π × I <sub>F(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum                                                                                                                     |                                  |                                                                       | 0.41     | 0.60 |                   |                    |
| Maximum forward voltage drop                                  | V <sub>FM</sub>     | I <sub>FM</sub> = 800 A, T <sub>J</sub> = 150 °C, t <sub>p</sub> = 10 ms<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> |                                  |                                                                       | 1.57     | 1.75 | V                 |                    |



## RECOVERY CHARACTERISTICS

| CODE | MAXIMUM VALUE<br>AT $T_J = 25^\circ\text{C}$    | TEST CONDITIONS                 |                                |              | TYPICAL VALUES<br>AT $T_J = 150^\circ\text{C}$     |                               |              |  |
|------|-------------------------------------------------|---------------------------------|--------------------------------|--------------|----------------------------------------------------|-------------------------------|--------------|-------------------------------------------------------------------------------------|
|      | $t_{rr}$ AT 25 % $I_{RRM}$<br>( $\mu\text{s}$ ) | $I_{pk}$<br>SQUARE PULSE<br>(A) | $di/dt$<br>(A/ $\mu\text{s}$ ) | $V_r$<br>(V) | $t_{rr}$<br>AT 25 % $I_{RRM}$<br>( $\mu\text{s}$ ) | $Q_{rr}$<br>( $\mu\text{C}$ ) | $I_r$<br>(A) |                                                                                     |
| S10  | 1.0                                             | 500                             | 100                            | - 50         | 2.7                                                | 135                           | 100          |                                                                                     |
| S20  | 2.0                                             |                                 |                                |              | 3.5                                                | 250                           | 145          |                                                                                     |
| S30  | 3.0                                             |                                 |                                |              | 3.6                                                | 360                           | 200          |                                                                                     |

## BLOCKING

| PARAMETER                            | SYMBOL    | TEST CONDITIONS                                                                      | VALUES | UNITS |
|--------------------------------------|-----------|--------------------------------------------------------------------------------------|--------|-------|
| Maximum peak reverse leakage current | $I_{RRM}$ | $T_J = 150^\circ\text{C}$ , leakage current                                          | 50     | mA    |
| RMS insulation voltage               | $V_{INS}$ | 50 Hz, circuit to base, all terminals shorted, $25^\circ\text{C}$ , $t = 1\text{ s}$ | 3000   | V     |

## THERMAL AND MECHANICAL SPECIFICATIONS

| PARAMETER                                                                  | SYMBOL         | TEST CONDITIONS                                                                                                                                | VALUES      | UNITS            |
|----------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------|
| Maximum junction operating and storage temperature range                   | $T_J, T_{Stg}$ |                                                                                                                                                | - 40 to 150 | $^\circ\text{C}$ |
| Maximum internal thermal resistance, junction to case per junction         | $R_{thJC}$     | DC operation                                                                                                                                   | 0.125       | K/W              |
| Thermal resistance, case to heatsink per module                            | $R_{thCS}$     | Mounting surface flat, smooth and greased                                                                                                      | 0.02        |                  |
| Mounting torque $\pm 10\%$ <div> MAP to heatsink<br/> busbar to MAP </div> |                | 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               |
|                                                                            |                |                                                                                                                                                | 8 to 10     |                  |
| Approximate weight                                                         |                |                                                                                                                                                | 850         | g                |
|                                                                            |                |                                                                                                                                                | 30          | oz.              |
| Case style                                                                 |                |                                                                                                                                                | MAGN-A-PAK  |                  |

## $\Delta R$ CONDUCTION PER JUNCTION

| CONDUCTION ANGLE | SINUSOIDAL CONDUCTION | RECTANGULAR CONDUCTION | TEST CONDITIONS     | UNITS |
|------------------|-----------------------|------------------------|---------------------|-------|
| 180°             | 0.008                 | 0.007                  | $T_J = T_J$ maximum | K/W   |
| 120°             | 0.010                 | 0.011                  |                     |       |
| 90°              | 0.013                 | 0.015                  |                     |       |
| 60°              | 0.019                 | 0.020                  |                     |       |
| 30°              | 0.032                 | 0.033                  |                     |       |

### Note

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

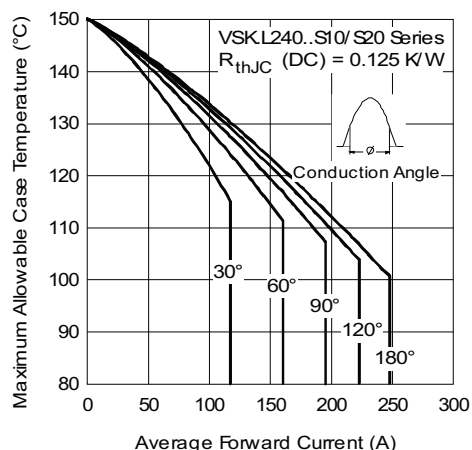


Fig. 1 - Current Ratings Characteristics

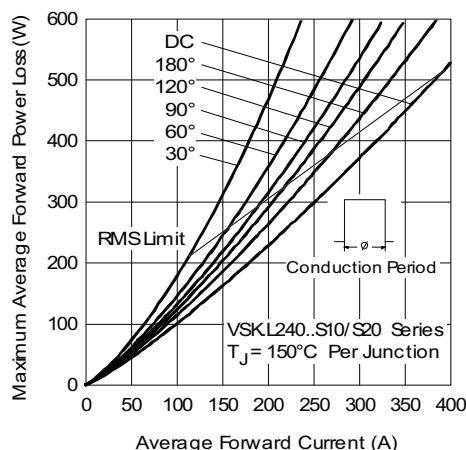


Fig. 4 - Forward Power Loss Characteristics

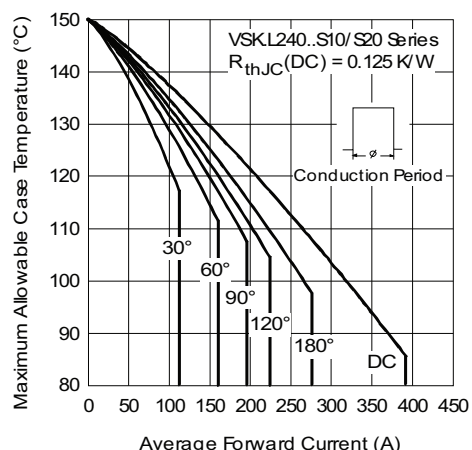


Fig. 2 - Current Ratings Characteristics

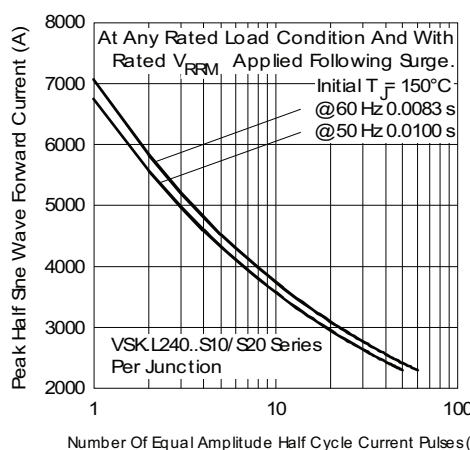


Fig. 5 - Maximum Non-Repetitive Surge Current

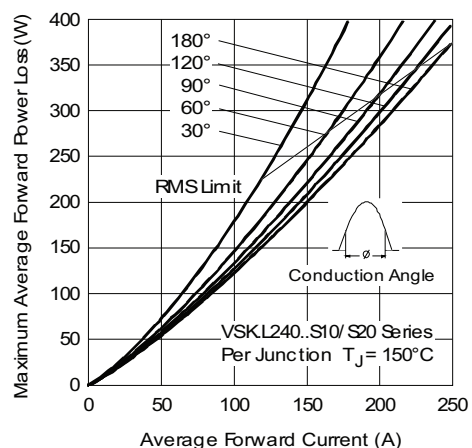


Fig. 3 - Forward Power Loss Characteristics

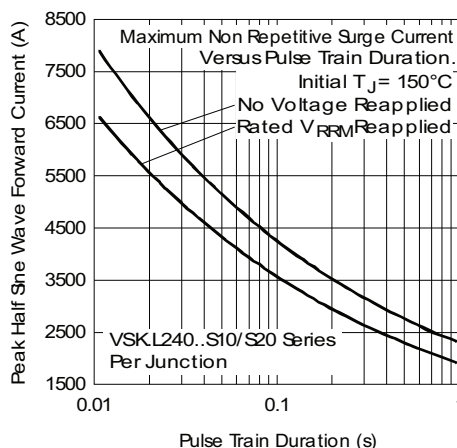


Fig. 6 - Maximum Non-Repetitive Surge Current

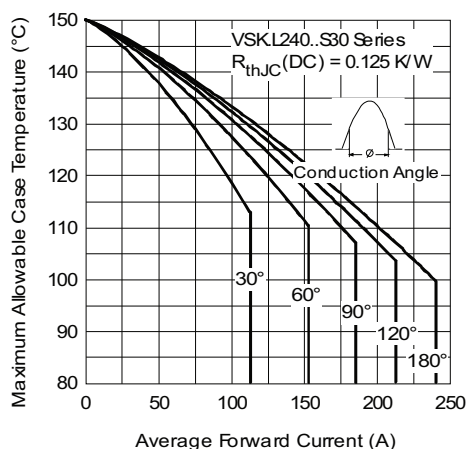


Fig. 7 - Current Ratings Characteristics

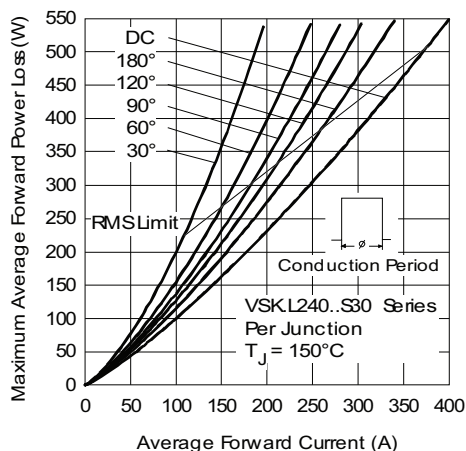


Fig. 10 - Forward Power Loss Characteristics

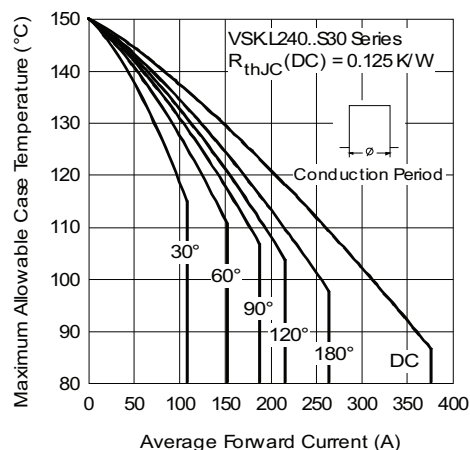


Fig. 8 - Current Ratings Characteristics

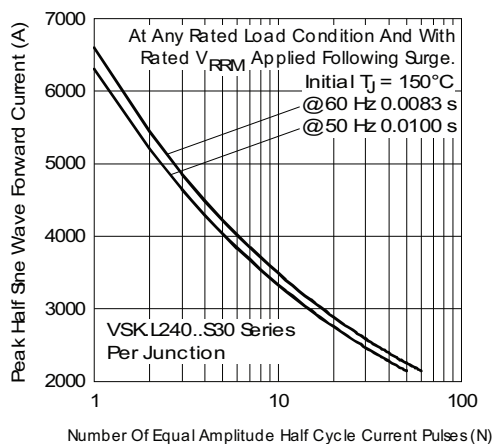


Fig. 11 - Maximum Non-Repetitive Surge Current

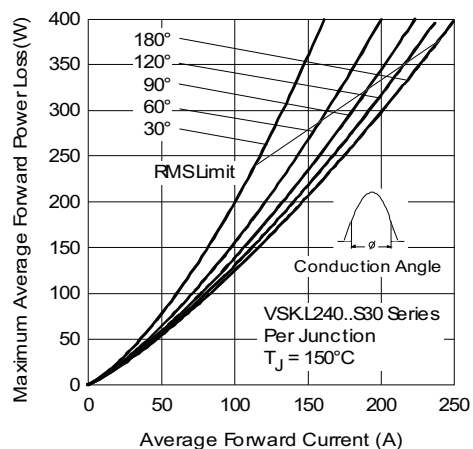


Fig. 9 - Forward Power Loss Characteristics

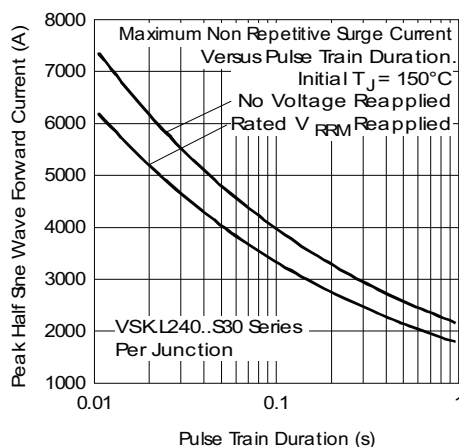


Fig. 12 - Maximum Non-Repetitive Surge Current

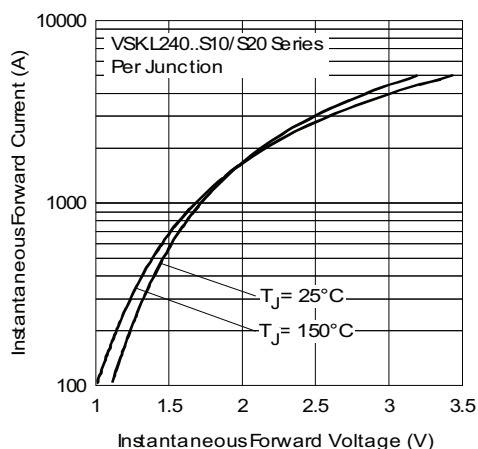


Fig. 13 - Forward Voltage Drop Characteristics

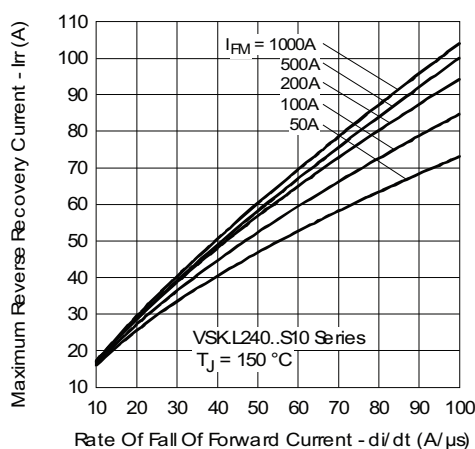


Fig. 16 - Reverse Recovery Current Characteristics

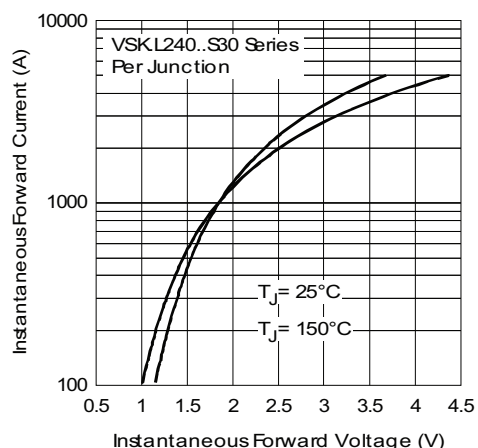


Fig. 14 - Forward Voltage Drop Characteristics

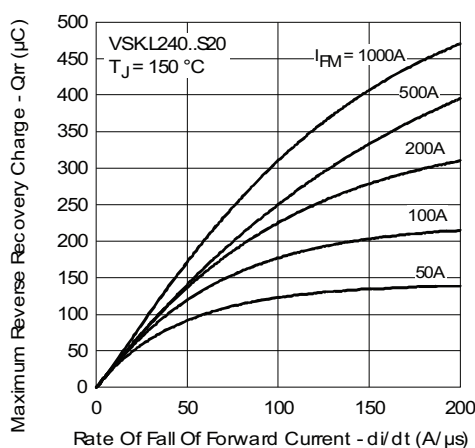


Fig. 17 - Reverse Recovery Charge Characteristics

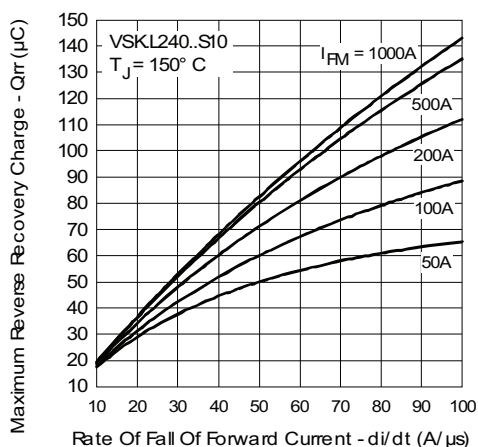


Fig. 15 - Reverse Recovery Charge Characteristics

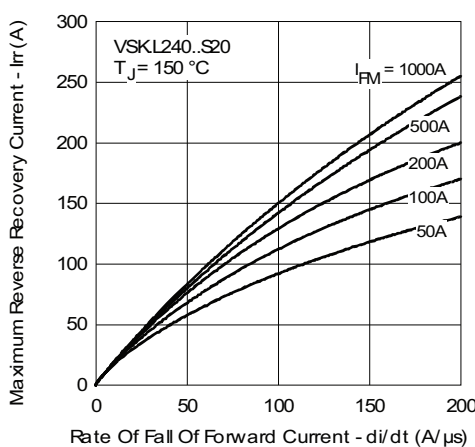


Fig. 18 - Reverse Recovery Current Characteristics

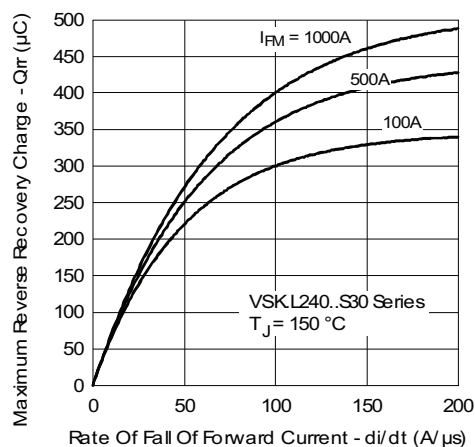


Fig. 19 - Reverse Recovery Charge Characteristics

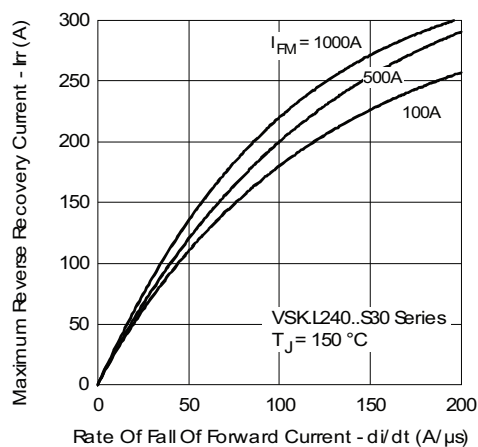


Fig. 20 - Reverse Recovery Current Characteristics

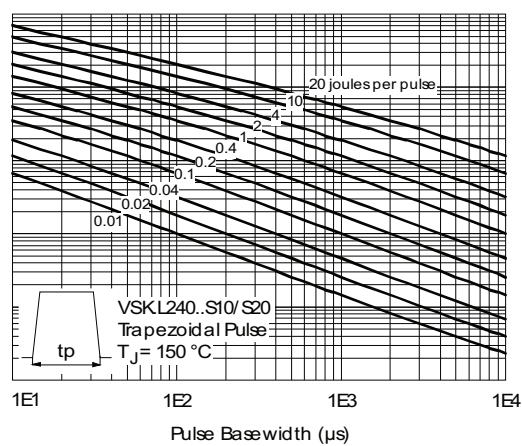
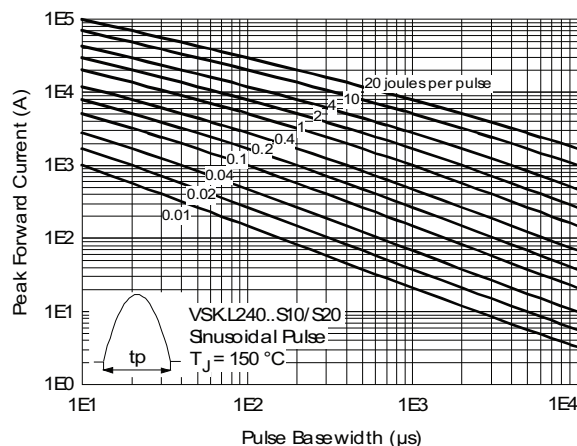


Fig. 21 - Maximum Forward Energy Power Loss Characteristics

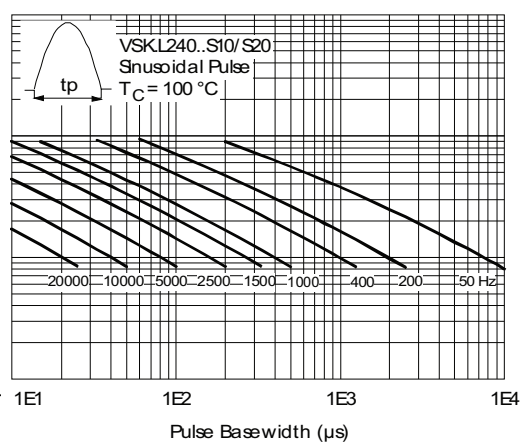
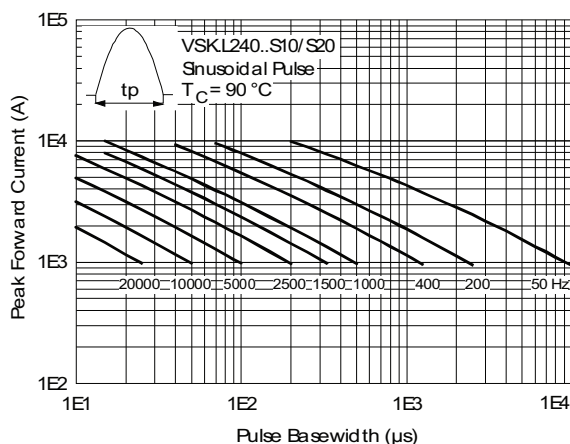


Fig. 22 - Frequency Characteristics

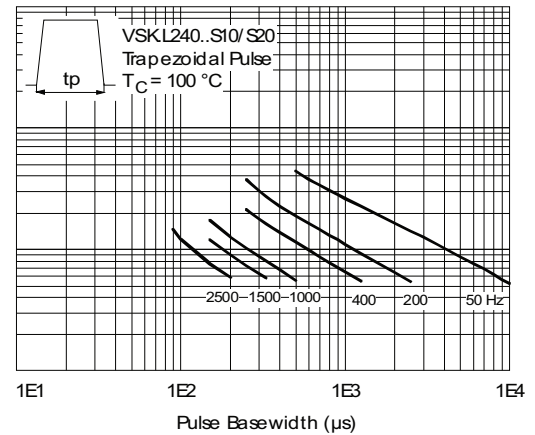
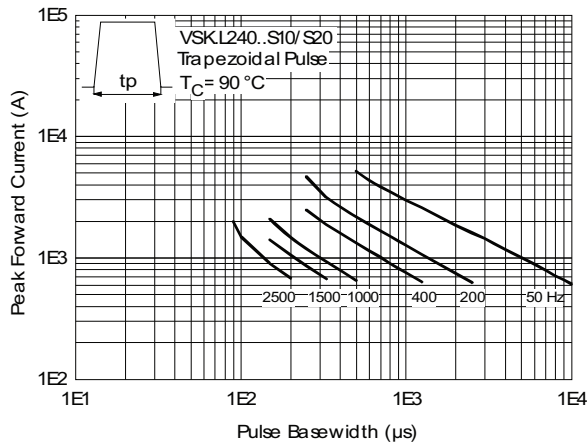


Fig. 23 - Frequency Characteristics

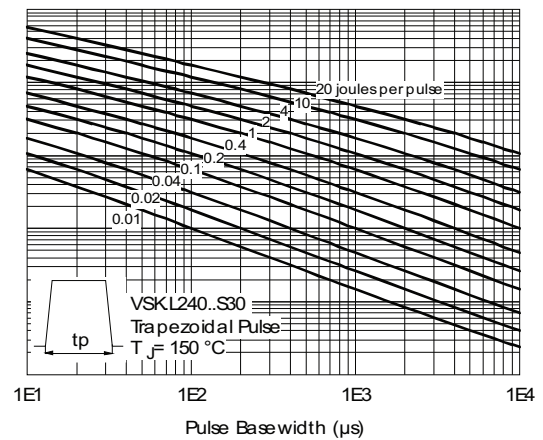
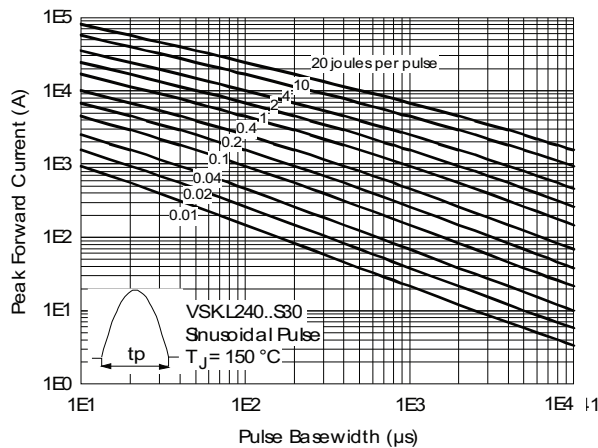


Fig. 24 - Maximum Forward Energy Power Loss Characteristics

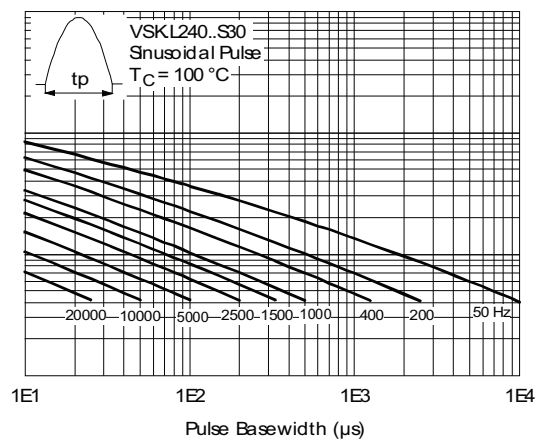
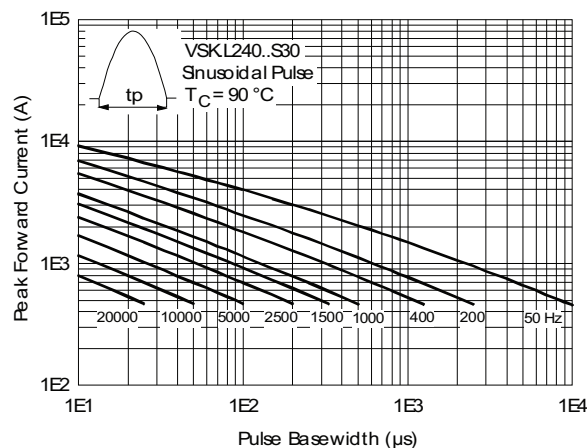


Fig. 25 - Frequency Characteristics

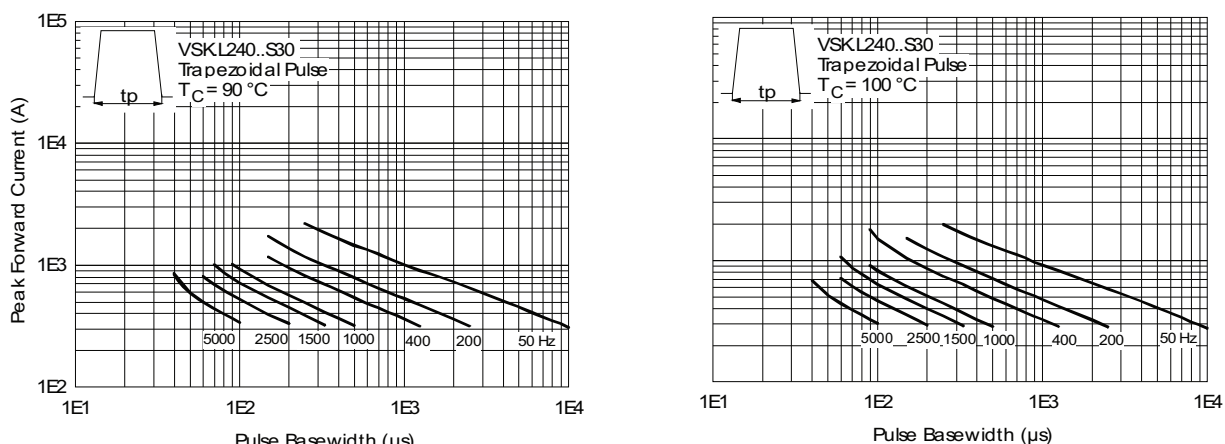
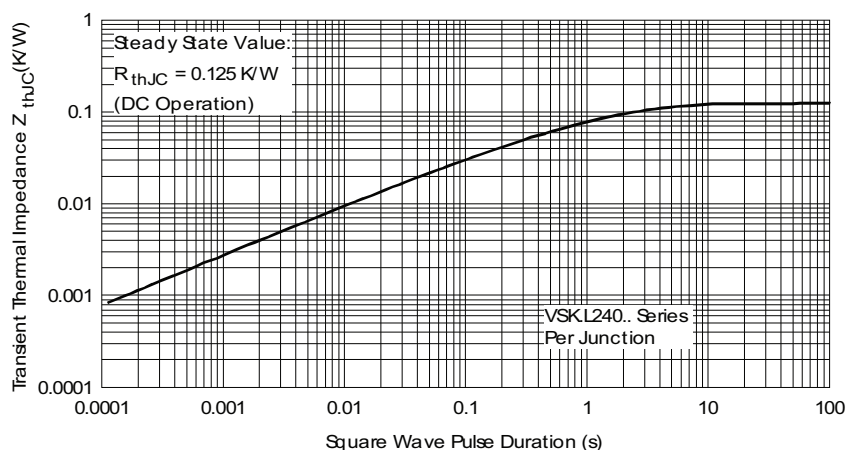


Fig. 26 - Frequency Characteristics


Fig. 27 - Thermal Impedance  $Z_{thJC}$  Characteristics

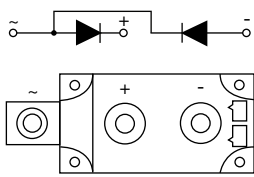
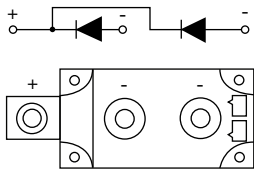
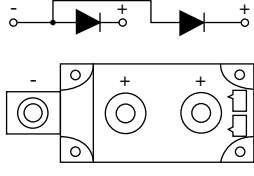
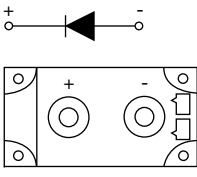
## ORDERING INFORMATION TABLE

| Device code | VSK | D | L | 240 | - | 25 | S30 |
|-------------|-----|---|---|-----|---|----|-----|
|             | ①   | ② | ③ | ④   |   | ⑤  | ⑥   |

- ① - Module type
- ② - Circuit configuration (see Circuit Configuration table)
- ③ - L = Fast recovery diode
- ④ - Current rating
- ⑤ - Voltage code x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- ⑥ -  $t_{rr}$  code (see Recovery Characteristics table)

S10 = 1000 ns  
 S20 = 2000 ns  
 S30 = 3000 ns

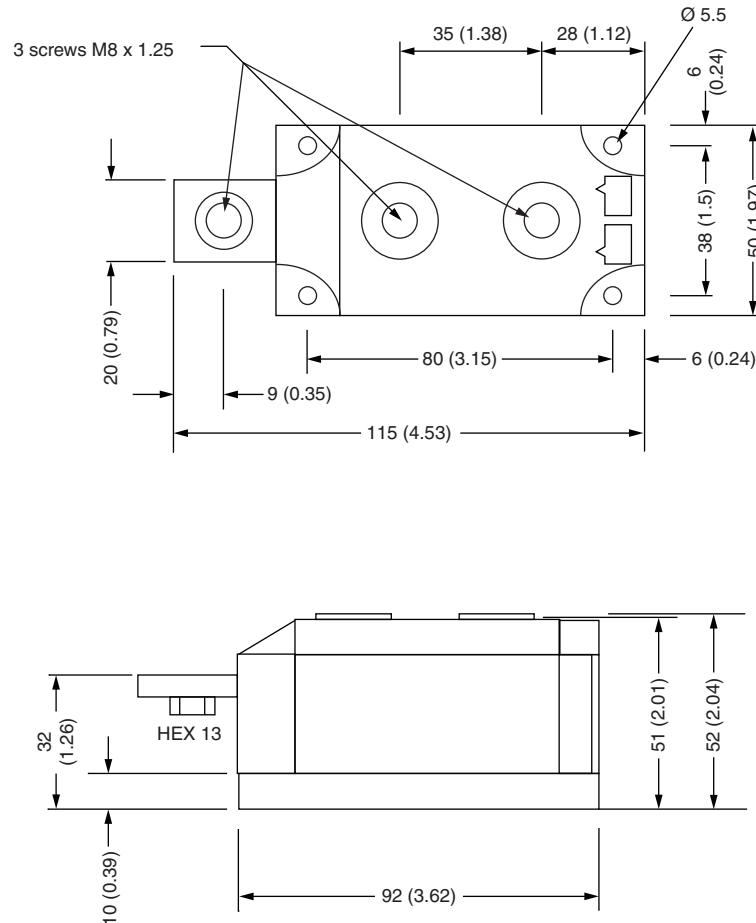


| CIRCUIT CONFIGURATION      |                            |                                                                                                             |
|----------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------|
| CIRCUIT                    | CIRCUIT CONFIGURATION CODE | CIRCUIT DRAWING                                                                                             |
| Two diodes doubler circuit | D                          | <p><b>VSKD...</b></p>    |
| Two diodes common cathodes | C                          | <p><b>VSKC...</b></p>    |
| Two diodes common anodes   | J                          | <p><b>VSKJ...</b></p>   |
| Single diode               | E                          | <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



## Disclaimer

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