

## SCR/Diode (MAGN-A-PAK Power Modules), 320 A


**MAGN-A-PAK**

### FEATURES

- High voltage
- Electrically isolated base plate
- 3500 V<sub>RMS</sub> isolating voltage
- Industrial standard package
- Simplified mechanical designs, rapid assembly
- High surge capability
- Large creepage distances
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?999912](http://www.vishay.com/doc?999912)


**RoHS**  
COMPLIANT

### DESCRIPTION

This VSK series of MAGN-A-PAK modules uses high voltage power thyristor/thyristor and thyristor / diode in seven 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 or as AC-switches when modules are connected in anti-parallel mode. These modules are intended for general purpose applications such as battery chargers, welders, motor drives, UPS, etc.

### PRIMARY CHARACTERISTICS

$I_{T(AV)}$ or $I_{F(AV)}$	320 A
Type	Modules - thyristor, standard
Package	MAGN-A-PAK

### MAJOR RATINGS AND CHARACTERISTICS

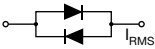
SYMBOL	CHARACTERISTICS	VALUES	UNITS
$I_{T(AV)}/I_{F(AV)}$	70 °C	320	A
$I_{T(RMS)}$		502	
$I_{TSM}/I_{FSM}$	50 Hz	9000	
	60 Hz	9420	kA <sup>2</sup> s
$I^2t$	50 Hz	405	
	60 Hz	370	kA <sup>2</sup> √s
$I^2\sqrt{t}$		4050	
$V_{DRM}/V_{RRM}$		1600	V
$T_J$	Range	-40 to +130	°C

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

TYPE NUMBER	VOLTAGE CODE	$V_{RRM}/V_{DRM}$ , MAXIMUM REPETITIVE PEAK REVERSE AND OFF-STATE BLOCKING VOLTAGE V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V	$I_{RRM}/I_{DRM}$ AT 130 °C MAXIMUM mA
VS-VSKH320-	16	1600	1700	50



ON-STATE CONDUCTION						
PARAMETER	SYMBOL	TEST CONDITIONS			VALUES	UNITS
Maximum average on-state current at case temperature (thyristor)	$I_{T(AV)}$	180° conduction, half sine wave			320	A
Maximum average forward current (diode)	$I_{F(AV)}$				70	°C
Maximum RMS on-state current	$I_{O(RMS)}$	As AC switch 			704	
Maximum peak, one-cycle on-state non-repetitive, surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial $T_J = T_J$ maximum	9000	A
		t = 8.3 ms			9420	
		t = 10 ms	100 % $V_{RRM}$ reapplied		7570	
		t = 8.3 ms			7920	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied		405	kA <sup>2</sup> s
		t = 8.3 ms			370	
		t = 10 ms	100 % $V_{RRM}$ reapplied		287	
		t = 8.3 ms			262	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied			4050	kA <sup>2</sup> √s
Low level value or threshold voltage	$V_{T(TO)1}$	(16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum			0.80	V
High level value of threshold voltage	$V_{T(TO)2}$	(1 $> \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum			1.03	
Low level value on-state slope resistance	$r_{t1}$	(16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum			0.75	mΩ
High level value on-state slope resistance	$r_{t2}$	(1 $> \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum			0.53	
Maximum on-state voltage drop	$V_{TM}, V_{FM}$	$I_{TM} = \pi \times I_{T(AV)}$ , $I_{FM} = \pi \times I_{F(AV)}$ , $T_J = T_J$ maximum, 180° conduction			1.50	V
Maximum holding current	$I_H$	Anode supply = 12 V, initial $I_T = 30$ A, $T_J = 25$ °C			500	mA
Maximum latching current	$I_L$	Anode supply = 12 V, resistive load = 1 Ω, gate pulse: 10 V, 100 μs, $T_J = 25$ °C			1000	

SWITCHING				
PARAMETER	SYMBOL	TEST CONDITIONS	VS-VSKH320	UNITS
Typical delay time	$t_d$	$T_J = 25$ °C, gate current = 1 A $dI_g/dt = 1$ A/μs $V_d = 0.67$ % $V_{DRM}$	1.0	μs
Typical rise time	$t_r$		2.0	
Typical turn-off time	$t_q$	$I_{TM} = 300$ A; $dI/dt = 15$ A/μs; $T_J = T_J$ maximum; $V_R = 50$ V; $dV/dt = 20$ V/μs; gate 0 V, 100 Ω	200 to 350	

BLOCKING				
PARAMETER	SYMBOL	TEST CONDITIONS	VS-VSKH320	UNITS
Maximum peak reverse and off-state leakage current	$I_{RRM}, I_{DRM}$	$T_J = T_J$ maximum	50	mA
RMS insulation voltage	$V_{INS}$	50 Hz, circuit to base, all terminals shorted, 25 °C, 1 s	3000	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



TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS		VS-VSKH320	UNITS
Maximum peak gate power	P <sub>GM</sub>	t <sub>p</sub> ≤ 5 ms, T <sub>J</sub> = T <sub>J</sub> maximum		10.0	W
Maximum average gate power	P <sub>G(AV)</sub>	f = 50 Hz, T <sub>J</sub> = T <sub>J</sub> maximum		2.0	
Maximum peak gate current	+ I <sub>GM</sub>	t <sub>p</sub> ≤ 5 ms, T <sub>J</sub> = T <sub>J</sub> maximum		3.0	A
Maximum peak negative gate voltage	- V <sub>GT</sub>	t <sub>p</sub> ≤ 5 ms, T <sub>J</sub> = T <sub>J</sub> maximum		5.0	V
Maximum required DC gate voltage to trigger	V <sub>GT</sub>	T <sub>J</sub> = - 40 °C	Anode supply = 12 V, resistive load; R <sub>a</sub> = 1 Ω	4.0	
		T <sub>J</sub> = 25 °C		3.0	
		T <sub>J</sub> = T <sub>J</sub> maximum		2.0	
Maximum required DC gate current to trigger	I <sub>GT</sub>	T <sub>J</sub> = - 40 °C	Anode supply = 12 V, resistive load; R <sub>a</sub> = 1 Ω	350	mA
		T <sub>J</sub> = 25 °C		200	
		T <sub>J</sub> = T <sub>J</sub> maximum		100	
Maximum gate voltage that will not trigger	V <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, rated V <sub>DRM</sub> applied		0.25	V
Maximum gate current that will not trigger	I <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, rated V <sub>DRM</sub> applied		10.0	mA
Maximum rate of rise of turned-on current	di/dt	T <sub>J</sub> = T <sub>J</sub> maximum, I <sub>TM</sub> = 400 A, rated V <sub>DRM</sub> applied		500	A/μs

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	TEST CONDITIONS		VS-VSKH320	UNITS
Junction operating and storage temperature range	$T_J, T_{Stg}$			-40 to +130	$^\circ\text{C}$
Maximum thermal resistance, junction to case per junction	$R_{thJC}$	DC operation		0.125	K/W
Typical thermal resistance, case to heatsink per module	$R_{thCS}$	Mounting surface flat, smooth, and greased		0.02	
Mounting torque $\pm 10\%$	MAGN-A-PAK to heatsink busbar to MAGN-A-PAK	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
Approximate weight				500 17.8	g oz.
Case style				MAGN-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°	
VS-VSKH320-	0.009	0.010	0.014	0.020	0.032	0.007	0.011	0.015	0.020	0.033	K/W

**Note**

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

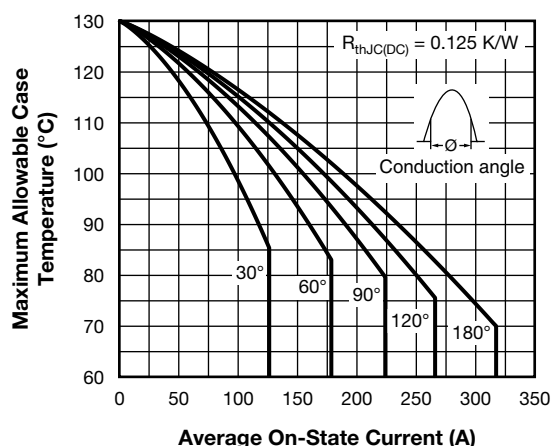


Fig. 1 - Current Ratings Characteristics

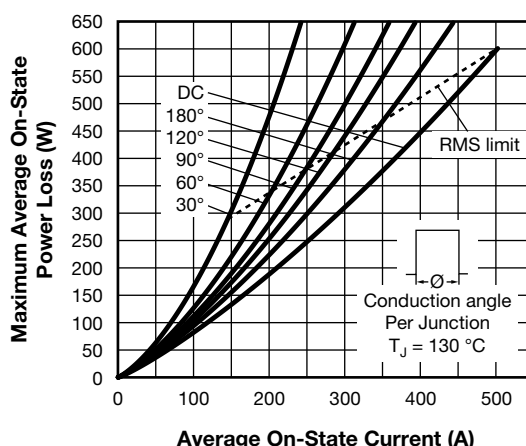


Fig. 4 - On-State Power Loss Characteristics

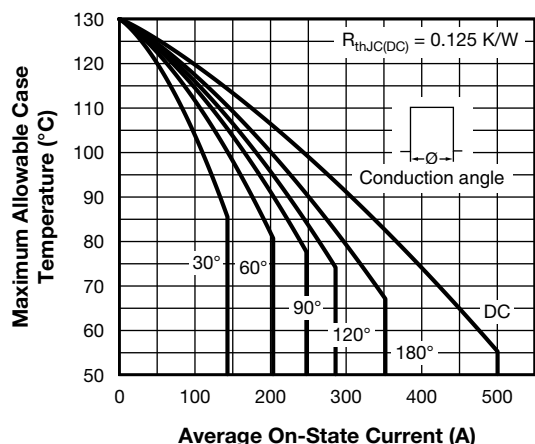


Fig. 2 - Current Ratings Characteristics

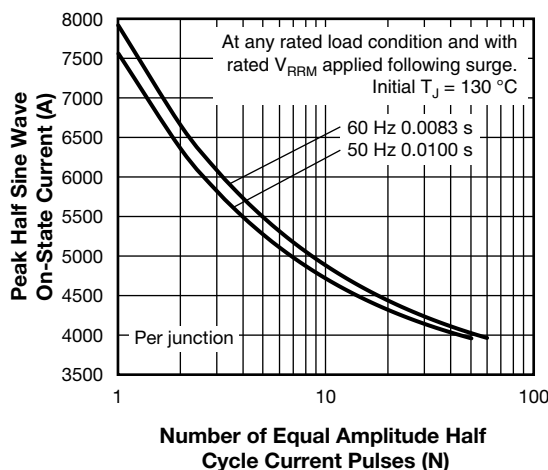


Fig. 5 - Maximum Non-Repetitive Surge Current

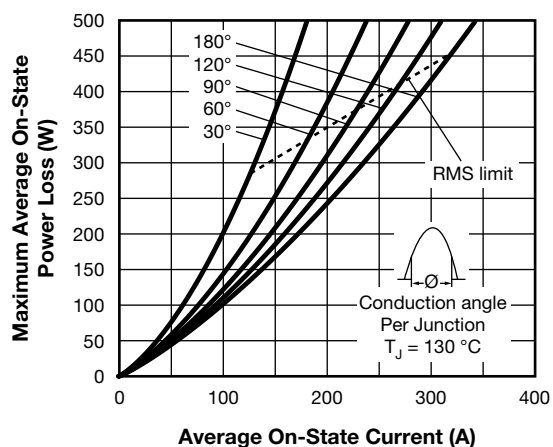


Fig. 3 - On-State Power Loss Characteristics

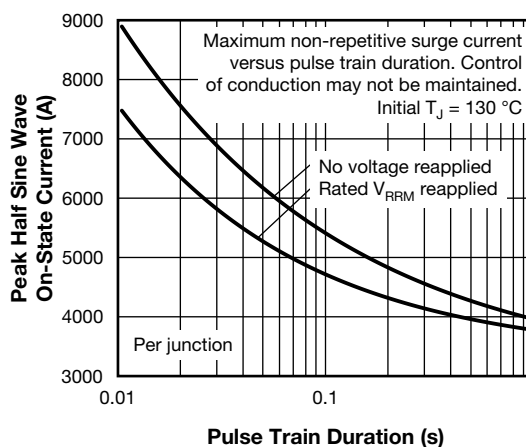


Fig. 6 - Maximum Non-Repetitive Surge Current

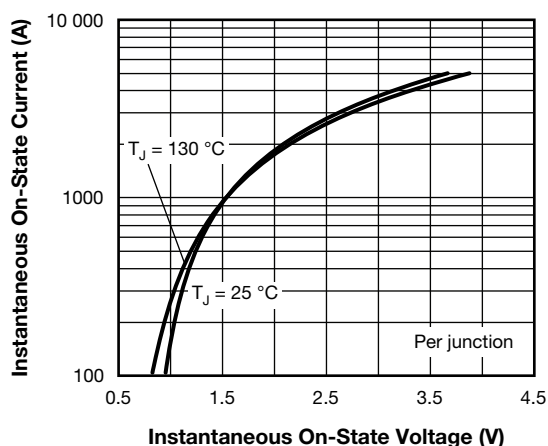
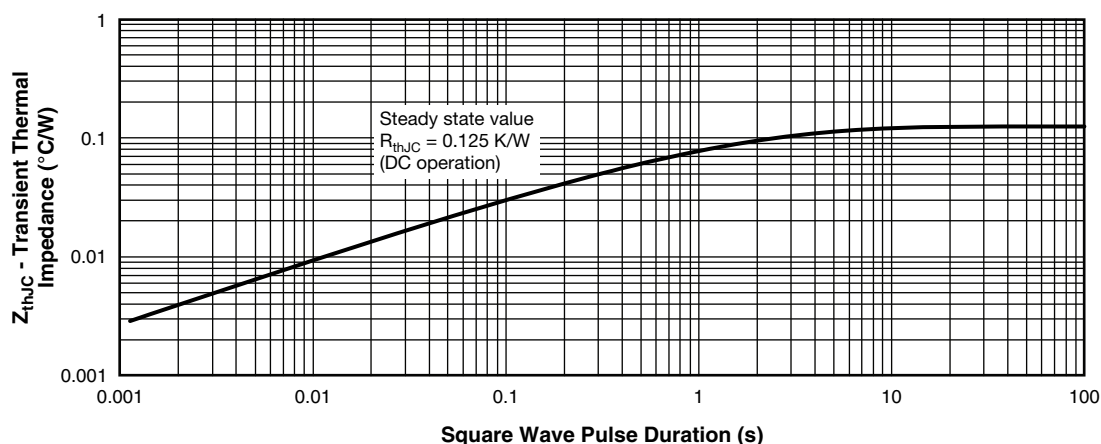


Fig. 7 - On-State Voltage Drop Characteristics


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

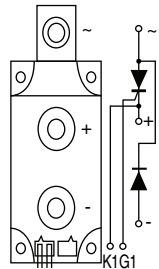
## ORDERING INFORMATION TABLE

Device code	VS-VS	KH	320	-	16	PbF
	①	②	③		④	⑤
①	-	Vishay Semiconductors product				
②	-	Circuit configuration (see end of datasheet)				
③	-	Current rating				
④	-	Voltage code x 100 = $V_{RRM}$ (see Voltage Ratings table)				
⑤	-	<ul style="list-style-type: none"> <li>None = Standard production</li> <li>PbF = Lead (Pb)-free</li> </ul>				

### Note

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

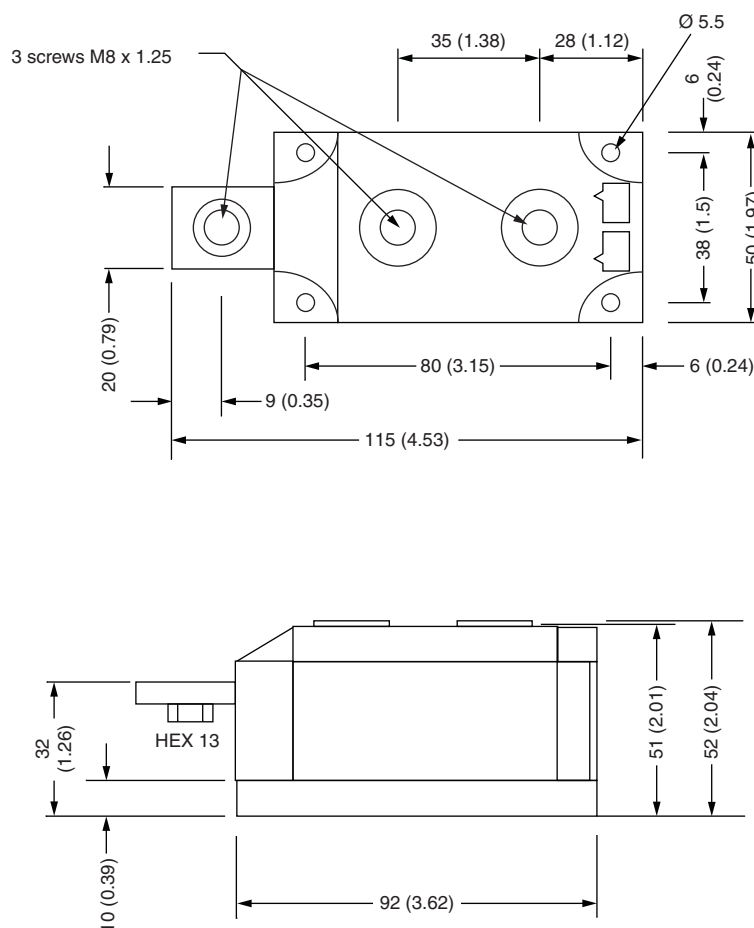


CIRCUIT CONFIGURATION		
CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
SCR/diode doubler circuit, positive control	KH	 <p>VSKH...</p>

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95086">www.vishay.com/doc?95086</a>
Application Note	<a href="http://www.vishay.com/doc?95557">www.vishay.com/doc?95557</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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