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

MAGN-A-PAK

FEATURES

- High voltage
- Electrically isolated base plate
- 3500 V_{RMS} 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?99912

RoHS COMPLIANT

DESCRIPTION

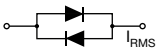
This VSK series of MAGN-A-PAK modules uses high voltage power thyristor/thyristor and thyristor / diode in seven basic configurations. The semiconductors are electrically isolated from the metal base, allowing common heatsinks and compact assemblies to be built. They can be interconnected to form single 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	
I^2t	50 Hz	405	kA^2s
	60 Hz	370	
$I^2\sqrt{t}$		4050	$kA^2\sqrt{s}$
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	A
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	
		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^2s
		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	$kA^2\sqrt{s}$
Low level value or threshold voltage	$V_{T(TO)1}$	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), T_J = T_J maximum			0.80	V
High level value of threshold voltage	$V_{T(TO)2}$	(I > π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), T_J = T_J maximum			1.03	
Low level value on-state slope resistance	r_{t1}	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), T_J = T_J maximum			0.75	mΩ
High level value on-state slope resistance	r_{t2}	(I > π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), T_J = T_J maximum			0.53	
Maximum on-state voltage drop	V_{TM}, V_{FM}	I_{TM} = π x $I_{T(AV)}$, I_{FM} = π x $I_{F(AV)}$, 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_{GM}	$t_p \leq 5$ ms, $T_J = T_J$ maximum		10.0	W
Maximum average gate power	$P_{G(AV)}$	f = 50 Hz, $T_J = T_J$ maximum		2.0	
Maximum peak gate current	+ I_{GM}	$t_p \leq 5$ ms, $T_J = T_J$ maximum		3.0	A
Maximum peak negative gate voltage	- V_{GT}	$t_p \leq 5$ ms, $T_J = T_J$ maximum		5.0	V
Maximum required DC gate voltage to trigger	V_{GT}	T_J = - 40 °C	Anode supply = 12 V, resistive load; R_a = 1 Ω	4.0	
		T_J = 25 °C		3.0	
		$T_J = T_J$ maximum		2.0	
Maximum required DC gate current to trigger	I_{GT}	T_J = - 40 °C	Anode supply = 12 V, resistive load; R_a = 1 Ω	350	mA
		T_J = 25 °C		200	
		$T_J = T_J$ maximum		100	
Maximum gate voltage that will not trigger	V_{GD}	$T_J = T_J$ maximum, rated V_{DRM} applied		0.25	V
Maximum gate current that will not trigger	I_{GD}	$T_J = T_J$ maximum, rated V_{DRM} applied		10.0	mA
Maximum rate of rise of turned-on current	dI/dt	$T_J = T_J$ maximum, I_{TM} = 400 A, rated V_{DRM} 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	°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 ± 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
Mounting torque ± 10 % — busbar to MAGN-A-PAK				
Approximate weight			500	g
			17.8	oz.
Case style			MAGN-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°**	
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

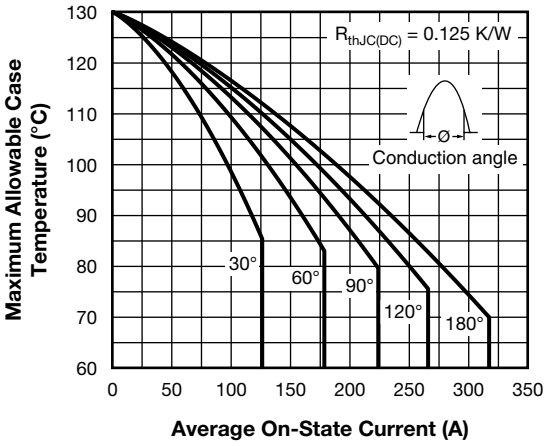


Fig. 1 - Current Ratings Characteristics

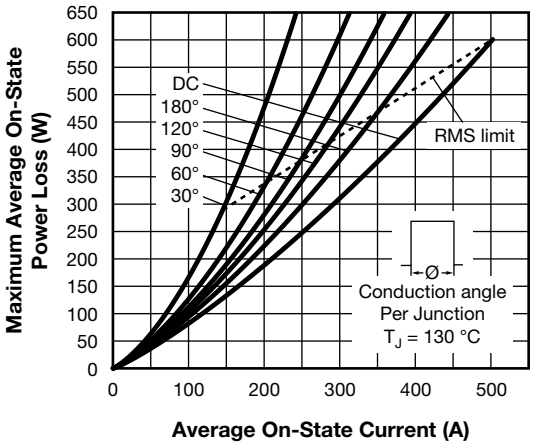


Fig. 4 - On-State Power Loss Characteristics

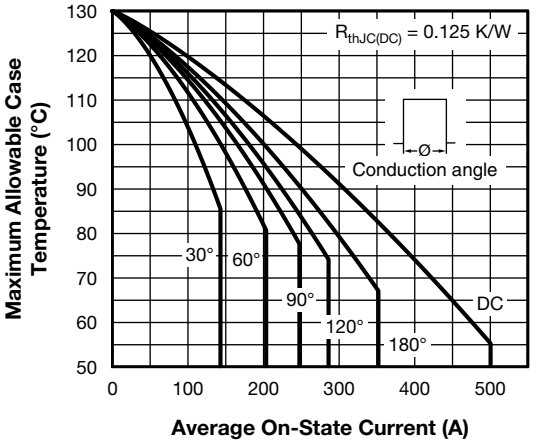


Fig. 2 - Current Ratings Characteristics

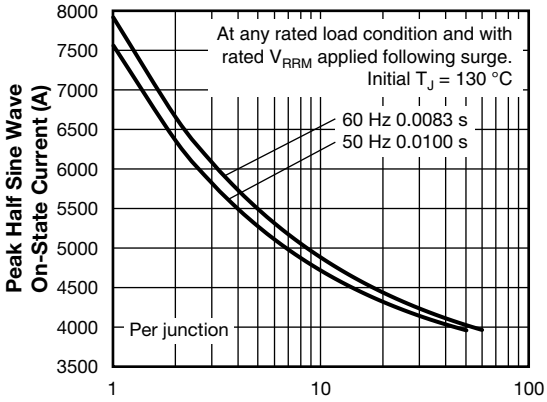


Fig. 5 - Maximum Non-Repetitive Surge Current

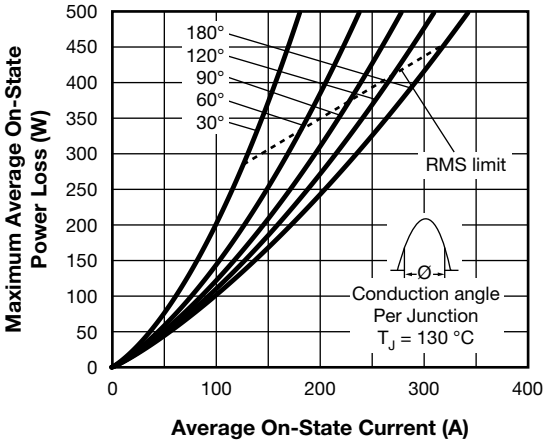


Fig. 3 - On-State Power Loss Characteristics

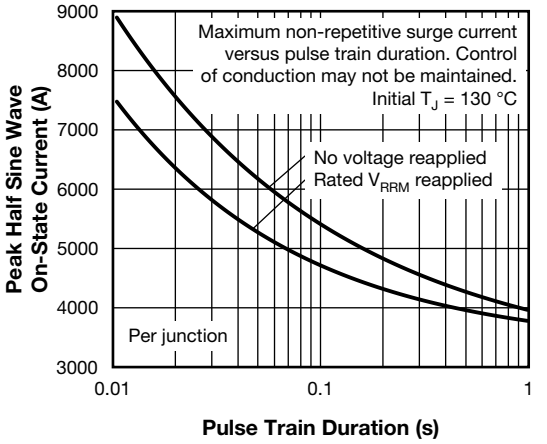


Fig. 6 - Maximum Non-Repetitive Surge Current

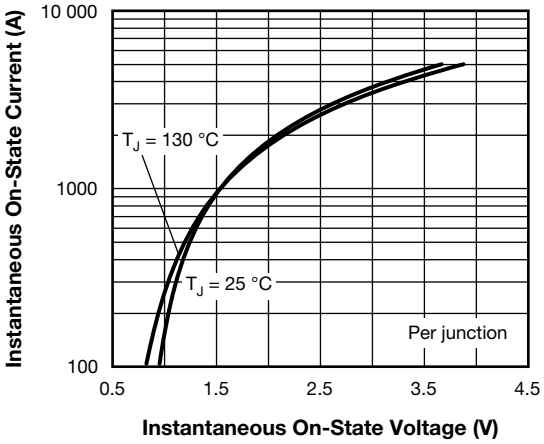


Fig. 7 - On-State Voltage Drop Characteristics

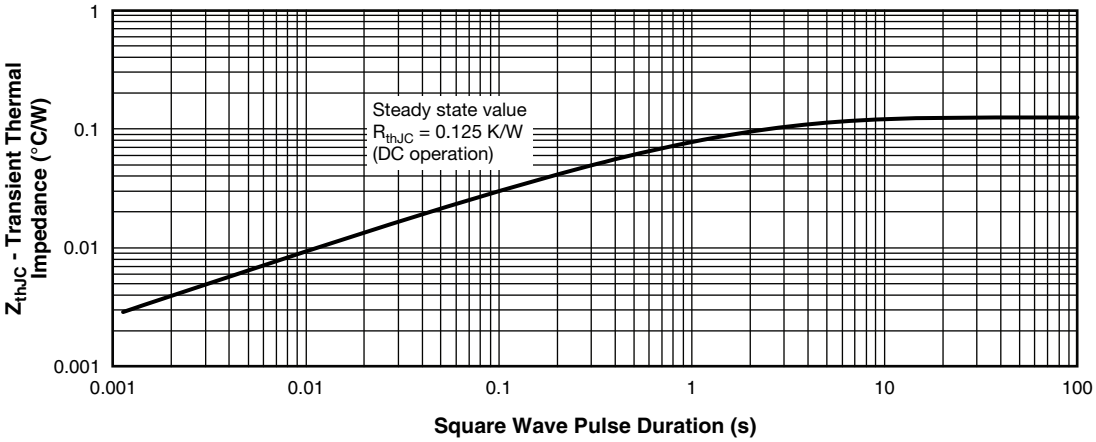


Fig. 8 - Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

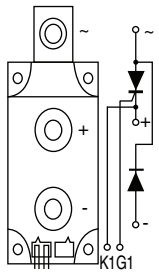
Device code

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	-	• None = Standard production • PbF = Lead (Pb)-free

Note

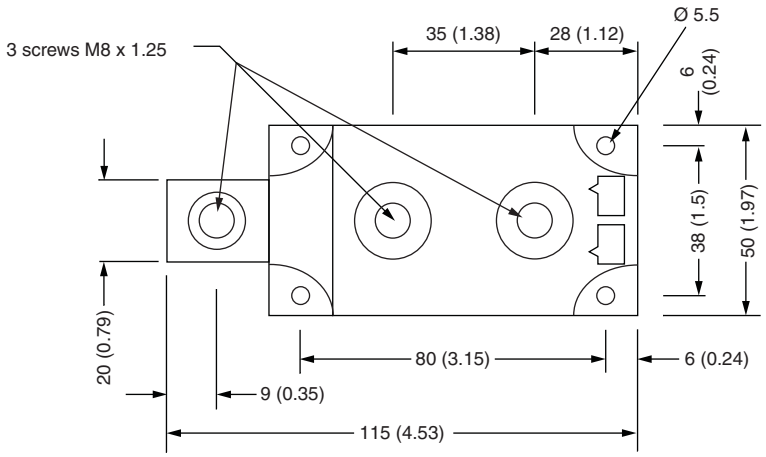
- To order the optional hardware go to www.vishay.com/doc?95172

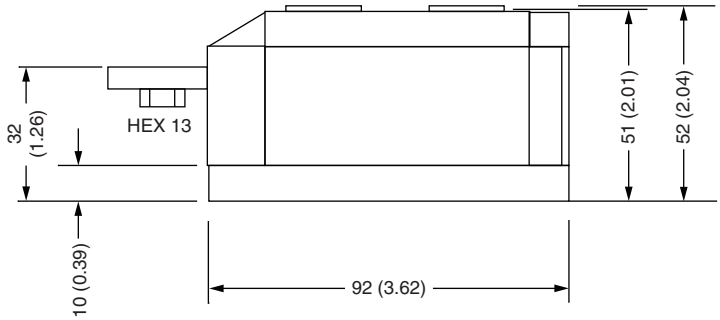
CIRCUIT CONFIGURATION		
CIRCUIT DESCRIPTION	**CIRCUIT CONFIGURATION CODE**	**CIRCUIT DRAWING**
SCR/diode doubler circuit, positive control	KH	VSKH... 

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95086
Application Note	www.vishay.com/doc?95557

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

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.