

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


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

- High voltage
- Electrically isolated base plate
- 3600 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>T(AV)</sub>	320 A
Type	Modules - thyristor, standard
Package	MAGN-A-PAK

**DESCRIPTION**

This VSK series of MAGN-A-PAK modules uses high voltage power thyristor/thyristor in doubler circuit configuration. 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.

MAJOR RATINGS AND CHARACTERISTICS			
SYMBOL	CHARACTERISTICS	VALUES	UNITS
I <sub>T(AV)</sub>	70 °C	320	A
I <sub>T(RMS)</sub>		710	
I <sub>TSM</sub>	50 Hz	9000	
	60 Hz	9420	
I <sup>2</sup> t	50 Hz	405	kA <sup>2</sup> s
	60 Hz	370	
I <sup>2</sup> √t		4050	kA <sup>2</sup> √s
V <sub>DRM</sub> /V <sub>RRM</sub>		1200 to 1600	V
T <sub>J</sub>	Range	-40 to +130	°C

**ELECTRICAL SPECIFICATIONS**

VOLTAGE RATINGS				
TYPE NUMBER	VOLTAGE CODE	V <sub>RRM</sub> /V <sub>DRM</sub> , MAXIMUM REPETITIVE PEAK REVERSE AND OFF-STATE BLOCKING VOLTAGE V	V <sub>RSM</sub> , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V	I <sub>RRM</sub> /I <sub>DRM</sub> AT 130 °C MAXIMUM mA
VS-VSKT320-	12	1200	1300	50
	16	1600	1700	



ON-STATE CONDUCTION					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave		320	A
				70	°C
Maximum RMS on-state current	$I_{T(RMS)}$	As AC switch		710	A
Maximum peak, one-cycle on-state non-repetitive, surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	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 <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	$V_{T(TO)2}$	(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	$r_{t2}$	(I $> \pi \times I_{T(AV)}$ ), $T_J = T_J$ maximum		0.53	
Maximum peak on-state or forward voltage drop	$V_{TM}, V_{FM}$	$I_{TM} = 750$ A, $T_J = 25$ °C, 180° conduction, average power = $V_{T(TO)} \times I_{T(AV)} + r_f \times (I_{T(RMS)})^2$		1.40	V
		$I_{TM} = 750$ A, $T_J = T_J$ maximum, 180° conduction, average power = $V_{T(TO)} \times I_{T(AV)} + r_f \times (I_{T(RMS)})^2$		1.37	
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		VALUES	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 range	$t_q$	$I_{TM} = 300$ 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		VALUES	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		3600	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



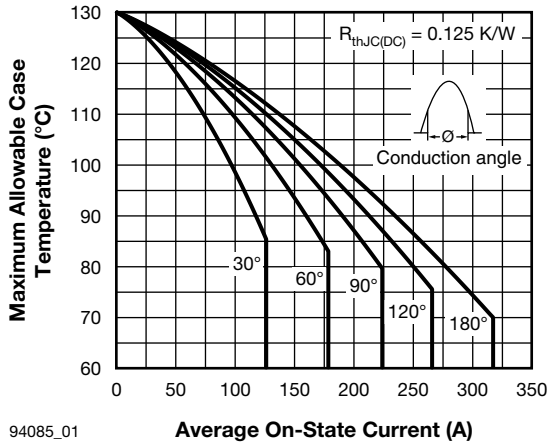
TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum peak gate power	$P_{GM}$	$t_p \leq 5 \text{ ms}$ , $T_J = T_J \text{ maximum}$		10.0	W
Maximum average gate power	$P_{G(AV)}$	$f = 50 \text{ Hz}$ , $T_J = T_J \text{ maximum}$		2.0	
Maximum peak gate current	$+ I_{GM}$	$t_p \leq 5 \text{ ms}$ , $T_J = T_J \text{ maximum}$		3.0	A
Maximum peak negative gate voltage	$- V_{GT}$	$t_p \leq 5 \text{ ms}$ , $T_J = T_J \text{ maximum}$		5.0	V
Maximum required DC gate voltage to trigger	$V_{GT}$	$T_J = -40 \text{ }^\circ\text{C}$	Anode supply = 12 V, resistive load; $R_a = 1 \text{ } \Omega$	4.0	
		$T_J = 25 \text{ }^\circ\text{C}$		3.0	
		$T_J = T_J \text{ maximum}$		2.0	
Maximum required DC gate current to trigger	$I_{GT}$	$T_J = -40 \text{ }^\circ\text{C}$	Anode supply = 12 V, resistive load; $R_a = 1 \text{ } \Omega$	350	mA
		$T_J = 25 \text{ }^\circ\text{C}$		200	
		$T_J = T_J \text{ maximum}$		100	
Maximum gate voltage that will not trigger	$V_{GD}$	$T_J = T_J \text{ maximum}$ , rated $V_{DRM}$ applied		0.25	V
Maximum gate current that will not trigger	$I_{GD}$	$T_J = T_J \text{ maximum}$ , rated $V_{DRM}$ applied		10.0	mA
Maximum rate of rise of turned-on current	$di/dt$	$T_J = T_J \text{ maximum}$ , $I_{TM} = 400 \text{ A}$ , rated $V_{DRM}$ applied		500	A/ $\mu\text{s}$

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	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	g
				17.8	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 $^\circ$	120 $^\circ$	90 $^\circ$	60 $^\circ$	30 $^\circ$	180 $^\circ$	120 $^\circ$	90 $^\circ$	60 $^\circ$	30 $^\circ$	
VSKT320-	0.009	0.010	0.013	0.020	0.032	0.007	0.011	0.015	0.020	0.033	K/W

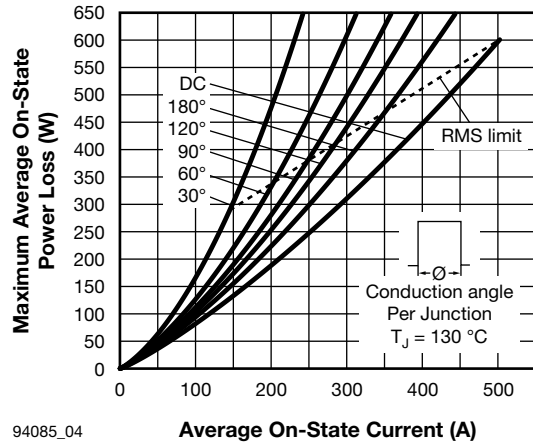
**Note**

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



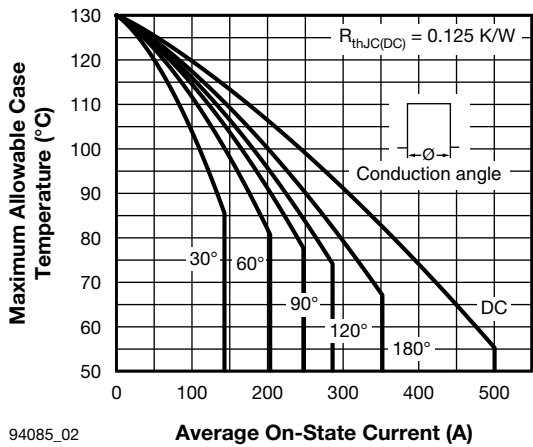
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Fig. 1 - Current Ratings Characteristics



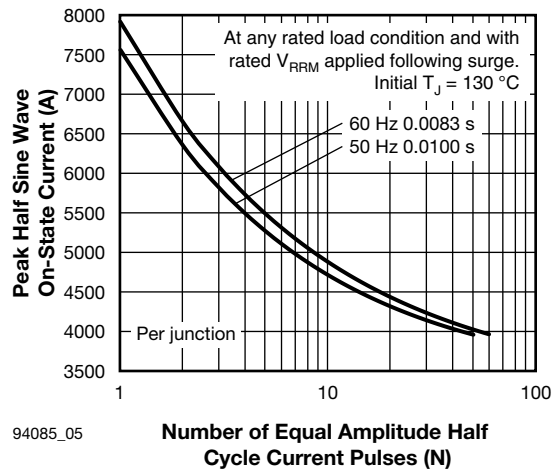
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Fig. 4 - On-State Power Loss Characteristics



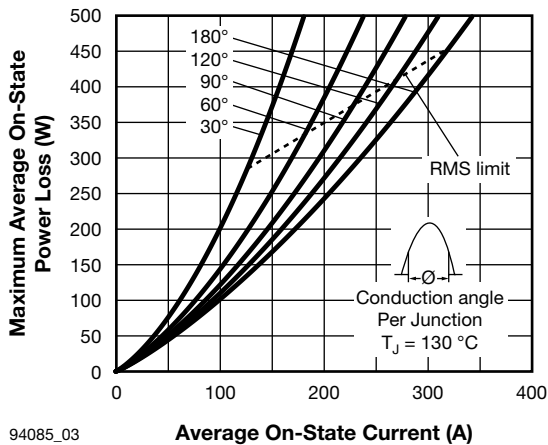
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Fig. 2 - Current Ratings Characteristics



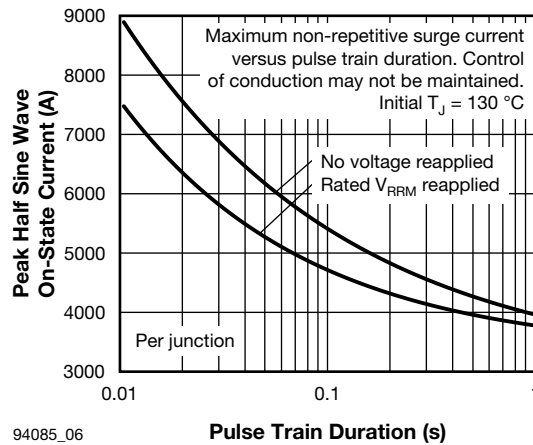
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Fig. 5 - Maximum Non-Repetitive Surge Current



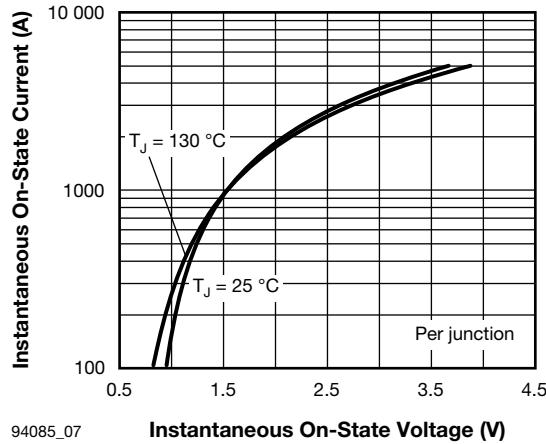
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Fig. 3 - On-State Power Loss Characteristics



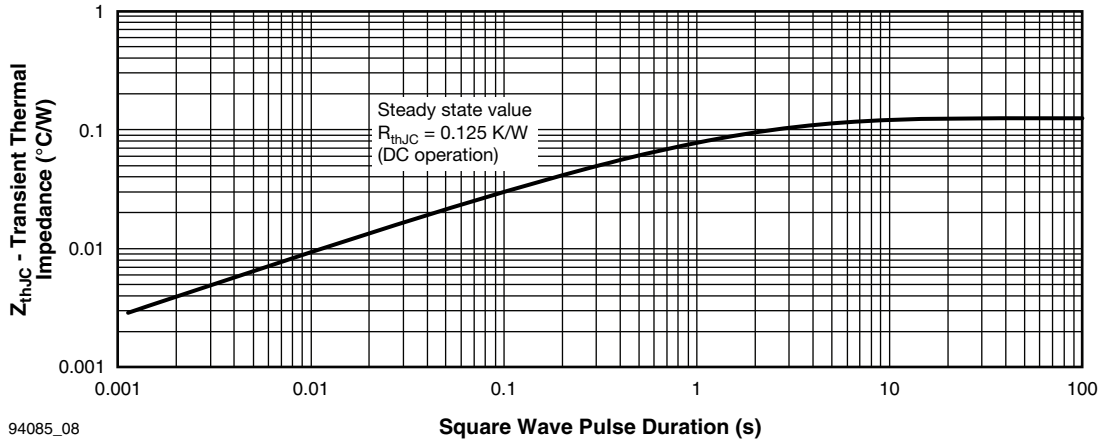
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Fig. 6 - Maximum Non-Repetitive Surge Current



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Fig. 7 - On-State Voltage Drop Characteristics



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

**ORDERING INFORMATION TABLE**

Device code	<b>VS-VS</b>	<b>KT</b>	<b>320</b>	<b>-</b>	<b>16</b>	<b>PbF</b>
	①	②	③		④	⑤

- 1** - Vishay Semiconductors product
- 2** - Circuit configuration (see dimensions - link at the 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](http://www.vishay.com/doc?95172)



CIRCUIT CONFIGURATION		
CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Two SCRs doubler circuit	KT	

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



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