


## SCR/SCR and SCR/Diode (MAGN-A-PAK Power Modules), 230 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
- 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

$I_{T(AV)}$	230 A
Type	Modules - thyristor, standard
Package	MAGN-A-PAK

### 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.

### MAJOR RATINGS AND CHARACTERISTICS

SYMBOL	CHARACTERISTICS	VALUES	UNITS
$I_{T(AV)}$	85 °C	230	A
$I_{T(RMS)}$		510	
$I_{TSM}$	50 Hz	7500	
	60 Hz	7850	
$I^2t$	50 Hz	280	kA <sup>2</sup> s
	60 Hz	260	
$I^2\sqrt{t}$		280	kA <sup>2</sup> √s
$V_{DRM}/V_{RRM}$		800 to 2000	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-VSK.230-	08	800	900	50
	12	1200	1300	
	16	1600	1700	
	18	1800	1900	
	20	2000	2100	



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		230	A
				85	°C
Maximum RMS on-state current	$I_{T(RMS)}$	As AC switch		510	
Maximum peak, one-cycle on-state non-repetitive, surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	7500	A
		t = 8.3 ms		7850	
		t = 10 ms	100 % $V_{RRM}$ reapplied	6300	
		t = 8.3 ms		6600	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	280	kA <sup>2</sup> s
		t = 8.3 ms		256	
		t = 10 ms	100 % $V_{RRM}$ reapplied	198	
		t = 8.3 ms		181	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied		2800	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		1.03	V
High level value of threshold voltage	$V_{T(TO)2}$	$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		1.07	
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		0.77	mΩ
High level value on-state slope resistance	$r_{t2}$	$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		0.73	
Maximum on-state voltage drop	$V_{TM}$	$I_{TM} = \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum, 180° conduction, average power = $V_{T(TO)} \times I_{T(AV)} + r_f \times (I_{T(RMS)})^2$		1.59	V
Maximum holding current	$I_H$	Anode supply = 12 V, initial $I_T = 30$ A, $T_J = 25$ °C		500	
Maximum latching current	$I_L$	Anode supply = 12 V, resistive load = 1 Ω, gate pulse: 10 V, 100 μs, $T_J = 25$ °C		1000	mA

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	$t_q$	$I_{TM} = 300$ 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		50 to 150	

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		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		VALUES	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	
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	V
		$T_J = 25$ °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	VALUES	UNITS
Junction operating temperature range	$T_J$		-40 to +130	°C
Storage temperature range	$T_{Stg}$		-40 to +150	
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 h 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°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
VSK.230-	0.009	0.010	0.010	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. 2 - Current Ratings Characteristics



Fig. 3 - On-State Power Loss Characteristics



Fig. 5 - Maximum Non-Repetitive Surge Current



Fig. 4 - On-State Power Loss Characteristics



Fig. 6 - Maximum Non-Repetitive Surge Current



Fig. 7 - On-State Power Loss Characteristics



Fig. 8 - On-State Power Loss Characteristics



Fig. 9 - On-State Power Loss Characteristics



Fig. 10 - On-State Voltage Drop Characteristics



Fig. 11 - Reverse Recovery Charge Characteristics



Fig. 12 - Gate Characteristics



Fig. 13 - Thermal Impedance  $Z_{thJC}$  Characteristics

**ORDERING INFORMATION TABLE**

Device code	<b>VS-VS</b>	<b>KT</b>	<b>230</b>	<b>-</b>	<b>20</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	<p>VSKT...</p> <p>Available 800 V: contact factory for different requirements</p>
SCR/diode doubler circuit, positive control	KH	<p>VSKH...</p> <p>Available 800 V: contact factory for different requirements</p>
SCR/diode doubler circuit, negative control	KL	<p>VSKL...</p> <p>Available 800 V: contact factory for different requirements</p>
Two SCRs common cathodes	KK	<p>VSKK...</p> <p>Available 800 V: contact factory for different requirements</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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