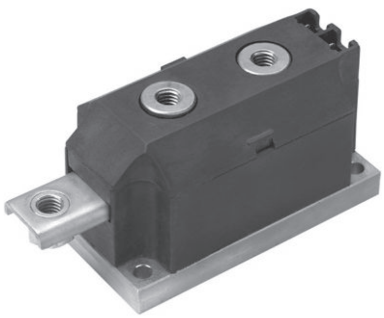
SCR/SCR and SCR/Diode (MAGN-A-PAK Power Modules), 170 A/250 A


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
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

PRODUCT SUMMARY	
$I_{T(AV)}$	170 A/250 A
Type	Modules - Thyristor, Standard

DESCRIPTION

This new 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	VSK.170..	VSK.250..	UNITS
$I_{T(AV)}$	85 °C	170	250	A
$I_{T(RMS)}$		377	555	
I_{TSM}	50 Hz	5100	8500	
	60 Hz	5350	8900	
I^2t	50 Hz	131	361	kA^2s
	60 Hz	119	330	
$I^2\sqrt{t}$		1310	3610	$kA^2\sqrt{s}$
V_{DRM}/V_{RRM}		Up to 1600	Up to 2000	V
T_J	Range	- 40 to 130		°C

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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
VSK.170-	04	400	500	50
	08	800	900	
	10	1000	1100	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	
VSK.250-	04	400	500	50
	08	800	900	
	10	1000	1100	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	
	18	1800	1900	60
	20	2000	2100	

ON-STATE CONDUCTION							
PARAMETER	SYMBOL	TEST CONDITIONS			VSK.170	VSK.250	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave			170	250	A
					85	85	°C
Maximum RMS on-state current	$I_{T(RMS)}$	As AC switch			377	555	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	5100	8500	
		t = 8.3 ms			5350	8900	
		t = 10 ms	100 % V_{RRM} reapplied		4300	7150	
		t = 8.3 ms			4500	7500	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied		131	361	kA^2s
		t = 8.3 ms			119	330	
		t = 10 ms	100 % V_{RRM} reapplied		92.5	255	
		t = 8.3 ms			84.4	233	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied			1310	3610	$kA^2\sqrt{s}$
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			0.89	0.97	V
High level value of threshold voltage	$V_{T(TO)2}$	$(I > \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ maximum			1.12	1.00	
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			1.34	0.60	mΩ
High level value on-state slope resistance	r_{t2}	$(I > \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ maximum			0.96	0.57	
Maximum on-state voltage drop	V_{TM}	$I_{TM} = \pi \times I_{T(AV)}$, $T_J = T_J$ maximum, 180° conduction, average power = $V_{T(TO)} \times I_{T(AV)} + r_f \times (I_{T(RMS)})^2$			1.60	1.44	V
Maximum holding current	I_H	Anode supply = 12 V, initial I_T = 30 A, T_J = 25 °C			500	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	1000	

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SWITCHING					
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**VSK.170**	**VSK.250**	**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**	**VSK.170**	**VSK.250**	**UNITS**
Maximum peak reverse and off-state leakage current	I_{RRM}, I_{DRM}	T_J = T_J maximum	50	60	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**		**VSK.170**	**VSK.250**	**UNITS**
Maximum peak gate power	P_{GM}	t_p ≤ 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 ≤ 5 ms, T_J = T_J maximum		3.0		A
Maximum peak negative gate voltage	- V_{GT}	t_p ≤ 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; Ra = 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; Ra = 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 willnot 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**	**VSK.170**	**VSK.250**	**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	0.17	0.125	K/W
Typical thermal resistance, case to heatsink per module		R_{thCS}	Mounting surface flat, smooth and greased	0.02	0.02	
Mounting torque ± 10 %	MAP 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
	busbar to MAP					
Approximate weight				500		g
				17.8		oz.
Case style				MAGN-A-PAK		

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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°	
VSK.170-	0.009	0.010	0.010	0.020	0.032	0.007	0.011	0.015	0.020	0.033	K/W
VSK.250-	0.009	0.010	0.014	0.020	0.032	0.007	0.011	0.015	0.020	0.033	

Note

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

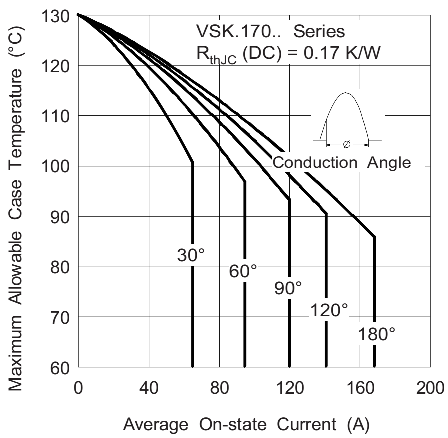

Fig. 1 - Current Ratings Characteristics

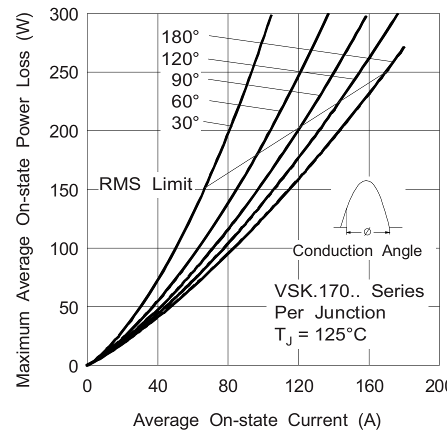

Fig. 3 - On-State Power Loss Characteristics

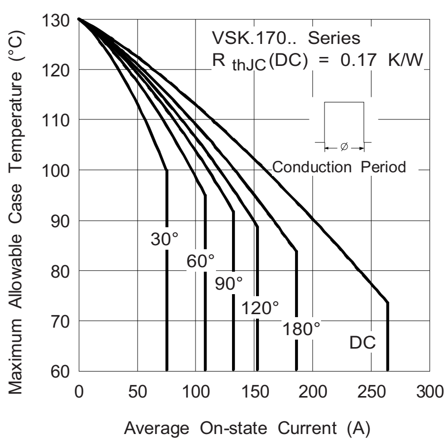

Fig. 2 - Current Ratings Characteristics

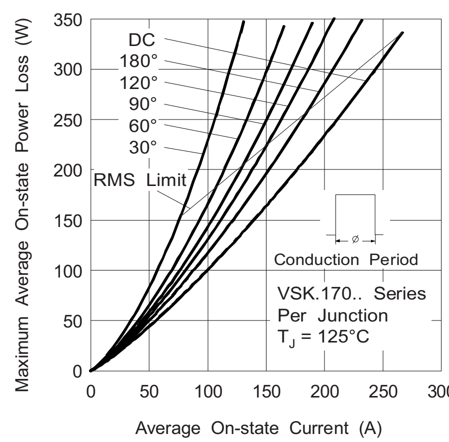

Fig. 4 - On-State Power Loss Characteristics

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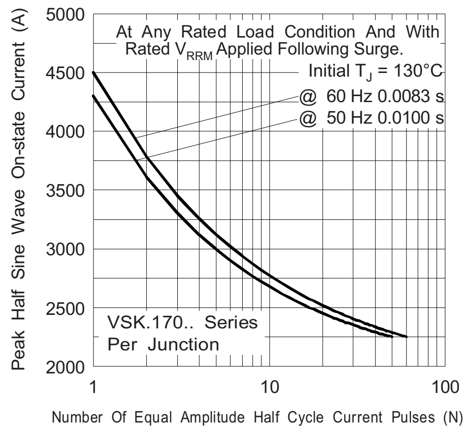

Fig. 5 - Maximum Non-Repetitive Surge Current

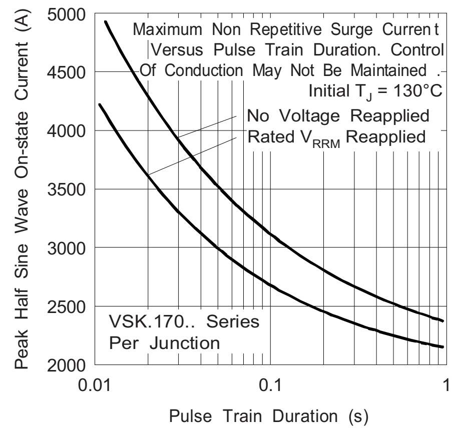

Fig. 6 - Maximum Non-Repetitive Surge Current

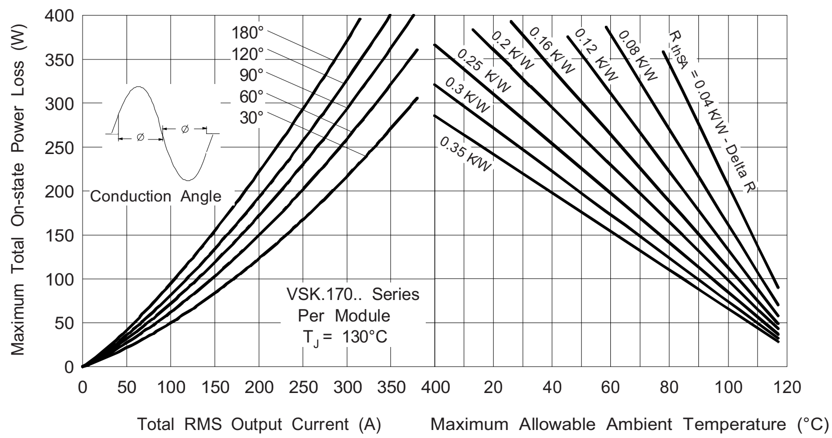

Fig. 7 - On-State Power Loss Characteristics

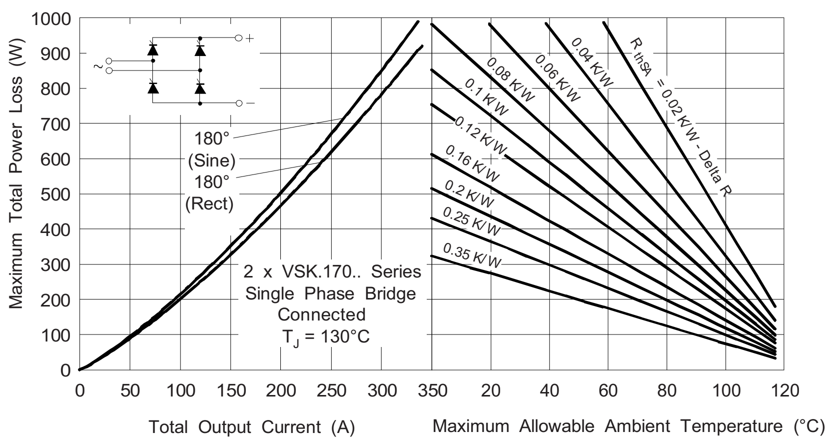

Fig. 8 - On-State Power Loss Characteristics

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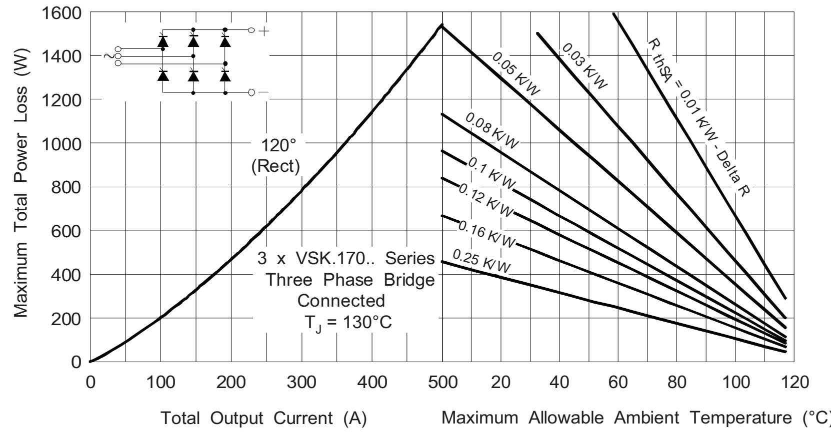

Fig. 9 - On-State Power Loss Characteristics

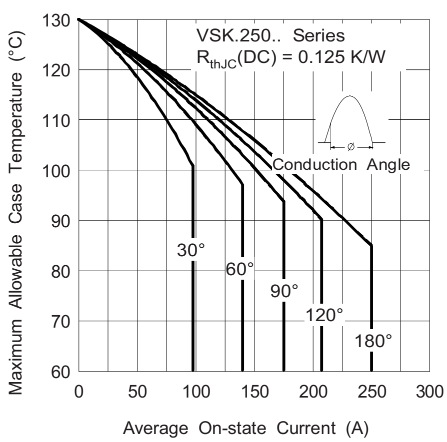

Fig. 10 - Current Ratings Characteristics

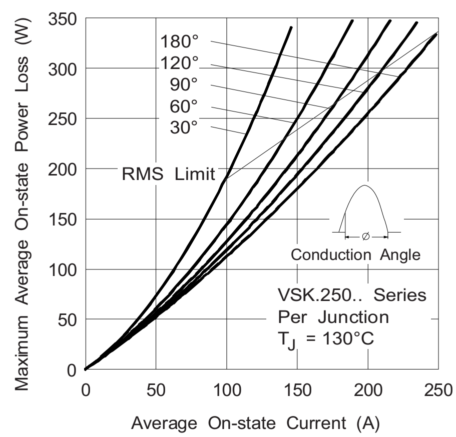

Fig. 12 - On-State Power Loss Characteristics

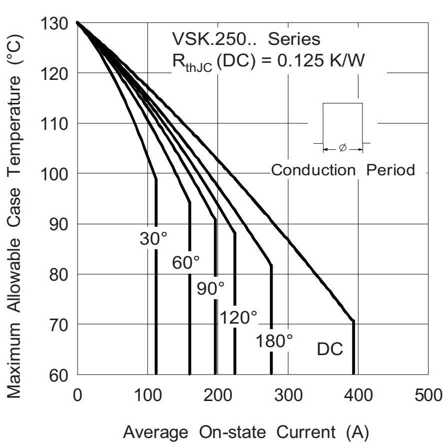

Fig. 11 - Current Ratings Characteristics

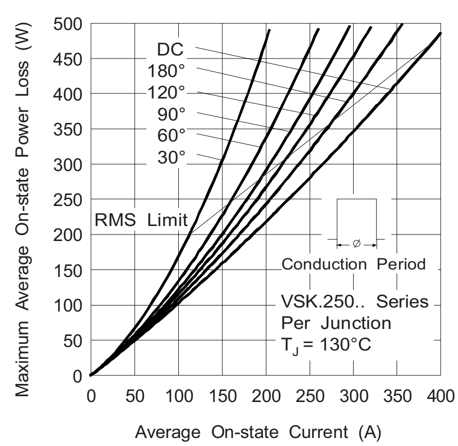

Fig. 13 - On-State Power Loss Characteristics

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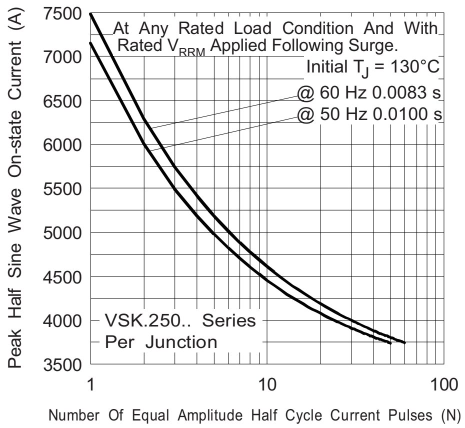

Fig. 14 - Maximum Non-Repetitive Surge Current

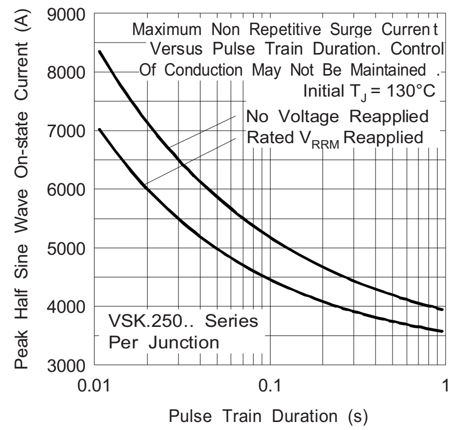

Fig. 15 - Maximum Non-Repetitive Surge Current

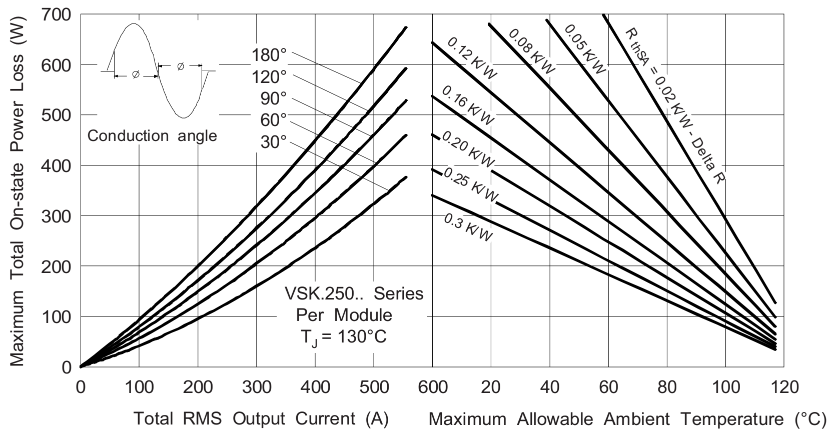

Fig. 16 - On-State Power Loss Characteristics

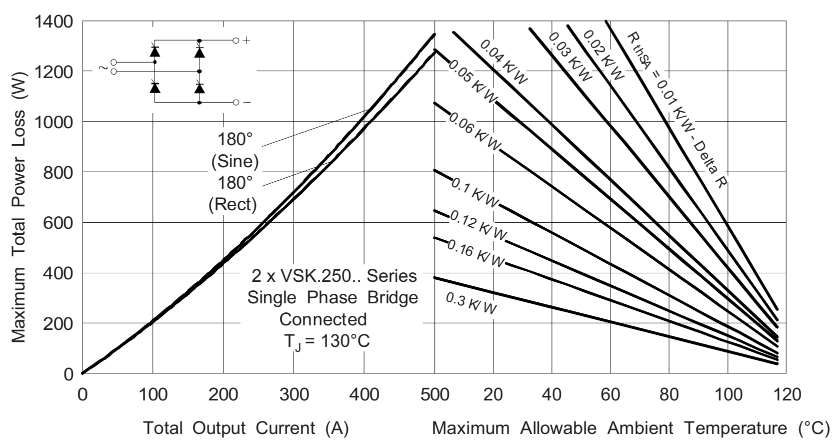

Fig. 17 - On-State Power Loss Characteristics

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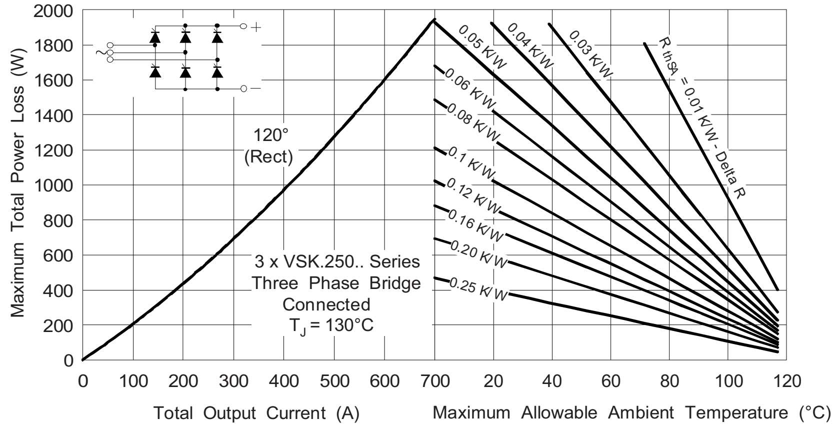

Fig. 18 - On-State Power Loss Characteristics

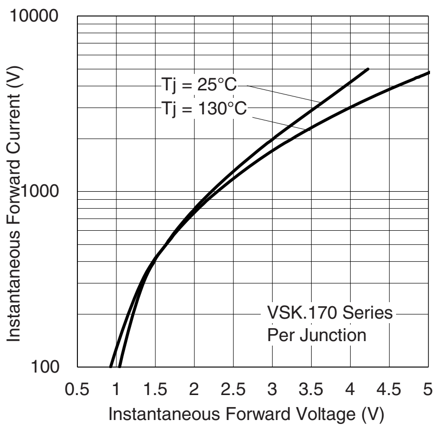

Fig. 19 - On-State Voltage Drop Characteristics

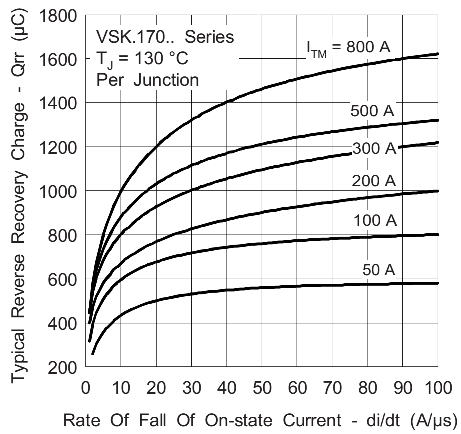

Fig. 21 - Reverse Recovery Charge Characteristics

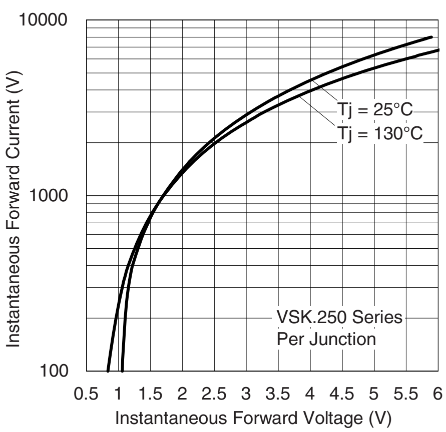

Fig. 20 - On-State Voltage Drop Characteristics

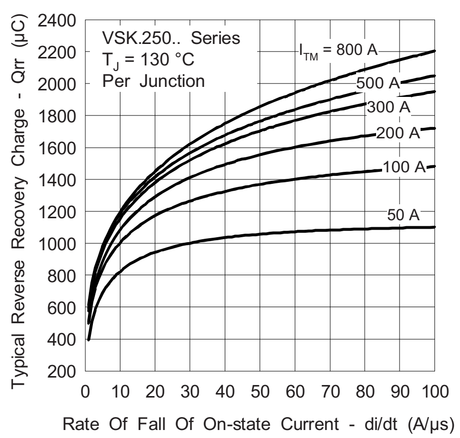

Fig. 22 - Reverse Recovery Charge Characteristics

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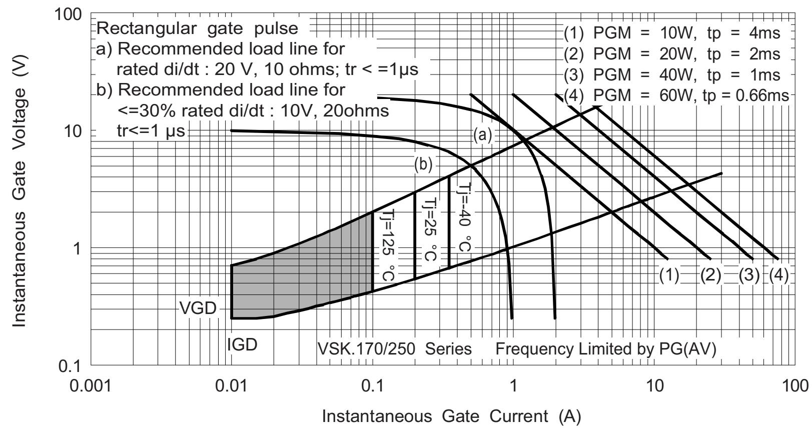

Fig. 23 - Gate Characteristics

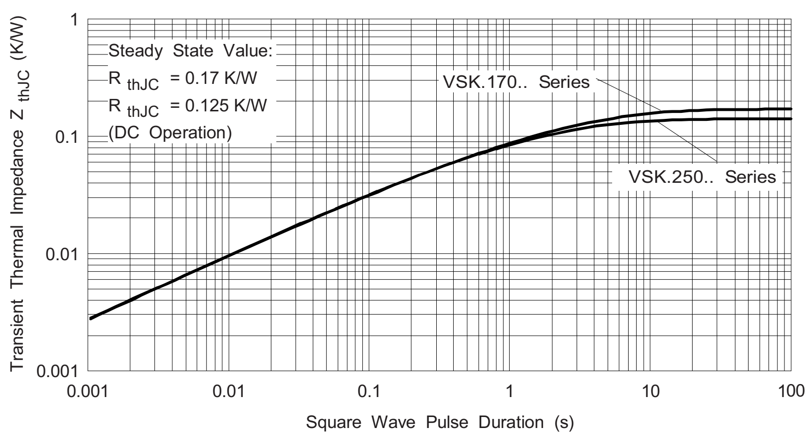

Fig. 24 - Thermal Impedance Z_{thJC} Characteristics

ORDERING INFORMATION TABLE

Device code	VSK	T	250	-	20	PbF
	1	2	3		4	5

1 - Module type

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

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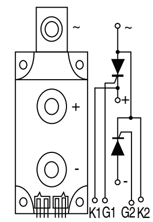
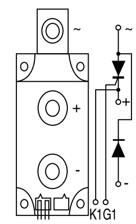
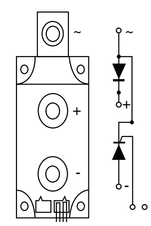
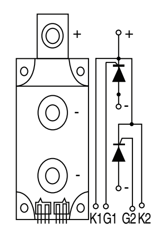
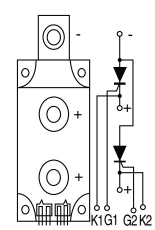
CIRCUIT CONFIGURATION

CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Two SCRs coubler circuit	T	VSKT...  Available from 400 V to 1600 V for VSK.170PbF Series, available from 400 V to 2000 V for VSK.250PbF Series
SCR/diode doubler circuit, positive control	H	VSKH...  Available from 400 V to 1600 V for VSK.170PbF Series, available from 400 V to 2000 V for VSK.250PbF Series
SCR/diode doubler circuit, negative control	L	VSKL...  Available from 400 V to 1600 V for VSK.170PbF Series, available from 400 V to 2000 V for VSK.250PbF Series
Two SCRs common cathodes	U	VSKU...  Available up to 1200 V, contact factory for different requirement
Two SCRs common anodes	V	VSKV...  Available up to 1200 V, contact factory for different requirement

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

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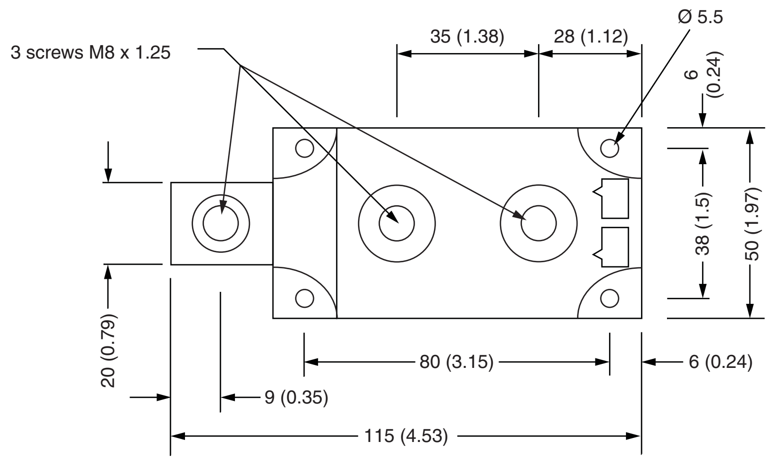
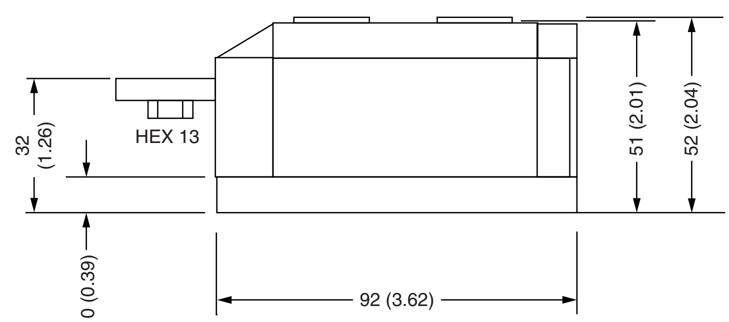
MAGN-A-PAK

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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