




Thyristor/Diode and Thyristor/Thyristor, 135 A to 160 A (New INT-A-PAK™ Power Modules)



New INT-A-PAK™

FEATURES

- High voltage
- Electrically isolated by DBC ceramic (Al_2O_3)
- 3500 V_{RMS} isolating voltage
- Industrial standard package
- High surge capability
- Glass passivated chips
- Modules uses high voltage power thyristor/diodes in three basic configurations
- Simple mounting
- UL E78996 approved 
- Totally lead (Pb)-free
- Designed and qualified for multiple level



RoHS
COMPLIANT

PRODUCT SUMMARY

$I_{T(AV)}$	135 to 160 A
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APPLICATIONS

- DC motor control and drives
- Battery charges
- Welders
- Power converters
- Lighting control
- Heat and temperature control

MAJOR RATINGS AND CHARACTERISTICS

SYMBOL	CHARACTERISTICS	VSK.136..	VSK.142..	VSK.162..	UNITS
$I_{T(AV)}$	85 °C	135	140	160	A
$I_{T(RMS)}$		300	310	355	A
I_{TSM}	50 Hz	3200	4500	4870	
	60 Hz	3360	4712	5100	
I^2t	50 Hz	51.5	102	119	kA ² s
	60 Hz	47	92.5	108	
$I^2\sqrt{t}$		515.5	1013	1190	kA ² √s
V_{RRM}	Range	400 to 1600			V
T_J	Range	- 40 to 125			°C

ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS

TYPE NUMBER	VOLTAGE CODE	V_{RRM}/V_{DRM} , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE V	V_{RSM}/V_{DSM} , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V	I_{RRM}/I_{DRM} AT 125 °C mA
VSK.136 VSK.142 VSK.162	04	400	500	50
	08	800	900	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	

FORWARD CONDUCTION									
PARAMETER	SYMBOL	TEST CONDITIONS		VSK.136	VSK.142	VSK.162	UNITS		
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave		135	140	160	A		
				85	85	85	°C		
Maximum RMS on-state current	$I_{T(RMS)}$	As AC switch		300	310	355	A		
Maximum peak, one-cycle on-state, non-repetitive surge current	I_{TSM}	t = 10 ms	No voltage reapplied	Sine half wave, initial $T_J = T_J$ maximum	3200	4500		4870	
		t = 8.3 ms			3360	4712		5100	
		t = 10 ms	100% V_{RRM} reapplied		2700	3785		4100	
		t = 8.3 ms			2800	3963		4300	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied		51.5	102		119	kA ² s
		t = 8.3 ms			47	92.5		108	
		t = 10 ms	100% V_{RRM} reapplied		36.5	71.6		84	
		t = 8.3 ms			33.3	65.4	76.7		
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		515.5	1013	1190	kA ² √s		
Low level value of threshold voltage	$V_{T(TO)1}$	(16.7% $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$), T_J maximum		0.86	0.83	0.8	V		
High level value of threshold voltage	$V_{T(TO)2}$	(I > $\pi \times I_{T(AV)}$), T_J maximum		1.05	1	0.98			
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 maximum		2.02	1.78	1.67	mΩ		
High level value on-state slope resistance	r_{t2}	(I > $\pi \times I_{T(AV)}$), T_J maximum		1.65	1.43	1.38			
Maximum on-state voltage drop	V_{TM}	$I_{TM} = \pi \times I_{T(AV)}$, $T_J = 25$ °C, 180° conduction		1.57	1.55	1.54	V		
Maximum forward voltage drop	V_{FM}	$I_{TM} = \pi \times I_{T(AV)}$, $T_J = 25$ °C, 180° conduction		1.57	1.55	1.54	V		
Maximum holding current	I_H	Anode supply = 6 V initial $I_T = 30$ A, $T_J = 25$ °C		200			mA		
Maximum latching current	I_L	Anode supply = 6 V resistive load = 1 Ω Gate pulse: 10 V, 100 μs, $T_J = 25$ °C		400					

SWITCHING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Typical delay time	t_{gd}	$T_J = 25$ °C	Gate current = 1 A, $di_g/dt = 1$ A/μs $V_d = 0.67\% V_{DRM}$	1	μs
Typical rise time	t_{gr}			2	
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 200	

BLOCKING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum peak reverse and off-state leakage current	I_{RRM} , I_{DRM}	$T_J = 125$ °C		50	mA
RMS insulation voltage	V_{INS}	50 Hz, circuit to base, all terminals shorted, t = 1 s		3500	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



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TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum peak gate power	P_{GM}	$t_p \leq 5$ ms, $T_J = T_J$ maximum		12	W
Maximum average gate power	$P_{G(AV)}$	$f = 50$ Hz, $T_J = T_J$ maximum		3	
Maximum peak gate current	I_{GM}	$t_p \leq 5$ ms, $T_J = T_J$ maximum		3	A
Maximum peak negative gate voltage	$-V_{GT}$			10	V
Maximum required DC gate voltage to trigger	V_{GT}	$T_J = -40$ °C	Anode supply = 6 V, resistive load; $R_a = 1$ Ω	4	
		$T_J = 25$ °C		2.5	
		$T_J = T_J$ maximum		1.7	
Maximum required DC gate current to trigger	I_{GT}	$T_J = -40$ °C		270	mA
		$T_J = 25$ °C		150	
		$T_J = T_J$ maximum		80	
Maximum gate voltage that will not trigger	V_{GD}	$T_J = T_J$ maximum, rated V_{DRM} applied		0.3	V
Maximum gate current that will not trigger	I_{GD}			10	mA
Maximum rate of rise of turned-on current	di/dt	$T_J = T_J$ maximum, $I_{TM} = 400$ A rated V_{DRM} applied		300	A/μs

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum junction operating temperature range	T_J			- 40 to 125	°C
Maximum storage temperature range	T_{Stg}			- 40 to 150	
Maximum thermal resistance, junction to case per junction	R_{thJC}	DC operation		0.18	K/W
Maximum thermal resistance, case to heatsink per module	R_{thCS}	Mounting surface, smooth, flat and greased		0.05	
Mounting torque ± 10 %	IAP to heatsink busbar to IAP	A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound. Lubricated threads.		4 to 6	Nm
Approximate weight				200	g
Case style				7.1	oz.
				New INT-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°	
VSK.136	0.007	0.01	0.013	0.0155	0.017	0.009	0.012	0.014	0.015	0.017	K/W
VSK.142	0.0019	0.0019	0.0020	0.0020	0.0021	0.0018	0.0022	0.0023	0.0023	0.0020	
VSK.162	0.0030	0.0031	0.0032	0.0033	0.0034	0.0029	0.0036	0.0039	0.0041	0.0040	

Note

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

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Vishay High Power Products

Thyristor/Diode and
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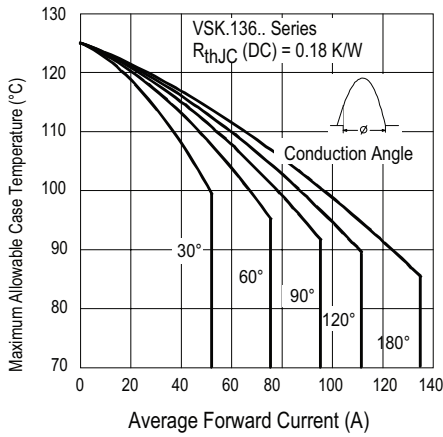


Fig. 1 - Current Ratings Characteristics

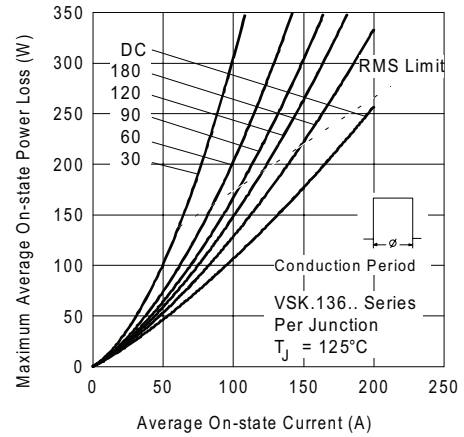


Fig. 4 - On-State Power Loss Characteristics

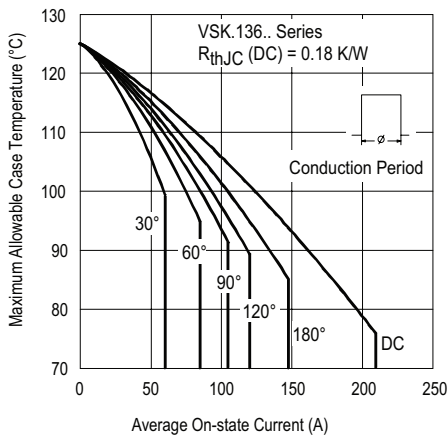


Fig. 2 - Current Ratings Characteristics

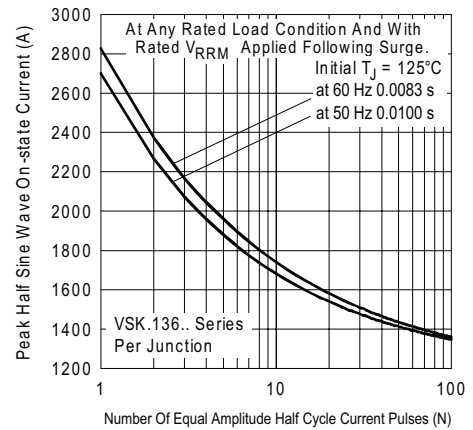


Fig. 5 - Maximum Non-Repetitive Surge Current

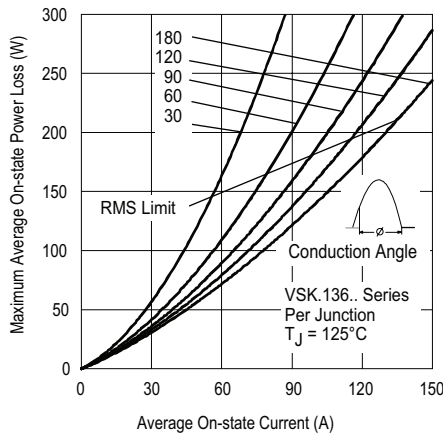


Fig. 3 - On-State Power Loss Characteristics

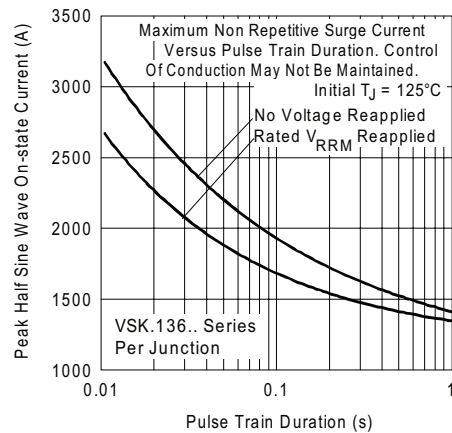


Fig. 6 - Maximum Non-Repetitive Surge Current



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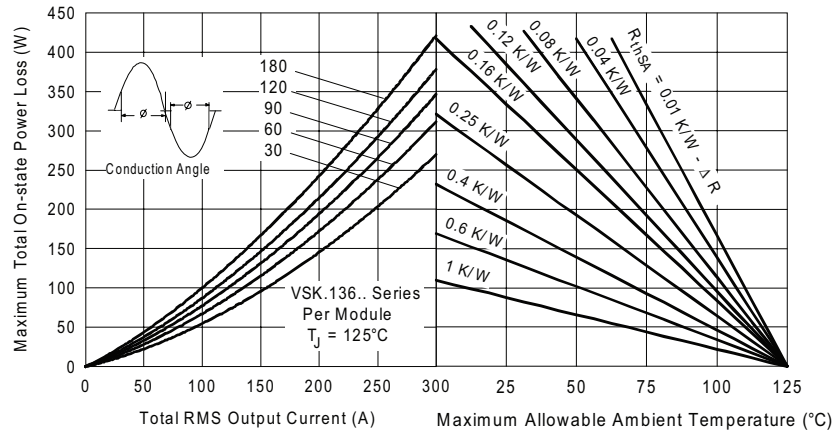


Fig. 7 - On-State Power Loss Characteristics

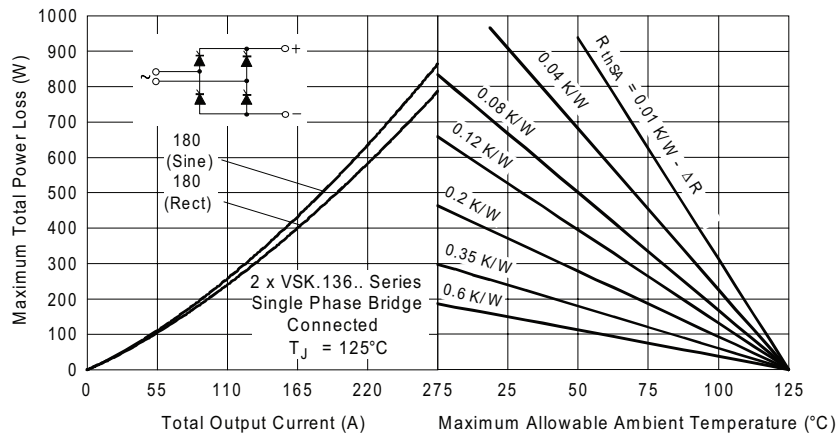


Fig. 8 - On-State Power Loss Characteristics

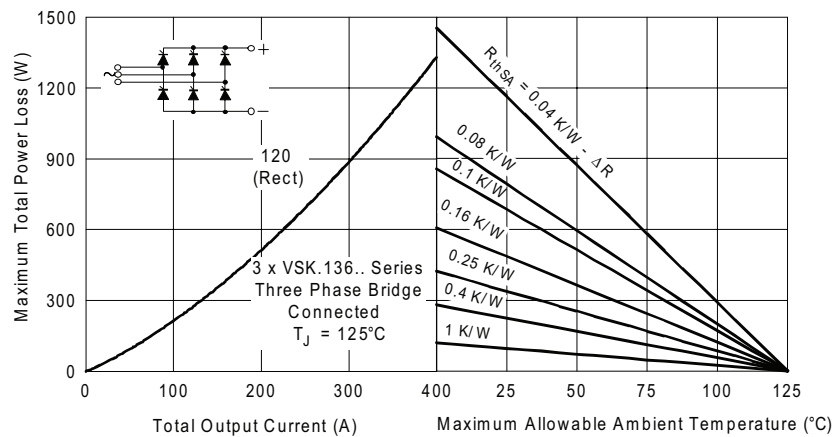


Fig. 9 - On-State Power Loss Characteristics

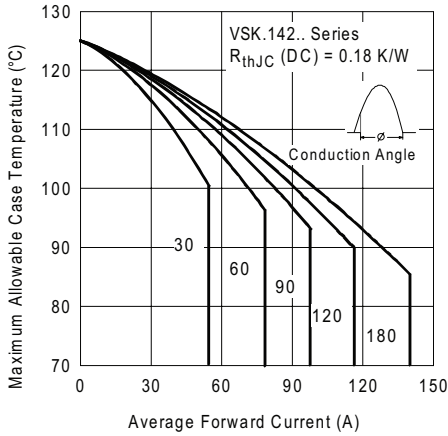


Fig. 10 - Current Ratings Characteristics

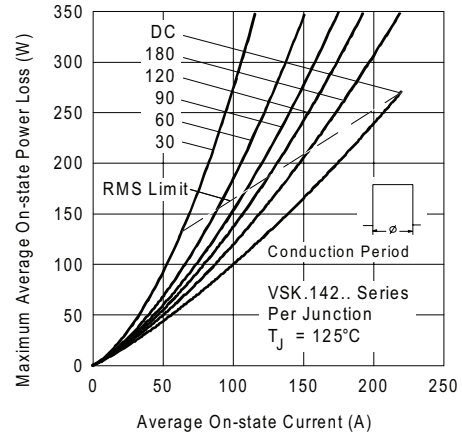


Fig. 13 - On-State Power Loss Characteristics

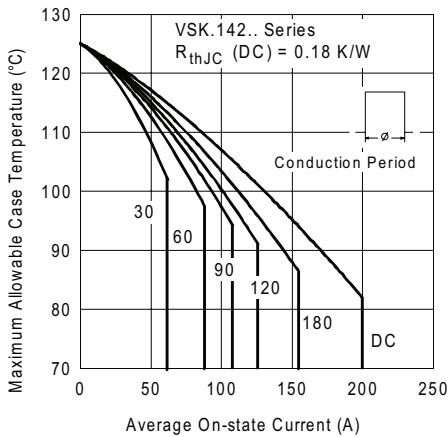


Fig. 11 - Current Ratings Characteristics

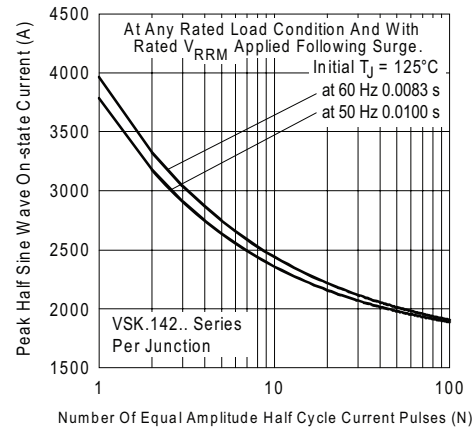


Fig. 14 - Maximum Non-Repetitive Surge Current

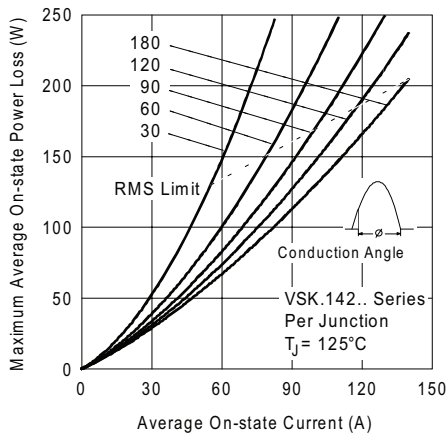


Fig. 12 - On-State Power Loss Characteristics

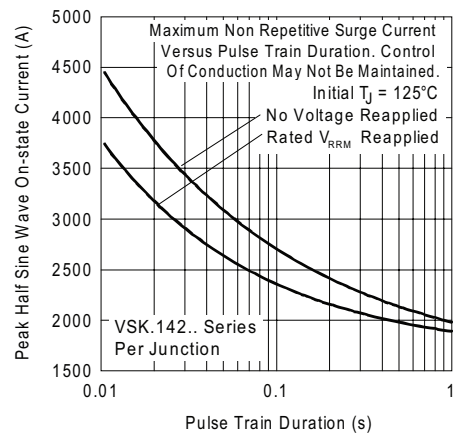


Fig. 15 - Maximum Non-Repetitive Surge Current



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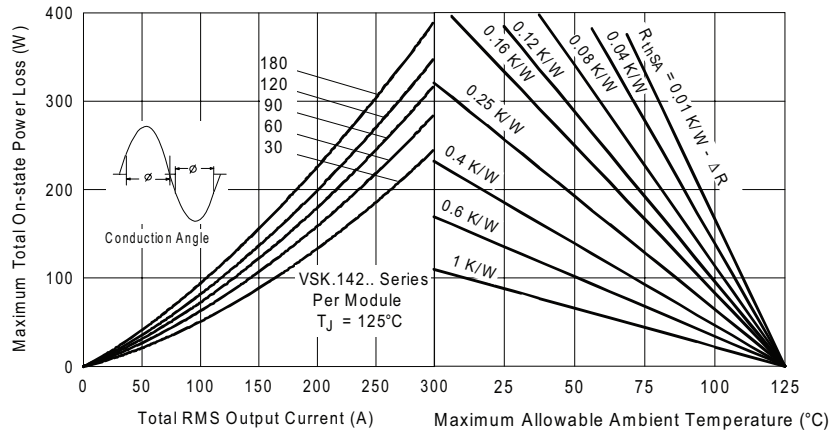


Fig. 16 - On-State Power Loss Characteristics

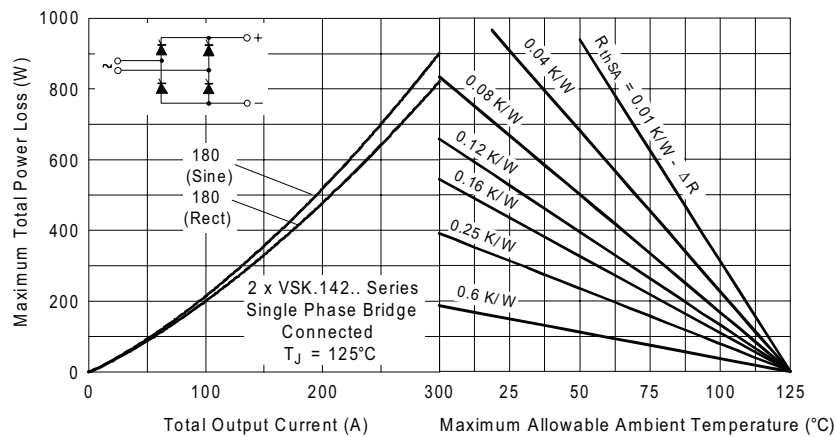


Fig. 17 - On-State Power Loss Characteristics

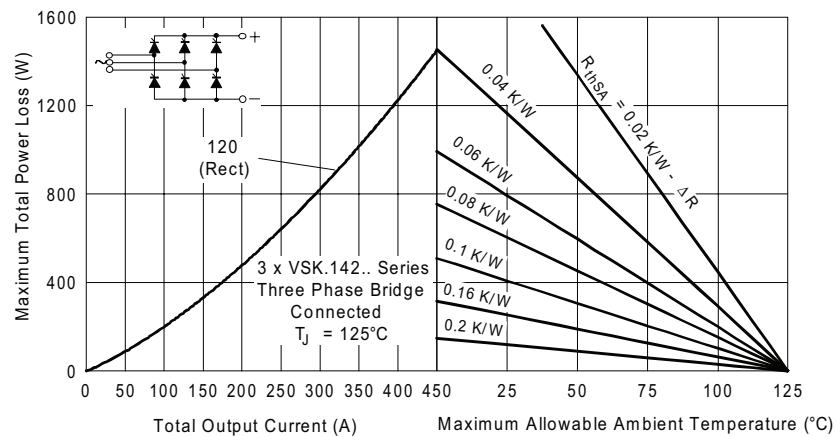


Fig. 18 - On-State Power Loss Characteristics

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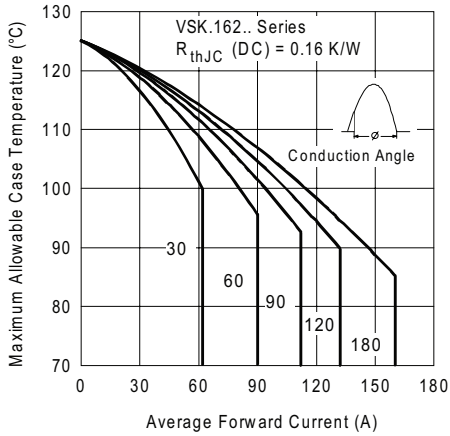


Fig. 19 - Current Ratings Characteristics

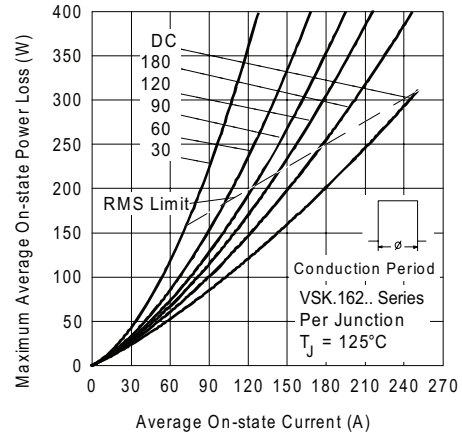


Fig. 22 - On-State Power Loss Characteristics

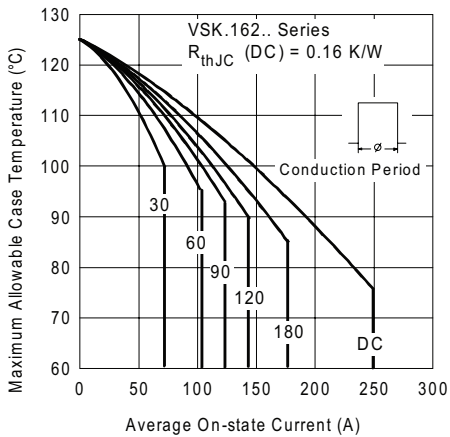


Fig. 20 - Current Ratings Characteristics

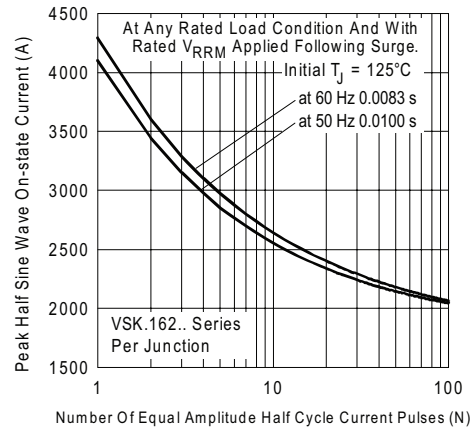


Fig. 23 - Maximum Non-Repetitive Surge Current

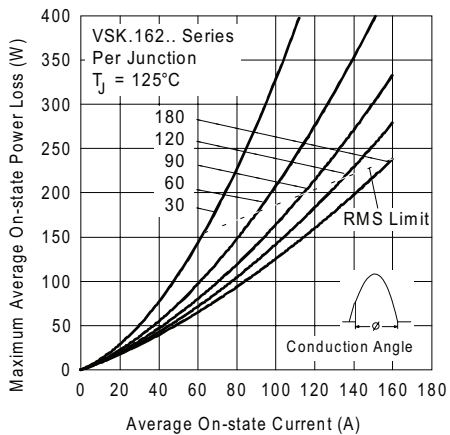


Fig. 21 - On-State Power Loss Characteristics

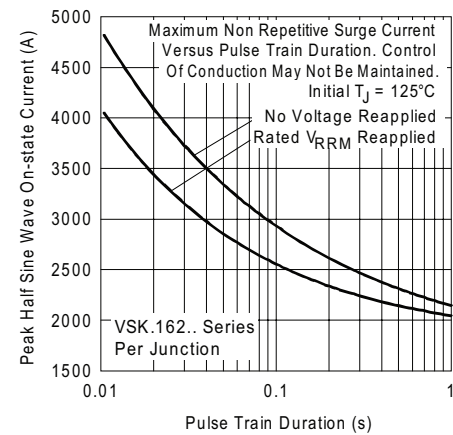


Fig. 24 - Maximum Non-Repetitive Surge Current



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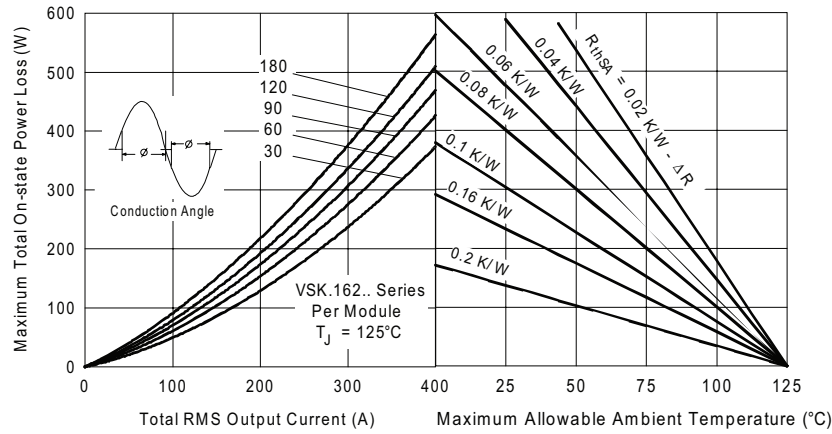


Fig. 25 - On-State Power Loss Characteristics

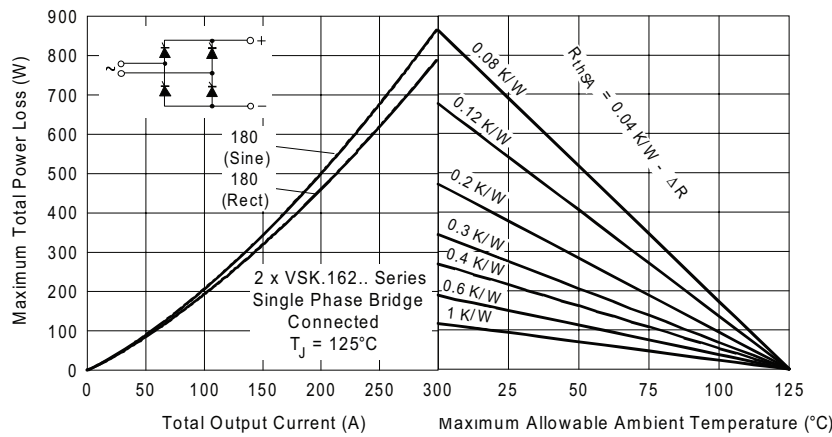


Fig. 26 - On-State Power Loss Characteristics

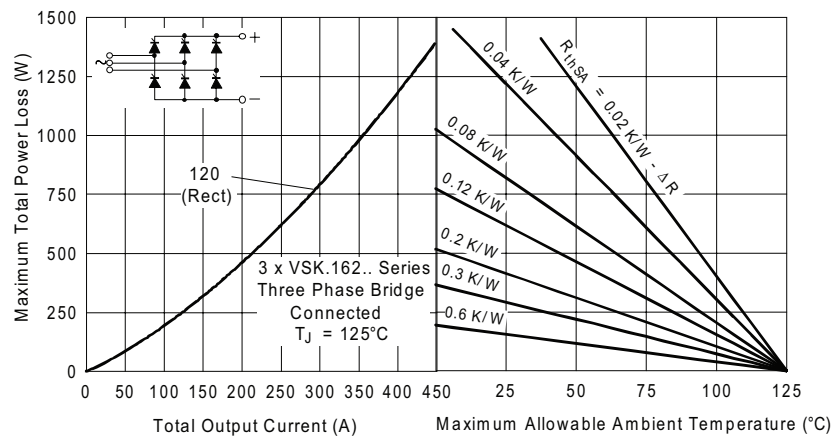


Fig. 27 - On-State Power Loss Characteristics

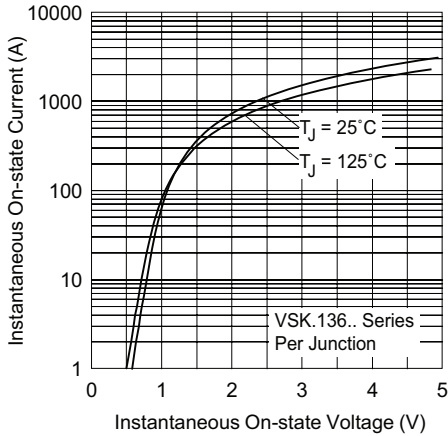


Fig. 28 - On-State Voltage Drop Characteristics

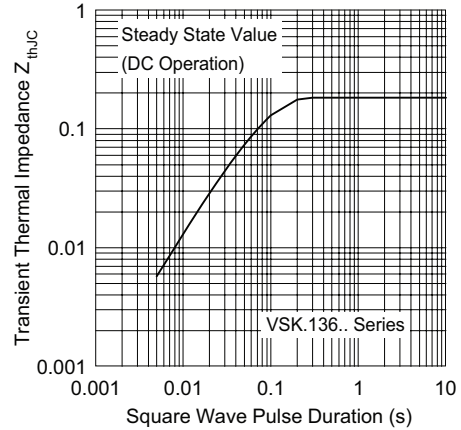


Fig. 31 - Thermal Impedance Z_{thJC} Characteristics

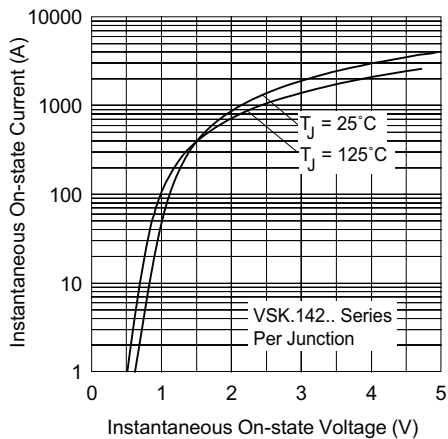


Fig. 29 - On-State Voltage Drop Characteristics

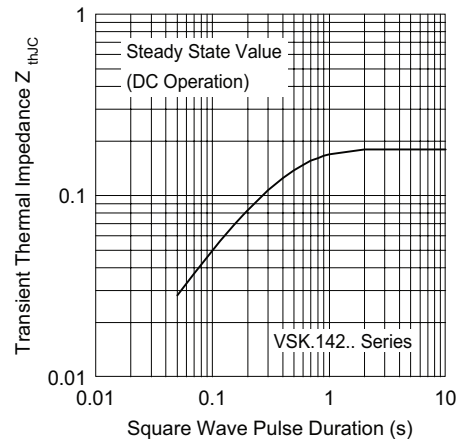


Fig. 32 - Thermal Impedance Z_{thJC} Characteristics

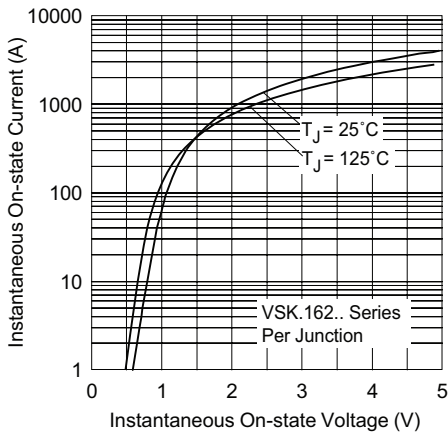


Fig. 30 - On-State Voltage Drop Characteristics

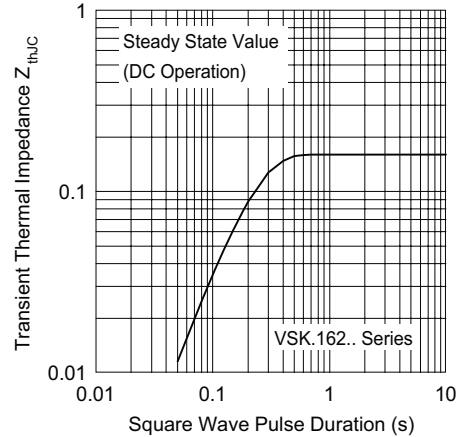


Fig. 33 - Thermal Impedance Z_{thJC} Characteristics



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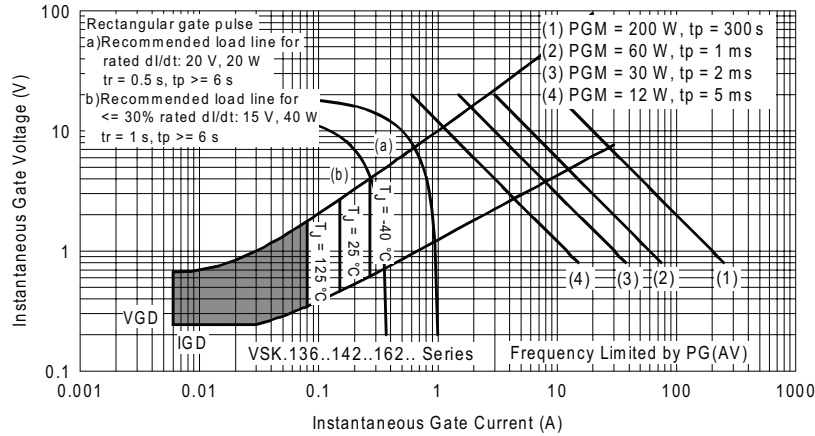


Fig. 34 - Gate Characteristics

ORDERING INFORMATION TABLE

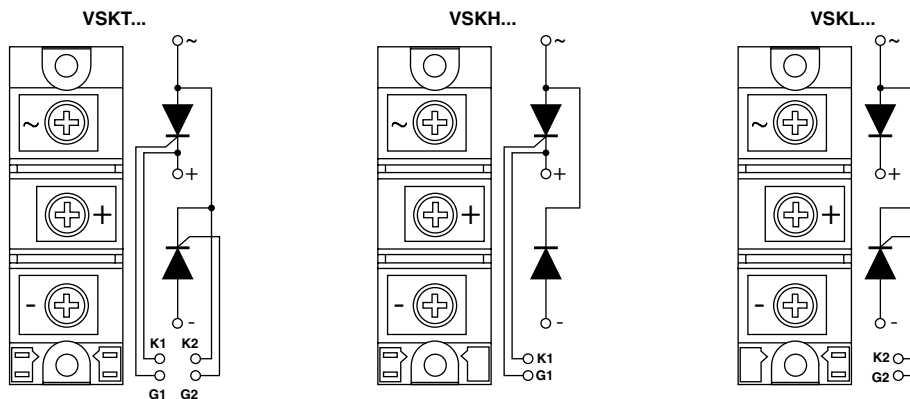
Device code	VSK	T	162	/	16	PbF
	①	②	③		④	⑤
	1	2	3		4	5

- 1 - Module type
- 2 - Circuit configuration
- 3 - Current rating: $I_{T(AV)}$
- 4 - Voltage code x 100 = V_{RRM}
- 5 - PbF = Lead (Pb)-free

Note

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

CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS

Dimensions

<http://www.vishay.com/doc?95067>



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