




## Standard Recovery Diodes, 165 A to 230 A (INT-A-PAK Power Modules)



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 diodes in four basic configurations
- Simple mounting
- UL approved file E78996 
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for multiple level



RoHS  
COMPLIANT

### PRODUCT SUMMARY

$I_{F(AV)}$	165 A to 230 A
Type	Modules - Diode, High Voltage

### APPLICATIONS

- DC motor control and drives
- Battery chargers
- Welders
- Power converters

### MAJOR RATINGS AND CHARACTERISTICS

SYMBOL	CHARACTERISTICS	VSK.166..	VSK.196..	VSK.236..	UNITS
$I_{F(AV)}$		165	195	230	A
	$T_C$	100	100	100	$^{\circ}C$
$I_{F(RMS)}$		260	305	360	A
$I_{FSM}$	50 Hz	4000	4750	5500	
	60 Hz	4200	4980	5765	
$I^2t$	50 Hz	80	113	151	$kA^2s$
	60 Hz	73	103	138	
$I^2\sqrt{t}$		798	1130	1516	$kA^2\sqrt{s}$
$V_{RRM}$		400 to 1600			V
$T_J$	Range	- 40 to 150			$^{\circ}C$

### ELECTRICAL SPECIFICATIONS

#### VOLTAGE RATINGS

TYPE NUMBER	VOLTAGE CODE	$V_{RRM}$ , MAXIMUM REPETITIVE PEAK REVERSE VOLTAGE V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK REVERSE VOLTAGE V	$I_{RRM}$ AT 150 $^{\circ}C$ mA
VSK.166 VSK.196 VSK.236	04	400	500	20
	08	800	900	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	

# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series



Vishay Semiconductors Standard Recovery Diodes, 165 A to 230 A  
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FORWARD CONDUCTION							
PARAMETER	SYMBOL	TEST CONDITIONS		VSK.166	VSK.196	VSK.236	UNITS
Maximum average on-state current at case temperature	$I_{F(AV)}$	180° conduction, half sine wave		165	195	230	A
				100	100	100	°C
Maximum RMS on-state current	$I_{F(RMS)}$			260	305	360	A
Maximum peak, one-cycle on-state, non-repetitive surge current	$I_{FSM}$	t = 10 ms	No voltage reappplied	4000	4750	5500	
		t = 8.3 ms		4200	4980	5765	
		t = 10 ms	100 % $V_{RRM}$ reappplied	3350	4000	4630	
		t = 8.3 ms		3500	4200	4850	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reappplied	80	113	151	kA <sup>2</sup> s
		t = 8.3 ms		73	103	138	
		t = 10 ms	100 % $V_{RRM}$ reappplied	56	80	107	
		t = 8.3 ms		52	73	98	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reappplied		798	1130	1516	kA <sup>2</sup> √s
Low level value of threshold voltage	$V_{F(TO)1}$	(16.7 % $\times \pi \times I_{F(AV)} < I < \pi \times I_{F(AV)}$ ), $T_J$ maximum		0.73	0.69	0.7	V
High level value of threshold voltage	$V_{F(TO)2}$	(I > $\pi \times I_{F(AV)}$ ), $T_J$ maximum		0.88	0.78	0.83	
Low level value on-state slope resistance	$r_{\theta 1}$	(16.7 % $\times \pi \times I_{F(AV)} < I < \pi \times I_{F(AV)}$ ), $T_J$ maximum		1.5	1.3	1.2	mΩ
High level value on-state	$r_{\theta 2}$	(I > $\pi \times I_{F(AV)}$ ), $T_J$ maximum		1.26	1.2	1.07	
Maximum forward voltage drop	$V_{FM}$	$I_{FM} = \pi \times I_{F(AV)}$ , $T_J = 25^\circ\text{C}$ , 180° conduction Average power = $V_{F(TO)} \times I_{F(AV)} + r_f \times (I_{F(RMS)})^2$		1.43	1.38	1.46	V

BLOCKING							
PARAMETER	SYMBOL	TEST CONDITIONS		VSK.166	VSK.196	VSK.236	UNITS
Maximum peak reverse and off-state leakage current	$I_{RRM}$	$T_J = 150^\circ\text{C}$		20			mA
RMS insulation voltage	$V_{INS}$	50 Hz, circuit to base, all terminals shorted, t = 1 s		3500			V

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES			UNITS
			VSK.166	VSK.196	VSK.236	
Maximum junction operating and storage temperature range	$T_J, T_{Stg}$		- 40 to 150			°C
Maximum thermal resistance, junction to case per junction	$R_{thJC}$	DC operation	0.2	0.16	0.14	K/W
Maximum thermal resistance, case to heatsink per module	$R_{thCS}$	Mounting surface smooth, flat and greased	0.05			
Mounting torque $\pm 10\%$	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
			7.1			oz.
Case style			INT-A-PAK			



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<b>ΔR CONDUCTION PER JUNCTION</b>											
DEVICES	SINUSOIDAL CONDUCTION AT T <sub>J</sub> MAXIMUM					RECTANGULAR CONDUCTION AT T <sub>J</sub> MAXIMUM					UNITS
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
VSK.166	0.025	0.03	0.038	0.055	0.089	0.018	0.031	0.041	0.057	0.089	K/W
VSK.196	0.016	0.019	0.024	0.034	0.053	0.012	0.02	0.026	0.035	0.054	
VSK.236	0.009	0.010	0.014	0.018	0.025	0.008	0.012	0.015	0.019	0.025	

**Note**

- Table shows the increment of thermal resistance R<sub>thJC</sub> when devices operate at different conduction angles than DC

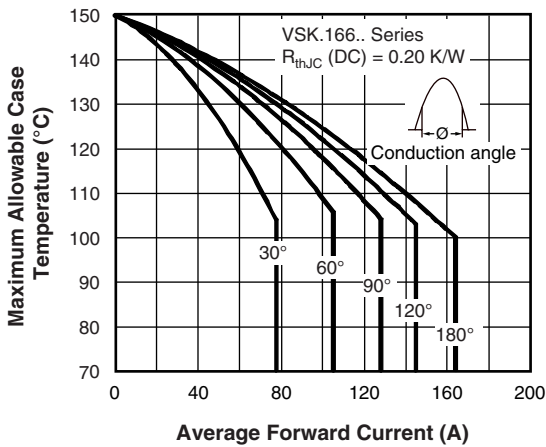


Fig. 1 - Current Ratings Characteristics

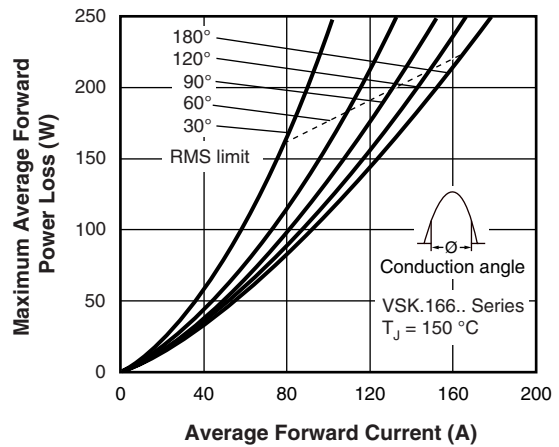


Fig. 3 - On-State Power Loss Characteristics

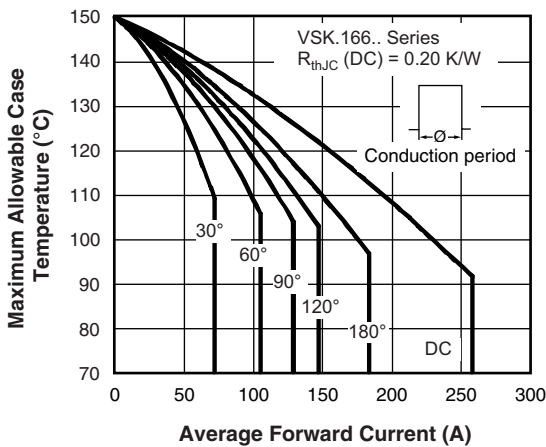


Fig. 2 - Current Ratings Characteristics

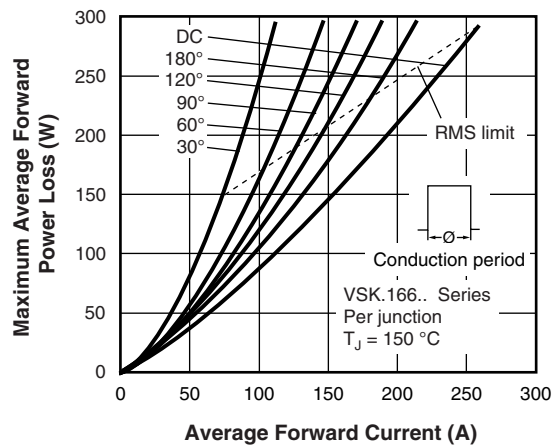


Fig. 4 - On-State Power Loss Characteristics

# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series



Vishay Semiconductors Standard Recovery Diodes, 165 A to 230 A  
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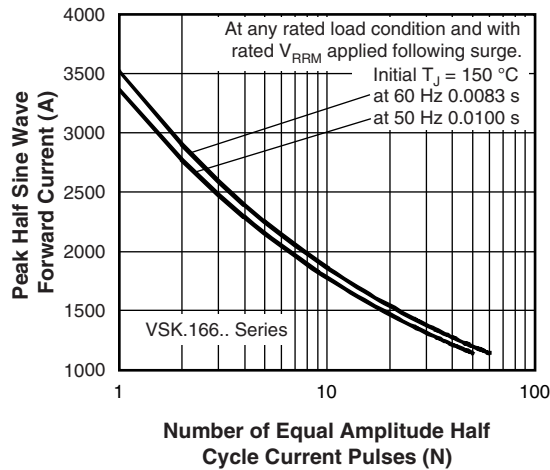


Fig. 5 - Maximum Non-Repetitive Surge Current

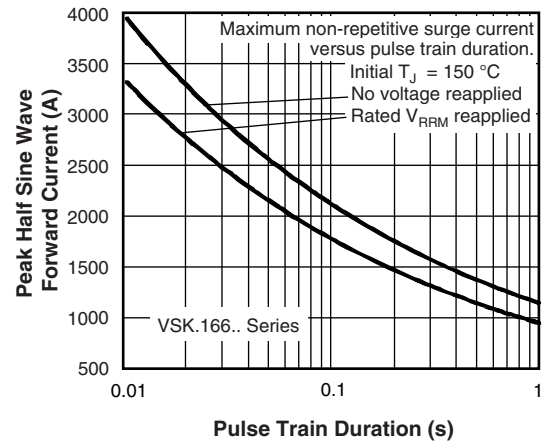


Fig. 6 - Maximum Non-Repetitive Surge Current

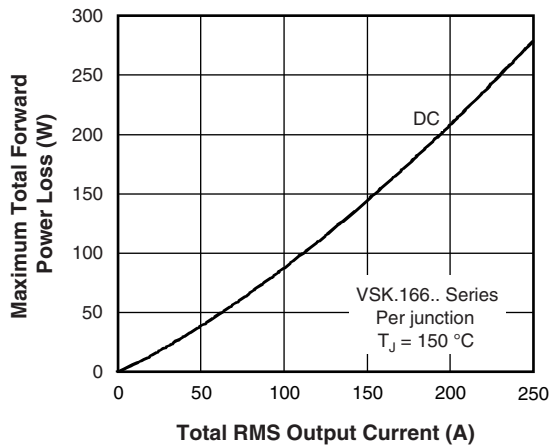


Fig. 7 - On-State Power Loss Characteristics

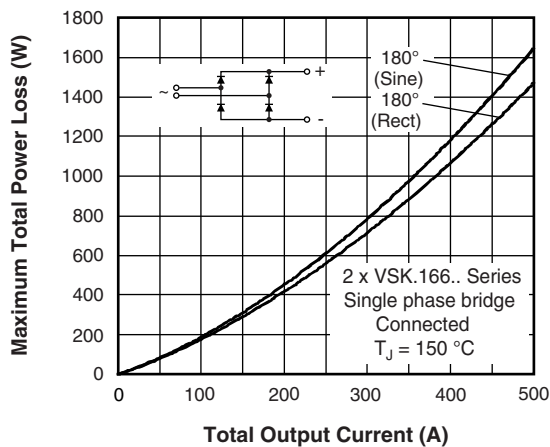
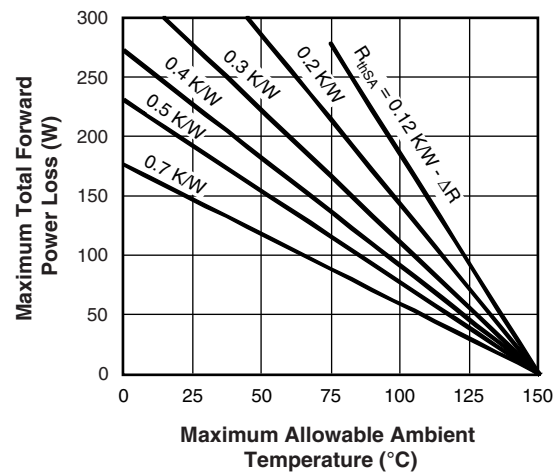
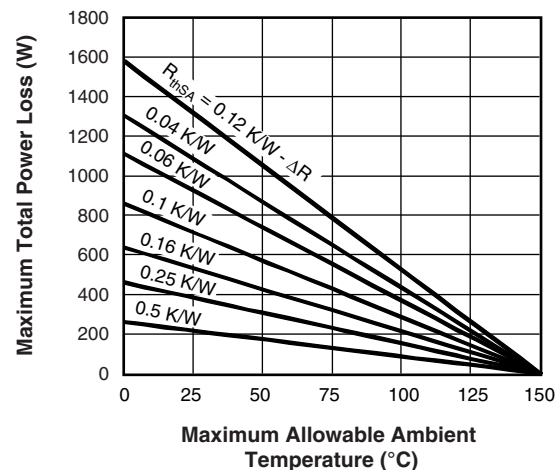


Fig. 8 - On-State Power Loss Characteristics





# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series

Standard Recovery Diodes, 165 A to 230 A Vishay Semiconductors  
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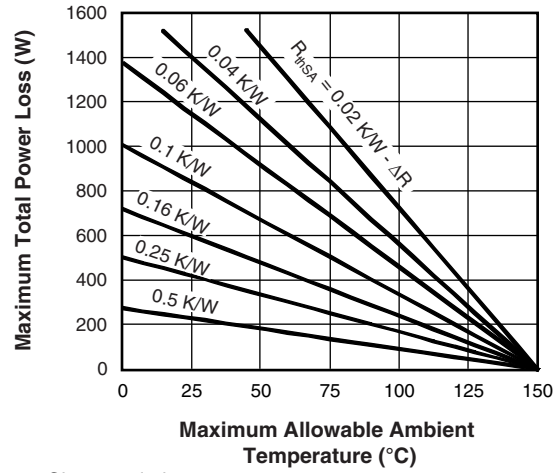
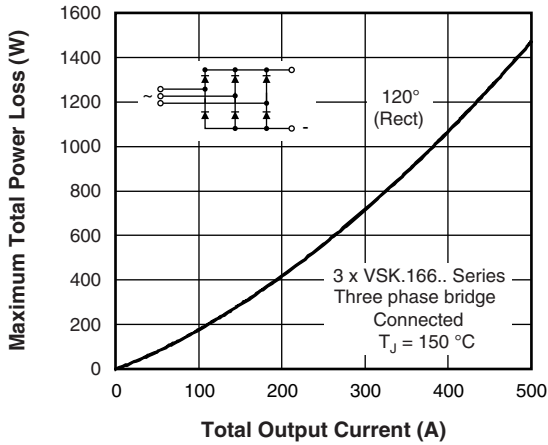


Fig. 9 - On-State Power Loss Characteristics

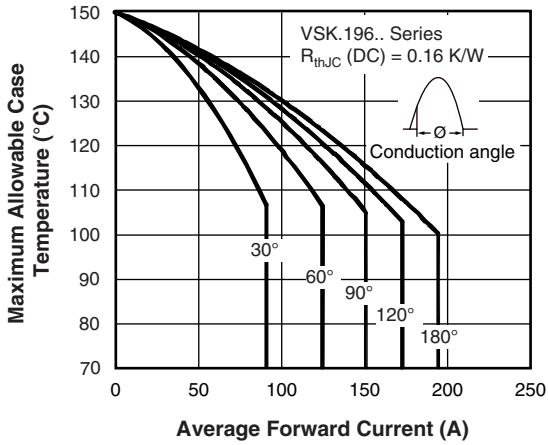


Fig. 10 - Current Ratings Characteristics

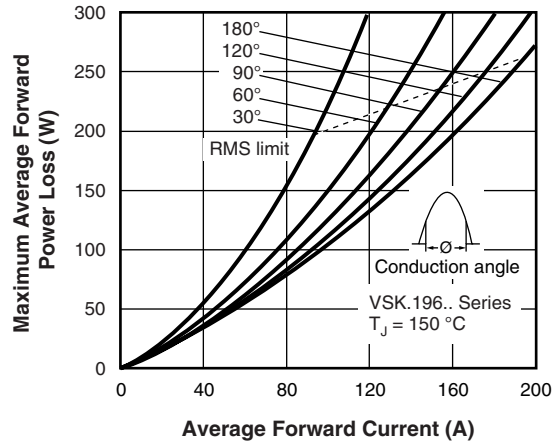


Fig. 12 - On-State Power Loss Characteristics

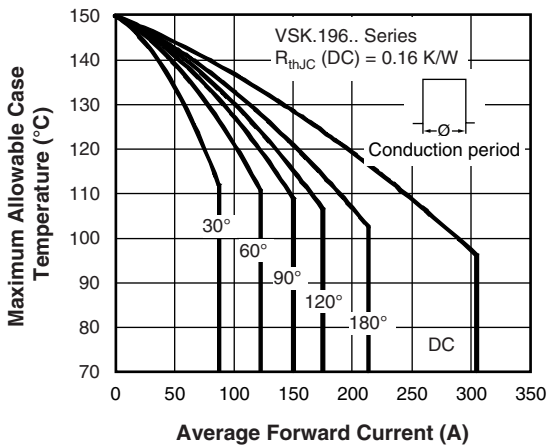


Fig. 11 - Current Ratings Characteristics

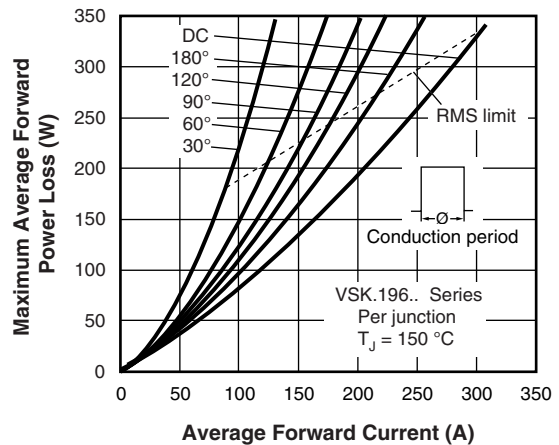


Fig. 13 - On-State Power Loss Characteristics

# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series



Vishay Semiconductors Standard Recovery Diodes, 165 A to 230 A  
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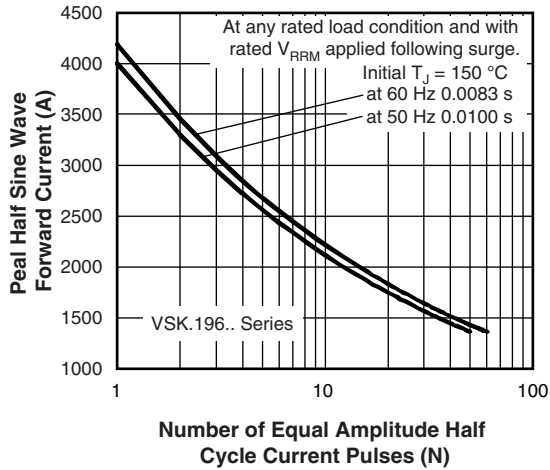


Fig. 14 - Maximum Non-Repetitive Surge Current

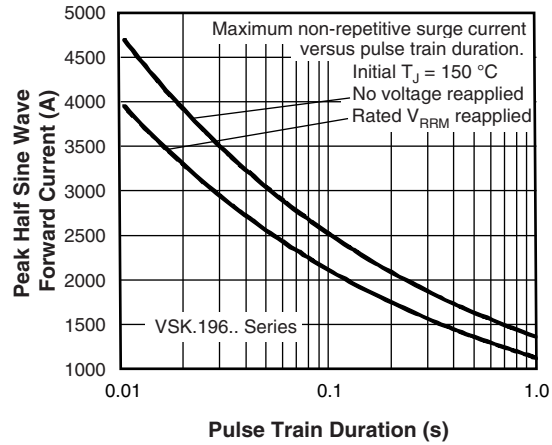


Fig. 15 - Maximum Non-Repetitive Surge Current

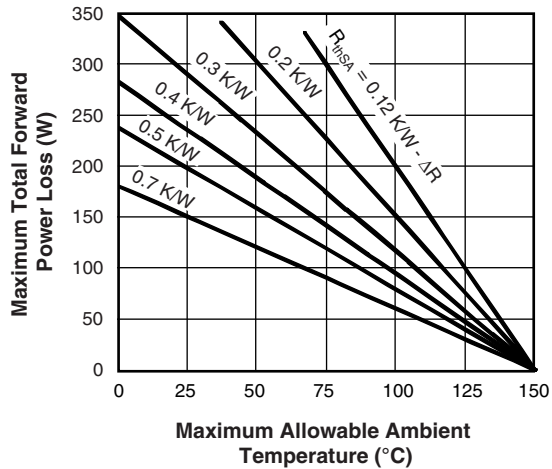
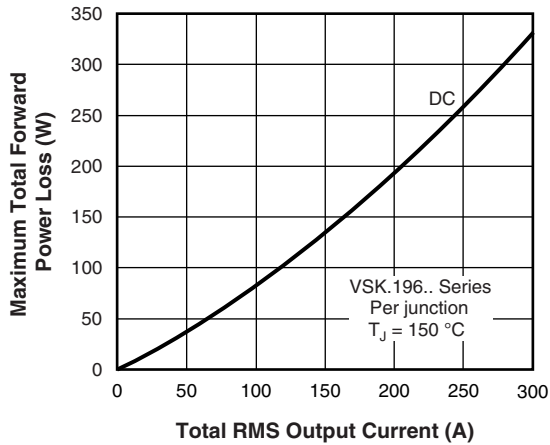


Fig. 16 - On-State Power Loss Characteristics

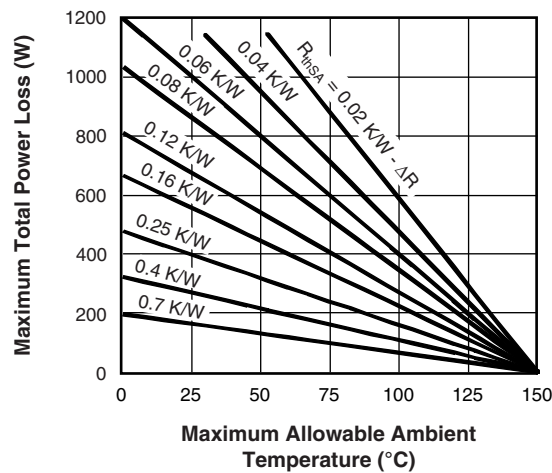
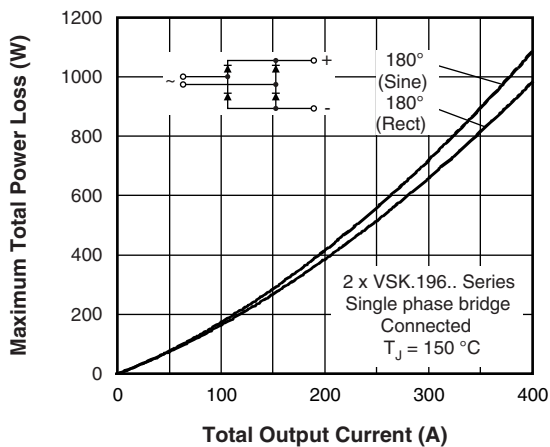


Fig. 17 - On-State Power Loss Characteristics



# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series

Standard Recovery Diodes, 165 A to 230 A Vishay Semiconductors  
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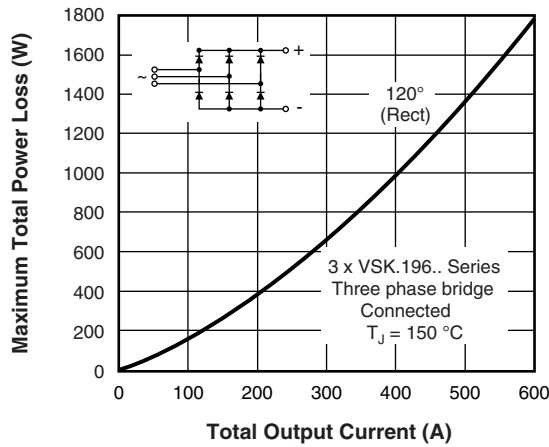


Fig. 18 - On-State Power Loss Characteristics

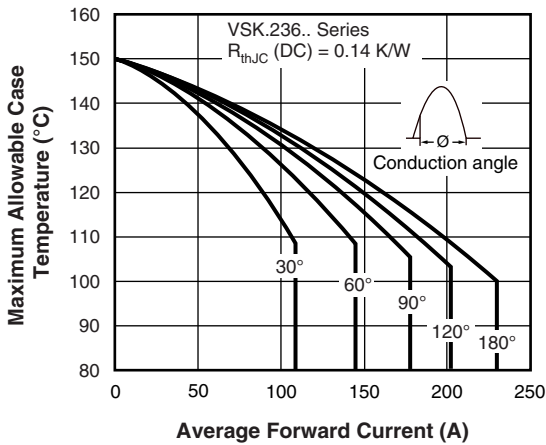
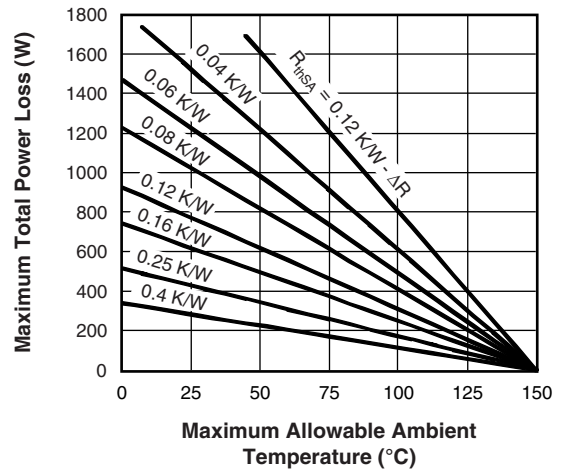


Fig. 19 - Current Ratings Characteristics

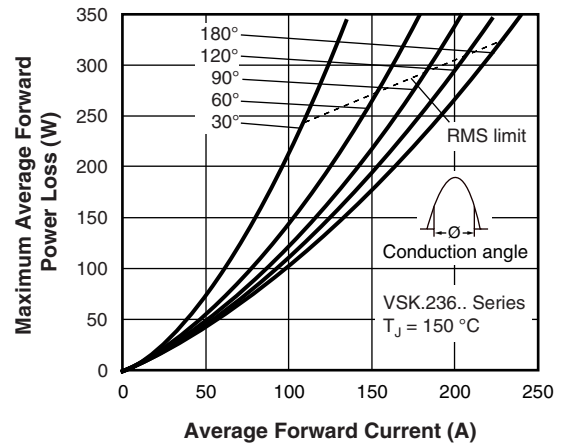


Fig. 21 - On-State Power Loss Characteristics

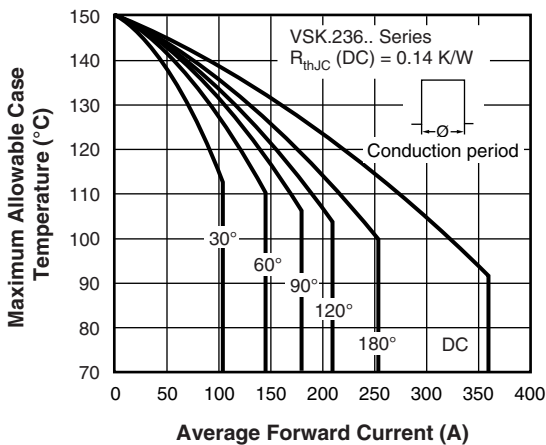


Fig. 20 - Current Ratings Characteristics

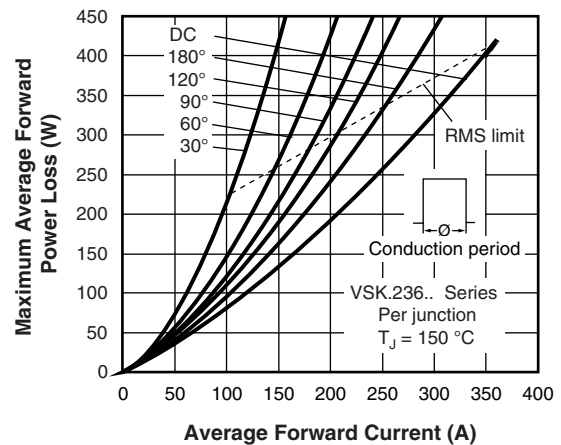


Fig. 22 - On-State Power Loss Characteristics



# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series



Vishay Semiconductors Standard Recovery Diodes, 165 A to 230 A  
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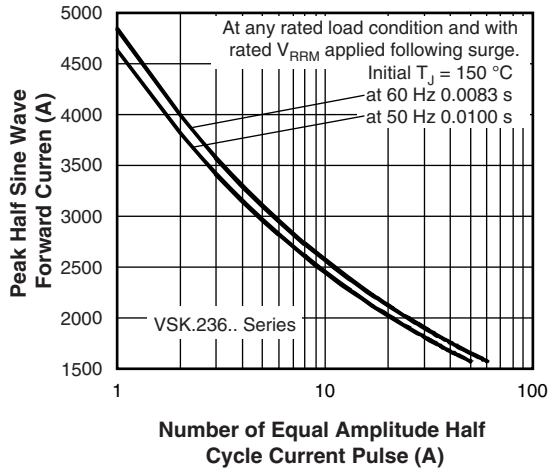


Fig. 23 - Maximum Non-Repetitive Surge Current

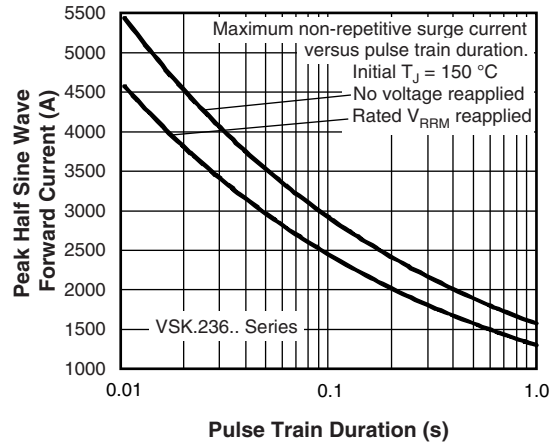


Fig. 24 - Maximum Non-Repetitive Surge Current

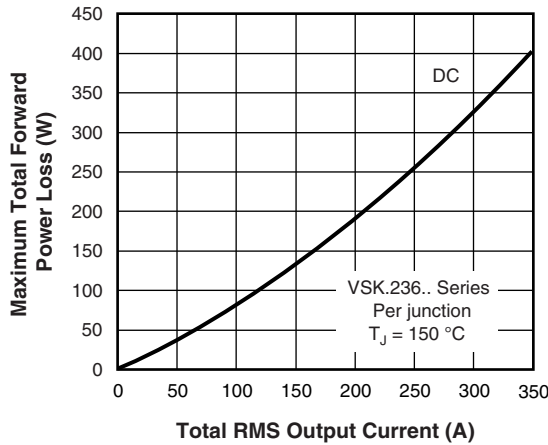


Fig. 25 - On-State Power Loss Characteristics

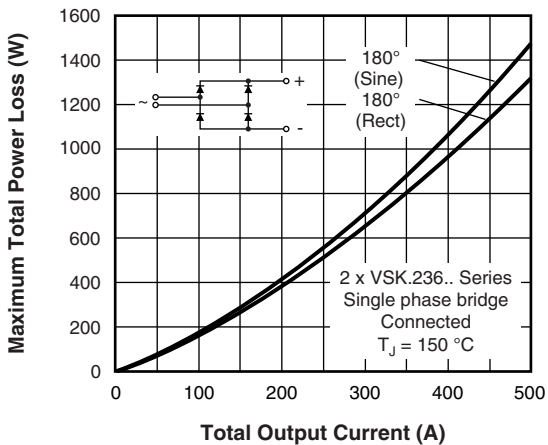
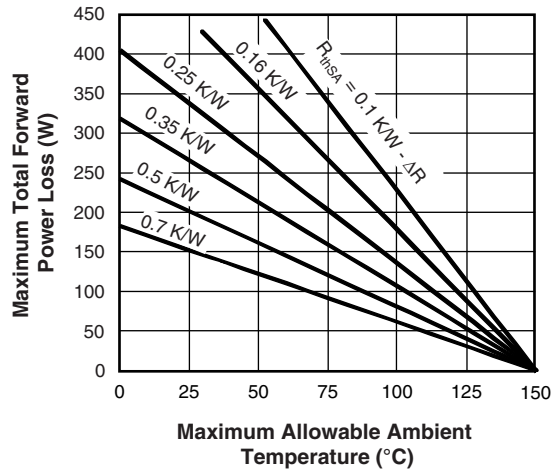
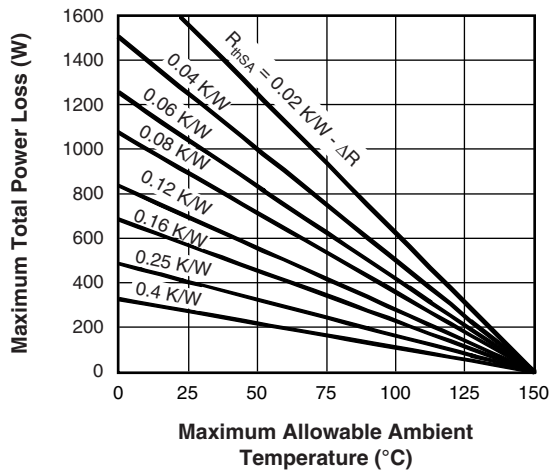


Fig. 26 - On-State Power Loss Characteristics







# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series

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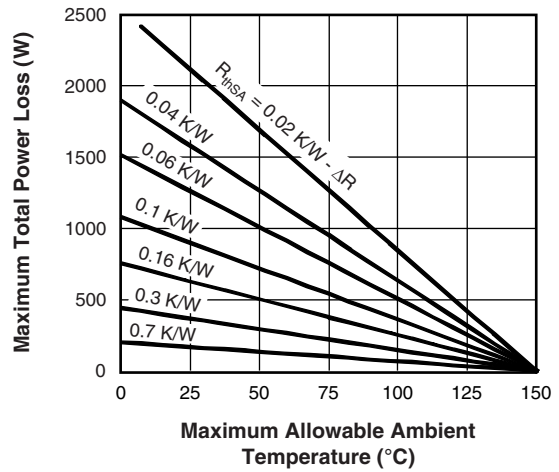
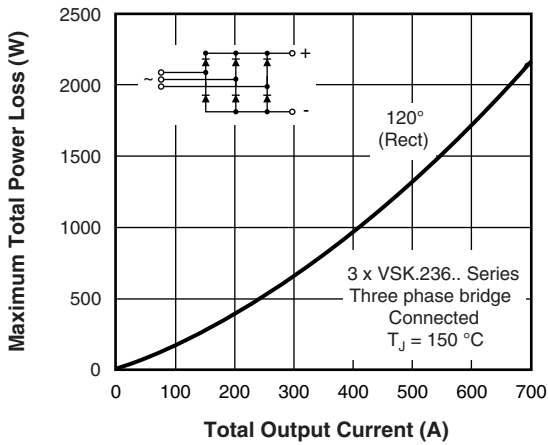


Fig. 27 - On-State Power Loss Characteristics

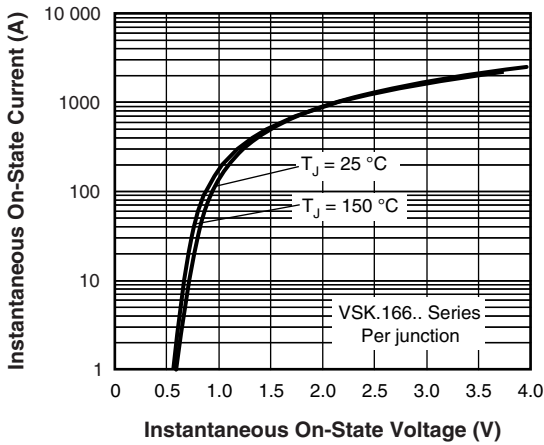


Fig. 28 - On-State Voltage Drop Characteristics

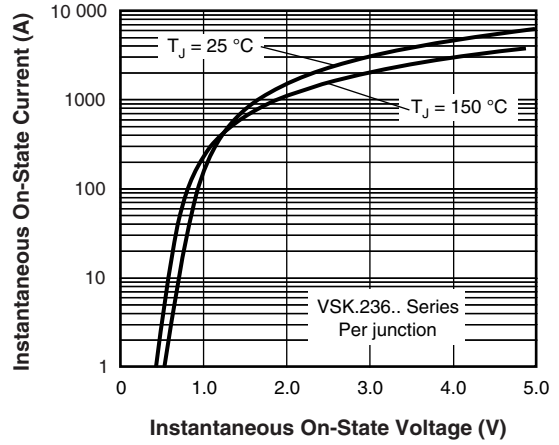


Fig. 30 - On-State Voltage Drop Characteristics

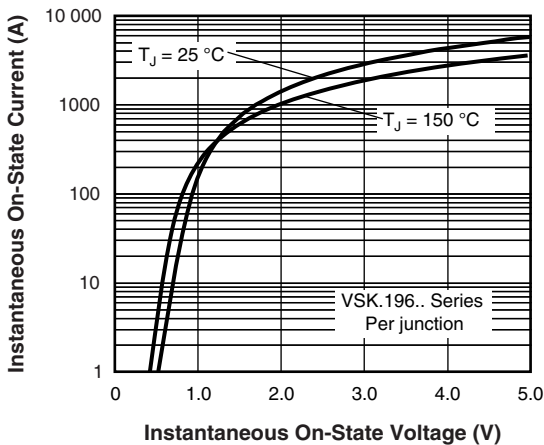


Fig. 29 - On-State Voltage Drop Characteristics

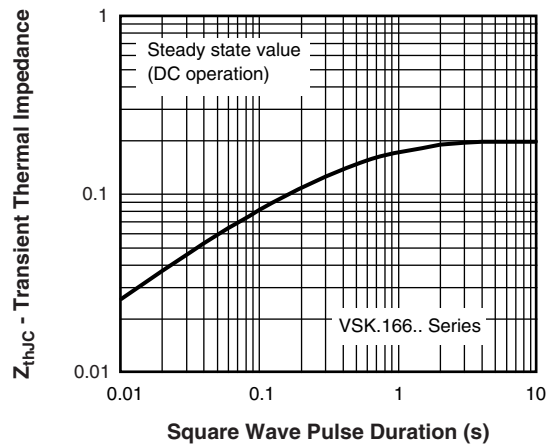


Fig. 31 - Thermal Impedance  $Z_{thJC}$  Characteristics

# VSK.166..PbF, VSK.196..PbF, VSK.236..PbF Series



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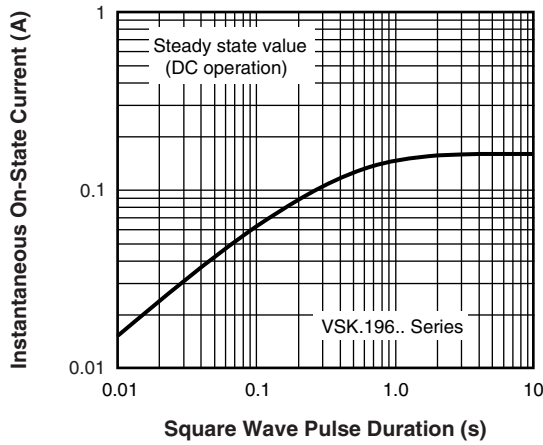


Fig. 32 - Thermal Impedance  $Z_{thJC}$  Characteristics

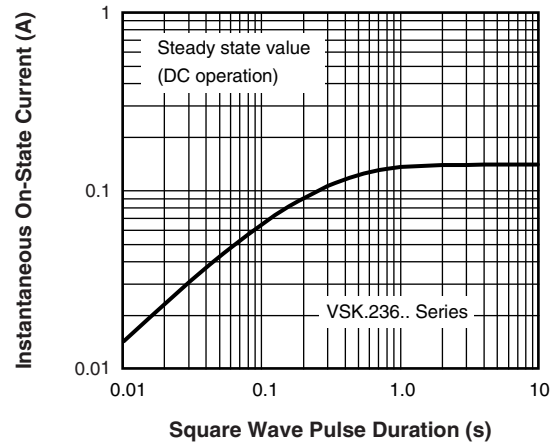


Fig. 33 - Thermal Impedance  $Z_{thJC}$  Characteristics

## ORDERING INFORMATION TABLE

Device code	VSK	D	236	/	16	PbF
	①	②	③		④	⑤
	1	-	Module type		2	-
	2	-	Circuit configuration (see Circuit Configuration table)		3	-
	3	-	Current rating: $I_{F(AV)}$		4	-
	4	-	Voltage code x 100 = $V_{RRM}$		5	-
	5	-	PbF = Lead (Pb)-free			

### Note

- To order the optional hardware go to [www.vishay.com/doc?95172](http://www.vishay.com/doc?95172)



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CIRCUIT CONFIGURATION		
CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Two diodes doubler circuit	D	<p>VSKD...</p>
Two diodes common cathodes	C	<p>VSKC...</p>
Two diodes common anodes	J	<p>VSKJ...</p>
Single diode	E	<p>VSKE...</p>

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95254">www.vishay.com/doc?95254</a>

## INT-A-PAK DBC

**DIMENSIONS** in millimeters (inches)





## Disclaimer

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