AAP Gen 7 (TO-240AA) Power Modules
Thyristor/Diode and Thyristor/Thyristor, 45 A, 60 A

ADD-A-PAK

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$ or $I_{F(AV)}$	45 A, 60 A
Type	Modules - thyristor, standard
Package	AAP Gen 7 (TO-240AA)

MECHANICAL DESCRIPTION

The AAP Gen 7 (TO-240AA), new generation of AAP module, combines the excellent thermal performances obtained by the usage of exposed direct bonded copper substrate, with advanced compact simple package solution and simplified internal structure with minimized number of interfaces.

FEATURES

- High voltage
- Industrial standard package
- Low thermal resistance
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

BENEFITS

- Excellent thermal performances obtained by the usage of exposed direct bonded copper substrate
- Up to 1600 V
- High surge capability
- Easy mounting on heatsink

ELECTRICAL DESCRIPTION

These modules are intended for general purpose high voltage applications such as high voltage regulated power supplies, lighting circuits, temperature and motor speed control circuits, UPS, and battery charger.

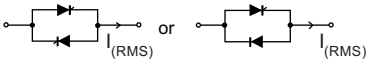
MAJOR RATINGS AND CHARACTERISTICS				
SYMBOL	CHARACTERISTICS	VS-VSK.41	VS-VSK.56	UNITS
$I_{T(AV)}$ or $I_{F(AV)}$	85 °C	45	60	A
$I_{O(RMS)}$	As AC switch	100	135	
I_{TSM}, I_{FSM}	50 Hz	850	1200	
	60 Hz	890	1256	
I^2t	50 Hz	3.61	7.20	kA^2s
	60 Hz	3.30	6.57	
$I^2\sqrt{t}$		36.1	72	$kA^2\sqrt{s}$
V_{DRM}/V_{RRM}	Range	400 to 1600	400 to 1600	V
T_{Stg}		-40 to +125		°C
T_J		-40 to +125		°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	V_{DRM}, MAXIMUM REPETITIVE PEAK OFF-STATE VOLTAGE, GATE OPEN CIRCUIT V	I_{RRM}, I_{DRM} AT 125 °C mA
VS-VSK.41 VS-VSK.56	04	400	500	400	15
	06	600	700	600	
	08	800	900	800	
	10	1000	1100	1000	
	12	1200	1300	1200	
	14	1400	1500	1400	
	16	1600	1700	1600	

ON-STATE CONDUCTION

PARAMETER	SYMBOL	TEST CONDITIONS			VSK.41	VSK.56	UNITS
Maximum average on-state current (thyristors)	$I_{T(AV)}$	180° conduction, half sine wave, T_C = 85 °C			45	60	A
Maximum average forward current (diodes)	$I_{F(AV)}$						
Maximum continuous RMS on-state current, as AC switch	$I_{O(RMS)}$				100	135	
Maximum peak, one-cycle non-repetitive on-state or forward current	I_{TSM} or I_{FSM}	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial T_J = T_J maximum	850	1200	
		t = 8.3 ms			890	1256	
		t = 10 ms	100 % V_{RRM} reapplied		715	1000	
		t = 8.3 ms			750	1056	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied	Initial T_J = T_J maximum	3.61	7.20	kA^2s
		t = 8.3 ms			3.30	6.57	
		t = 10 ms	100 % V_{RRM} reapplied		2.56	5.10	
		t = 8.3 ms			2.33	4.56	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$ (1)	t = 0.1 ms to 10 ms, no voltage reapplied T_J = T_J maximum			36.1	72	$kA^2\sqrt{s}$
Maximum value or threshold voltage	$V_{T(TO)}$ (2)	Low level (3)	T_J = T_J maximum		1.08	0.91	V
		High level (4)			1.12	1.02	
Maximum value of on-state slope resistance	r_t (2)	Low level (3)	T_J = T_J maximum		4.7	4.27	mΩ
		High level (4)			4.5	3.77	
Maximum peak on-state or forward voltage	V_{TM}	$I_{TM} = \pi \times I_{T(AV)}$	T_J = 25 °C		1.81	1.7	V
	V_{FM}	$I_{FM} = \pi \times I_{F(AV)}$					
Maximum non-repetitive rate of rise of turned on current	dI/dt	T_J = 25 °C, from 0.67 V_{DRM}, $I_{TM} = \pi \times I_{T(AV)}$, I_g = 500 mA, t_r < 0.5 µs, t_p > 6 µs			150		A/µs
Maximum holding current	I_H	T_J = 25 °C, anode supply = 6 V, resistive load, gate open circuit			200		mA
Maximum latching current	I_L	T_J = 25 °C, anode supply = 6 V, resistive load			400	400	

Notes

(1) I^2t for time $t_x = I^2\sqrt{t} \times \sqrt{t_x}$

(2) Average power = $V_{T(TO)} \times I_{T(AV)} + r_t \times (I_{T(RMS)})^2$

(3) 16.7 % x π x I_{AV} < I < π x I_{AV}

(4) I > π x I_{AV}

TRIGGERING

PARAMETER	SYMBOL	TEST CONDITIONS		VS-VSK.41	VS-VSK.56	UNITS
Maximum peak gate power	P_{GM}			10		W
Maximum average gate power	$P_{G(AV)}$			2.5		
Maximum peak gate current	I_{GM}			2.5		A
Maximum peak negative gate voltage	- V_{GM}			10		V
Maximum gate voltage required to trigger	V_{GT}	T_J = -40 °C	Anode supply = 6 V resistive load	4.0		
		T_J = 25 °C		2.5		
		T_J = 125 °C		1.7		
Maximum gate current required to trigger	I_{GT}	T_J = -40 °C	Anode supply = 6 V resistive load	270		mA
		T_J = 25 °C		150		
		T_J = 125 °C		80		
Maximum gate voltage that will not trigger	V_{GD}	T_J = 125 °C, rated V_{DRM} applied		0.25		V
Maximum gate current that will not trigger	I_{GD}	T_J = 125 °C, rated V_{DRM} applied		6		mA

BLOCKING

PARAMETER	SYMBOL	TEST CONDITIONS	VS-VSK.41	VS-VSK.56	UNITS
Maximum peak reverse and off-state leakage current at V_{RRM}, V_{DRM}	I_{RRM}, I_{DRM}	T_J = 125 °C, gate open circuit	15		mA
Maximum RMS insulation voltage	V_{INS}	50 Hz	3000 (1 min) 3600 (1 s)		V
Maximum critical rate of rise of off-state voltage	dV/dt	T_J = 125 °C, linear to 0.67 V_{DRM}	1000		V/µs

THERMAL AND MECHANICAL SPECIFICATIONS

PARAMETER		SYMBOL	TEST CONDITIONS	VS-VSK.41	VS-VSK.56	UNITS
Junction operating and storage temperature range		T_J, T_{Stg}		-40 to +125		°C
Maximum internal thermal resistance, junction to case per leg		R_{thJC}	DC operation	0.44	0.35	°C/W
Typical thermal resistance, case to heatsink per module		R_{thCS}	Mounting surface flat, smooth and greased	0.1		
Mounting torque ± 10 %	to heatsink		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.	4		Nm
	busbar			3		
Approximate weight				75		g
				2.7		oz.
Case style			JEDEC®	AAP Gen 7 (TO-240AA)		

ΔR CONDUCTION PER JUNCTION

DEVICES	SINE HALF WAVE CONDUCTION					RECTANGULAR WAVE CONDUCTION					UNITS
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
VSK.41..	0.110	0.131	0.17	0.23	0.342	0.085	0.138	0.177	0.235	0.345	°C/W
VSK.56..	0.088	0.104	0.134	0.184	0.273	0.07	0.111	0.143	0.189	0.275	

Note

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

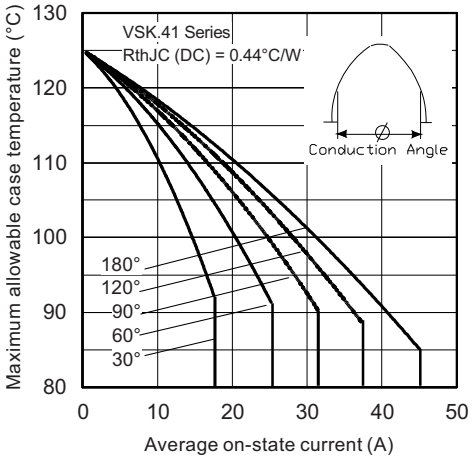


Fig. 1 - Current Ratings Characteristics

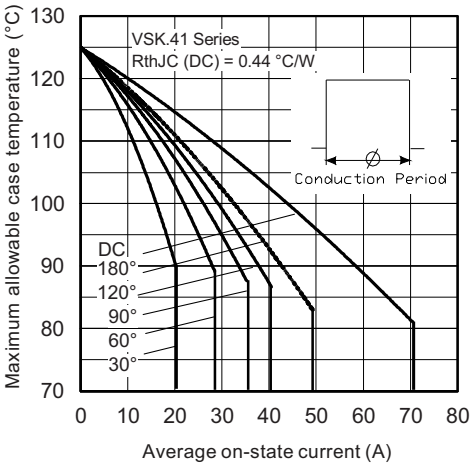


Fig. 2 - Current Ratings Characteristics

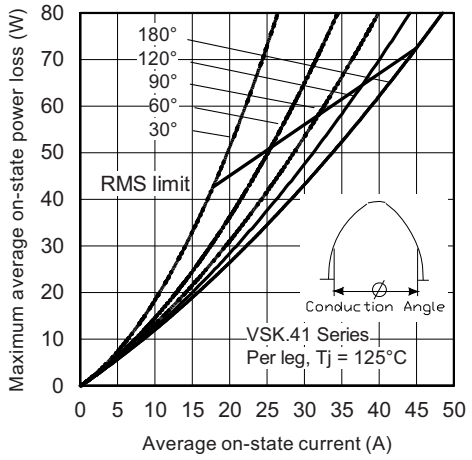


Fig. 3 - On-State Power Loss Characteristics

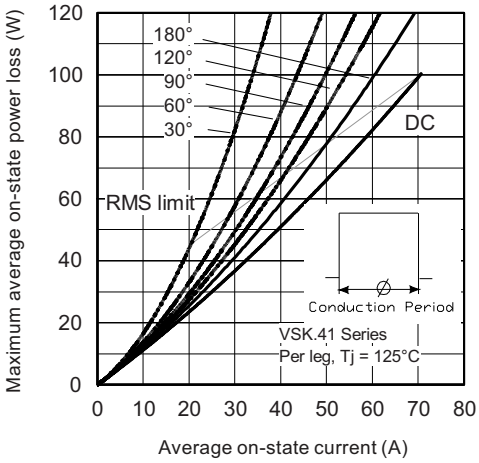


Fig. 4 - On-State Power Loss Characteristics

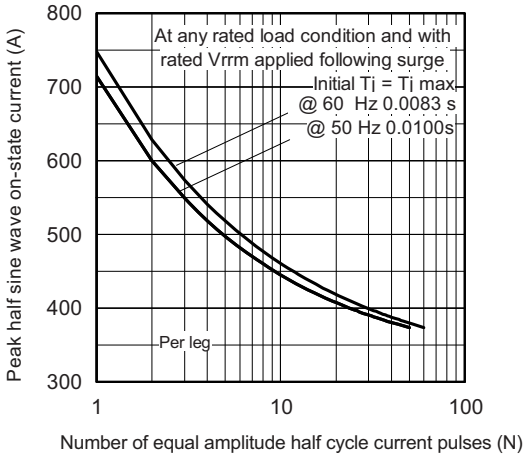


Fig. 5 - Maximum Non-Repetitive Surge Current

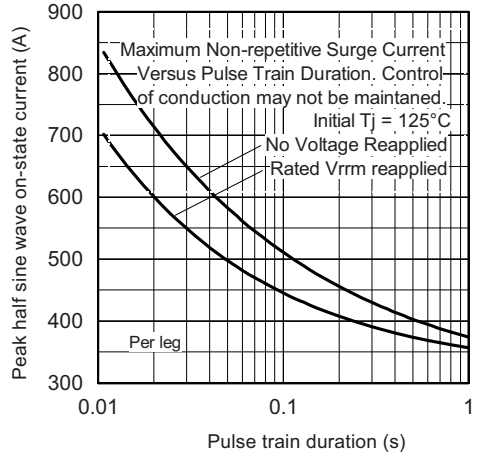


Fig. 6 - Maximum Non-Repetitive Surge Current

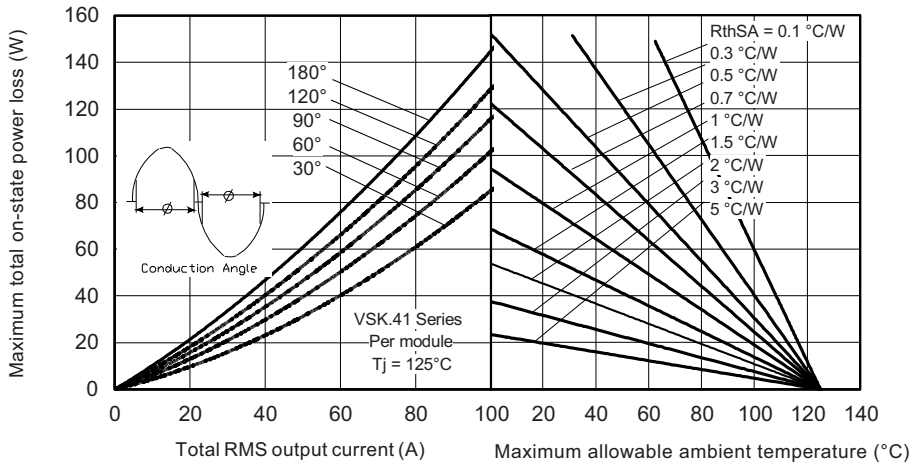


Fig. 7 - On-State Power Loss Characteristics

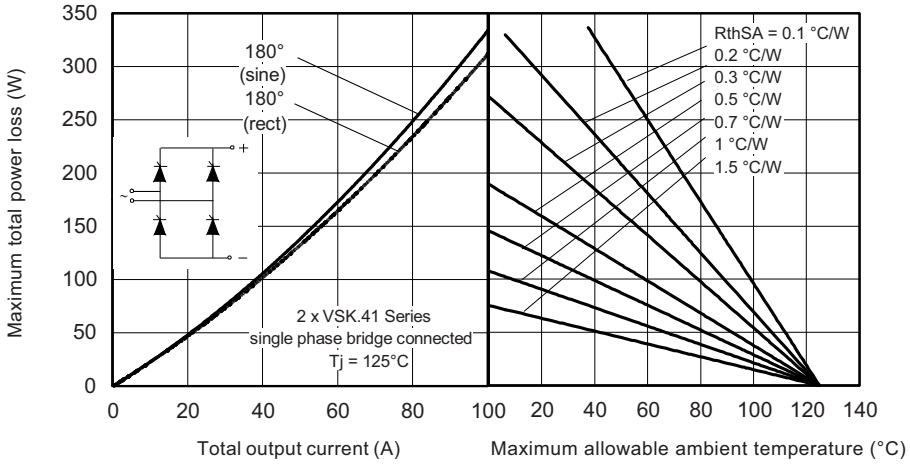


Fig. 8 - On-State Power Loss Characteristics

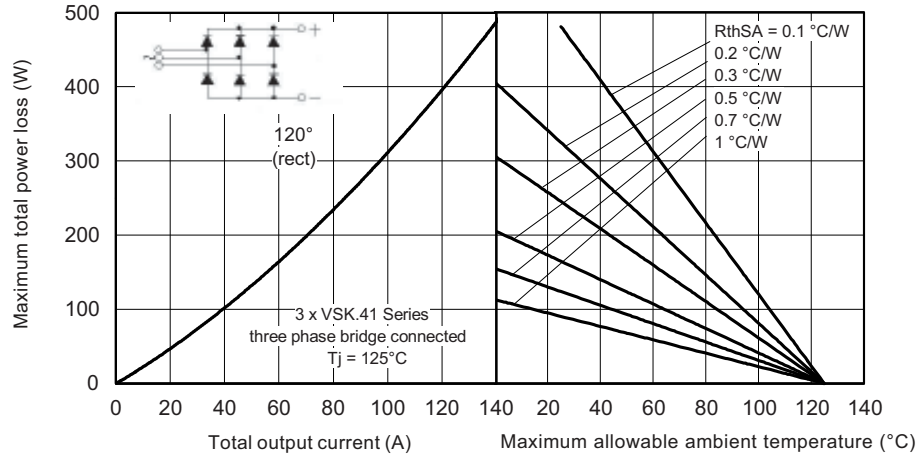


Fig. 9 - On-State Power Loss Characteristics

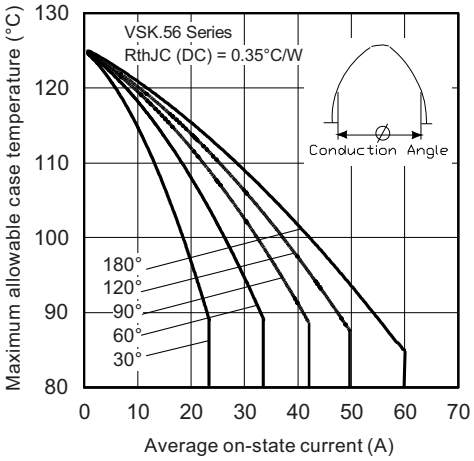


Fig. 10 - Current Ratings Characteristics

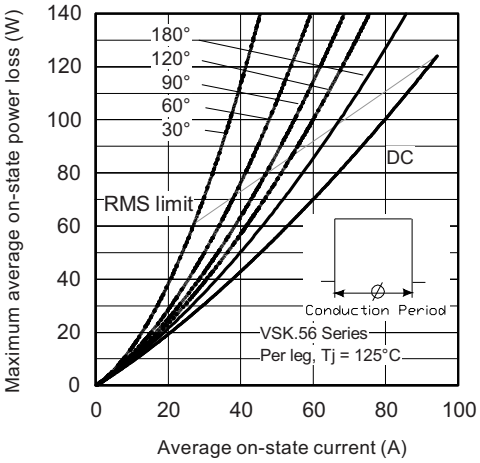


Fig. 13 - On-State Power Loss Characteristics

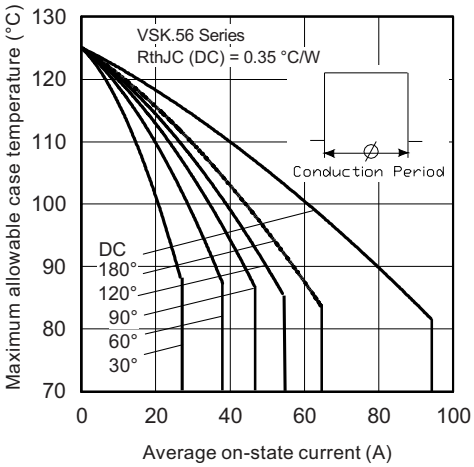


Fig. 11 - Current Ratings Characteristics

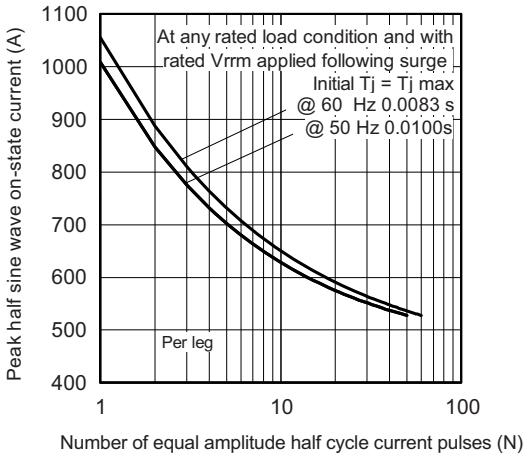


Fig. 14 - Maximum Non-Repetitive Surge Current

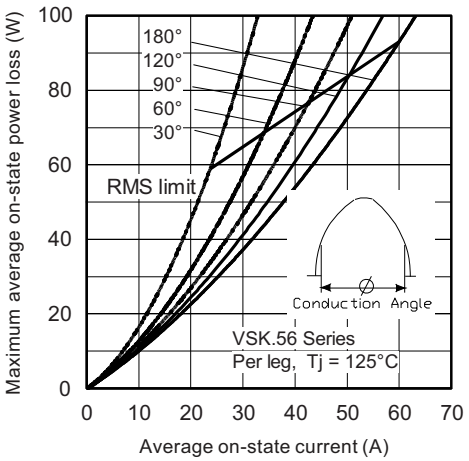


Fig. 12 - On-State Power Loss Characteristics

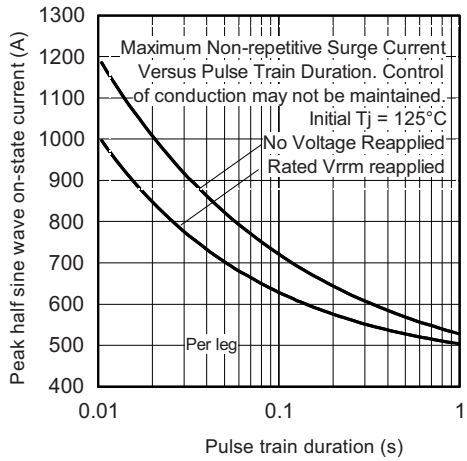


Fig. 15 - Maximum Non-Repetitive Surge Current

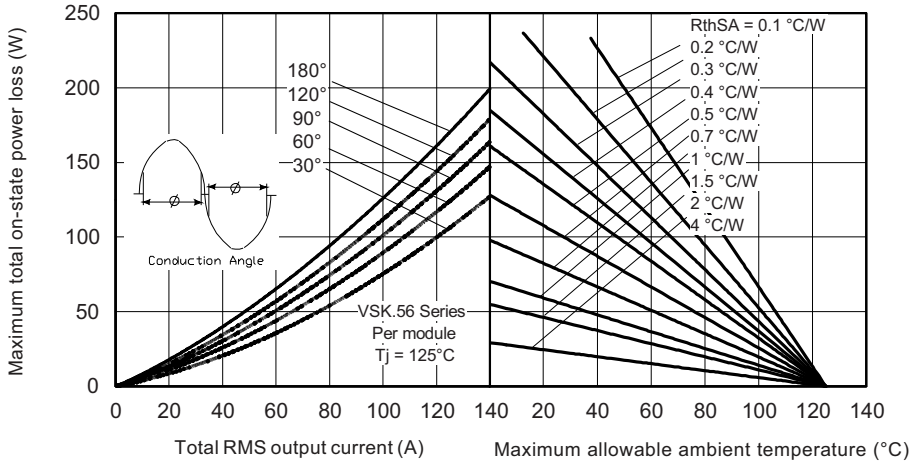


Fig. 16 - On-State Power Loss Characteristics

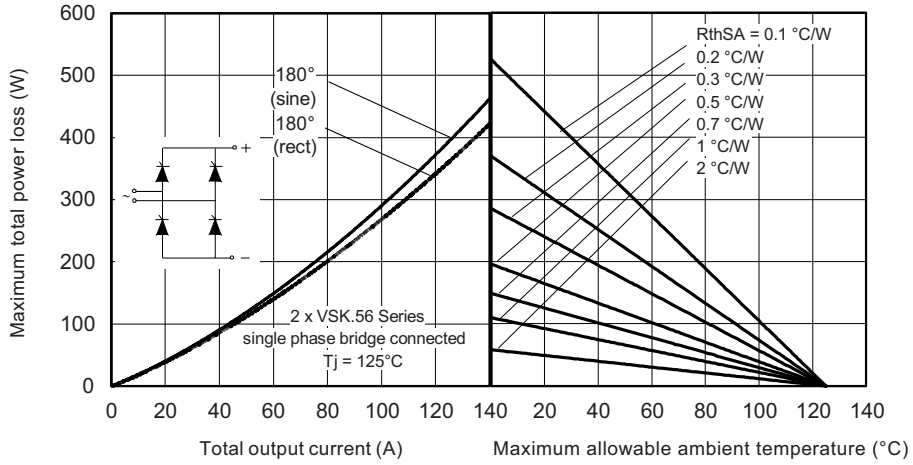


Fig. 17 - On-State Power Loss Characteristics

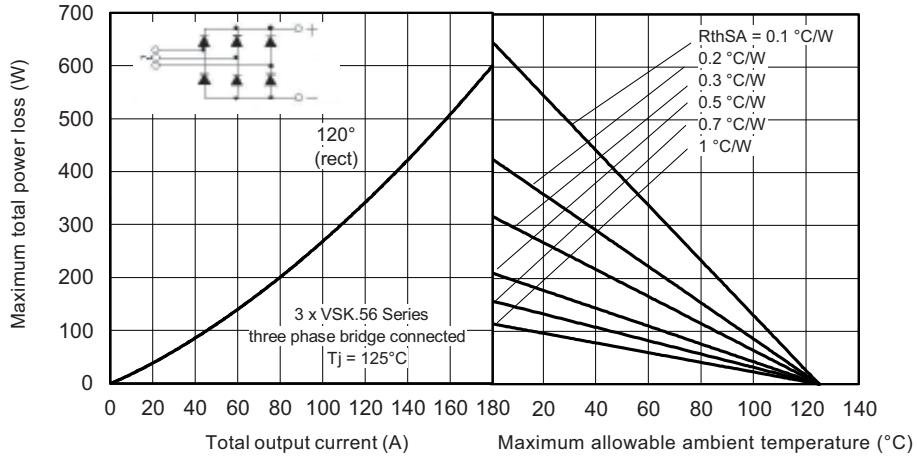


Fig. 18 - On-State Power Loss Characteristics

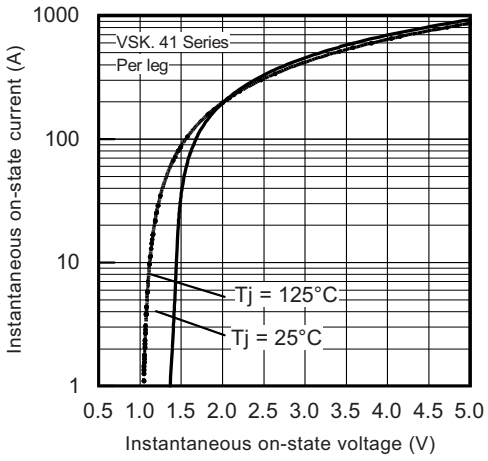


Fig. 19 - On-State Voltage Drop Characteristics

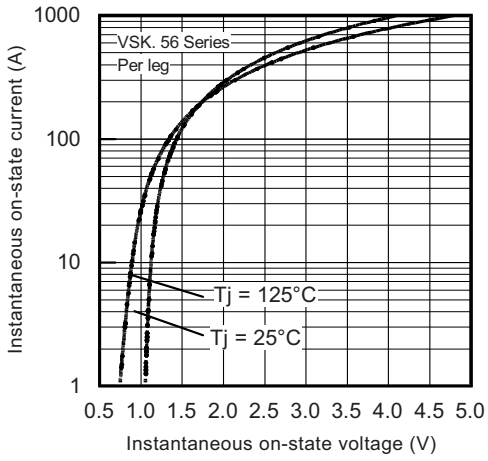


Fig. 20 - On-State Voltage Drop Characteristics

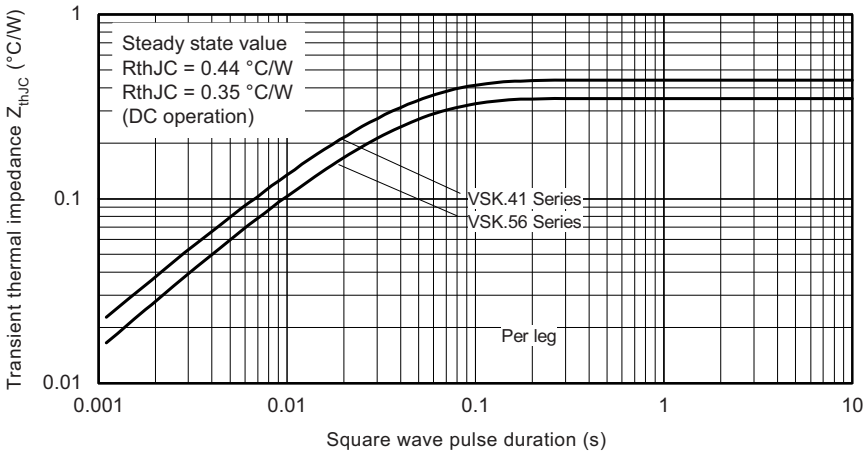


Fig. 21 - Thermal Impedance Z_{thJC} Characteristics

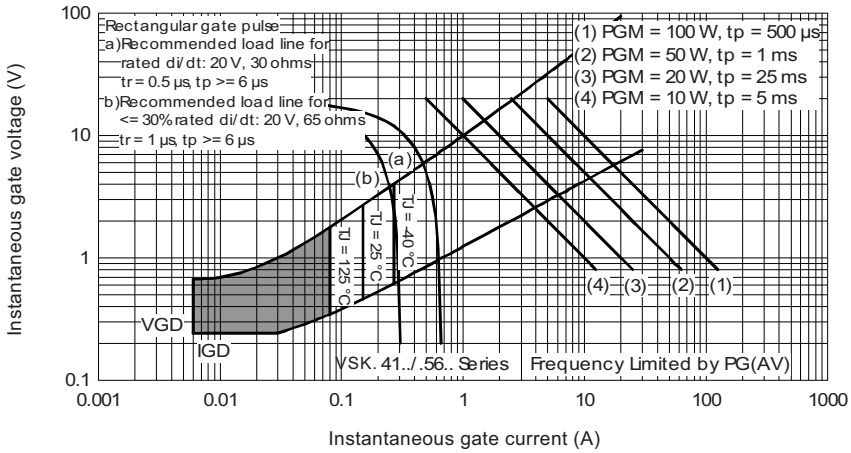


Fig. 22 - Gate Characteristics

ORDERING INFORMATION TABLE

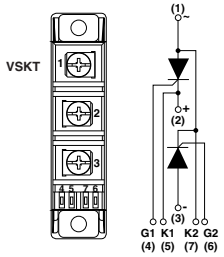
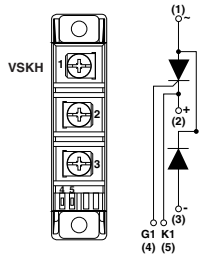
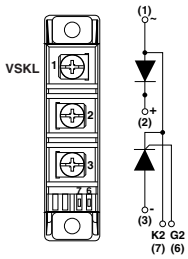
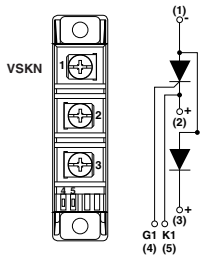
Device code	VS-VS	K	T	56	/	16
	1	2	3	4		5

1 - Vishay Semiconductors product
2 - Module type
3 - Circuit configuration (see Circuit configuration table)
4 - Current code — 41 = 45 A, 56 = 60 A
5 - Voltage code (see Voltage Ratings table)

Note

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

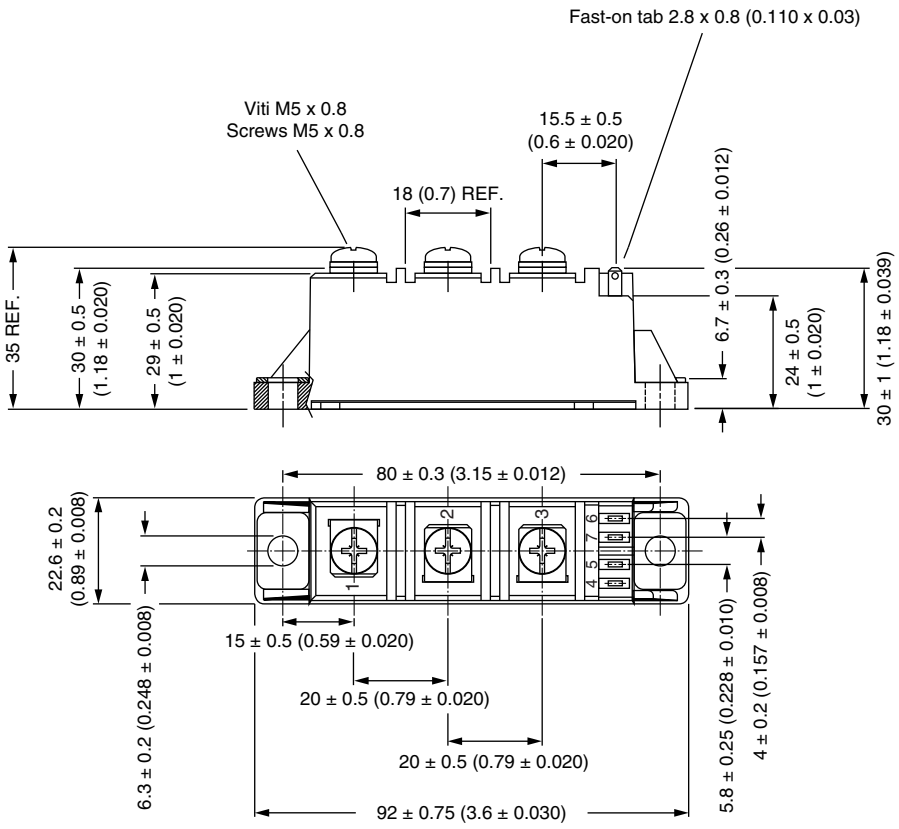
CIRCUIT CONFIGURATION

CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Two SCRs doubler circuit	T	
SCR/diode doubler circuit, positive control	H	
SCR/diode doubler circuit, negative control	L	
SCR/diode common anodes	N	

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95368

ADD-A-PAK Generation VII - Thyristor

DIMENSIONS in millimeters (inches)



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