



## Thyristor/Thyristor, 160 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 thyristor/diodes in three basic configurations
- Simple mounting
- UL approved file E78996 
- Designed and qualified for multiple level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

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

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	160 A
Type	Modules - thyristor, standard
Package	INT-A-PAK

MAJOR RATINGS AND CHARACTERISTICS			
SYMBOL	CHARACTERISTICS	VALUES	UNITS
$I_{T(AV)}$	85 °C	160	A
$I_{T(RMS)}$		355	
$I_{TSM}$	50 Hz	4870	
	60 Hz	5100	
$I^2t$	50 Hz	119	kA <sup>2</sup> s
	60 Hz	108	
$I^2\sqrt{t}$		1190	kA <sup>2</sup> $\sqrt{s}$
$V_{RRM}$	Range	1200, 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
VS-VSK.162	12	1200	1300	50
	16	1600	1700	



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		160	A	
				85	°C	
Maximum RMS on-state current	$I_{T(RMS)}$	As AC switch		355		
Maximum peak, one-cycle on-state, non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	4870	A	
		t = 8.3 ms		Sine half wave, initial $T_J = T_J$ maximum		5100
		t = 10 ms	100 % $V_{RRM}$ reapplied			4100
		t = 8.3 ms	4300			
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied		119	kA <sup>2</sup> s
		t = 8.3 ms		108		
		t = 10 ms	100 % $V_{RRM}$ reapplied	84		
		t = 8.3 ms	76.7			
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied		1190	kA <sup>2</sup> √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)		0.8	V	
High level value of threshold voltage	$V_{T(TO)2}$	(I > $\pi \times I_{T(AV)}$ , $T_J$ maximum)		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)		1.67	mΩ	
High level value on-state slope resistance	$r_{t2}$	(I > $\pi \times I_{T(AV)}$ , $T_J$ maximum)		1.38		
Maximum on-state voltage drop	$V_{TM}$	$I_{TM} = \pi \times I_{T(AV)}$ , $T_J = 25$ °C, 180° conduction		1.54	V	
Maximum forward voltage drop	$V_{FM}$	$I_{TM} = \pi \times I_{T(AV)}$ , $T_J = 25$ °C, 180° conduction		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



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; $R_a = 1$ $\Omega$	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/ $\mu$ s

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		0.16	K/W
Maximum thermal resistance, case to heat sink per module	$R_{thCS}$	Mounting surface, smooth, flat and greased		0.05	
Mounting torque $\pm 10$ %	IAP to heat sink 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.
				INT-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°	
VS-VSK.162	0.0030	0.0031	0.0032	0.0033	0.0034	0.0029	0.0036	0.0039	0.0041	0.0040	K/W

**Note**

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

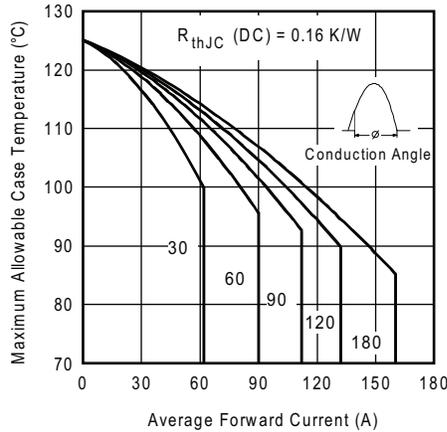


Fig. 1 - Current Ratings Characteristics

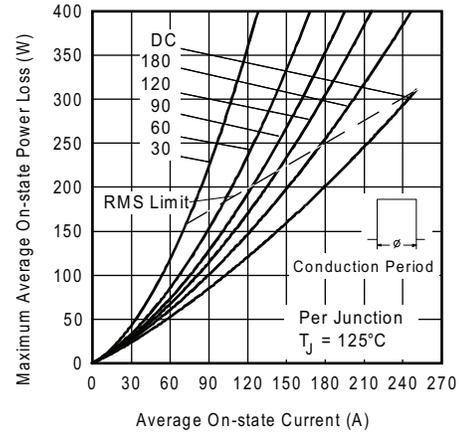


Fig. 4 - On-State Power Loss Characteristics

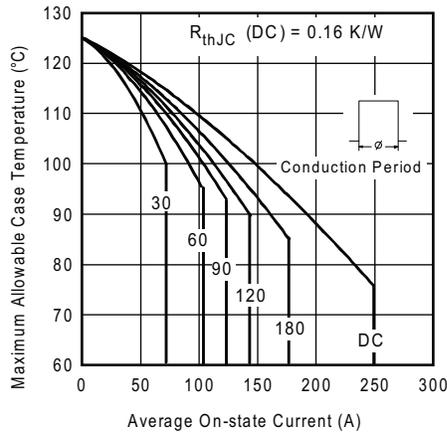


Fig. 2 - Current Ratings Characteristics

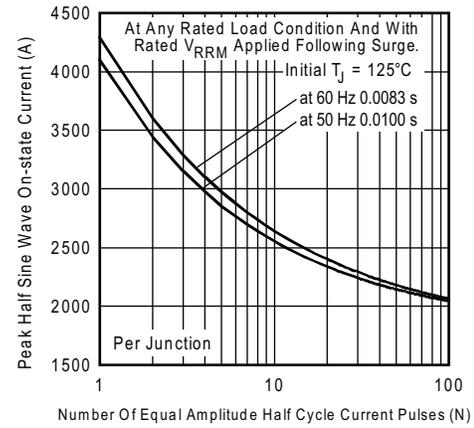


Fig. 5 - Maximum Non-Repetitive Surge Current

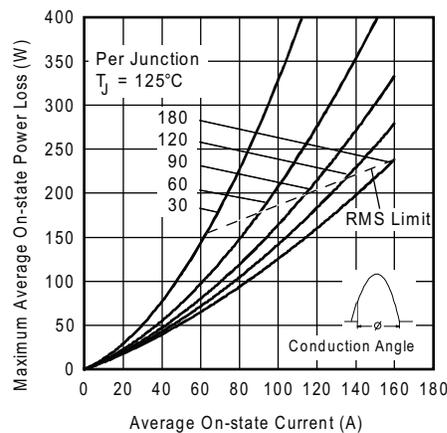


Fig. 3 - On-State Power Loss Characteristics

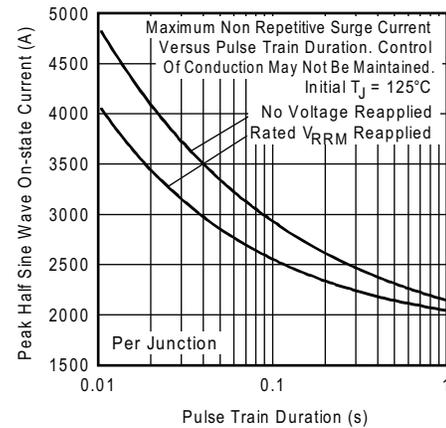


Fig. 6 - Maximum Non-Repetitive Surge Current

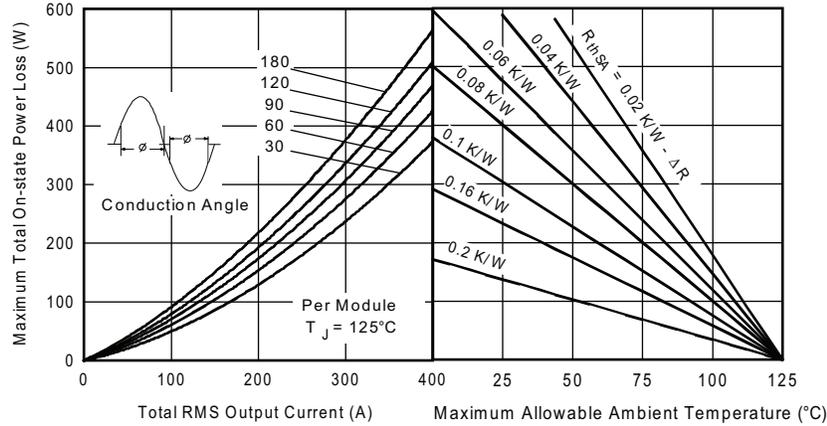


Fig. 7 - On-State Power Loss Characteristics

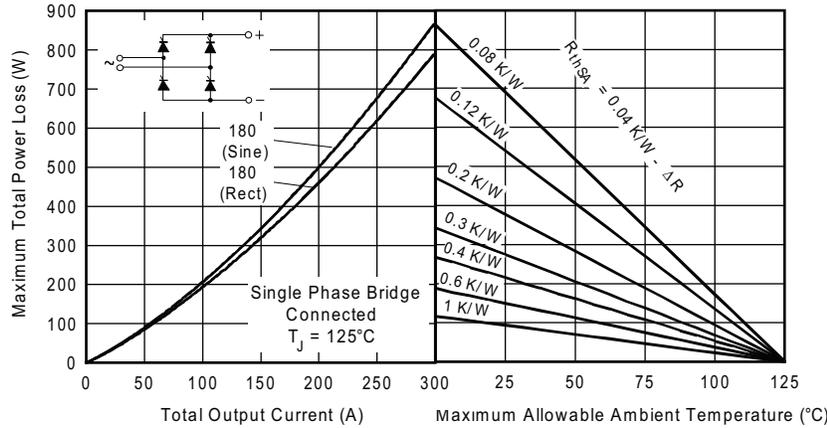


Fig. 8 - On-State Power Loss Characteristics

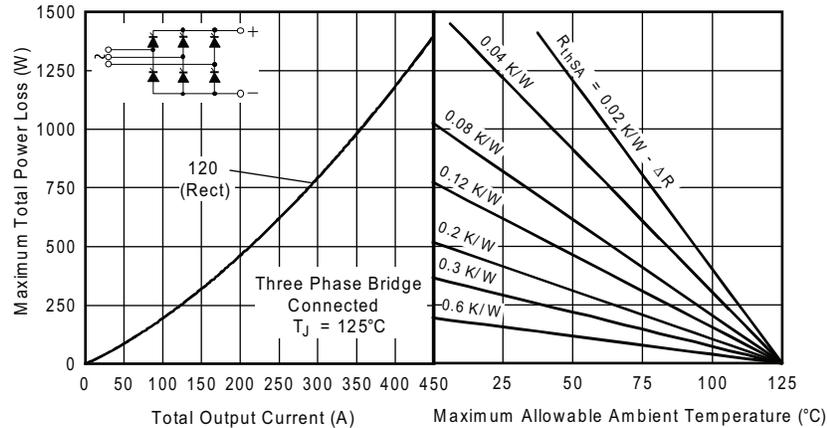


Fig. 9 - On-State Power Loss Characteristics

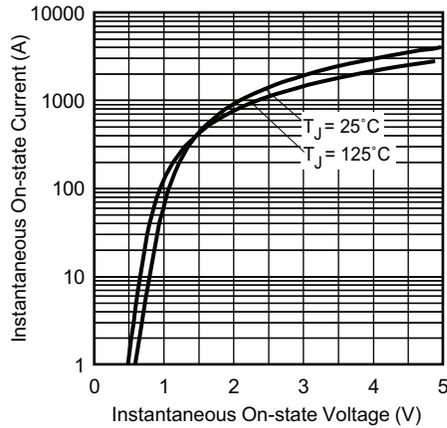


Fig. 10 - On-State Voltage Drop Characteristics

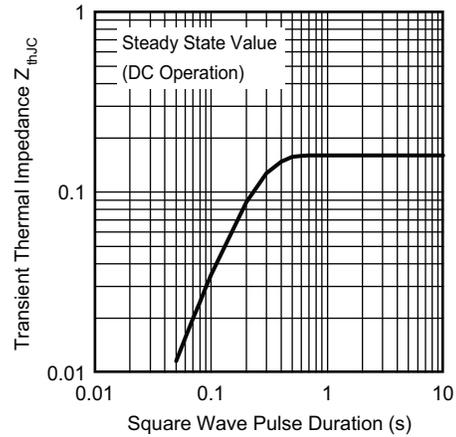


Fig. 11 - Thermal Impedance  $Z_{thJC}$  Characteristics

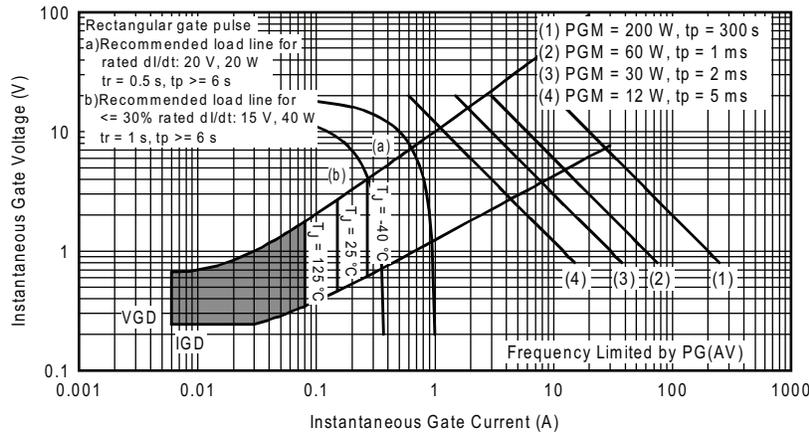


Fig. 12 - Gate Characteristics

**ORDERING INFORMATION TABLE**

Device code	<b>VS-VS</b>	<b>KU</b>	<b>162</b>	<b>16</b>	<b>PbF</b>
	①	②	③	④	⑤
	<b>1</b>	-	Vishay Semiconductors product		
	<b>2</b>	-	Circuit configuration		
	<b>3</b>	-	Current rating: $I_{T(AV)}$		
	<b>4</b>	-	Voltage code x 100 = $V_{RRM}$		
	<b>5</b>	-	PbF = Lead (Pb)-free		

**Note**

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

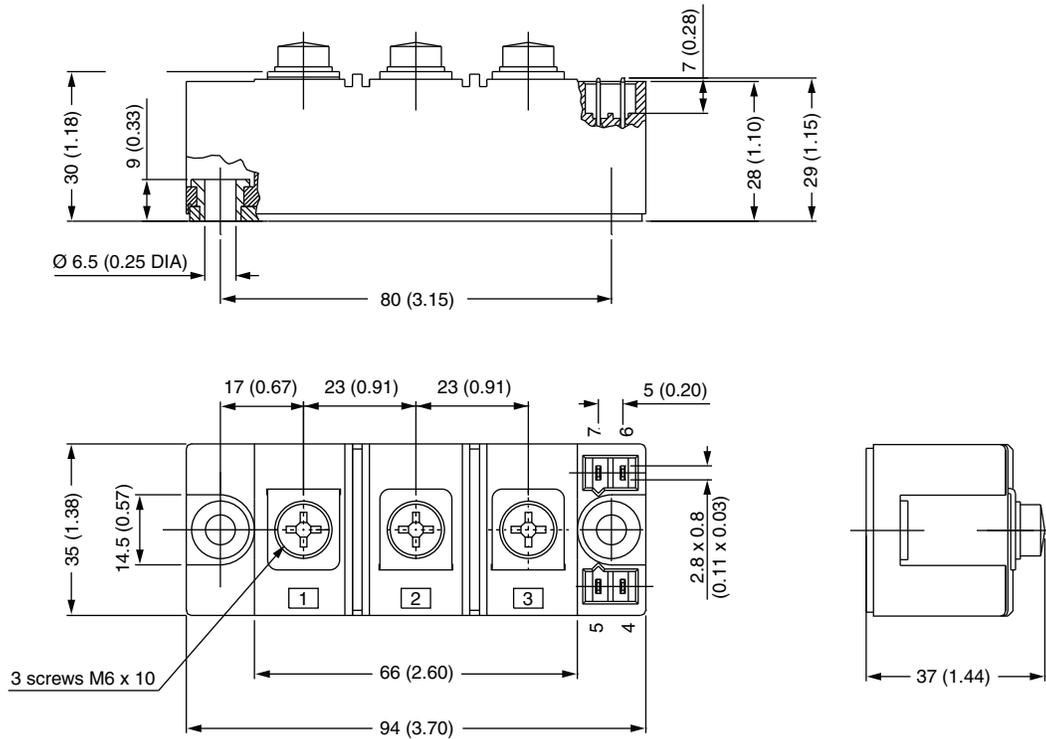


CIRCUIT CONFIGURATION		
CIRCUIT DESCRIPTION	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
Two SCRs common cathodes	U	
Two SCRs common anodes	V	

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95067">www.vishay.com/doc?95067</a>

## INT-A-PAK IGBT/Thyristor

**DIMENSIONS** in millimeters (inches)





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