

## Medium Power Phase Control Thyristors (Stud Version), 16 A



TO-48 (TO-208AA)

### FEATURES

- Improved glass passivation for high reliability and exceptional stability at high temperature
- High  $di/dt$  and  $dV/dt$  capabilities
- Standard package
- Low thermal resistance
- Metric threads version available
- Types up to 1200 V  $V_{DRM}/V_{RRM}$
- Designed and qualified for industrial and consumer level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS  
COMPLIANT

### TYPICAL APPLICATIONS

- Medium power switching
- Phase control applications

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	16 A
$V_{DRM}/V_{RRM}$	100 V, 200 V, 400 V, 600 V, 800 V, 1000 V, 1200 V
$V_{TM}$	1.75 V
$I_{GT}$	60 mA
$T_J$	-65 °C to +125 °C
Package	TO-48 (TO-208AA)
Circuit configuration	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		16	A
	$T_C$	85	°C
$I_{T(RMS)}$		35	A
$I_{TSM}$	50 Hz	340	A
	60 Hz	360	
$I^2t$	50 Hz	574	A <sup>2</sup> s
	60 Hz	524	
$V_{DRM}/V_{RRM}$		100 to 1200	V
$t_q$	Typical	110	μs
$T_J$		-65 to +125	°C

### ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS				
TYPE NUMBER	VOLTAGE CODE	$V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE <sup>(1)</sup> V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE <sup>(2)</sup> V	$I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = T_J$ MAXIMUM mA
VS-16RIA	10	100	150	20
	20	200	300	10
	40	400	500	
	60	600	700	
	80	800	900	
	100	1000	1100	
	120	1200	1300	

#### Notes

- <sup>(1)</sup> Units may be broken over non-repetitively in the off-state direction without damage, if  $di/dt$  does not exceed 20 A/μs  
<sup>(2)</sup> For voltage pulses with  $t_p \leq 5$  ms



ABSOLUTE MAXIMUM RATINGS					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° sinusoidal conduction		16	A
				85	°C
Maximum RMS on-state current	$I_{T(RMS)}$			35	A
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial $T_J = T_J$ maximum	A
		t = 8.3 ms			
		t = 10 ms	100 % $V_{RRM}$ reapplied		
		t = 8.3 ms			
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied		A <sup>2</sup> s
		t = 8.3 ms			
		t = 10 ms	100 % $V_{RRM}$ reapplied		
		t = 8.3 ms			
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied, $T_J = T_J$ maximum		5740	A <sup>2</sup> √s
Low level value of threshold voltage	$V_{T(TO)1}$	(16.7 % $\times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)		0.97	V
High level value of threshold voltage	$V_{T(TO)2}$	(I $> \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)		1.24	
Low level value of 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)		17.9	mΩ
High level value of on-state slope resistance	$r_{t2}$	(I $> \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)		13.6	
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 50$ A, $T_J = 25$ °C		1.75	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 6 V, resistive load		130	mA
Latching current	$I_L$			200	

SWITCHING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum rate of rise of turned-on current	di/dt	$T_J = T_J$ maximum, $V_{DM} = \text{Rated } V_{DRM}$ Gate pulse = 20 V, 15 Ω, $t_p = 6$ μs, $t_r = 0.1$ μs maximum $I_{TM} = (2 \times \text{rated } di/dt)$ A		200	A/μs
				$V_{DRM} \leq 600$ V	
				$V_{DRM} \leq 800$ V	
				$V_{DRM} \leq 1000$ V	
Typical turn-on time	$t_{gt}$	$T_J = 25$ °C, at rated $V_{DRM}/V_{RRM}$ , $T_J = 125$ °C		0.9	μs
Typical reverse recovery time	$t_{rr}$	$T_J = T_J$ maximum, $I_{TM} = I_{T(AV)}$ , $t_p > 200$ μs, di/dt = - 10 A/μs		4	
Typical turn-off time	$t_q$	$T_J = T_J$ maximum, $I_{TM} = I_{T(AV)}$ , $t_p > 200$ μs, $V_R = 100$ V, di/dt = - 10 A/μs, dV/dt = 20 V/μs linear to 67 % $V_{DRM}$ , gate bias 0 V to 100 W		110	

**Note**

- $t_q = 10$  μs up to 600 V,  $t_q = 30$  μs up to 1600 V available on special request

BLOCKING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum critical rate of rise of off-state voltage	dV/dt	$T_J = T_J$ maximum linear to 100 % rated $V_{DRM}$		100	V/μs
		$T_J = T_J$ maximum linear to 67 % rated $V_{DRM}$		300 <sup>(1)</sup>	

**Note**

- <sup>(1)</sup> Available with: dV/dt = 1000 V/μs, to complete code add S90 i.e. 16RIA120S90



TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum peak gate power	$P_{GM}$	$T_J = T_J$ maximum		8.0	W
Maximum average gate power	$P_{G(AV)}$			2.0	
Maximum peak positive gate current	$I_{GM}$	$T_J = T_J$ maximum		1.5	A
Maximum peak negative gate voltage	$-V_{GM}$	$T_J = T_J$ maximum		10	V
DC gate current required to trigger	$I_{GT}$	$T_J = -65\text{ }^\circ\text{C}$	Maximum required gate trigger current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied	90	mA
		$T_J = 25\text{ }^\circ\text{C}$		60	
		$T_J = 125\text{ }^\circ\text{C}$		35	
DC gate voltage required to trigger	$V_{GT}$	$T_J = -65\text{ }^\circ\text{C}$		3.0	V
		$T_J = 25\text{ }^\circ\text{C}$		2.0	
		$T_J = 125\text{ }^\circ\text{C}$		1.0	
DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum, $V_{DRM} =$ Rated value		2.0	mA
DC gate voltage not to trigger	$V_{GD}$	$T_J = T_J$ maximum, $V_{DRM} =$ Rated value	Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated $V_{DRM}$ anode to cathode applied	0.2	V

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES		UNITS
Maximum operating junction and storage temperature range	$T_J, T_{Stg}$		-65 to +125		$^\circ\text{C}$
Maximum thermal resistance, junction to case	$R_{thJC}$	DC operation	0.86		K/W
Maximum thermal resistance, case to heat sink	$R_{thCS}$	Mounting surface, smooth, flat and greased	0.35		
Mounting torque		Lubricated threads (Non-lubricated threads)	<b>TO NUT</b>	<b>TO DEVICE</b>	
			20 (27.5)	25	lbf · in
			0.23 (0.32)	0.29	kgf · m
Approximate weight			14		g
			0.49		oz.
Case style		See dimensions - link at the end of datasheet	TO-48 (TO-208AA)		

$\Delta R_{thJC}$ CONDUCTION				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.21	0.15	$T_J = T_J$ maximum	K/W
120°	0.25	0.25		
90°	0.31	0.34		
60°	0.45	0.47		
30°	0.76	0.76		

**Note**

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

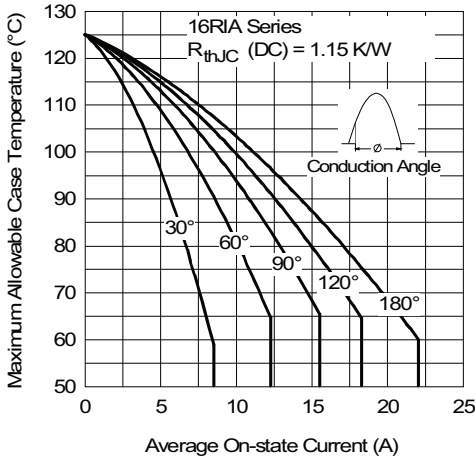


Fig. 1 - Current Ratings Characteristics

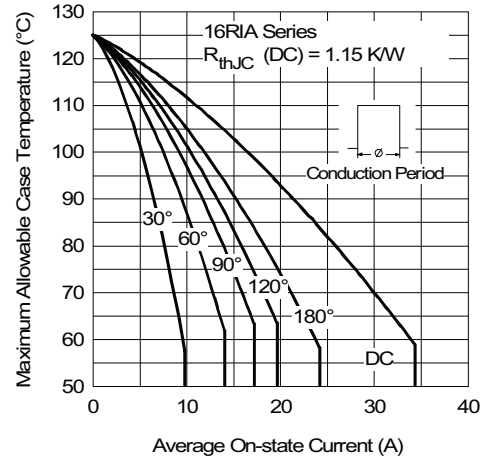


Fig. 2 - Current Ratings Characteristics

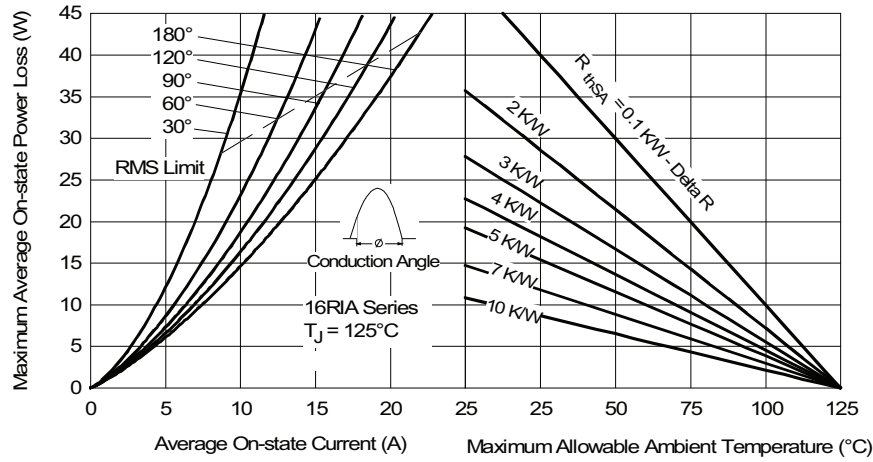


Fig. 3 - On-State Power Loss Characteristics

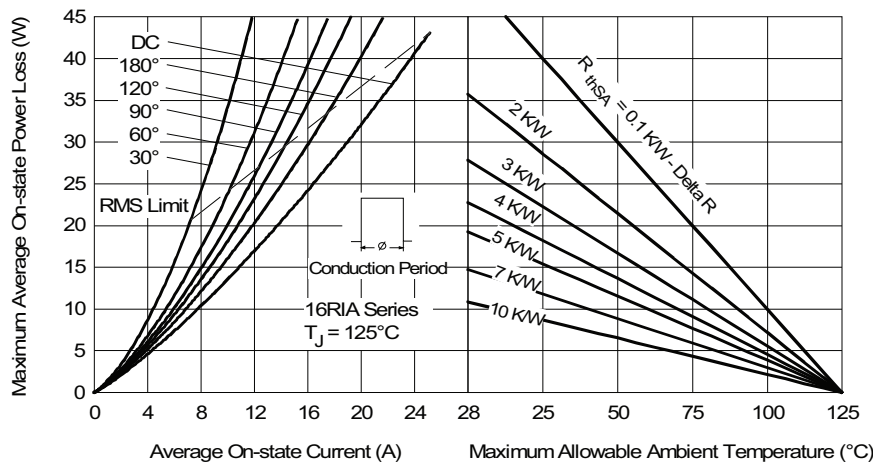


Fig. 4 - On-State Power Loss Characteristics



Fig. 5 - Maximum Non-Repetitive Surge Current



Fig. 6 - Maximum Non-Repetitive Surge Current



Fig. 7 - Forward Voltage Drop Characteristics

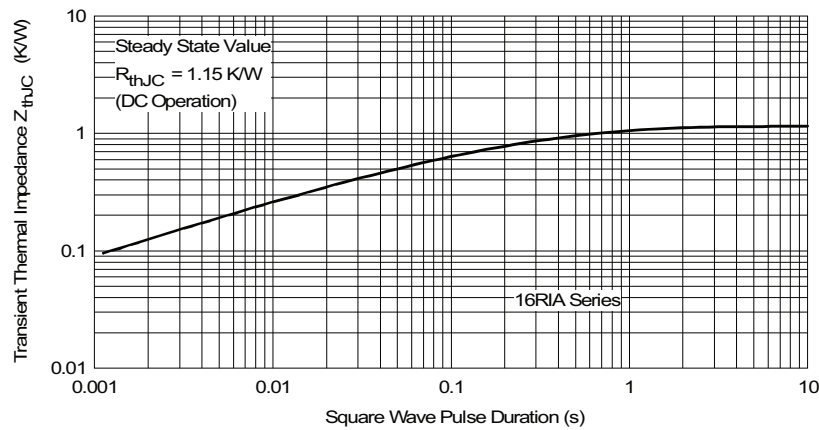


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics



Fig. 9 - Gate Characteristics

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>16</b>	<b>RIA</b>	<b>120</b>	<b>M</b>	<b>S90</b>
	①	②	③	④	⑤	⑥

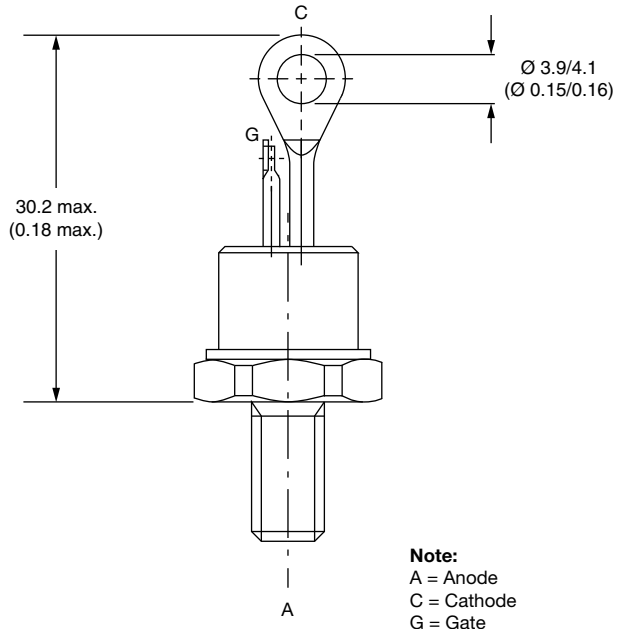
- 1** - Vishay Semiconductors product
- 2** - Current code
- 3** - Essential part number
- 4** - Voltage code x 10 =  $V_{RRM}$  (see Voltage Ratings table)
- 5** - None = stud base TO-48 (TO-208AA) 1/4" 28UNF-2A  
M = stud base TO-48 (TO-208AA) M6 x 1
- 6** - Critical dV/dt:  
None = 300 V/μs (standard value)  
S90 = 1000 V/μs (special selection)

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95333">www.vishay.com/doc?95333</a>



## TO-208AA (TO-48)

**DIMENSIONS** in millimeters (inches)





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