

## 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

### 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

### TYPICAL APPLICATIONS

- Medium power switching
- Phase control applications

### MAJOR RATINGS AND CHARACTERISTICS

PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$	$T_C$	16	A
$I_{T(RMS)}$		85	°C
		35	A
$I_{TSM}$	50 Hz	340	A
	60 Hz	360	A
$I^2t$	50 Hz	574	A <sup>2</sup> s
	60 Hz	524	A <sup>2</sup> s
$V_{DRM}/V_{RRM}$		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 <sub>T(AV)</sub>	180° sinusoidal conduction			16	A
					85	°C
Maximum RMS on-state current	I <sub>T(RMS)</sub>				35	A
Maximum peak, one-cycle non-repetitive surge current	I <sub>TSM</sub>	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial T <sub>J</sub> = T <sub>J</sub> maximum	340	A
		t = 8.3 ms			360	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		285	
		t = 8.3 ms			300	
Maximum I <sup>2</sup> t for fusing	I <sup>2</sup> t	t = 10 ms	No voltage reapplied		574	A <sup>2</sup> s
		t = 8.3 ms			524	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		405	
		t = 8.3 ms			375	
Maximum I <sup>2</sup> √t for fusing	I <sup>2</sup> √t	t = 0.1 to 10 ms, no voltage reapplied, T <sub>J</sub> = T <sub>J</sub> maximum			5740	A <sup>2</sup> √s
Low level value of threshold voltage	V <sub>T(TO)1</sub>	(16.7 % × π × I <sub>T(AV)</sub> ) < I < π × I <sub>T(AV)</sub> , T <sub>J</sub> = T <sub>J</sub> maximum			0.97	V
High level value of threshold voltage	V <sub>T(TO)2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			1.24	
Low level value of on-state slope resistance	r <sub>t1</sub>	(16.7 % × π × I <sub>T(AV)</sub> ) < I < π × I <sub>T(AV)</sub> , T <sub>J</sub> = T <sub>J</sub> maximum			17.9	mΩ
High level value of on-state slope resistance	r <sub>t2</sub>	(I > π × I <sub>T(AV)</sub> ), T <sub>J</sub> = T <sub>J</sub> maximum			13.6	
Maximum on-state voltage	V <sub>TM</sub>	I <sub>pk</sub> = 50 A, T <sub>J</sub> = 25 °C			1.75	V
Maximum holding current	I <sub>H</sub>	T <sub>J</sub> = 25 °C, anode supply 6 V, resistive load			130	mA
Latching current	I <sub>L</sub>				200	

SWITCHING					
PARAMETER		SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum rate of rise of turned-on current	$V_{\text{DRM}} \leq 600\text{ V}$	di/dt	$T_J = T_J$ maximum, $V_{\text{DM}} = \text{Rated } V_{\text{DRM}}$ Gate pulse = 20 V, 15 $\Omega$ , $t_p = 6\text{ }\mu\text{s}$ , $t_r = 0.1\text{ }\mu\text{s}$ maximum $I_{\text{TM}} = (2 \times \text{rated di/dt})\text{ A}$	200	A/ $\mu\text{s}$
	$V_{\text{DRM}} \leq 800\text{ V}$			180	
	$V_{\text{DRM}} \leq 1000\text{ V}$			160	
	$V_{\text{DRM}} \leq 1600\text{ V}$			150	
Typical turn-on time		$t_{\text{gt}}$	$T_J = 25\text{ }^\circ\text{C}$ , at rated $V_{\text{DRM}}/V_{\text{RRM}}$ , $T_J = 125\text{ }^\circ\text{C}$	0.9	$\mu\text{s}$
Typical reverse recovery time		$t_{\text{rr}}$	$T_J = T_J$ maximum, $I_{\text{TM}} = I_{\text{T(AV)}}$ , $t_p > 200\text{ }\mu\text{s}$ , di/dt = - 10 A/ $\mu\text{s}$	4	
Typical turn-off time		$t_{\text{q}}$	$T_J = T_J$ maximum, $I_{\text{TM}} = I_{\text{T(AV)}}$ , $t_p > 200\text{ }\mu\text{s}$ , $V_{\text{R}} = 100\text{ V}$ , di/dt = - 10 A/ $\mu\text{s}$ , dV/dt = 20 V/ $\mu\text{s}$ linear to 67 % $V_{\text{DRM}}$ , gate bias 0 V to 100 W	110	

**Note**

- $t_q = 10\text{ }\mu s$  up to 600 V,  $t_q = 30\text{ }\mu s$  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/ $\mu s$
		$T_J = T_J$ maximum linear to 67 % rated $V_{DRM}$		300 <sup>(1)</sup>	

**Note**

- <sup>(1)</sup> Available with:  $dV/dt = 1000\text{ V}/\mu s$ , to complete code add S90 i.e. 16RIA120S90



TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum peak gate power	P <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum		8.0	W
Maximum average gate power	P <sub>G(AV)</sub>			2.0	
Maximum peak positive gate current	I <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum		1.5	A
Maximum peak negative gate voltage	-V <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum		10	V
DC gate current required to trigger	I <sub>GT</sub>	T <sub>J</sub> = - 65 °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 <sub>J</sub> = 25 °C		60	
		T <sub>J</sub> = 125 °C		35	
DC gate voltage required to trigger	V <sub>GT</sub>	T <sub>J</sub> = - 65 °C		3.0	V
		T <sub>J</sub> = 25 °C		2.0	
		T <sub>J</sub> = 125 °C		1.0	
DC gate current not to trigger	I <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, V <sub>DRM</sub> = Rated value		2.0	mA
DC gate voltage not to trigger	V <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, V <sub>DRM</sub> = Rated value	Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V <sub>DRM</sub> 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 <sub>J</sub> , T <sub>Stg</sub>		-65 to +125		°C
Maximum thermal resistance, junction to case	R <sub>thJC</sub>	DC operation	0.86		K/W
Maximum thermal resistance, case to heat sink	R <sub>thCS</sub>	Mounting surface, smooth, flat and greased	0.35		
			TO NUT	TO DEVICE	
Mounting torque		Lubricated threads (Non-lubricated threads)	20 (27.5)	25	lbf · in
			0.23 (0.32)	0.29	kgf · m
			2.3 (3.1)	2.8	N · 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

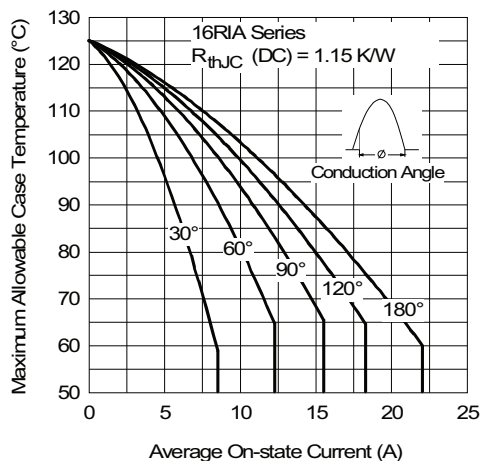


Fig. 1 - Current Ratings Characteristics

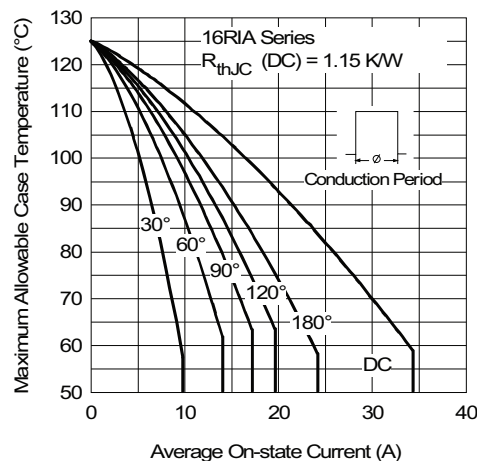


Fig. 2 - Current Ratings Characteristics

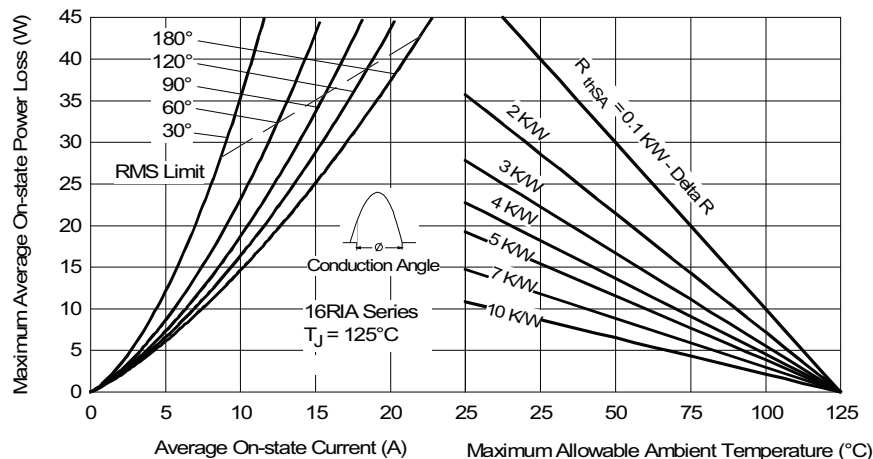


Fig. 3 - On-State Power Loss Characteristics

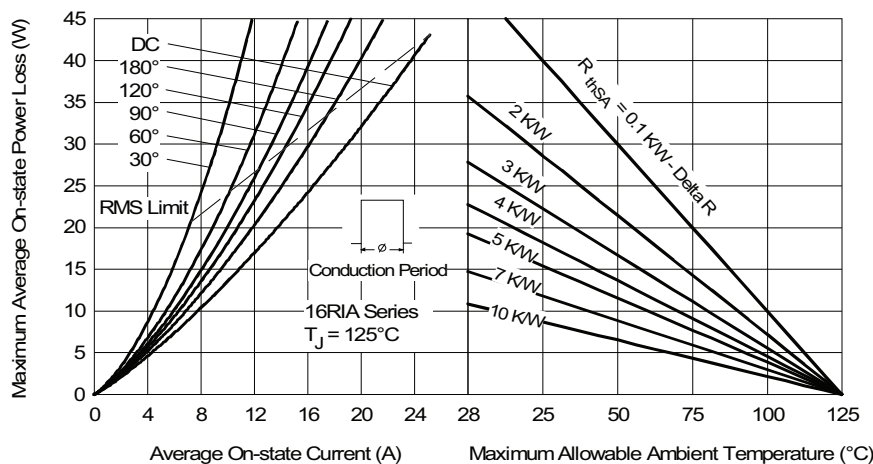


Fig. 4 - On-State Power Loss Characteristics

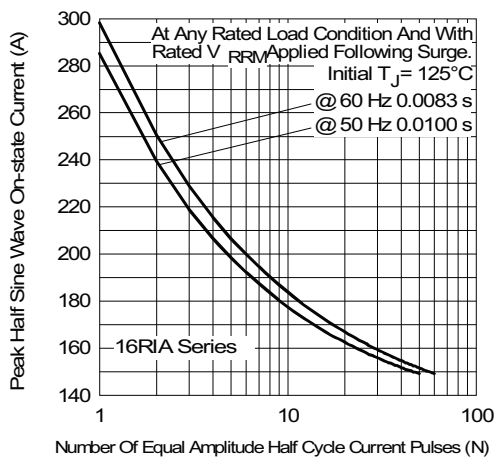


Fig. 5 - Maximum Non-Repetitive Surge Current

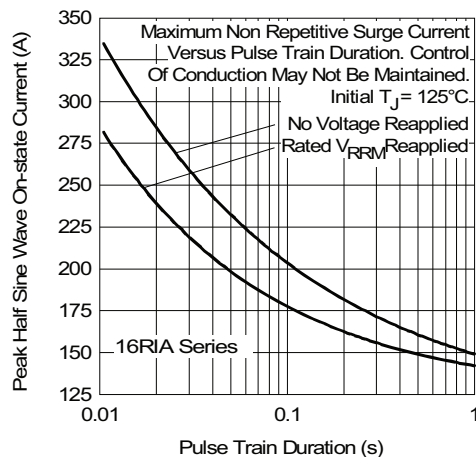


Fig. 6 - Maximum Non-Repetitive Surge Current

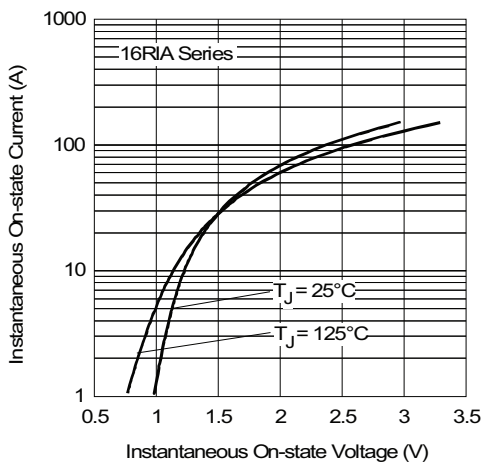


Fig. 7 - Forward Voltage Drop Characteristics

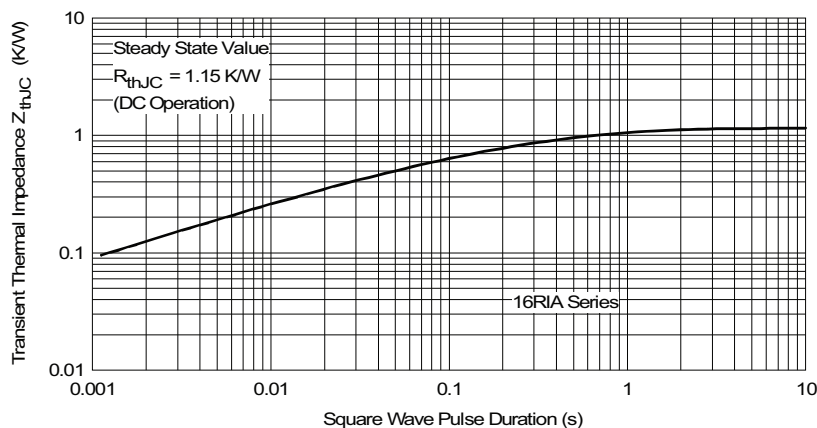


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

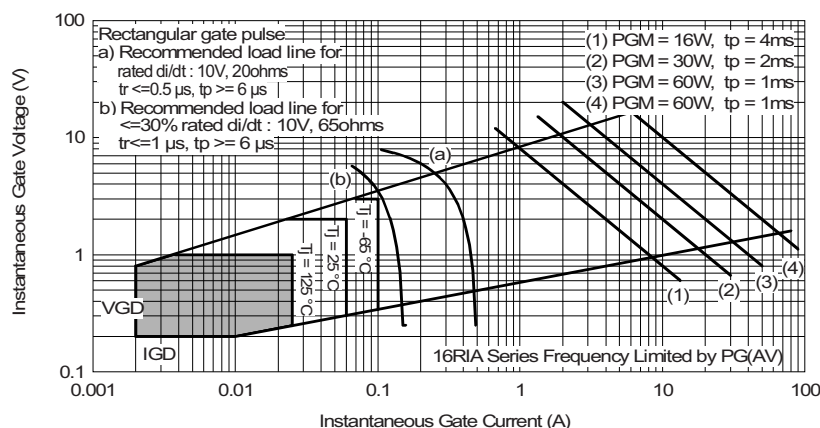


Fig. 9 - Gate Characteristics

## ORDERING INFORMATION TABLE

**Device code**

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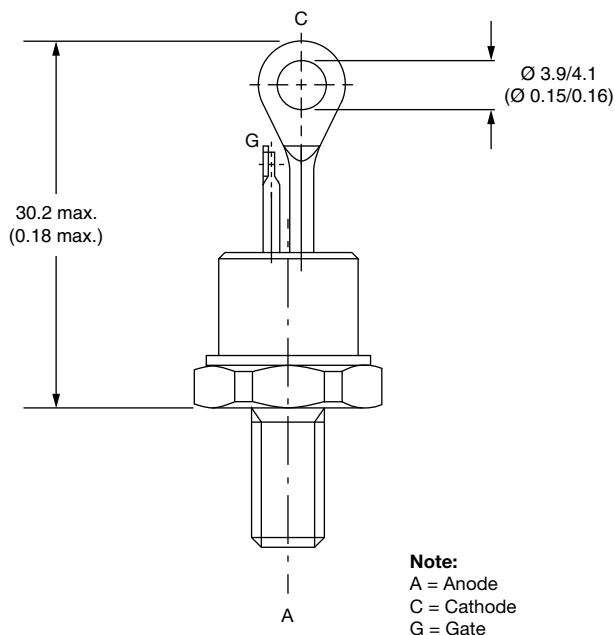
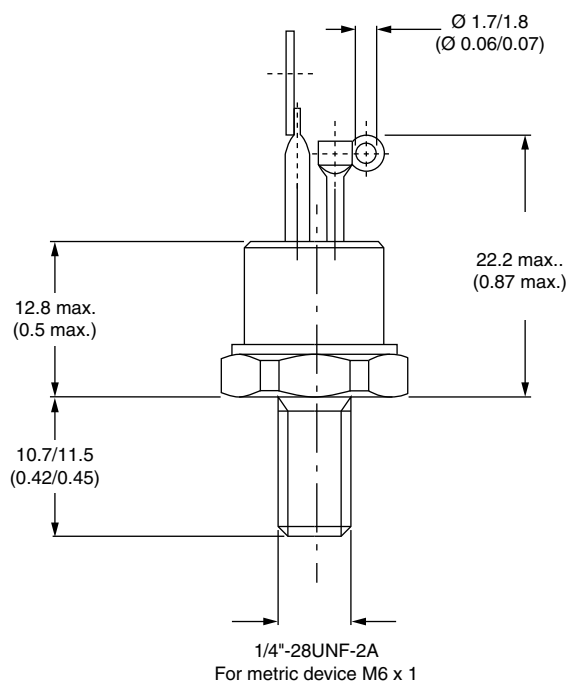
1 2 3 4 5 6

- 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)

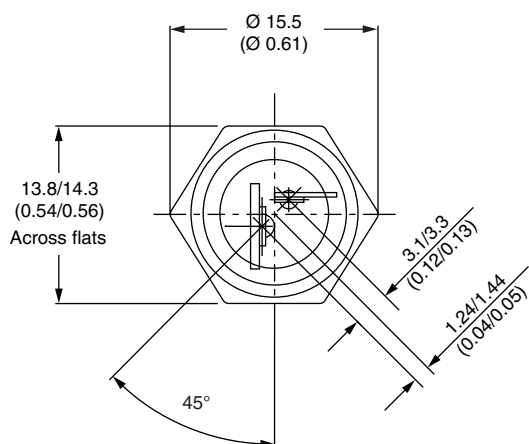
LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95333">www.vishay.com/doc?95333</a>

# TO-208AA (TO-48)

**DIMENSIONS** in millimeters (inches)



**Note:**  
A = Anode  
C = Cathode  
G = Gate





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