

## Medium Power Phase Control Thyristors (Stud Version), 50 A



TO-65 (TO-208AC)

### FEATURES

- High current rating
- Excellent dynamic characteristics
- $dV/dt = 1000 \text{ V}/\mu\text{s}$  option
- Superior surge capabilities
- Standard package
- Metric threads version available
- Types up to 1200 V  $V_{DRM}/V_{RRM}$
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

### PRIMARY CHARACTERISTICS

$I_{T(AV)}$	50 A
$V_{DRM}/V_{RRM}$	100 V, 200 V, 400 V, 600 V, 800 V, 1000 V, 1200 V
$V_{TM}$	1.60 V
$I_{GT}$	100 mA
$T_J$	-40 °C to 125 °C
Package	TO-65 (TO-208AC)
Circuit configuration	Single SCR

### TYPICAL APPLICATIONS

- Phase control applications in converters
- Lighting circuits
- Battery charges
- Regulated power supplies and temperature and speed control circuit

### MAJOR RATINGS AND CHARACTERISTICS

PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		50	A
	$T_C$	94	°C
$I_{T(RMS)}$		80	A
$I_{TSM}$	50 Hz	1430	A
	60 Hz	1490	
$I^2t$	50 Hz	10.18	kA <sup>2</sup> s
	60 Hz	9.30	
$V_{DRM}/V_{RRM}$		100 to 1200	V
$t_q$	Typical	110	$\mu\text{s}$
$T_J$		-40 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-50RIA	10	100	150	15
	20	200	300	
	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/ $\mu\text{s}$

<sup>(2)</sup> For voltage pulses with  $t_p \leq 5 \text{ ms}$



ABSOLUTE MAXIMUM RATINGS					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° sinusoidal conduction		50	A
				94	°C
Maximum RMS on-state current	$I_{T(RMS)}$			80	A
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reappplied	Sinusoidal half wave, initial $T_J = T_J$ maximum	A
		t = 8.3 ms			
		t = 10 ms	100 % $V_{RRM}$ reappplied		
		t = 8.3 ms			
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reappplied		kA <sup>2</sup> s
		t = 8.3 ms			
		t = 10 ms	100 % $V_{RRM}$ reappplied		
		t = 8.3 ms			
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reappplied, $T_J = T_J$ maximum		101.8	kA <sup>2</sup> √s
Low level value of threshold voltage	$V_{T(TO)1}$	$(16.7 \% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		0.94	V
High level value of threshold voltage	$V_{T(TO)2}$	$(\pi \times I_{T(AV)} < I < 20 \times \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		1.08	
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		4.08	mΩ
High level value of on-state slope resistance	$r_{t2}$	$(\pi \times I_{T(AV)} < I < 20 \times \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		3.34	
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 157$ A, $T_J = 25$ °C		1.60	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 22 V, resistive load, initial $I_T = 2$ A		200	mA
Latching current	$I_L$	Anode supply 6 V, resistive load		400	

SWITCHING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum rate of rise of turned-on current	dI/dt	$T_C = 125$ °C, $V_{DM} = \text{Rated } V_{DRM}$ , 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	
Typical delay time	$t_d$	$T_C = 25$ °C, $V_{DM} = \text{Rated } V_{DRM}$ , $I_{TM} = 10$ A dc resistive circuit Gate pulse = 10 V, 15 Ω source, $t_p = 20$ μs		0.9	μs
Typical turn-off time	$t_q$	$T_C = 125$ °C, $I_{TM} = 50$ A, reappplied $dV/dt = 20$ V/μs $dI_r/dt = -10$ A/μs, $V_R = 50$ V		110	

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 $V_{DRM}$		200	V/μs
		$T_J = T_J$ maximum linear to 67 % rated $V_{DRM}$		500 <sup>(1)</sup>	

**Note**

<sup>(1)</sup> Available with  $dV/dt = 1000$  V/μs, to complete code add S90 i.e. 50RIA120S90



<b>TRIGGERING</b>					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum peak gate power	$P_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms		10	W
Maximum average gate power	$P_{G(AV)}$			2.5	
Maximum peak positive gate current	$I_{GM}$			2.5	A
Maximum peak positive gate voltage	$+V_{GM}$			20	V
Maximum peak negative gate voltage	$-V_{GM}$			10	
DC gate current required to trigger	$I_{GT}$	$T_J = -40$ °C	Maximum required gate trigger current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied	250	mA
		$T_J = 25$ °C		100	
		$T_J = 125$ °C		50	
DC gate voltage required to trigger	$V_{GT}$	$T_J = -40$ °C		3.5	V
		$T_J = 25$ °C		2.5	
DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum, $V_{DRM} =$ Rated voltage		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	5.0
DC gate voltage not to trigger	$V_{GD}$	$T_J = T_J$ maximum	0.2		V

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum operating junction and storage temperature range	$T_J, T_{Stg}$			-40 to +125	°C
Maximum thermal resistance, junction to case	$R_{thJC}$	DC operation		0.35	K/W
Maximum thermal resistance, case to heat sink	$R_{thCS}$	Mounting surface, smooth, flat and greased		0.25	
Allowable mounting torque		Non-lubricated threads		$3.4 + 0 - 10\%$ (30)	N · m (lb · in)
		Lubricated threads		$2.3 + 0 - 10\%$ (20)	
Approximate weight				28	g
				1.0	oz.
Case style		See dimensions - link at the end of datasheet		TO-65 (TO-208AC)	

<b><math>\Delta R_{thJC}</math> CONDUCTION</b>				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.078	0.057	$T_J = T_J$ maximum	K/W
120°	0.094	0.098		
90°	0.120	0.130		
60°	0.176	0.183		
30°	0.294	0.296		

**Note**

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

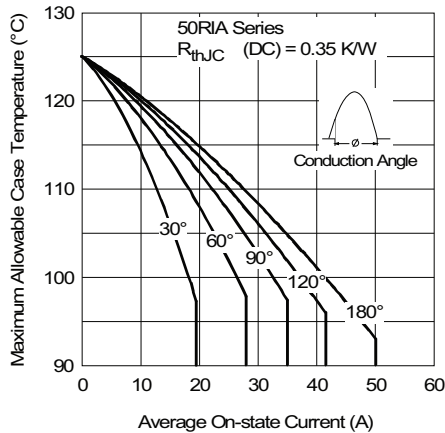


Fig. 1 - Current Ratings Characteristics

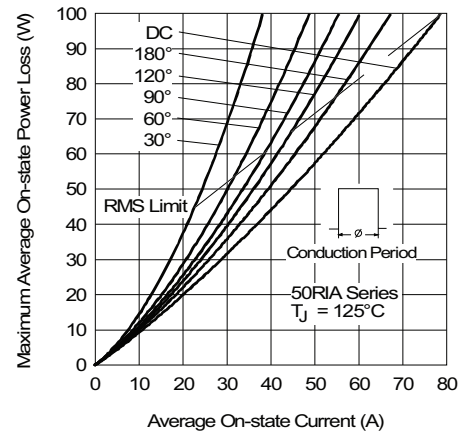


Fig. 4 - On-State Power Loss Characteristics

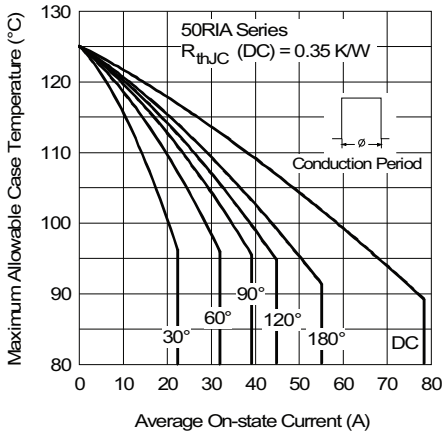


Fig. 2 - Current Ratings Characteristics

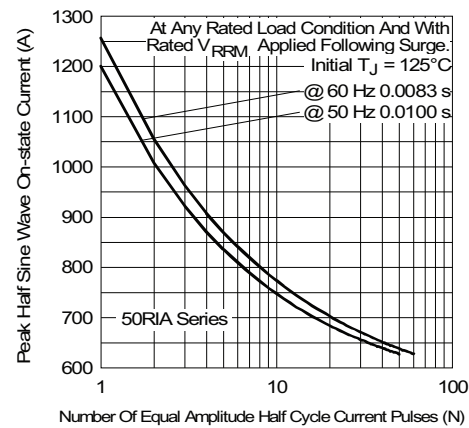


Fig. 5 - Maximum Non-Repetitive Surge Current

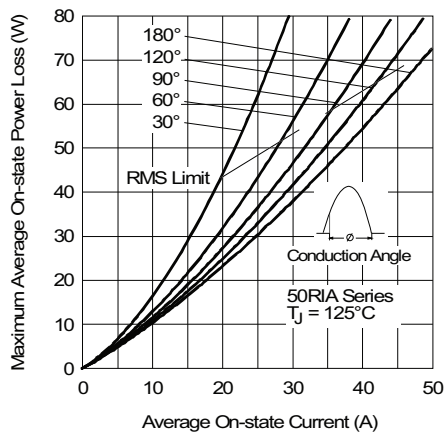


Fig. 3 - On-State Power Loss Characteristics

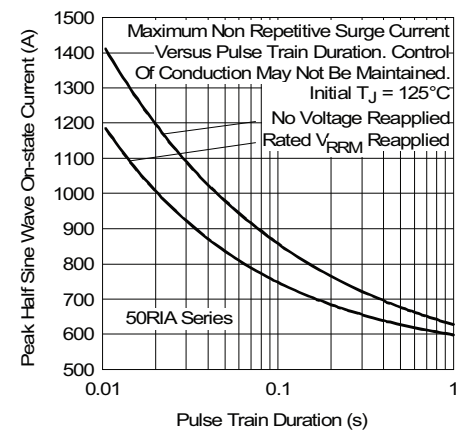


Fig. 6 - Maximum Non-Repetitive Surge Current



Fig. 7 - Forward Voltage Drop Characteristics



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



Fig. 9 - Gate Characteristics



**ORDERING INFORMATION TABLE**

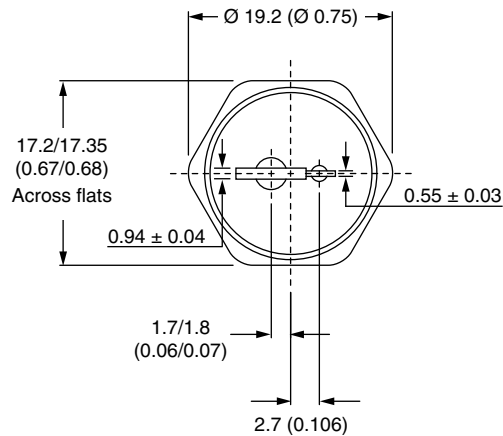
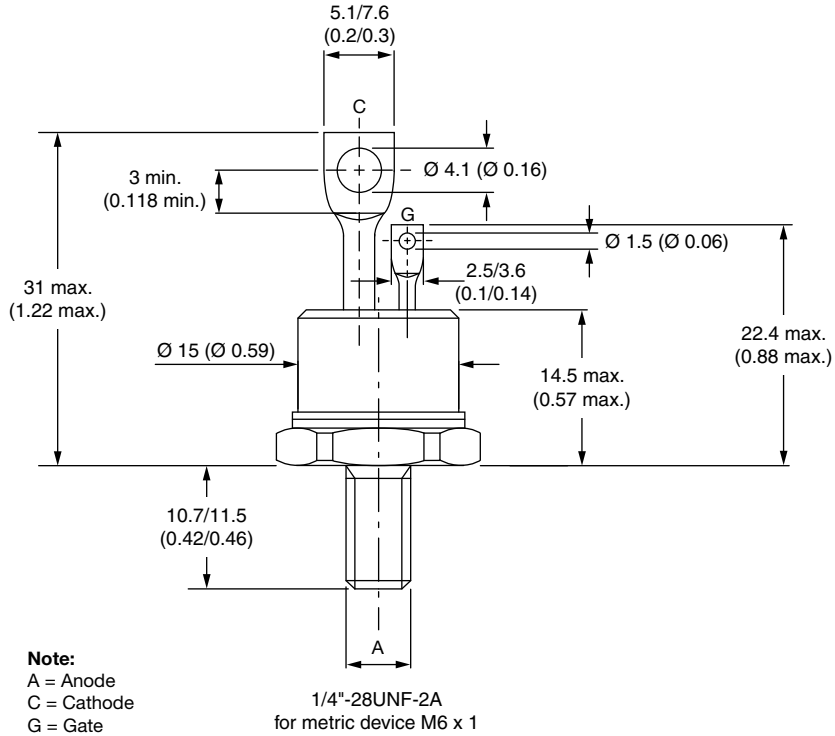
Device code	<b>VS-</b>	<b>50</b>	<b>RIA</b>	<b>120</b>	<b>S90</b>	<b>M</b>
	①	②	③	④	⑤	⑥
	<b>1</b>	-	Vishay Semiconductors product			
	<b>2</b>	-	Current code			
	<b>3</b>	-	Essential part number			
	<b>4</b>	-	Voltage code x 10 = $V_{RRM}$ (see Voltage Ratings table)			
	<b>5</b>	-	Critical dV/dt:			
			• None = 500 V/μs (standard value)			
			• S90 = 1000 V/μs (special selection)			
	<b>6</b>	-	• None = stud base TO-65 (TO-208AC) 1/4" 28UNF-2A			
			• M = stud base TO-65 (TO-208AC) M6 x 1			

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95334">www.vishay.com/doc?95334</a>



# TO-208AC (TO-65)

**DIMENSIONS** in millimeters (inches)





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