



## Phase Control Thyristors (Stud Version), 300 A



TO-118 (TO- 209AE)

### FEATURES

- Center amplifying gate
- International standard case TO-118 (TO-209AE)
- Hermetic metal case with ceramic insulator
- Threaded studs UNF 3/4"-16UNF-2A or ISO M24 x 1.5
- Compression bonded encapsulation for heavy duty operations such as severe thermal cycling
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS  
COMPLIANT

### TYPICAL APPLICATIONS

- DC motor controls
- Controlled DC power supplies
- AC controllers

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	300 A
$V_{DRM}/V_{RRM}$	400 V, 800 V, 1200 V, 1600 V, 1800 V, 2000 V
$V_{TM}$	1.28 V
$I_{GT}$	200 mA
$T_J$	-40 °C to +125 °C
Package	TO-118 (TO-209AE)
Circuit configuration	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		300	A
	$T_C$	75	°C
$I_{T(RMS)}$		470	A
$I_{TSM}$	50 Hz	8000	
	60 Hz	8380	
$I^2t$	50 Hz	320	kA <sup>2</sup> s
	60 Hz	292	
$V_{DRM}/V_{RRM}$		400 to 2000	V
$t_q$	Typical	100	µs
$T_J$		-40 to 125	°C

### ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS				
TYPE NUMBER	VOLTAGE CODE	$V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE V	$I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = T_J$ MAXIMUM mA
VS-ST300S	04	400	500	50
	08	800	900	
	12	1200	1300	
	16	1600	1700	
	18	1800	1900	
	20	2000	2100	



ABSOLUTE MAXIMUM RATINGS					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave		300	A
				75	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 64 °C case temperature		470	
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	8000	A
		t = 8.3 ms		8380	
		t = 10 ms	100 % $V_{RRM}$ reapplied	6730	
		t = 8.3 ms		7040	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	320	kA <sup>2</sup> s
		t = 8.3 ms		292	
		t = 10 ms	100 % $V_{RRM}$ reapplied	226	
		t = 8.3 ms		207	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied		3200	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)		0.97	V
High level value of threshold voltage	$V_{T(TO)2}$	(I > $\pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)		0.98	
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)		0.74	mΩ
High level value of on-state slope resistance	$r_{t2}$	(I > $\pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)		0.73	
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 940$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		1.66	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 12 V resistive load		600	mA
Typical latching current	$I_L$			1000	

SWITCHING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum non-repetitive rate of rise of turned-on current	$di/dt$	Gate drive 20 V, 20 Ω, $t_r \leq 1$ μs $T_J = T_J$ maximum, anode voltage $\leq 80$ % $V_{DRM}$		1000	A/μs
Typical delay time	$t_d$	Gate current 1 A, $di_g/dt = 1$ A/μs $V_d = 0.67$ % $V_{DRM}$ , $T_J = 25$ °C		1.0	μs
Typical turn-off time	$t_q$	$I_{TM} = 550$ A, $T_J = T_J$ maximum, $di/dt = 40$ A/μs, $V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 100 Ω, $t_p = 500$ μs		100	

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 80 % rated $V_{DRM}$		500	V/μs
Maximum peak reverse and off-state leakage current	$I_{RRM}, I_{DRM}$	$T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ applied		30	mA



<b>TRIGGERING</b>						
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES		UNITS	
			TYP.	MAX.		
Maximum peak gate power	$P_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms	10.0		W	
Maximum average gate power	$P_{G(AV)}$	$T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$	2.0			
Maximum peak positive gate current	$I_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms	3.0		A	
Maximum peak positive gate voltage	$+V_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms	20		V	
Maximum peak negative gate voltage	$-V_{GM}$		5.0			
DC gate current required to trigger	$I_{GT}$	Maximum required gate trigger/ current/voltage are the lowest value which will trigger all units 12 V anode to cathode applied	$T_J = -40$ °C	200	-	mA
			$T_J = 25$ °C	100	200	
			$T_J = 125$ °C	50	-	
DC gate voltage required to trigger	$V_{GT}$		$T_J = -40$ °C	2.5	-	V
			$T_J = 25$ °C	1.8	3	
			$T_J = 125$ °C	1.1	-	
DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum	10		mA	
DC gate voltage not to trigger	$V_{GD}$		0.25		V	

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum operating junction temperature range	$T_J$		-40 to 125	°C
Maximum storage temperature range	$T_{Stg}$		-40 to 150	
Maximum thermal resistance, junction to case	$R_{thJC}$	DC operation	0.10	K/W
Maximum thermal resistance, case to heatsink	$R_{thCS}$	Mounting surface, smooth, flat and greased	0.03	
Mounting torque, $\pm 10$ %		Non-lubricated threads	48.5 (425)	N · m (lbf · in)
Approximate weight			535	g
Case style		See dimensions - link at the end of datasheet	TO-118 (TO-209AE)	

<b><math>\Delta R_{thJC}</math> CONDUCTION</b>				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.011	0.008	$T_J = T_J$ maximum	K/W
120°	0.013	0.014		
90°	0.017	0.018		
60°	0.025	0.026		
30°	0.041	0.042		

**Note**

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

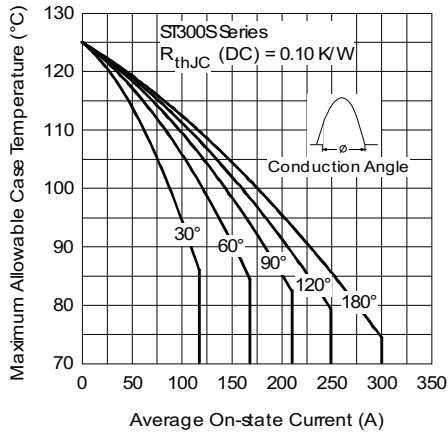


Fig. 1 - Current Ratings Characteristics

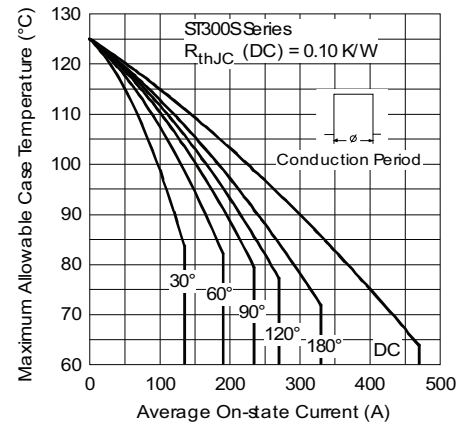


Fig. 2 - Current Ratings Characteristics

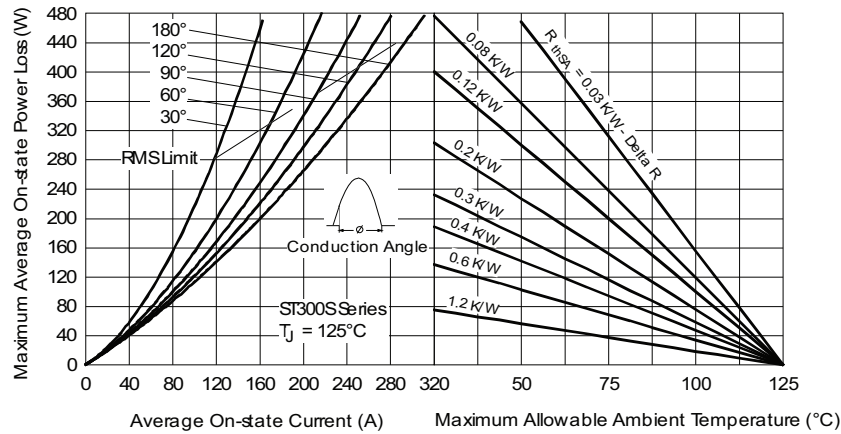


Fig. 3 - On-State Power Loss Characteristics

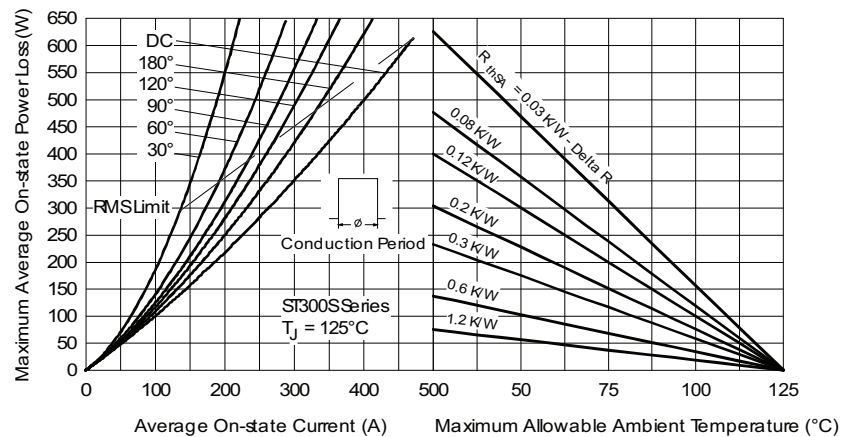


Fig. 4 - On-State Power Loss Characteristics

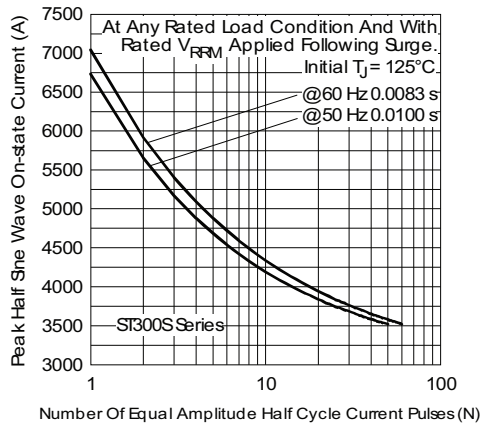


Fig. 5 - Maximum Non-Repetitive Surge Current

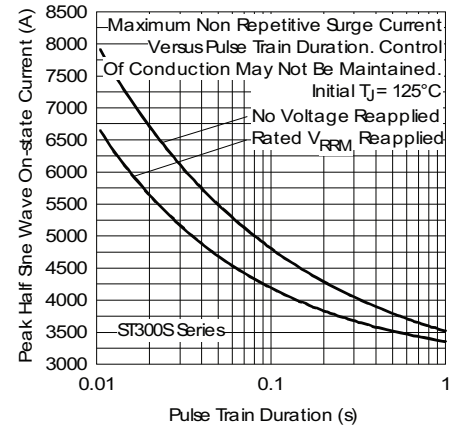


Fig. 6 - Maximum Non-Repetitive Surge Current

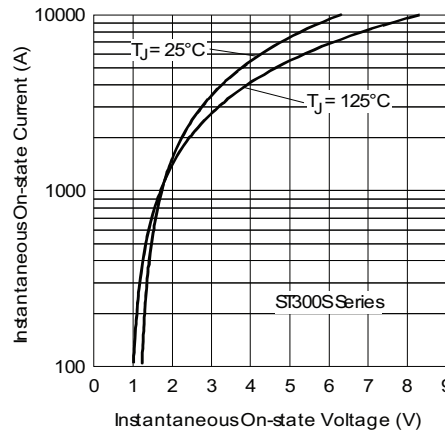


Fig. 7 - On-State Voltage Drop Characteristics

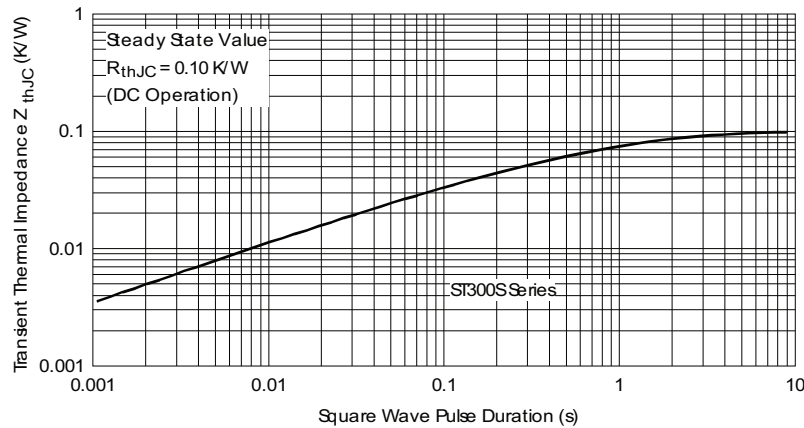


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

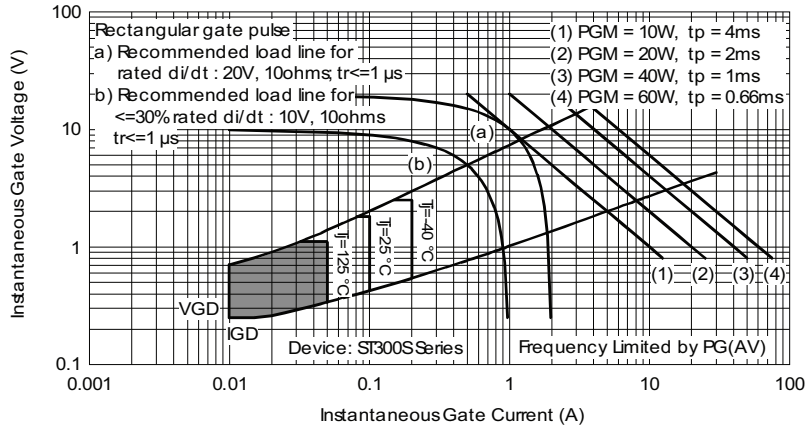


Fig. 9 - Gate Characteristics

### ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>ST</b>	<b>30</b>	<b>0</b>	<b>S</b>	<b>20</b>	<b>P</b>	<b>0</b>	<b>-</b>	<b>PbF</b>
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

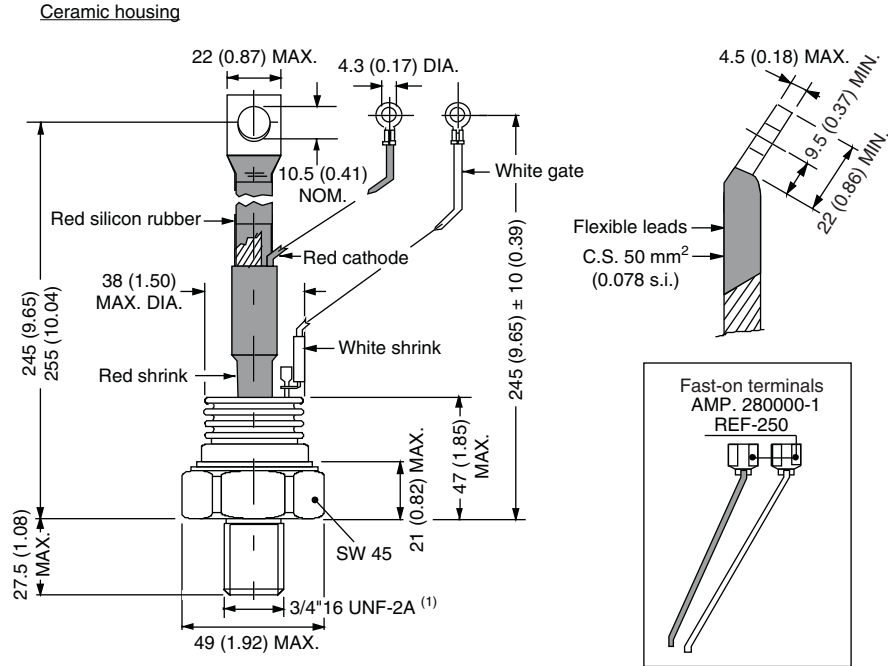
- ① - Vishay Semiconductors product
- ② - Thyristor
- ③ - Essential part number
- ④ - 0 = Converter grade
- ⑤ - S = Compression bonding stud
- ⑥ - Voltage code x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- ⑦ - P = stud base 3/4" 16UNF-2A threads  
M = stud base metric threads (M24 x 1.5)
- ⑧ - 0 = Eyelet terminals (gate and auxiliary cathode leads)  
1 = Fast-on terminals (gate and auxiliary cathode leads)  
3 = Threaded top terminal 3/8" 24UNF-2A
- ⑨ - Critical  $dV/dt$ : • None = 500 V/ $\mu$ s (standard value)  
• L = 1000 V/ $\mu$ s (special selection)
- ⑩ - None = Standard production  
PbF = Lead (Pb)-free

#### LINKS TO RELATED DOCUMENTS

Dimensions	<a href="http://www.vishay.com/doc?95084">www.vishay.com/doc?95084</a>
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## TO-209AE (TO-118)

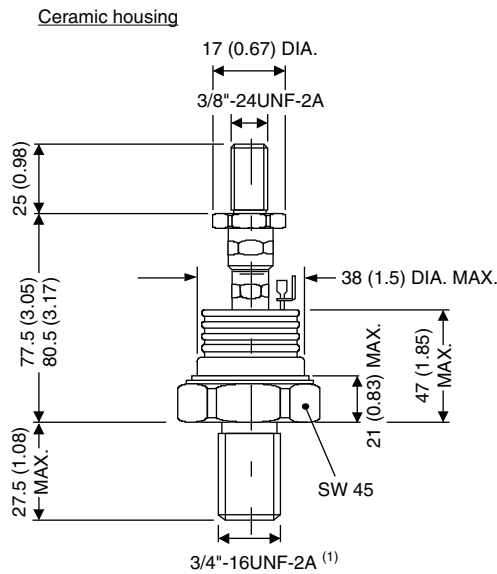
### DIMENSIONS - TO-209AE (TO-118) in millimeters (inches)



**Note**

(1) For metric device: M24 x 1.5 - length screw 21 (0.83) maximum

### DIMENSIONS - TO-209AE (TO-118) WITH TOP THREAD TERMINAL 3/8" in millimeters (inches)



**Note**

(1) For metric device: M24 x 1.5 - length screw 21 (0.83) maximum



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