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## Phase Control Thyristors (Stud Version), 330 A


**TO- 209AE (TO-118)**

**RoHS  
COMPLIANT**
**FEATURES**

- Center amplifying gate
- International standard case TO-209AE (TO-118)
- Hermetic metal case with ceramic insulator
- 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)

**TYPICAL APPLICATIONS**

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

PRODUCT SUMMARY	
$I_{T(AV)}$	330 A
$V_{DRM}/V_{RRM}$	400 V, 2000 V
$V_{TM}$	1.52 V
$I_{GT}$	200 mA
$T_J$	-40 °C to 125 °C
Package	TO-209AE (TO-118)
Diode variation	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		330	A
	$T_C$	75	°C
$I_{T(RMS)}$		520	A
$I_{TSM}$	50 Hz	9000	
	60 Hz	9420	
$i^2t$	50 Hz	405	kA <sup>2</sup> s
	60 Hz	370	
$V_{DRM}/V_{RRM}$		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-ST330S	04	400	500	50
	08	800	900	
	12	1200	1300	
	16	1600	1700	
	20	2000	2100	



<b>ABSOLUTE MAXIMUM RATINGS</b>					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave		330	A
				75	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 75 °C case temperature		520	
Maximum peak, one-cycle non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	9000	A
		t = 8.3 ms		9420	
		t = 10 ms	100 % $V_{RRM}$ reapplied	7570	
		t = 8.3 ms		7920	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	405	kA <sup>2</sup> s
		t = 8.3 ms		370	
		t = 10 ms	100 % $V_{RRM}$ reapplied	287	
		t = 8.3 ms		262	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		4050	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)		0.834	V
High level value of threshold voltage	$V_{T(TO)2}$	(I > $\pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)		0.898	
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)		0.687	mΩ
High level value of on-state slope resistance	$r_{t2}$	(I > $\pi \times I_{T(AV)}$ , $T_J = T_J$ maximum)		0.636	
Maximum on-state voltage	$V_{TM}$	$I_{pk} = 1000$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		1.52	V
Maximum holding current	$I_H$	$T_J = 25$ °C, anode supply 12 V resistive load		600	mA
Typical latching current	$I_L$			1000	

<b>SWITCHING</b>					
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 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	

<b>BLOCKING</b>					
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		50	mA





TRIGGERING						
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	

THERMAL AND MECHANICAL SPECIFICATIONS				
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	$R_{thC-hs}$	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 dimension - link at the end of datasheet	TO-209AE (TO-118)	

$\Delta R_{thJC}$ CONDUCTION				
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

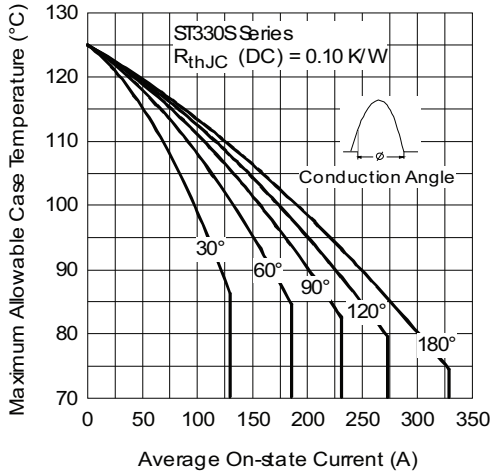


Fig. 1 - Current Ratings Characteristics

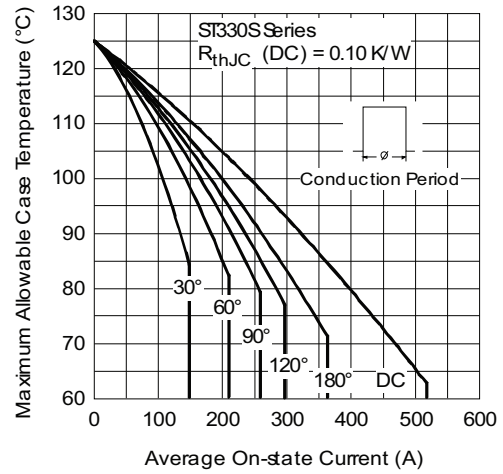


Fig. 2 - Current Ratings Characteristics

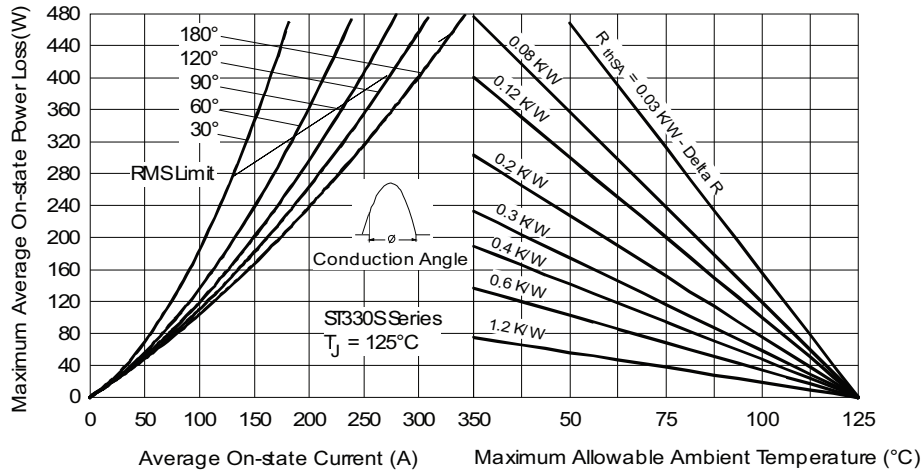


Fig. 3 - On-State Power Loss Characteristics

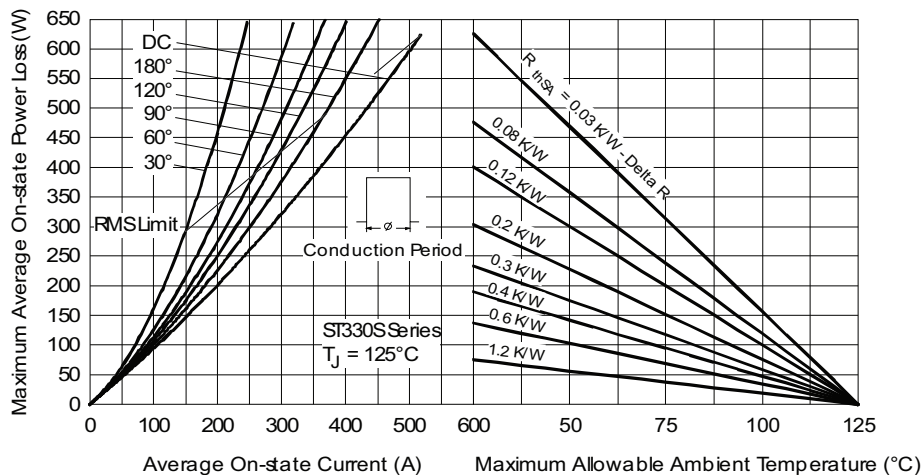


Fig. 4 - On-State Power Loss Characteristics

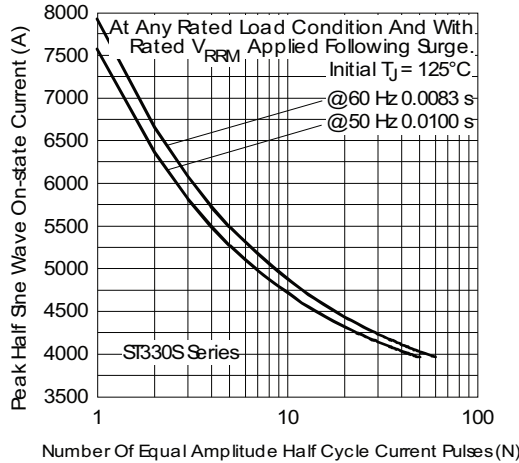


Fig. 5 - Maximum Non-Repetitive Surge Current

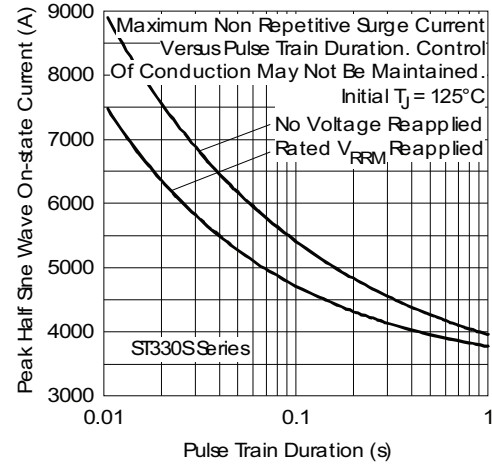


Fig. 6 - Maximum Non-Repetitive Surge Current

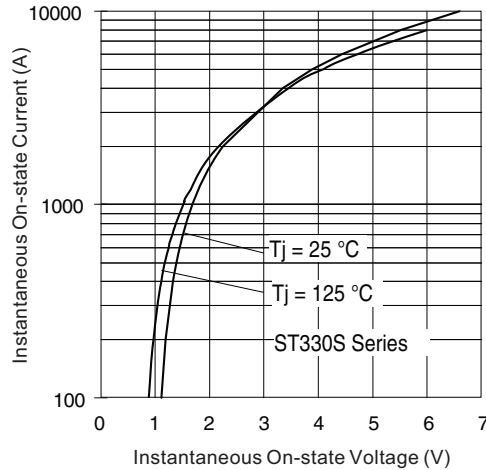


Fig. 7 - On-State Voltage Drop Characteristics

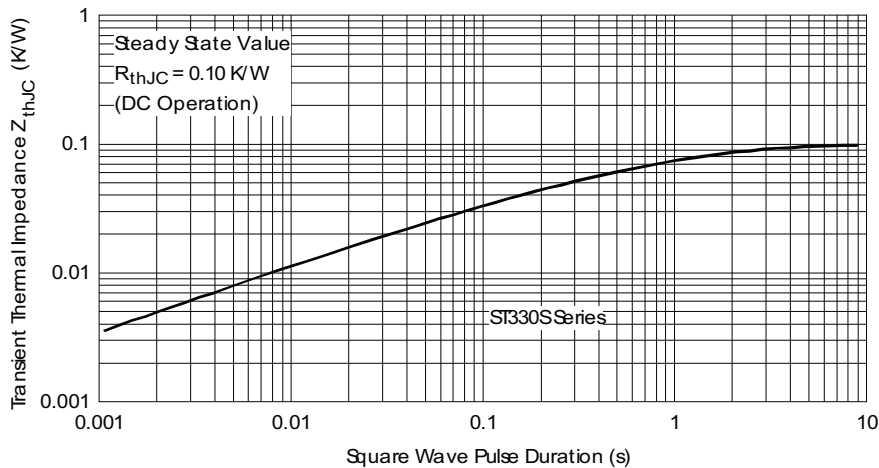


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

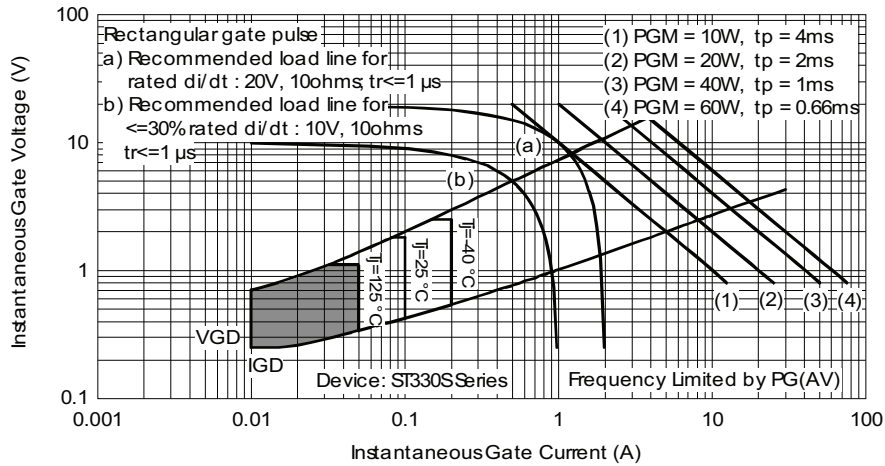


Fig. 9 - Gate Characteristics

**ORDERING INFORMATION TABLE**

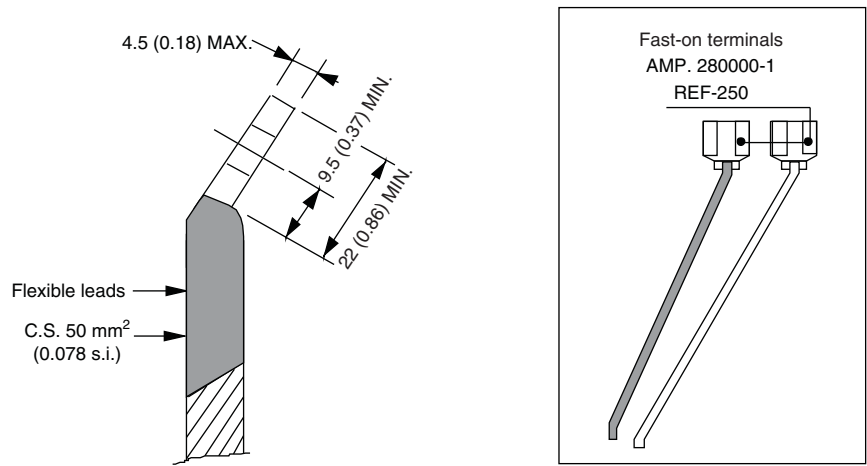
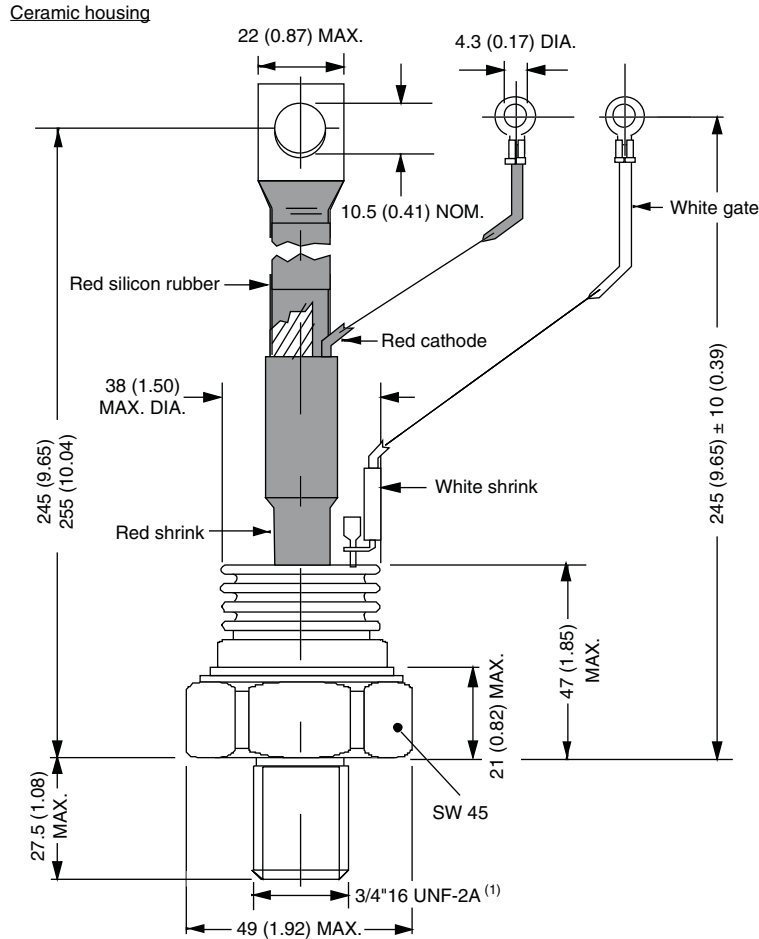
Device code	<b>VS-</b>	<b>ST</b>	<b>33</b>	<b>0</b>	<b>S</b>	<b>16</b>	<b>P</b>	<b>0</b>	<b>PbF</b>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

- 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)
- 9** - None = standard production  
- PbF = lead (Pb)-free

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95080">www.vishay.com/doc?95080</a>

## TO-209AE (TO-118)

**DIMENSIONS** in millimeters (inches)



**Note**

<sup>(1)</sup> For metric device: M24 x 1.5 - length 21 (0.83) maximum





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