

## Phase Control Thyristors (Stud Version), 280 A



TO-93 (TO-209AB)

### FEATURES

- Center amplifying gate
- International standard case TO-93 (TO-209AB)
- Hermetic metal case with glass-metal seal 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)


**RoHS**  
COMPLIANT

### PRODUCT SUMMARY

$I_{T(AV)}$	280 A
$V_{DRM}/V_{RRM}$	400 V, 600 V
$V_{TM}$	1.28 V
$I_{GT}$	150 mA
$T_J$	-40 °C to +125 °C
Package	TO-93 (TO-209AB)
Circuit configuration	Single SCR

### TYPICAL APPLICATIONS

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

### MAJOR RATINGS AND CHARACTERISTICS

PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		280	A
	$T_C$	85	°C
$I_{T(RMS)}$		440	A
$I_{TSM}$	50 Hz	7850	
	60 Hz	8220	
$I^2t$	50 Hz	308	kA <sup>2</sup> s
	60 Hz	281	
$V_{DRM}/V_{RRM}$		400/600	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-ST280S	04	400	500	30
	06	600	700	



ABSOLUTE MAXIMUM RATINGS						
PARAMETER	SYMBOL	TEST CONDITIONS			VALUES	UNITS
Maximum average on-state current at case temperature	I <sub>T(AV)</sub>	180° conduction, half sine wave			280	A
					85	°C
Maximum RMS on-state current	I <sub>T(RMS)</sub>	DC at 75 °C case temperature			440	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	7850	
		t = 8.3 ms			8220	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		6600	
		t = 8.3 ms			6900	
Maximum I <sup>2</sup> t for fusing	I <sup>2</sup> t	t = 10 ms	No voltage reapplied		310	kA <sup>2</sup> s
		t = 8.3 ms			220	
		t = 10 ms	100 % V <sub>RRM</sub> reapplied		218	
		t = 8.3 ms			200	
Maximum I <sup>2</sup> √t for fusing	I <sup>2</sup> √t	t = 0.1 to 10 ms, no voltage reapplied			3100	kA <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			0.84	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			0.88	
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			0.50	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			0.47	
Maximum on-state voltage	V <sub>TM</sub>	I <sub>pk</sub> = 880 A, T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> = 10 ms sine pulse			1.28	V
Maximum holding current	I <sub>H</sub>	T <sub>J</sub> = 25 °C, anode supply 12 V resistive load			600	mA
Maximum (typical) latching current	I <sub>L</sub>				1000 (300)	

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	$t_q$	$I_{TM} = 300$ A, $T_J = T_J$ maximum, $di/dt = 20$ 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	UNIT S
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



TRIGGERING					
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES		UNIT
			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	$I_{GT}$	$T_J = -40$ °C	180	-	mA
		$T_J = 25$ °C	90	150	
		$T_J = 125$ °C	40	-	
DC gate voltage required to trigger	$V_{GT}$	$T_J = -40$ °C	2.9	-	V
		$T_J = 25$ °C	1.8	3.0	
		$T_J = 125$ °C	1.2	-	
DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum	Maximum required gate trigger/current/voltage are the lowest value which will trigger all units 12 V anode to cathode applied		mA
DC gate voltage not to trigger	$V_{GD}$				
			10		
			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	0.105	K/W	
Maximum thermal resistance, case to heatsink	$R_{thCS}$	Mounting surface, smooth, flat and greased	0.04		
Mounting torque, $\pm 10$ %		Non-lubricated threads	31 (275)	N · m (lbf · in)	
		Lubricated threads	24.5 (210)		
Approximate weight			280	g	
Case style		See dimensions - link at the end of datasheet	TO-93 (TO-209AB)		

$\Delta R_{thJC}$ CONDUCTION					
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS	
180°	0.016	0.012	$T_J = T_J$ maximum	K/W	
120°	0.019	0.020			
90°	0.025	0.027			
60°	0.036	0.037			
30°	0.060	0.060			

**Note**

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

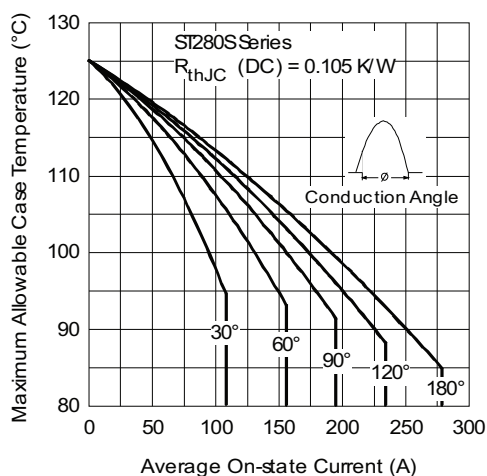


Fig. 1 - Current Ratings Characteristics

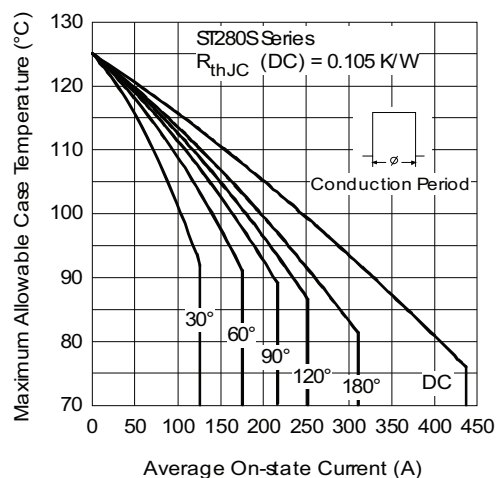


Fig. 2 - Current Ratings Characteristics

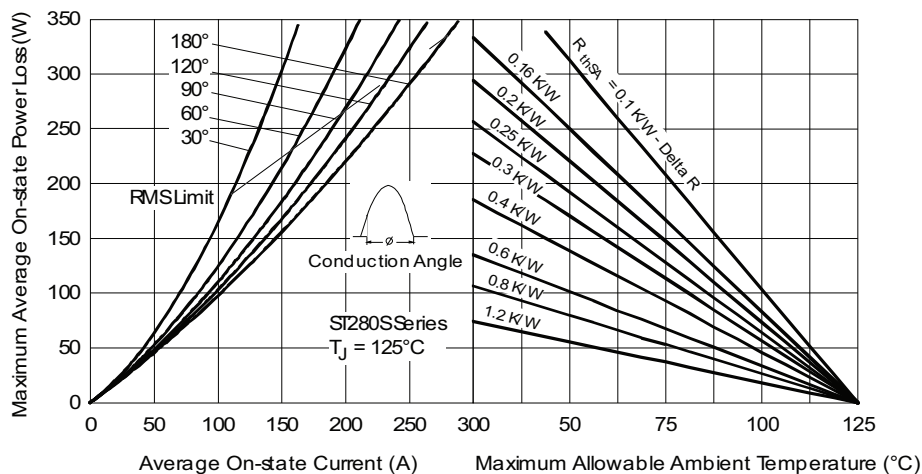


Fig. 3 - On-State Power Loss Characteristics

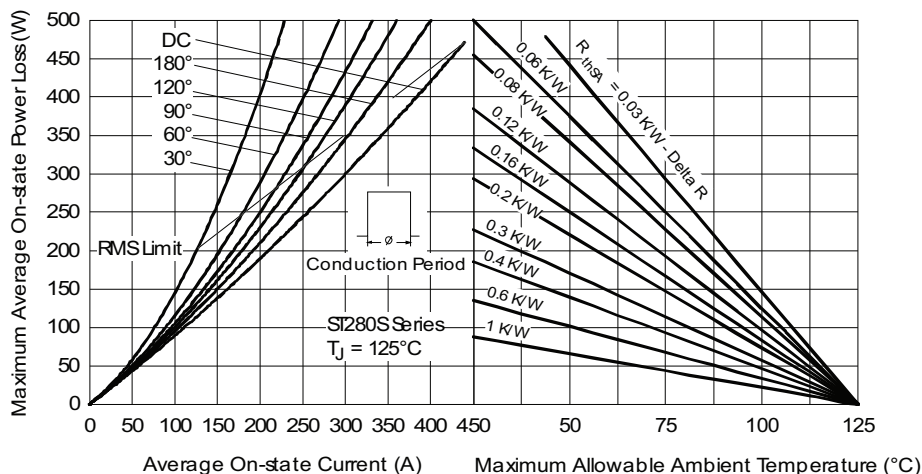


Fig. 4 - On-State Power Loss Characteristics

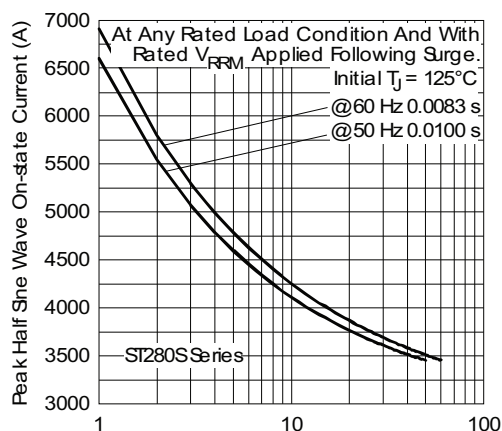


Fig. 5 - Maximum Non-Repetitive Surge Current

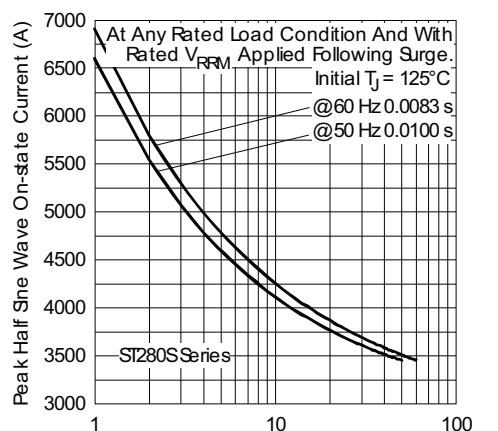


Fig. 6 - Maximum Non-Repetitive Surge Current

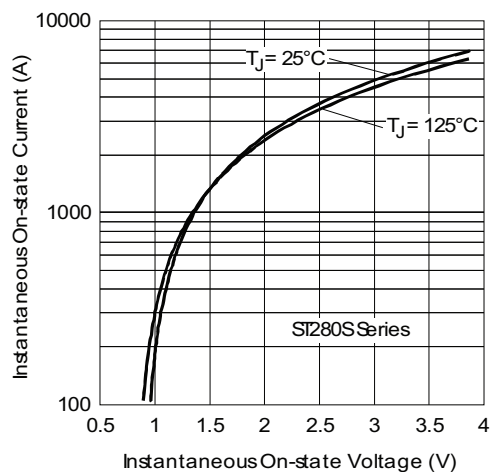
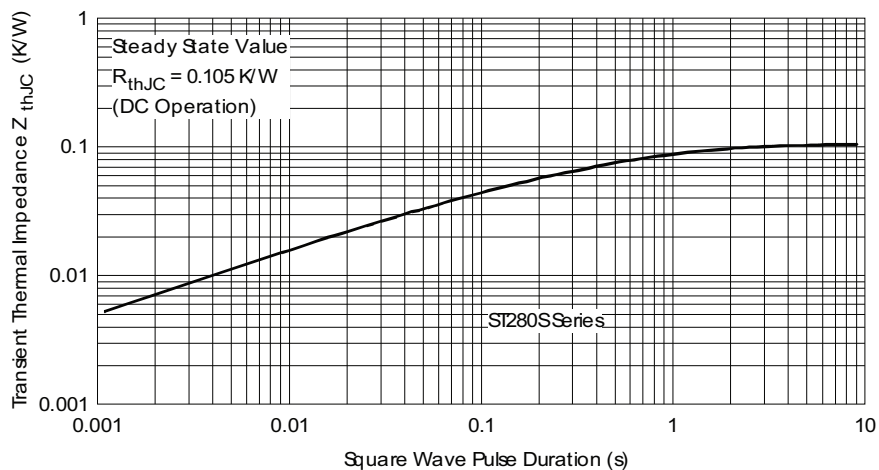


Fig. 7 - On-State Voltage Drop Characteristics


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

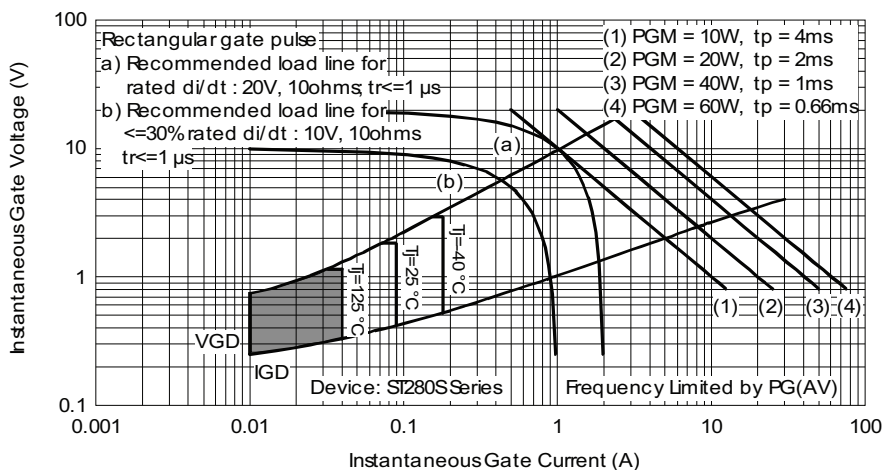


Fig. 9 - Gate Characteristics

### ORDERING INFORMATION TABLE

Device code	VS-	ST	28	0	S	06	P	0	V
	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								
8	0 = eyelet terminals (gate and auxiliary cathode leads) 1 = fast-on terminals (gate and auxiliary cathode leads)								
9	V = glass-metal seal								

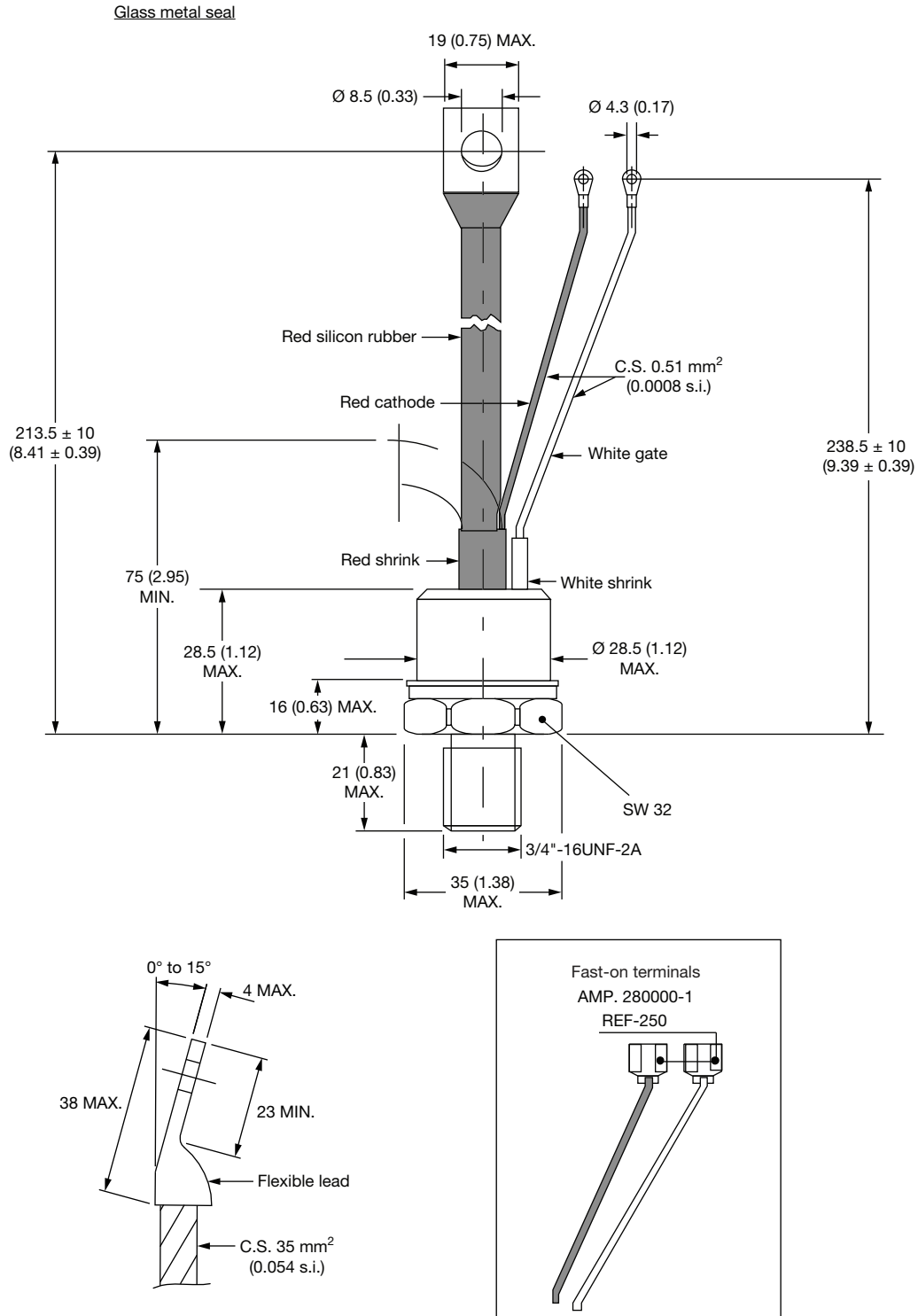
#### LINKS TO RELATED DOCUMENTS

Dimensions

[www.vishay.com/doc?95077](http://www.vishay.com/doc?95077)

## TO-209AB (TO-93)

**DIMENSIONS** in millimeters (inches)





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