

## Inverter Grade Thyristors (Stud Version), 175 A



TO-93 (TO-209AB)


**RoHS  
COMPLIANT**
**FEATURES**

- All diffused design
- Center amplifying gate
- Guaranteed high  $dV/dt$
- Guaranteed high  $dI/dt$
- High surge current capability
- Low thermal impedance
- High speed performance
- Compression bonding
- 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**

- Inverters
- Choppers
- Induction heating
- All types of force-commutated converters

**PRIMARY CHARACTERISTICS**

$I_{T(AV)}$	175 A
$V_{DRM}/V_{RRM}$	1000 V, 1200 V
$V_{TM}$	2.07 V
$I_{TSM}$ at 50 Hz	4680 A
$I_{TSM}$ at 60 Hz	4900 A
$I_{GT}$	200 mA
$T_J$	-40 °C to 125 °C
$T_C$	85 °C
Package	TO-93 (TO-209AB)
Circuit configuration	Single SCR

**MAJOR RATINGS AND CHARACTERISTICS**

PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		175	A
	$T_C$	85	°C
$I_{T(RMS)}$		275	A
$I_{TSM}$	50 Hz	4680	
	60 Hz	4900	
$I^2t$	50 Hz	110	kA <sup>2</sup> s
	60 Hz	100	
$V_{DRM}/V_{RRM}$		1000 to 1200	V
$t_q$	Range	15 to 25	μs
$T_J$		-40 to 125	°C

**ELECTRICAL SPECIFICATIONS**
**VOLTAGE RATINGS**

TYPE NUMBER	VOLTAGE CODE	$V_{DRM}/V_{RRM}$ , MAXIMUM REPETITIVE PEAK VOLTAGE V	$V_{RSM}$ , MAXIMUM NON-REPETITIVE PEAK VOLTAGE V	$I_{DRM}/I_{RRM}$ MAXIMUM AT $T_J = T_J$ MAXIMUM mA
VS-ST173S	10	1000	1100	40
	12	1200	1300	



CURRENT CARRYING CAPABILITY							
FREQUENCY							UNITS
50 Hz	500	320	790	550	4510	3310	A
400 Hz	450	290	810	540	1970	1350	
1000 Hz	330	190	760	490	1050	680	
2500 Hz	170	80	510	300	480	280	
Recovery voltage $V_r$	50		50		50		V
Voltage before turn-on $V_d$	$V_{DRM}$		$V_{DRM}$		$V_{DRM}$		
Rise of on-state current $di/dt$	50		-		-		A/μs
Case temperature	60	85	60	85	60	85	°C
Equivalent values for RC circuit	47/0.22		47/0.22		47/0.22		Ω/μF

ON-STATE CONDUCTION					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave		175	A
				85	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 75 °C case temperature		275	
Maximum peak, one half cycle, non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	4680	A
				t = 8.3 ms	
		t = 10 ms	100 % $V_{RRM}$ reapplied	3940	
				t = 8.3 ms	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	110	kA <sup>2</sup> s
				t = 8.3 ms	
		t = 10 ms	100 % $V_{RRM}$ reapplied	77	
				t = 8.3 ms	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		1100	kA <sup>2</sup> √s
Maximum peak on-state voltage	$V_{TM}$	$I_{TM} = 600$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse		2.07	V
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		1.55	
High level value of threshold voltage	$V_{T(TO)2}$	$I > \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum		1.58	
Low level value of forward slope resistance	$r_{t1}$	$(16.7\% \times \pi \times I_{T(AV)}) < I < \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum		0.87	
High level value of forward slope resistance	$r_{t2}$	$I > \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum		0.82	mΩ
Maximum holding current	$I_H$	$T_J = 25$ °C, $I_T > 30$ A		600	mA
Typical latching current	$I_L$	$T_J = 25$ °C, $V_A = 12$ V, $R_a = 6$ Ω, $I_G = 1$ A		1000	

SWITCHING					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum non-repetitive rate of rise of turned on current	$di/dt$	$T_J = T_J$ maximum, $V_{DRM} = \text{Rated } V_{DRM}$ $I_{TM} = 2 \times di/dt$		1000	A/μs
Typical delay time	$t_d$	$T_J = 25$ °C, $V_{DM} = \text{Rated } V_{DRM}$ , $I_{TM} = 50$ A DC, $t_p = 1$ μs Resistive load, gate pulse: 10 V, 5 Ω source		1.1	
Maximum turn-off time	minimum	$t_q$	$T_J = T_J$ maximum, $I_{TM} = 300$ A, commutating $di/dt = 20$ A/μs $V_R = 50$ V, $t_p = 500$ μs, $dV/dt$ : See table in device code	15	μs
	maximum			25	



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 % $V_{DRM}$ , higher value available on request	500	V/ $\mu$ s
Maximum peak reverse and off-state leakage current	$I_{RRM}$ , $I_{DRM}$	$T_J = T_J$ maximum, rated $V_{DRM}/V_{RRM}$ applied	40	mA

TRIGGERING				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum peak gate power	$P_{GM}$	$T_J = T_J$ maximum, f = 50 Hz, d% = 50	60	W
Maximum average gate power	$P_{G(AV)}$		10	
Maximum peak positive gate current	$I_{GM}$	$T_J = T_J$ maximum, $t_p \leq 5$ ms	10	A
Maximum peak positive gate voltage	+ $V_{GM}$		20	
Maximum peak negative gate voltage	- $V_{GM}$		5	
Maximum DC gate current required to trigger	$I_{GT}$	$T_J = 25$ °C, $V_A = 12$ V, $R_a = 6$ $\Omega$	200	mA
Maximum DC gate voltage required to trigger	$V_{GT}$		3	V
Maximum DC gate current not to trigger	$I_{GD}$	$T_J = T_J$ maximum, rated $V_{DRM}$ applied	20	mA
Maximum DC gate voltage not to trigger	$V_{GD}$		0.25	V

THERMAL AND MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum junction operating 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

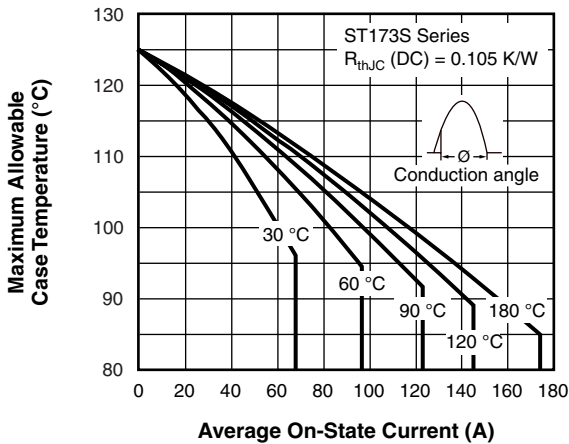


Fig. 1 - Current Ratings Characteristics

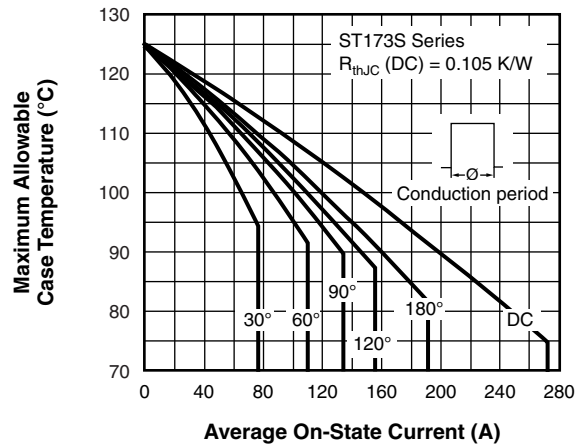


Fig. 2 - Current Ratings Characteristics

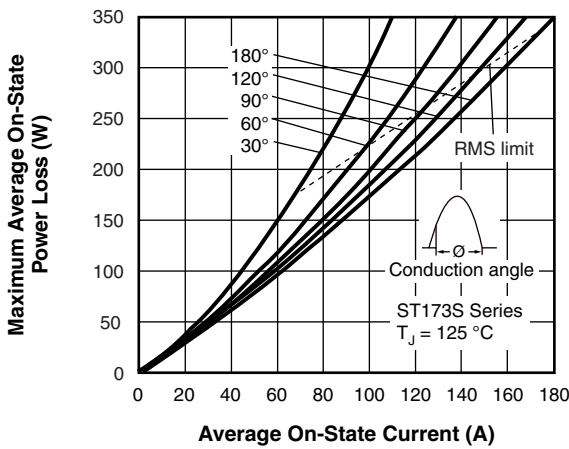


Fig. 3 - On-State Power Loss Characteristics

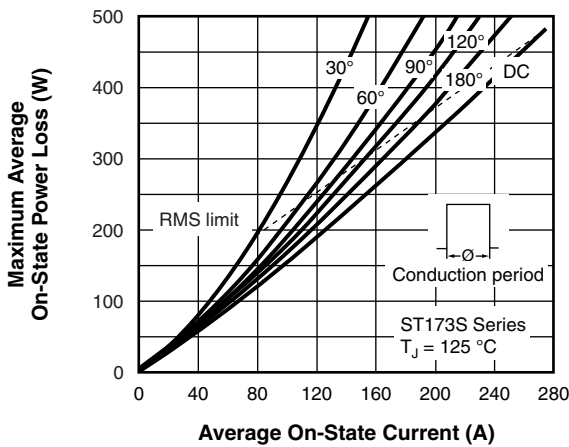
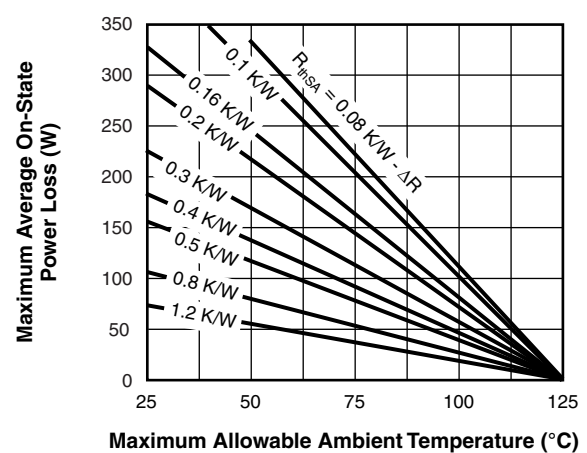
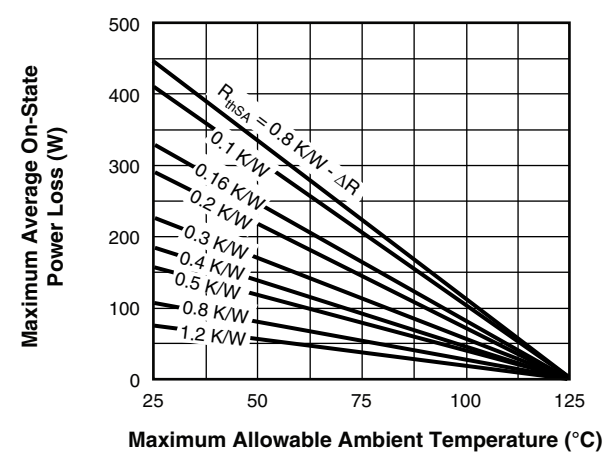


Fig. 4 - On-State Power Loss Characteristics



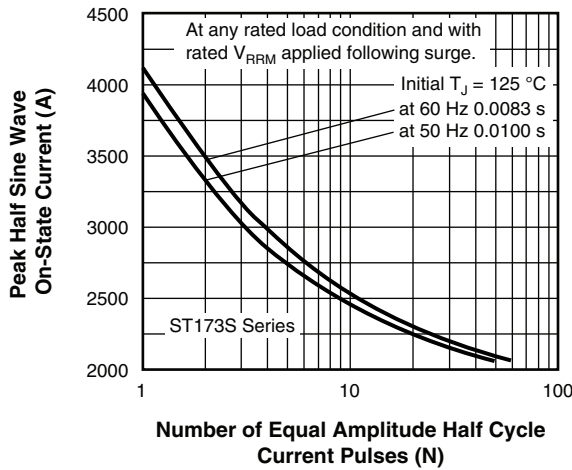


Fig. 5 - Maximum Non-Repetitive Surge Current

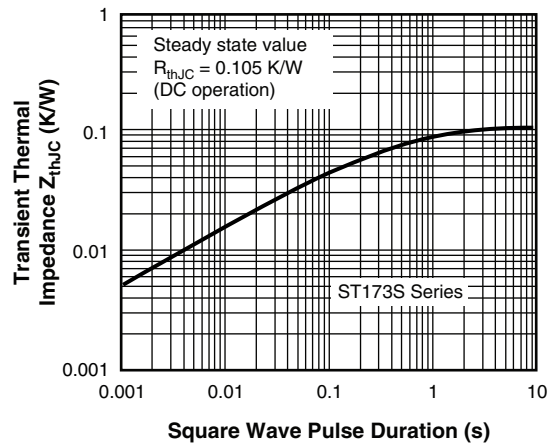


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

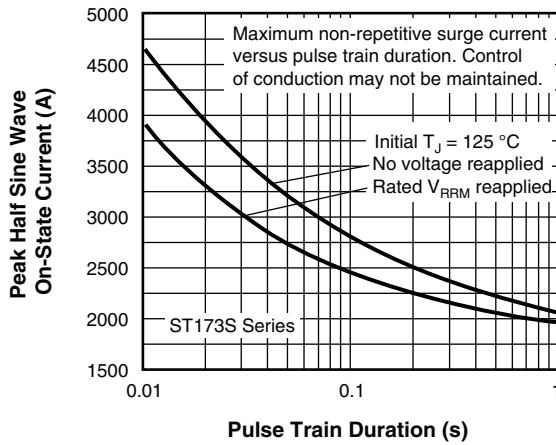


Fig. 6 - Maximum Non-Repetitive Surge Current

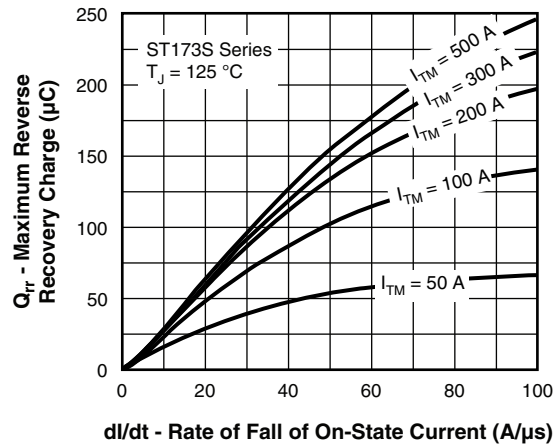


Fig. 9 - Reverse Recovered Current Characteristics

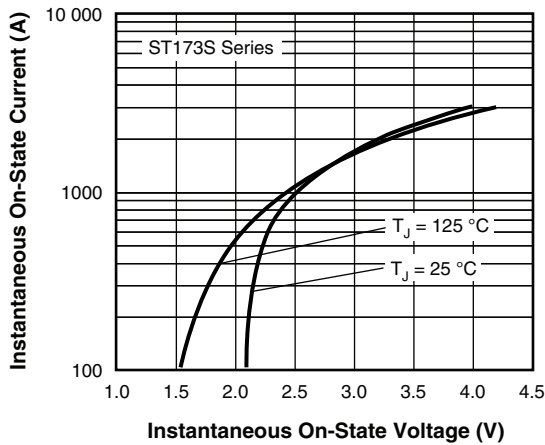


Fig. 7 - On-State Voltage Drop Characteristics

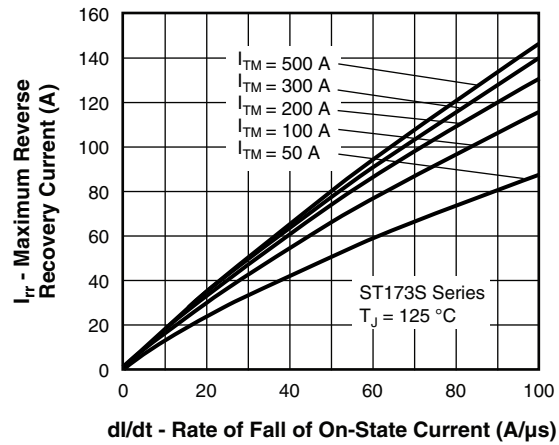


Fig. 10 - Reverse Recovery Current Characteristics

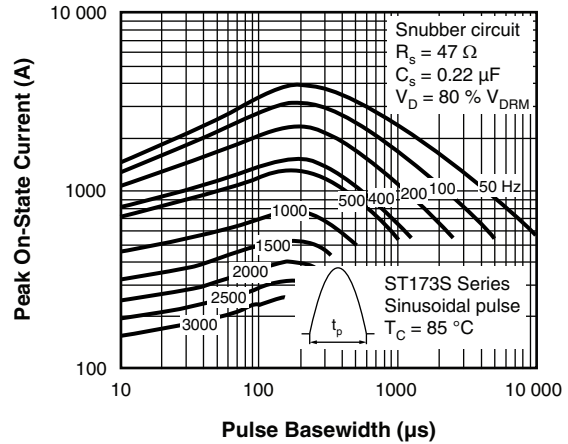
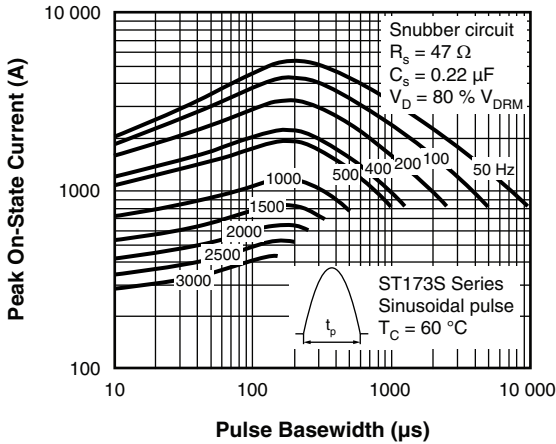


Fig. 11 - Frequency Characteristics

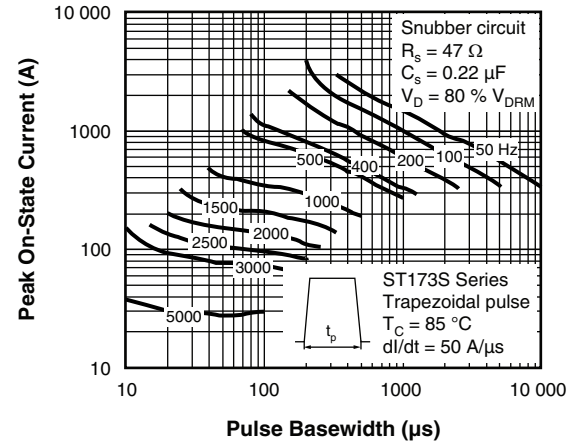
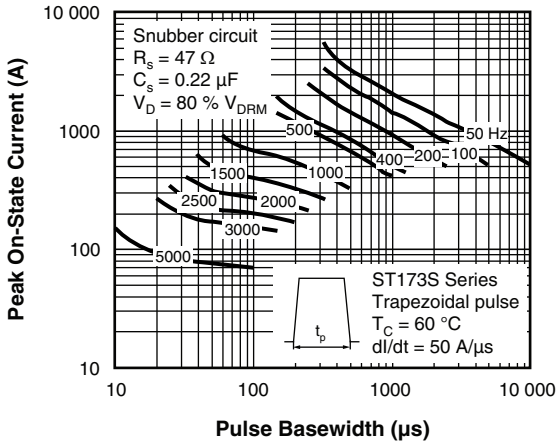


Fig. 12 - Frequency Characteristics

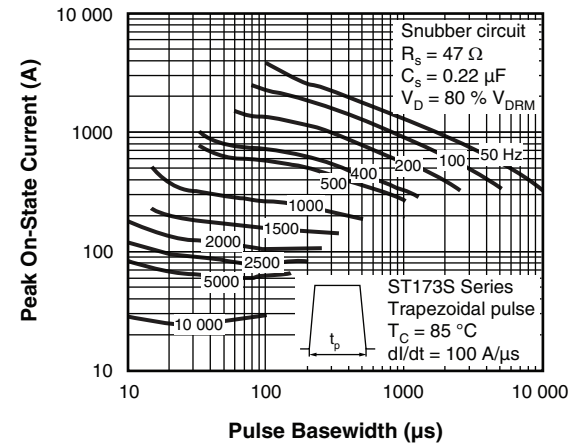
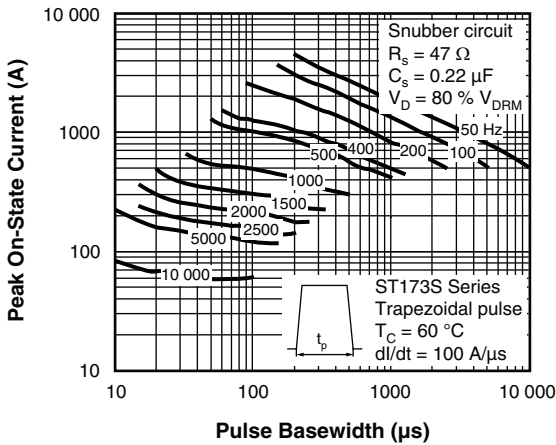


Fig. 13 - Frequency Characteristics

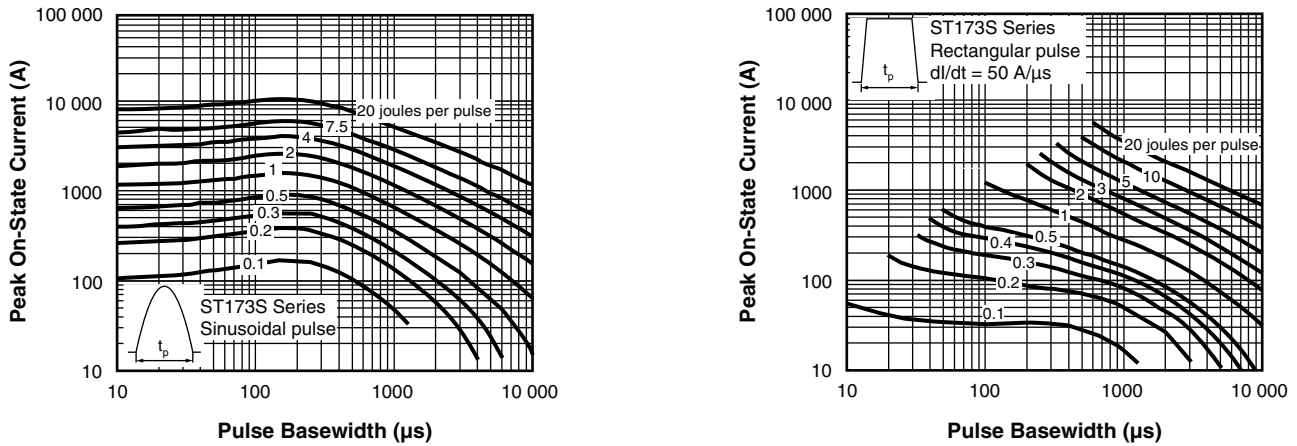


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

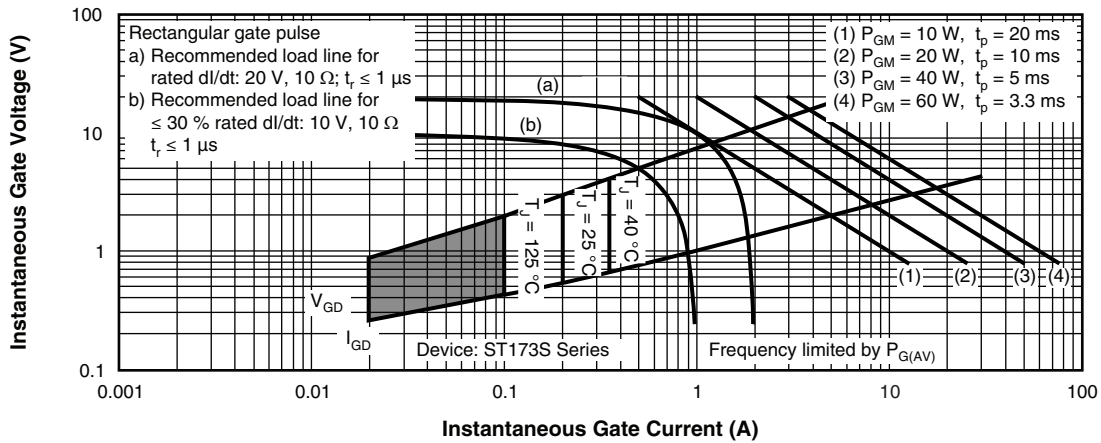
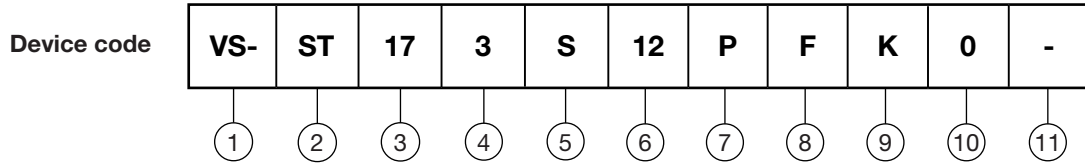


Fig. 15 - Gate Characteristics



**ORDERING INFORMATION TABLE**



- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 3 = fast turn-off
- 5** - S = compression bonding stud
- 6** - Voltage code x 100 =  $V_{RRM}$  (see Voltage Ratings table)
- 7** - P = stud base 3/4" 16UNF-2A  
M = stud base metric threads M16 x 1.5
- 8** - Reapplied dV/dt code (for  $t_q$  test condition)
- 9** -  $t_q$  code
- 10** - 0 = eyelet terminals (gate and aux. cathode leads)  
1 = fast-on terminals (gate and aux. cathode leads)  
2 = flag terminals (for cathode and gate terminals)
- 11** - Critical dV/dt:
  - None = 500 V/ $\mu$ s (standard value)
  - L = 1000 V/ $\mu$ s (special selection)

dV/dt - $t_q$ combinations available					
dV/dt (V/ $\mu$ s)	20	50	100	200	400
15	CL	-	-	-	-
18	CP	DP	EP	<b>FP*</b>	-
20	CK	DK	EK	<b>FK*</b>	HK
25	CJ	DJ	EJ	FJ	HJ
30	-	DH	EH	FH	HH

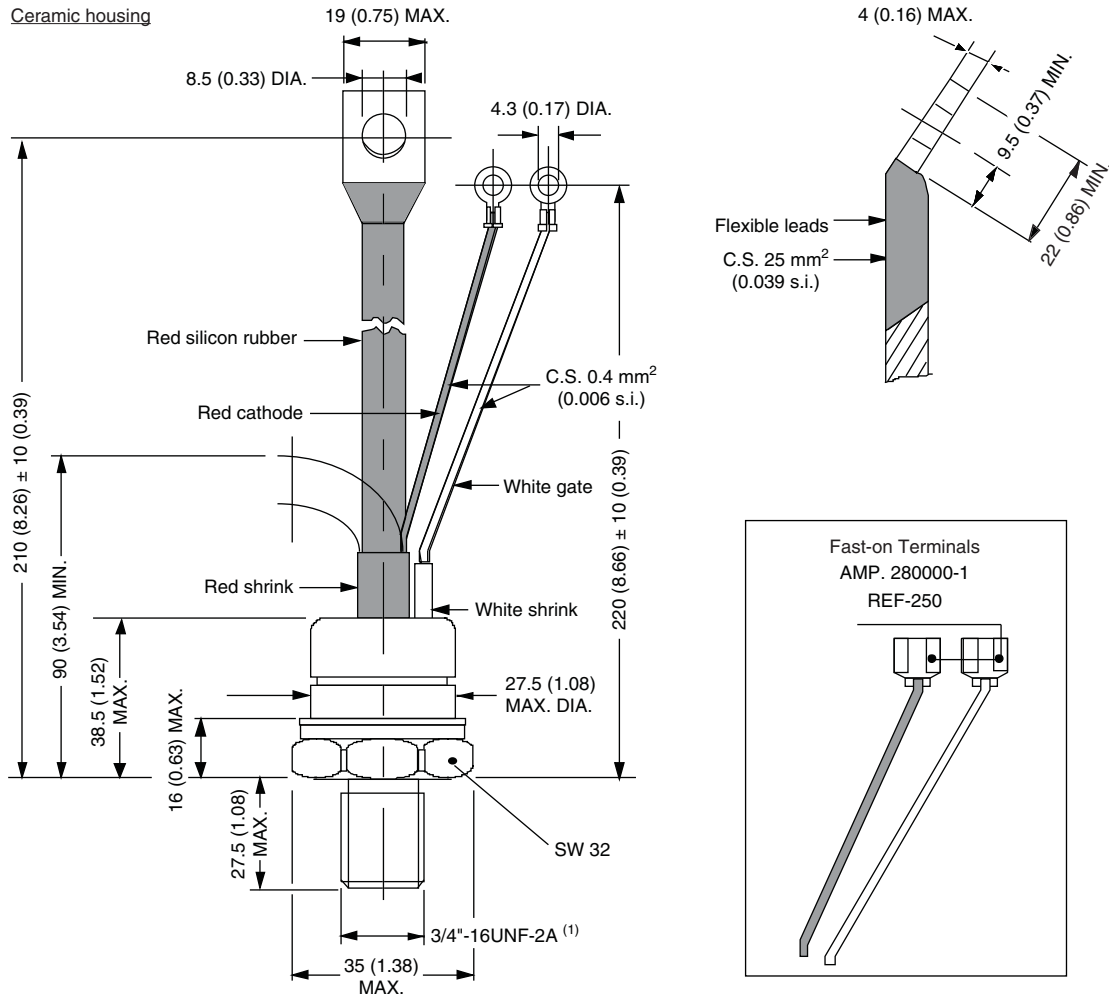
\* Standard part number.  
All other types available only on request.

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95079">www.vishay.com/doc?95079</a>



## TO-209AB (TO-93)

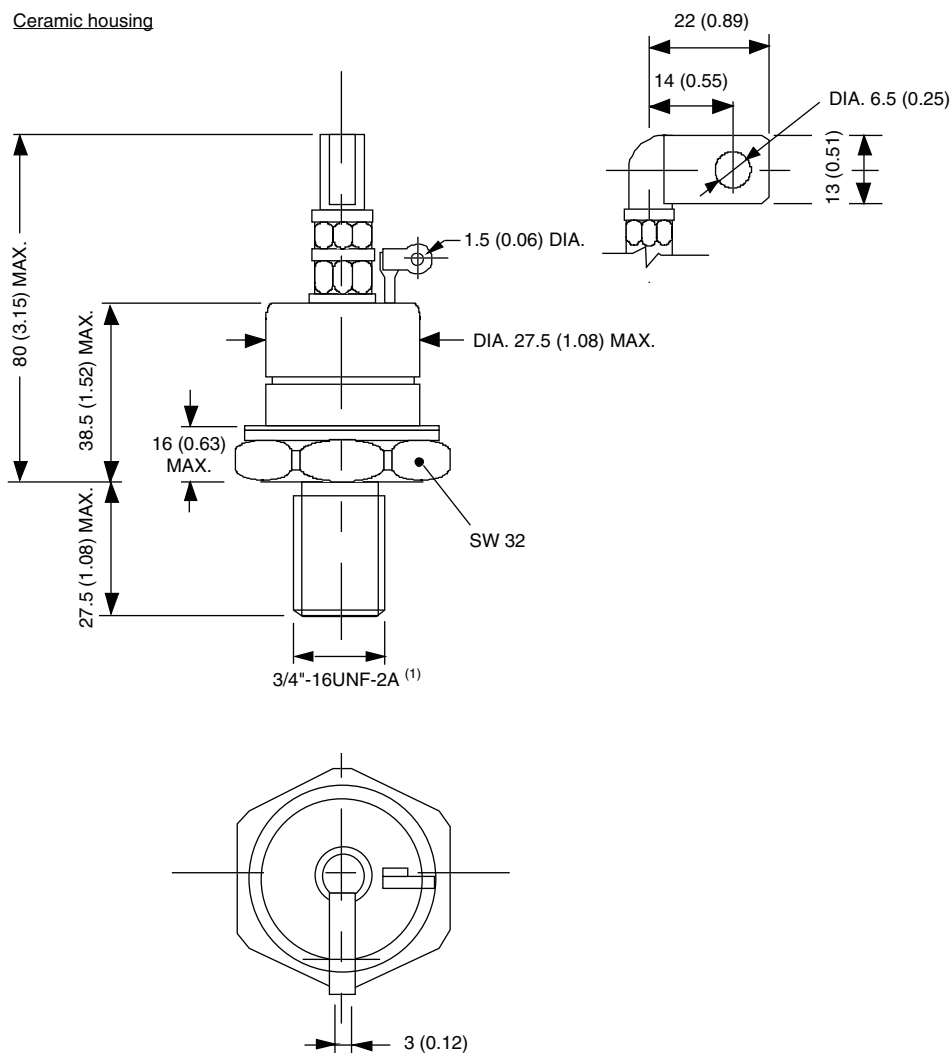
### DIMENSIONS - TO-209AB (TO-93) in millimeters (inches)



#### Note

(1) For metric device: M16 x 1.5 - length 21 (0.83) maximum

## DIMENSIONS - TO-209AB (TO-93) FLAG TERMINALS in millimeters (inches)



### Note

<sup>(2)</sup> For metric device: M16 x 1.5 - length 21 (0.83) maximum



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