

## Inverter Grade Thyristors (Stud Version), 195 A



TO-93 (TO-209AB)

**FEATURES**

- Center amplifying gate
- 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)


**RoHS  
COMPLIANT**

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	195 A
$V_{DRM}/V_{RRM}$	400 V, 800 V
$V_{TM}$	1.80 V
$I_{TSM}$ at 50 Hz	4900 A
$I_{TSM}$ at 60 Hz	5130 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

**TYPICAL APPLICATIONS**

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

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		195	A
	$T_C$	85	°C
$I_{T(RMS)}$		306	A
$I_{TSM}$	50 Hz	4900	
	60 Hz	5130	
$I^2t$	50 Hz	120	kA <sup>2</sup> s
	60 Hz	110	
$V_{DRM}/V_{RRM}$		400 to 800	V
$t_q$		15 to 20	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-ST183S	04	400	500	40
	08	800	900	



CURRENT CARRYING CAPABILITY							
FREQUENCY							UNITS
50 Hz	570	370	900	610	7040	5220	A
400 Hz	560	360	940	630	3200	2280	
1000 Hz	500	300	925	610	1780	1200	
2500 Hz	340	190	760	490	880	560	
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		195	A
				85	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 74 °C case temperature		306	A
Maximum peak, one half cycle, non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	4900	
		t = 8.3 ms	No voltage reapplied	5130	
		t = 10 ms	100 % $V_{RRM}$ reapplied	4120	
		t = 8.3 ms	100 % $V_{RRM}$ reapplied	4310	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	120	kA <sup>2</sup> s
		t = 8.3 ms	No voltage reapplied	110	
		t = 10 ms	100 % $V_{RRM}$ reapplied	85	
		t = 8.3 ms	100 % $V_{RRM}$ reapplied	78	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		1200	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		1.80	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		1.40	
High level value of threshold voltage	$V_{T(TO)2}$	$I > \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum		1.45	
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		0.67	mΩ
High level value of forward slope resistance	$r_{t2}$	$I > \pi \times I_{T(AV)}$ , $T_J = T_J$ maximum		0.58	
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	μs
Maximum turn-off time	$t_q$	$T_J = T_J$ maximum, $I_{TM} = 300$ A, commutating $di/dt = 20$ A/μs $V_R = 50$ V, $t_p = 500$ μs, $dV/dt = 200$ V/μs		15	
				20	



<b>BLOCKING</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum critical rate of rise of off-state voltage	dV/dt	T <sub>J</sub> = T <sub>J</sub> maximum, linear to 80 % V <sub>DRM</sub> , higher value available on request	500	V/μs
Maximum peak reverse and off-state leakage current	I <sub>RRM</sub> , I <sub>DRM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, rated V <sub>DRM</sub> /V <sub>RRM</sub> applied	40	mA

<b>TRIGGERING</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum peak gate power	P <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, f = 50 Hz, d% = 50	60	W
Maximum average gate power	P <sub>G(AV)</sub>		10	
Maximum peak positive gate current	I <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms	10	A
Maximum peak positive gate voltage	+ V <sub>GM</sub>		20	
Maximum peak negative gate voltage	- V <sub>GM</sub>		5	
Maximum DC gate current required to trigger	I <sub>GT</sub>	T <sub>J</sub> = T <sub>J</sub> maximum V <sub>A</sub> = 12 V, R <sub>a</sub> = 6 Ω	200	mA
Maximum DC gate voltage required to trigger	V <sub>GT</sub>		3	
Maximum DC gate current not to trigger	I <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, rated V <sub>DRM</sub> applied	20	mA
Maximum DC gate voltage not to trigger	V <sub>GD</sub>		0.25	

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum junction operating temperature range	T <sub>J</sub>		-40 to 125	°C
Maximum storage temperature range	T <sub>Stg</sub>		-40 to 150	
Maximum thermal resistance, junction to case	R <sub>thJC</sub>	DC operation	0.105	K/W
Maximum thermal resistance, case to heatsink	R <sub>thCS</sub>	Mounting surface, smooth, flat and greased	0.04	
Mounting torque, ± 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)	

<b>ΔR<sub>thJC</sub> CONDUCTION</b>				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.016	0.012	T <sub>J</sub> = T <sub>J</sub> 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<sub>thJC</sub> when devices operate at different conduction angles than DC

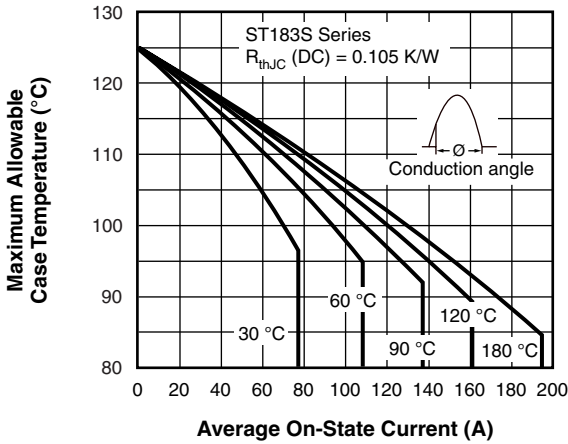


Fig. 1 - Current Ratings Characteristics

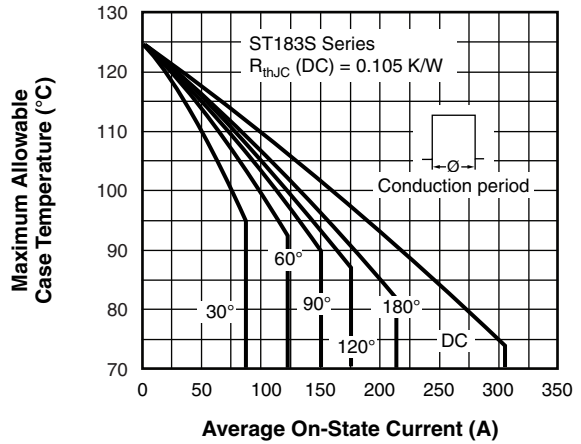


Fig. 2 - Current Ratings Characteristics

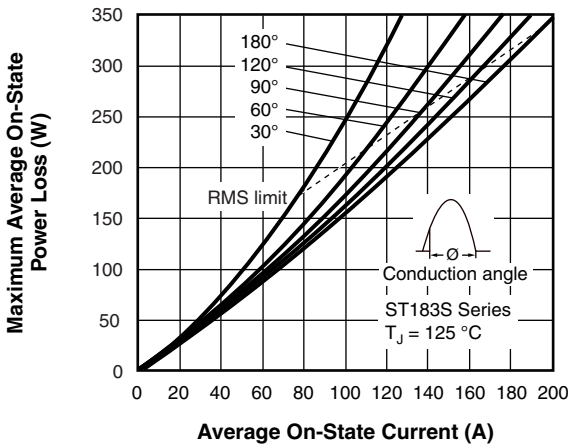


Fig. 3 - On-State Power Loss Characteristics

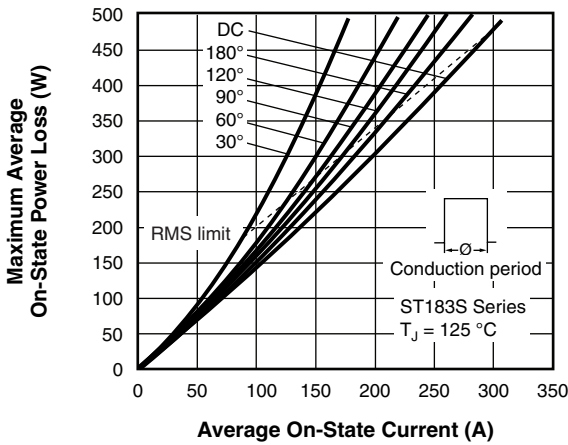
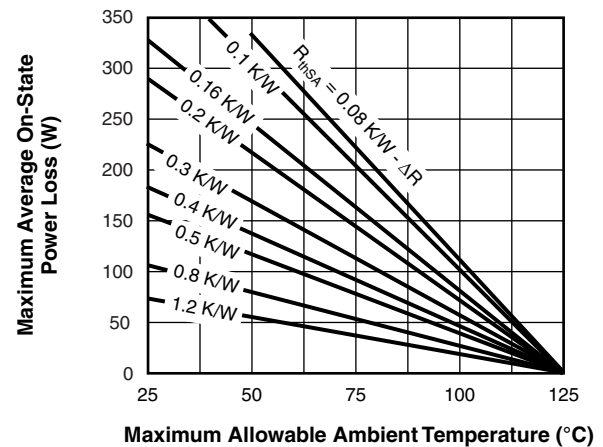
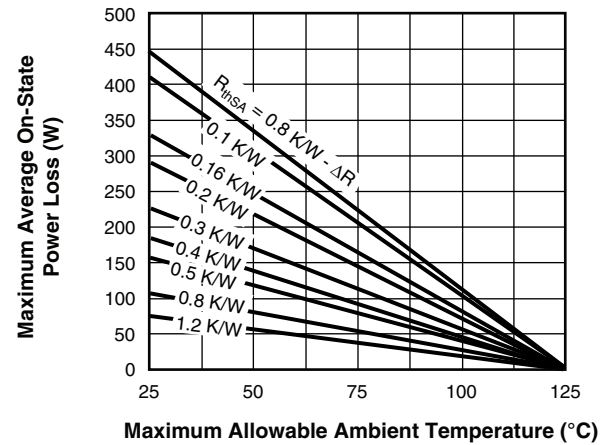


Fig. 4 - On-State Power Loss Characteristics



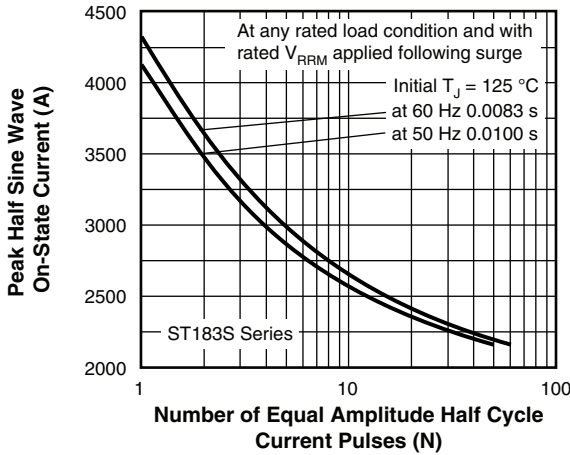


Fig. 5 - Maximum Non-Repetitive Surge Current

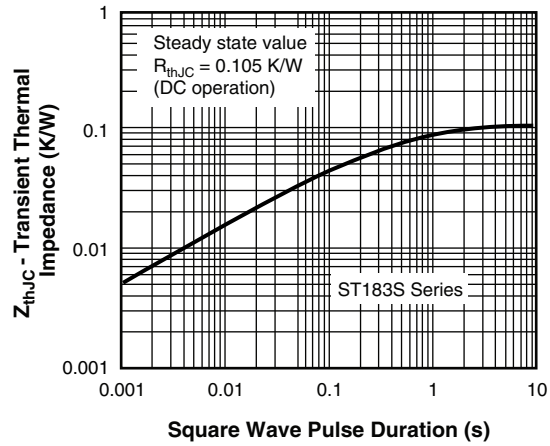


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristics

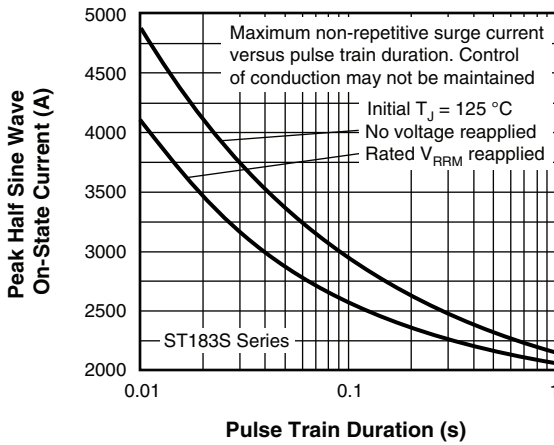


Fig. 6 - Maximum Non-Repetitive Surge Current

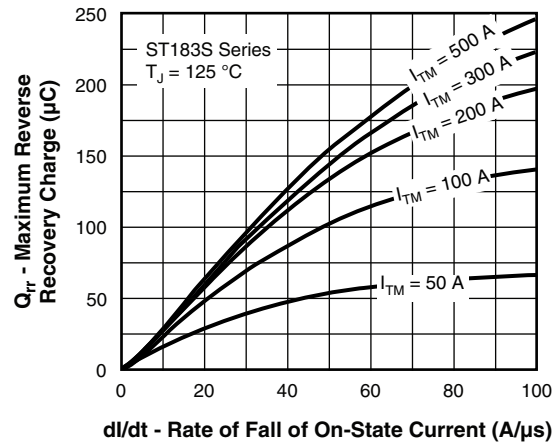


Fig. 9 - Reverse Recovered Charge Characteristics

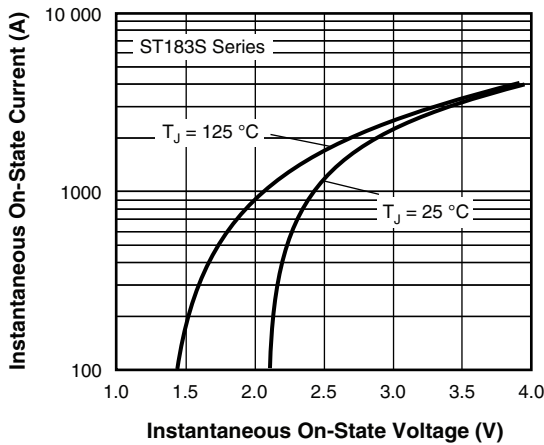


Fig. 7 - On-State Voltage Drop Characteristics

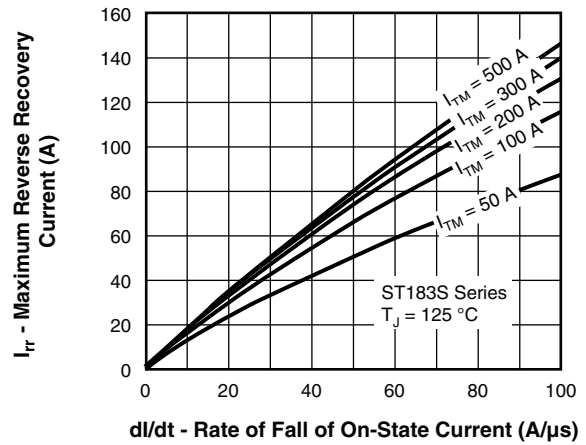


Fig. 10 - Reverse Recovery Current Characteristics

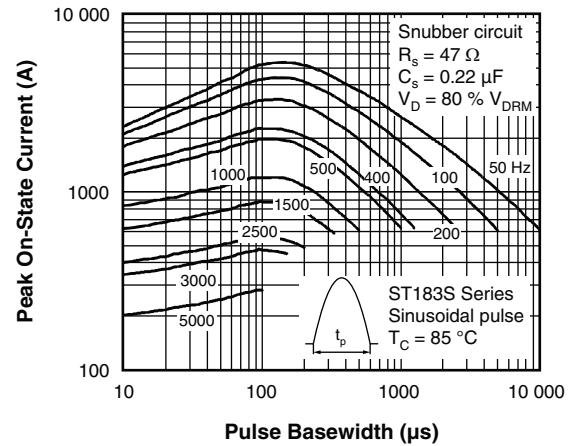
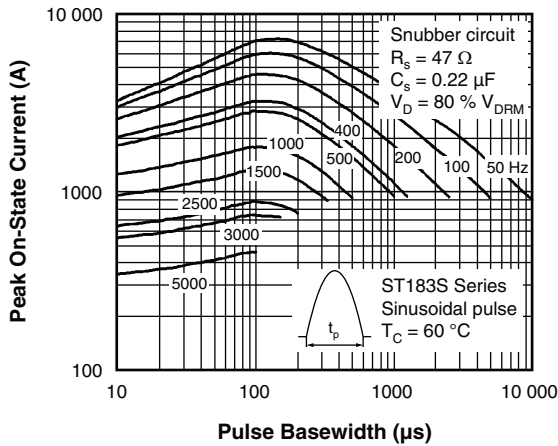


Fig. 11 - Frequency Characteristics

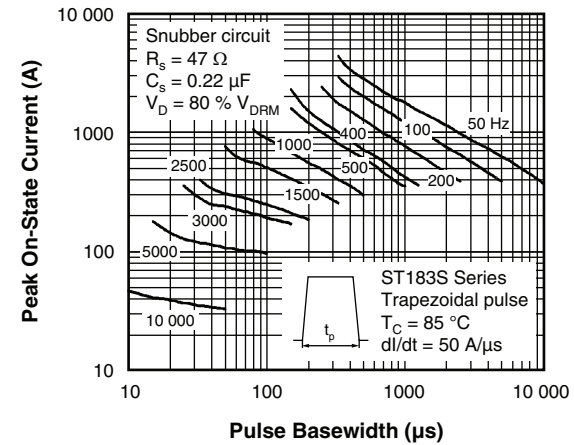
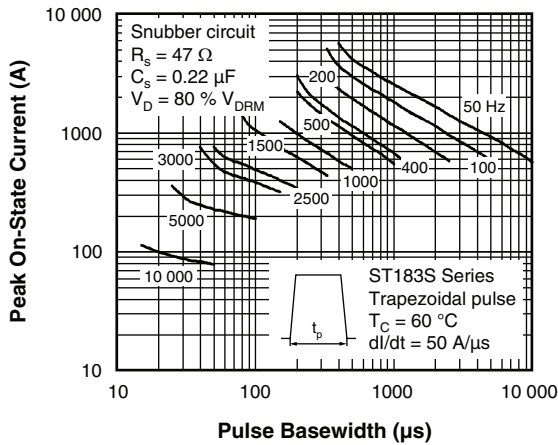


Fig. 12 - Frequency Characteristics

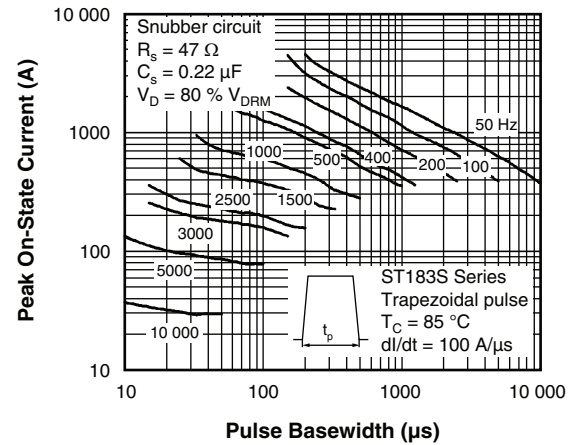
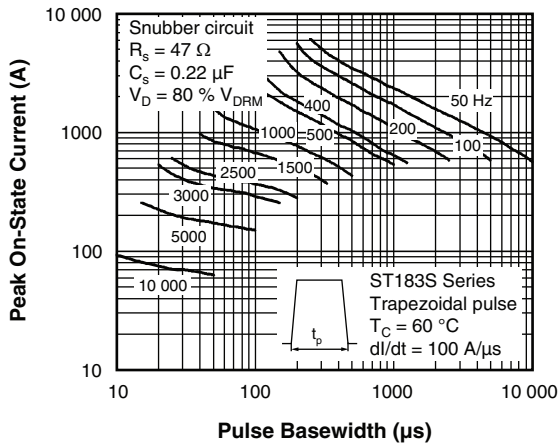


Fig. 13 - Frequency Characteristics

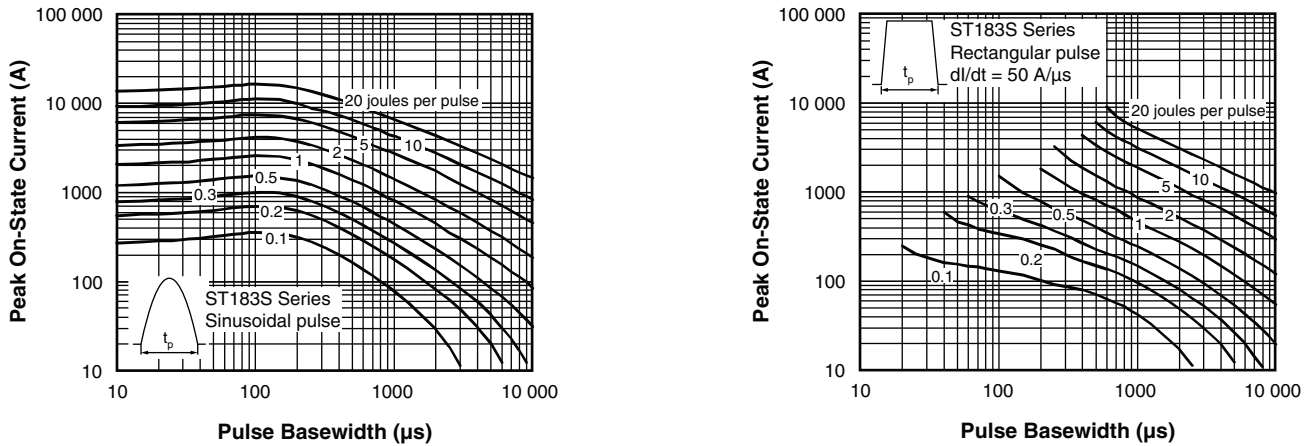


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

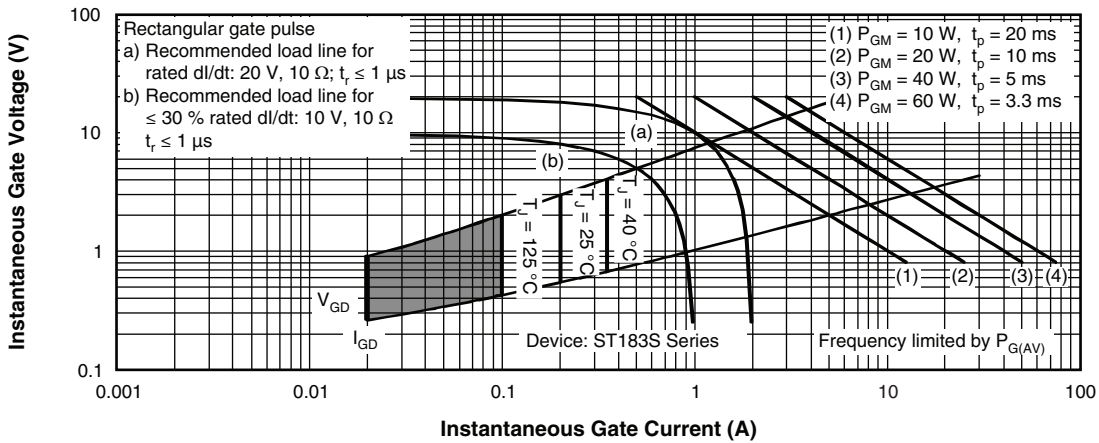
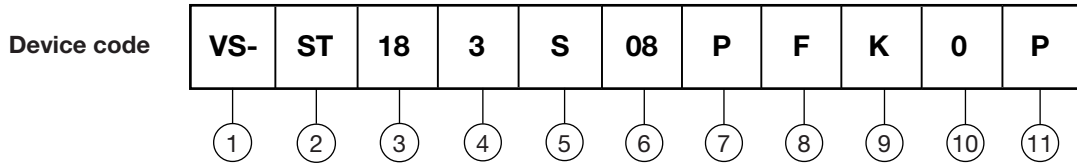


Fig. 15 - Gate Characteristics



## 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
- 8** - Reapplied dV/dt code (for  $t_q$  test condition)
- 9** -  $t_q$  code
- 10** - 0 = eyelet terminals  
(gate and auxiliary cathode leads)  
1 = fast-on terminals  
(gate and auxiliary cathode leads)
- 11** - None = standard production  
P = lead (Pb)-free

dV/dt - $t_q$ combinations available		
	dV/dt (V/ $\mu$ s)	200
$t_q$ ( $\mu$ s)	15	FL
	20	FK

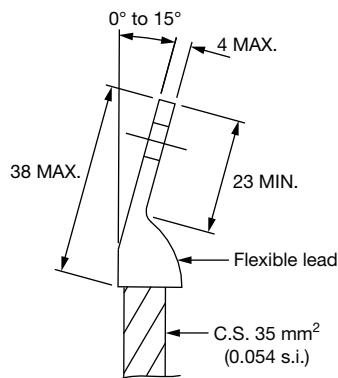
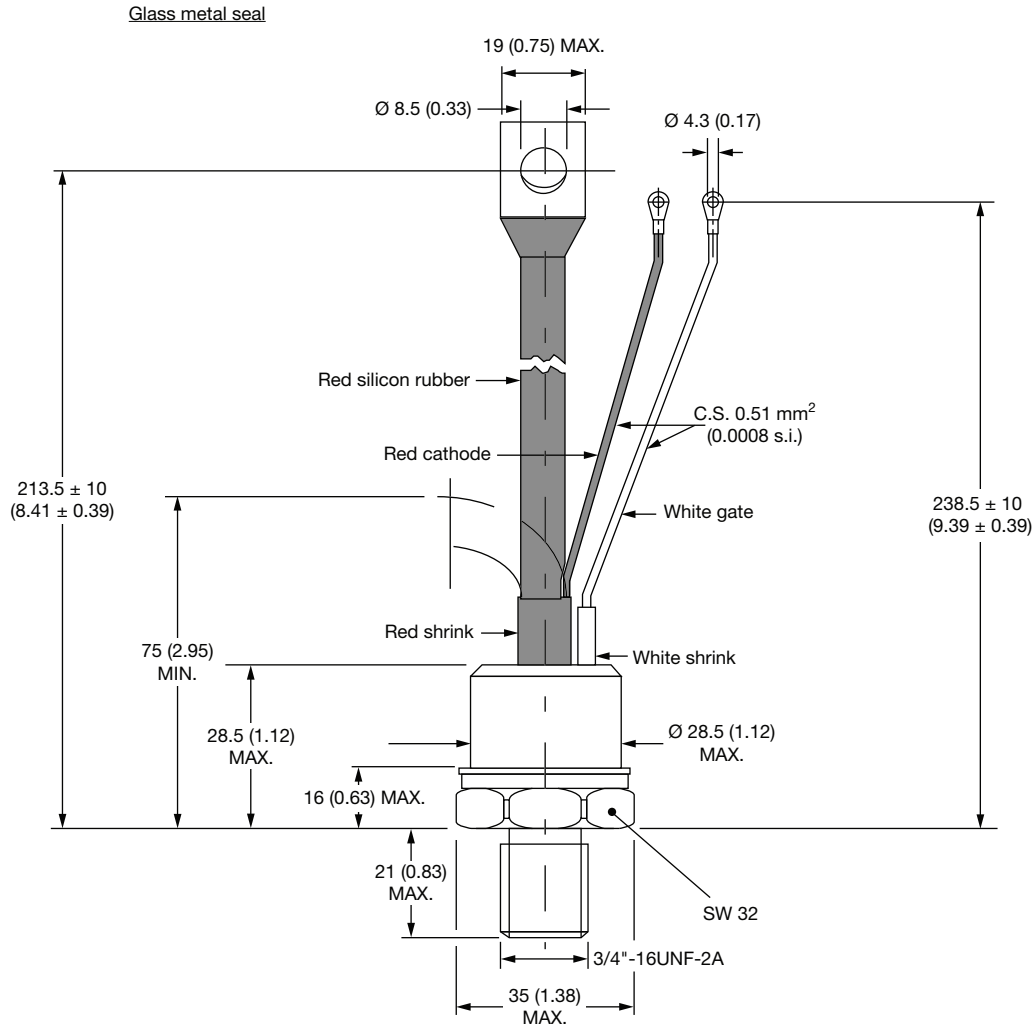
Note: For metric device M16 x 1.5 contact factory

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95077">www.vishay.com/doc?95077</a>



## TO-209AB (TO-93)

**DIMENSIONS** in millimeters (inches)





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