

## Inverter Grade Thyristors (Stud Version), 105 A



TO-209AC (TO-94)



### 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

PRODUCT SUMMARY	
Package	TO-209AC (TO-94)
Diode variation	Single SCR
$I_{T(AV)}$	105 A
$V_{DRM}/V_{RRM}$	400 V, 800 V
$V_{TM}$	1.73 V
$I_{TSM}$ at 50 Hz	3000 A
$I_{TSM}$ at 60 Hz	3150 A
$I_{GT}$	200 mA
$T_C/T_{hs}$	85 °C

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		105	A
	$T_C$	85	°C
$I_{T(RMS)}$		165	A
$I_{TSM}$	50 Hz	3000	
	60 Hz	3150	
$I^2t$	50 Hz	45	kA <sup>2</sup> s
	60 Hz	41	
$V_{DRM}/V_{RRM}$		400 to 800	V
$t_q$	Range	10 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-ST103S	04	400	500	30
	08	800	900	



CURRENT CARRYING CAPABILITY							
FREQUENCY							UNITS
50 Hz	280	180	440	330	4730	3630	A
400 Hz	310	200	470	300	2500	1850	
1000 Hz	320	200	480	310	1530	1090	
2500 Hz	340	210	490	320	840	580	
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/ $\mu$ s
Case temperature	60	85	60	85	60	85	$^{\circ}$ C
Equivalent values for RC circuit	22/0.15		22/0.15		22/0.15		$\Omega/\mu$ F

ON-STATE CONDUCTION					
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180 $^{\circ}$ conduction, half sine wave		105	A
				85	$^{\circ}$ C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 76 $^{\circ}$ C case temperature		165	
Maximum peak, one half cycle, non-repetitive surge current	$I_{TSM}$	t = 10 ms	No voltage reapplied	3000	A
				t = 8.3 ms	
		t = 10 ms	100 % $V_{RRM}$ reapplied	2530	
				t = 8.3 ms	
Maximum $I^2t$ for fusing	$I^2t$	t = 10 ms	No voltage reapplied	45	$kA^2s$
				t = 8.3 ms	
		t = 10 ms	100 % $V_{RRM}$ reapplied	32	
				t = 8.3 ms	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		450	$kA^2\sqrt{s}$
Maximum peak on-state voltage	$V_{TM}$	$I_{TM} = 300$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse		1.73	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		1.32	
High level value of threshold voltage	$V_{T(TO)2}$	$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		1.35	
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		1.40	$m\Omega$
High level value of forward slope resistance	$r_{t2}$	$(I > \pi \times I_{T(AV)})$ , $T_J = T_J$ maximum		1.30	
Maximum holding current	$I_H$	$T_J = 25$ $^{\circ}$ C, $I_T > 30$ A		600	mA
Typical latching current	$I_L$	$T_J = 25$ $^{\circ}$ C, $V_A = 12$ V, $R_a = 6$ $\Omega$ , $I_G = 1$ 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/ $\mu$ s
Typical delay time	$t_d$	$T_J = 25$ $^{\circ}$ C, $V_{DM} = \text{Rated } V_{DRM}$ , $I_{TM} = 50$ A DC, $t_p = 1$ $\mu$ s Resistive load, gate pulse: 10 V, 5 $\Omega$ source		0.80	$\mu$ s
Maximum turn-off time	minimum	$t_q$	$T_J = T_J$ maximum, $I_{TM} = 100$ A, commutating $di/dt = 10$ A/ $\mu$ s $V_R = 50$ V, $t_p = 200$ $\mu$ s, $dV/dt$ : See table in device code	10	
	maximum			25	



<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	30	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	40	W
Maximum average gate power	P <sub>G(AV)</sub>		5	
Maximum peak positive gate current	I <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms	5	A
Maximum peak positive gate voltage	+V <sub>GM</sub>		20	V
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> = 25 °C, 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	V
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	V

<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	0.195	K/W
Maximum thermal resistance, case to heatsink	R <sub>thCS</sub>	Mounting surface, smooth, flat and greased	0.08	
Mounting torque, ± 10 %		Non-lubricated threads	15.5 (137)	N · m (lbf · in)
		Lubricated threads	14 (120)	
Approximate weight			130	g
Case style		See dimensions - link at the end of datasheet	TO-209AC (TO-94)	

<b>ΔR<sub>thJC</sub> CONDUCTION</b>				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.034	0.025	T <sub>J</sub> = T <sub>J</sub> maximum	K/W
120°	0.040	0.042		
90°	0.052	0.056		
60°	0.076	0.079		
30°	0.126	0.127		

**Note**

- The table above shows the increment of thermal resistance R<sub>thJC</sub> when devices operate at different conduction angles than DC

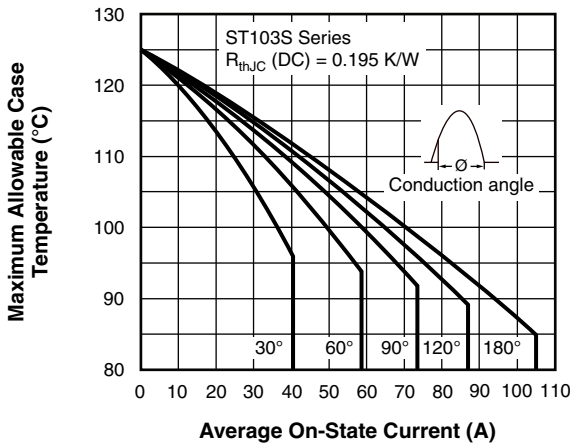


Fig. 1 - Current Ratings Characteristics

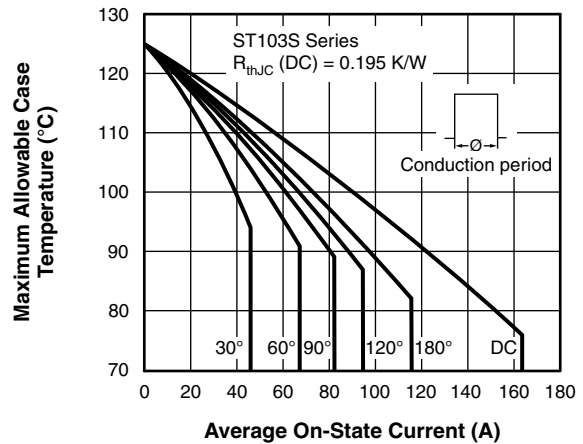


Fig. 2 - Current Ratings Characteristics

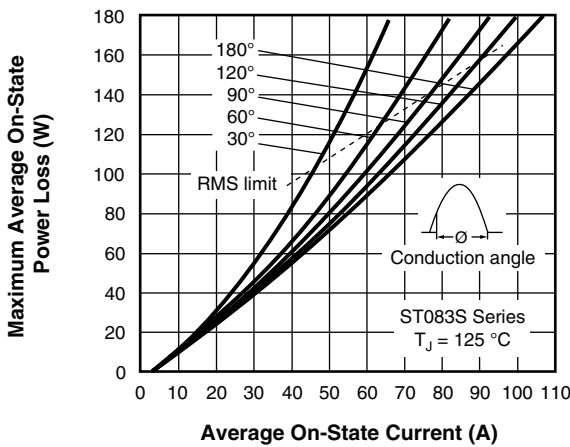


Fig. 3 - On-State Power Loss Characteristics

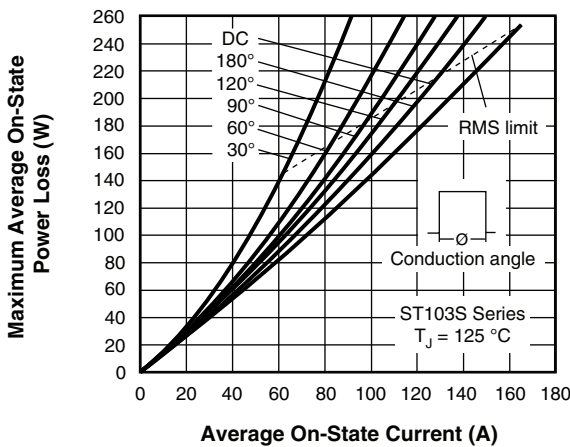
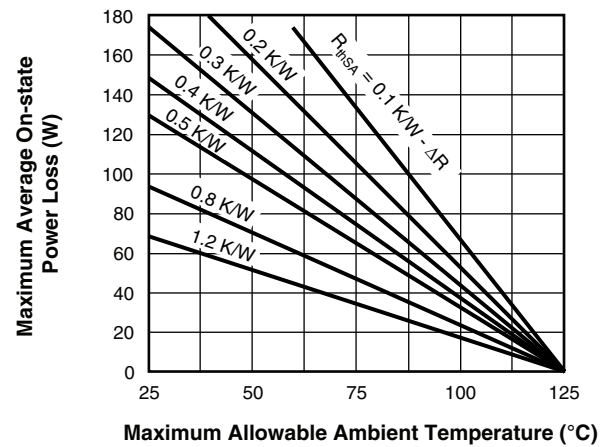
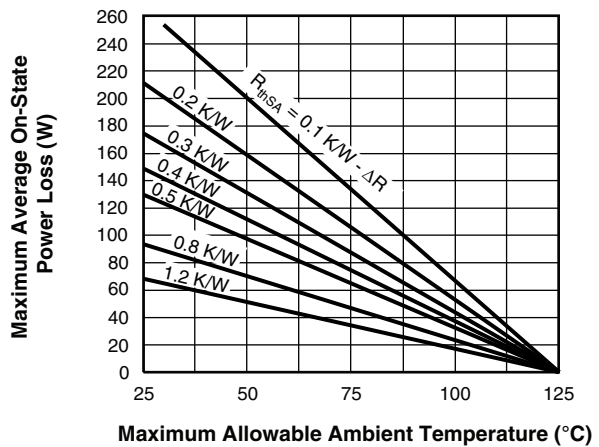


Fig. 4 - On-State Power Loss Characteristics



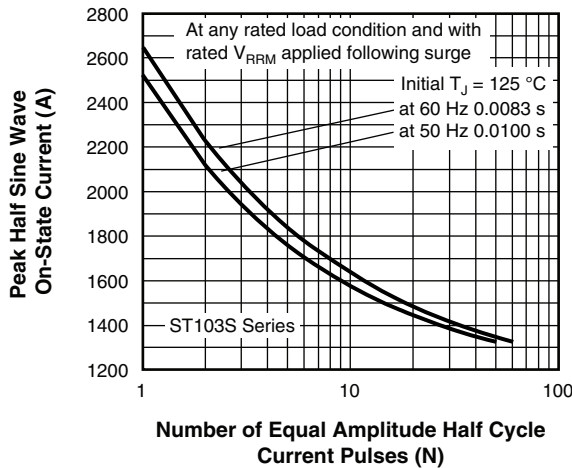


Fig. 5 - Maximum Non-Repetitive Surge Current

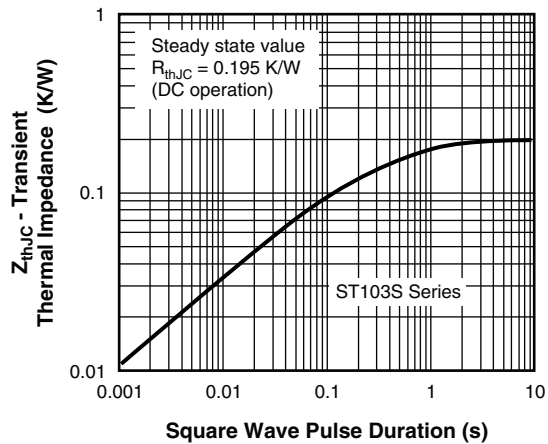


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristic

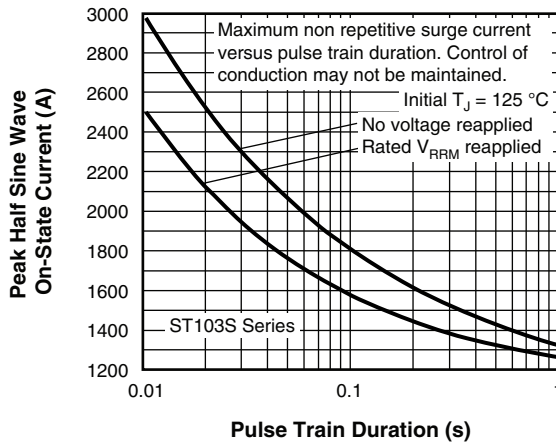


Fig. 6 - Maximum Non-Repetitive Surge Current

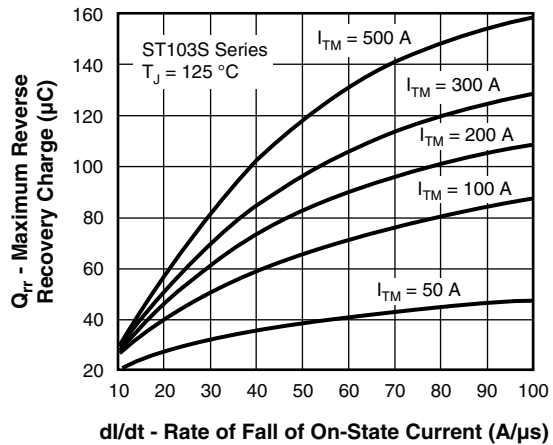


Fig. 9 - Reverse Recovered Charge Characteristics

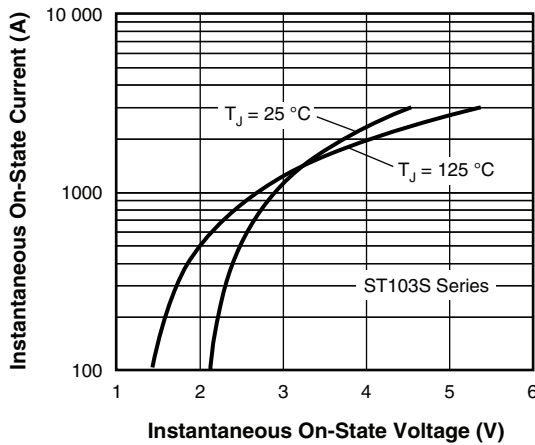


Fig. 7 - On-State Voltage Drop Characteristics

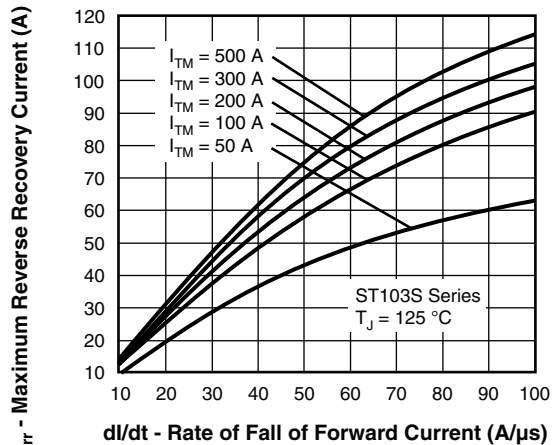


Fig. 10 - Reverse Recovery Current Characteristics

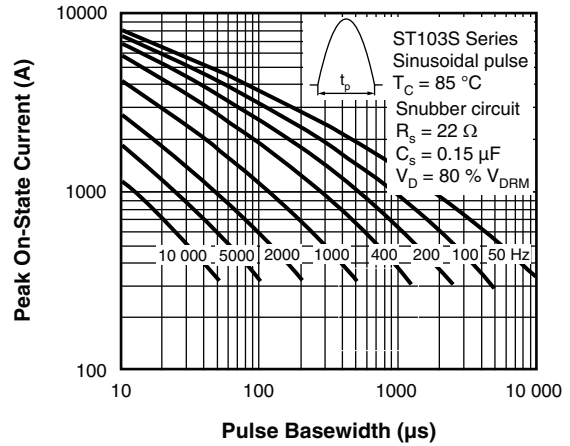
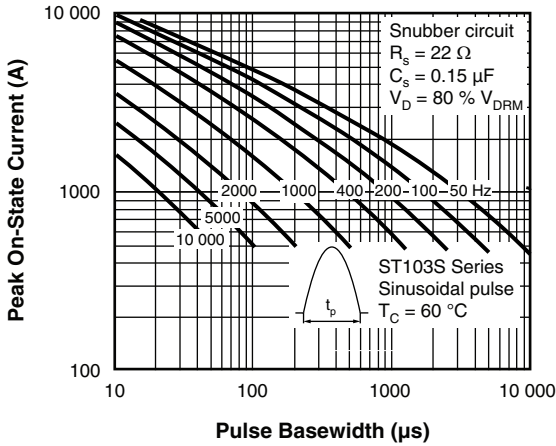


Fig. 11 - Frequency Characteristics

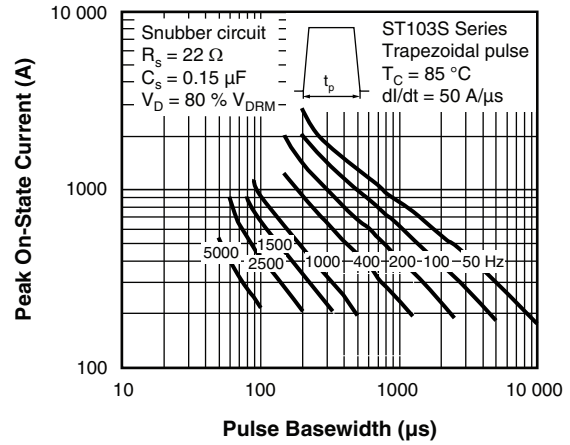
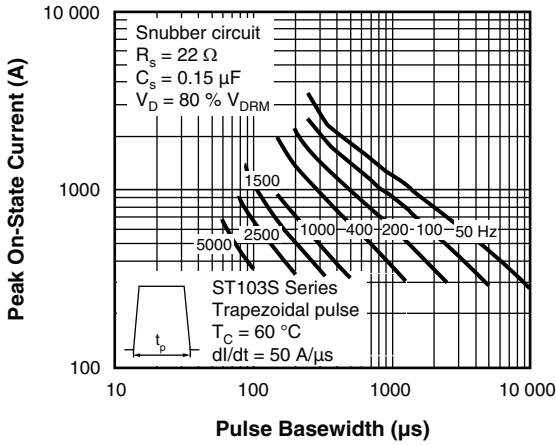


Fig. 12 - Frequency Characteristics

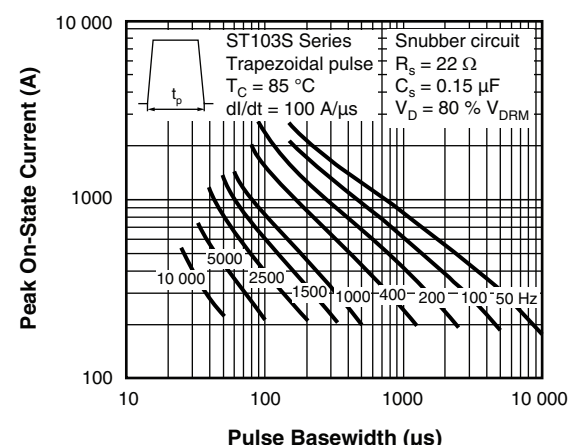
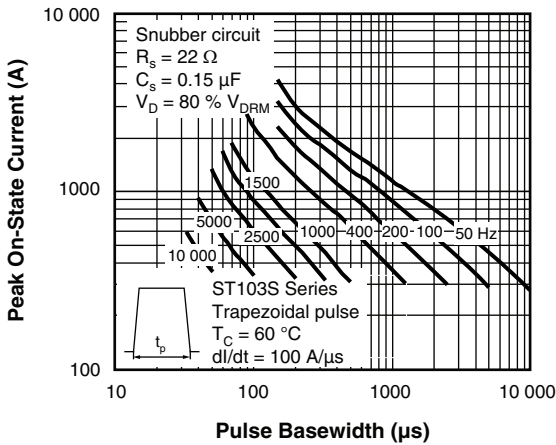


Fig. 13 - Frequency Characteristics

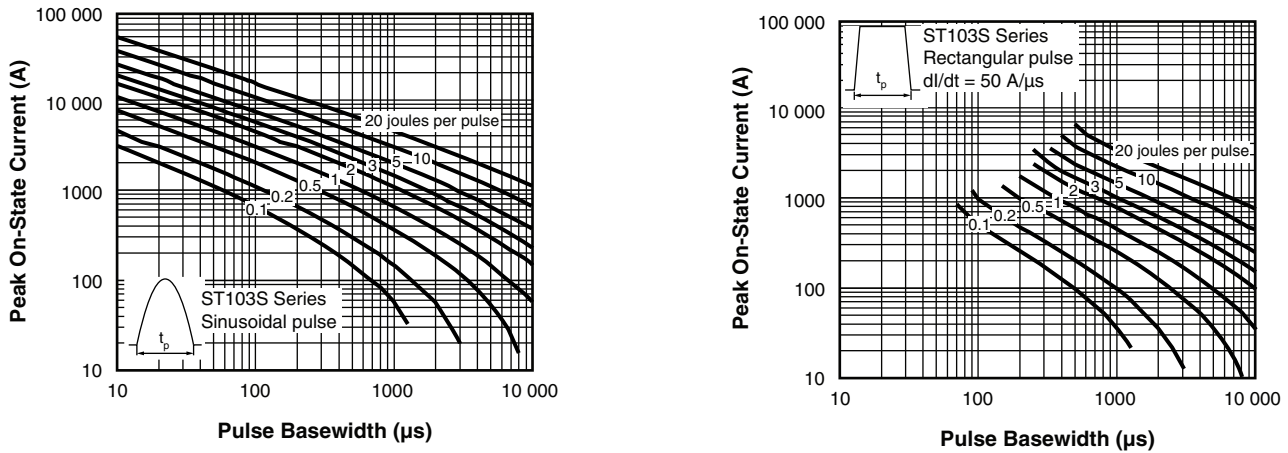


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

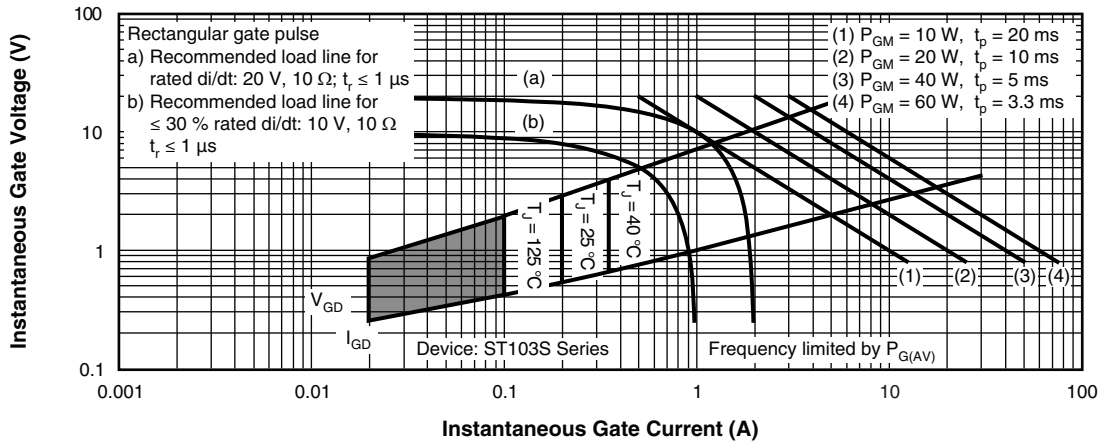
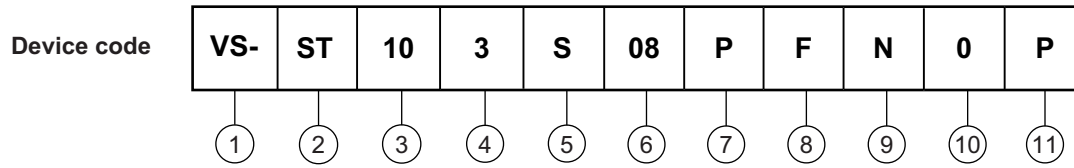


Fig. 15 - Gate Characteristics



## 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 1/2"-20UNF-2A
- 8** - Reapplied dV/dt code (for  $t_q$  test conditions)
- 9** -  $t_q$  code
- 10** - 0 = Eyelet terminals (gate and aux. cathode leads)  
1 = Fast-on terminals (gate and aux. cathode leads)
- 11** - None = Standard production  
P = Lead (Pb)-free

dV/dt - $t_q$ combinations available					
dV/dt (V/ $\mu$ s)	20	50	100	200	400
10	CN	DN	EN	<b>FN*</b>	-
12	CM	DM	EM	FM	HM
15	CL	DL	EL	<b>FL*</b>	HL
18	CP	DP	EP	FP	HP
20	CK	DK	EK	FK	HK
25	-	-	-	-	HJ

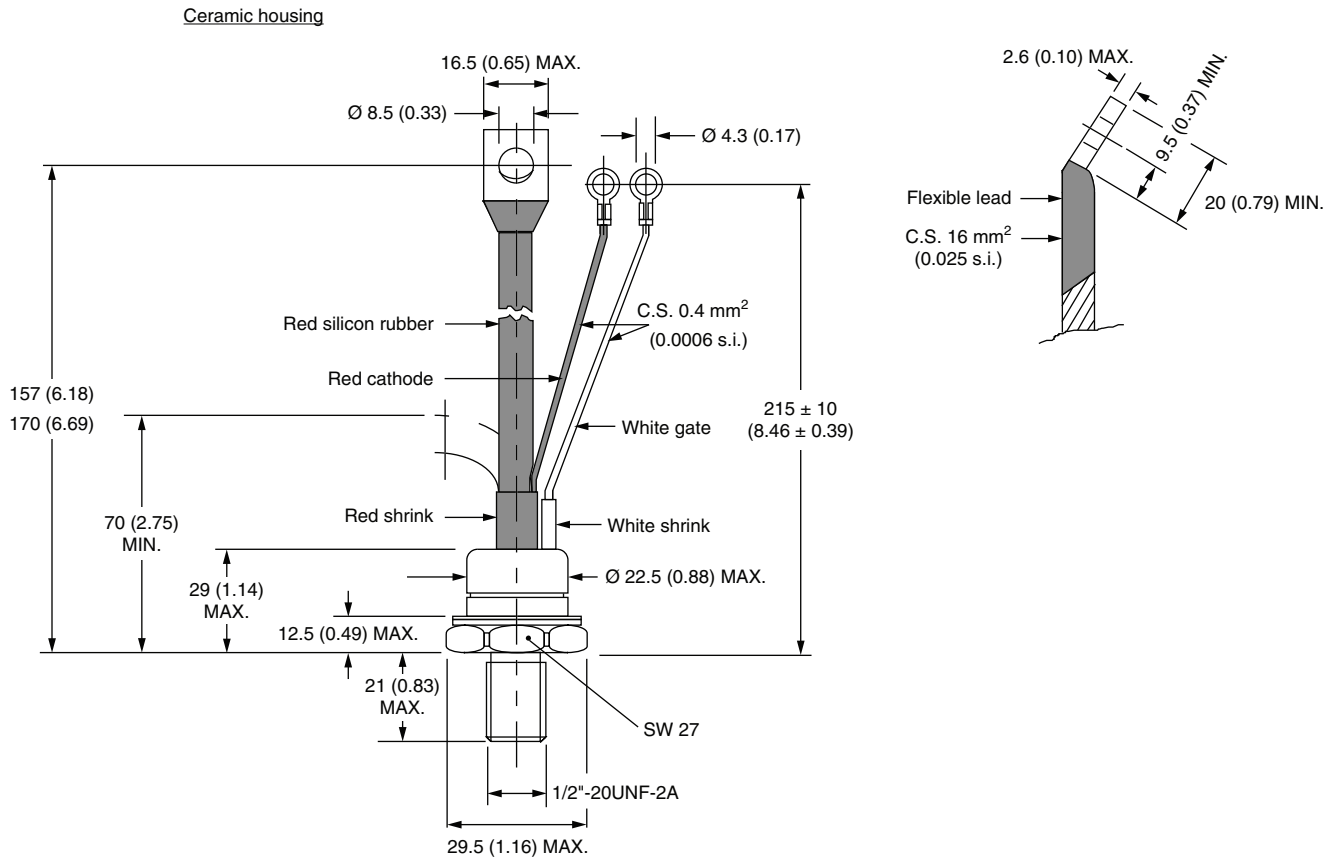
\* Standard part number.  
All other types available only on request.

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95003">www.vishay.com/doc?95003</a>



## TO-209AC (TO-94) for ST083S and ST103S Series

**DIMENSIONS** in millimeters (inches)





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