

Inverter Grade Thyristors (Stud Version), 85 A



TO-209AC (TO-94)

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


RoHS
COMPLIANT

PRODUCT SUMMARY

Package	TO-209AC (TO-94)
Diode variation	Single SCR
$I_{T(AV)}$	85 A
V_{DRM}/V_{RRM}	400 V to 1200 V
V_{TM}	2.15 V
I_{TSM} at 50 Hz	2450 A
I_{TSM} at 60 Hz	2560 A
I_{GT}	200 mA
T_C/T_{hs}	85 °C

TYPICAL APPLICATIONS

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

MAJOR RATINGS AND CHARACTERISTICS

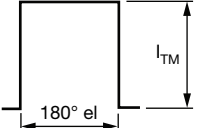
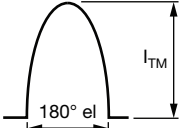
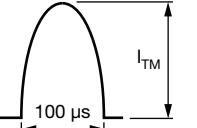
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		85	A
	T_C	85	°C
$I_{T(RMS)}$		135	A
I_{TSM}	50 Hz	2450	A
	60 Hz	2560	A
I^2t	50 Hz	30	kA ² s
	60 Hz	27	
V_{DRM}/V_{RRM}		400 to 1200	V
t_q	Range	10 to 20	μs
T_J		-40 to 125	°C

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} MAX. AT $T_J = T_J$ MAX. mA
VS-ST083S	04	400	500	30
	08	800	900	
	10	1000	1100	
	12	1200	1300	

**CURRENT CARRYING CAPABILITY**

FREQUENCY							UNITS
50 Hz	210	120	330	270	2540	1930	A
400 Hz	200	120	350	210	1190	810	
1000 Hz	150	80	320	190	630	400	
2500 Hz	70	25	220	85	250	100	
Recovery voltage V_r	50	50	50	50	50	50	V
Voltage before turn-on V_d	V_{DRM}		V_{DRM}		V_{DRM}		
Rise of on-state current di/dt	50	50	-	-	-	-	A/μs
Case temperature	60	85	60	85	60	85	°C
Equivalent values for RC circuit	22/0.15		22/0.15		22/0.15		W/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		85	A
				85	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 77 °C case temperature		135	A
Maximum peak, one half cycle, non-repetitive surge current	I_{TSM}	t = 10 ms	No voltage reapplied	2450	
		t = 8.3 ms	No voltage reapplied	2560	
		t = 10 ms	100 % V_{RRM} reapplied	2060	
		t = 8.3 ms	100 % V_{RRM} reapplied	2160	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied	30	kA ² s
		t = 8.3 ms	No voltage reapplied	27	
		t = 10 ms	100 % V_{RRM} reapplied	21	
		t = 8.3 ms	100 % V_{RRM} reapplied	19	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied		300	kA ² /s
Maximum peak on-state voltage	V_{TM}	$I_{TM} = 300$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine wave pulse		2.15	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		1.46	
High level value of threshold voltage	$V_{T(TO)2}$	$(I > \pi \times I_{T(AV)})$, $T_J = T_J$ maximum		1.52	
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		2.32	mΩ
High level value of forward slope resistance	r_{t2}	$(I > \pi \times I_{T(AV)})$, $T_J = T_J$ maximum		2.34	
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
			MIN.	MAX.	
Maximum non-repetitive rate of rise of turned on current	di/dt	$T_J = T_J$ max., $V_{DRM} = \text{Rated } V_{DRM}$, $I_{TM} = 2 \times di/dt$	1000		A/μs
Typical delay time	t_d	$T_J = 25$ °C, $V_{DM} = \text{Rated } V_{DM}$, $I_{TM} = 50$ A DC, $t_p = 1$ μs Resistive load, gate pulse: 10 V, 5 Ω source	0.80		μs
Maximum turn-off time	t_q	$T_J = T_J$ maximum, $I_{TM} = 100$ A, commutating $di/dt = 10$ A/μs $V_R = 50$ V, $t_p = 200$ μs, $dV/dt = 200$ V/μs	10	20	

**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/ μ s
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	UNITS
Maximum peak gate power	P_{GM}	$T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$	40	W
Maximum average gate power	$P_{G(AV)}$		5	
Maximum peak positive gate current	I_{GM}	$T_J = T_J$ maximum, $t_p \leq 5$ ms	5	A
Maximum peak positive gate voltage	$+V_{GM}$		20	V
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, $R_a = 6$ Ω	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}/V_{RRM} 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	0.195	K/W
Maximum thermal resistance, case to heatsink	R_{thCS}	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)	

 ΔR_{thJC} CONDUCTION

CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.034	0.025	$T_J = T_J$ maximum	K/W
120°	0.041	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_{thJC} when devices operate at different conduction angles than DC

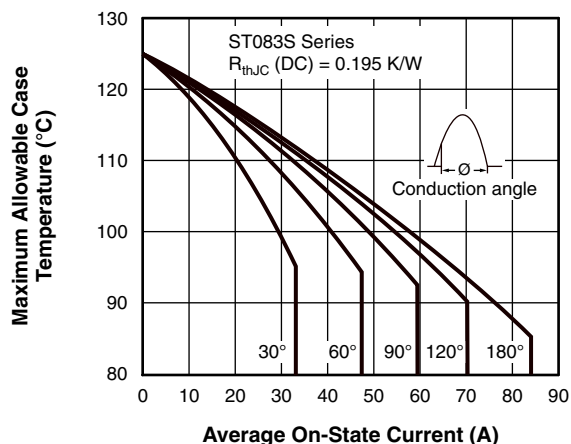


Fig. 1 - Current Ratings Characteristics

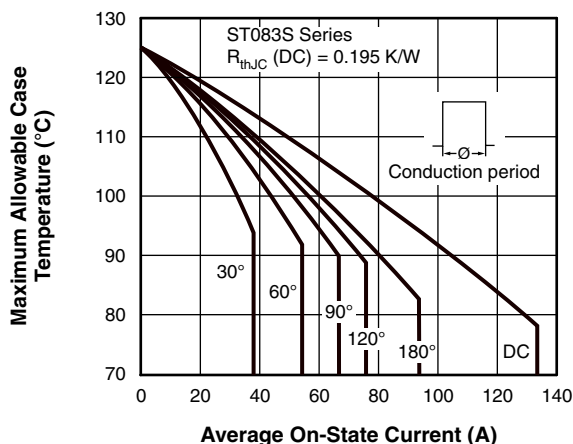


Fig. 2 - Current Ratings Characteristics

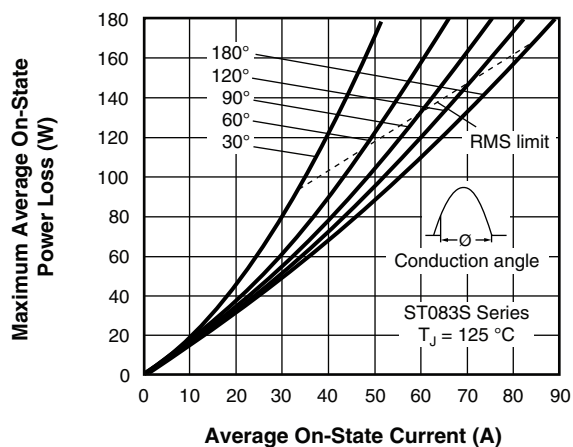


Fig. 3 - On-State Power Loss Characteristics

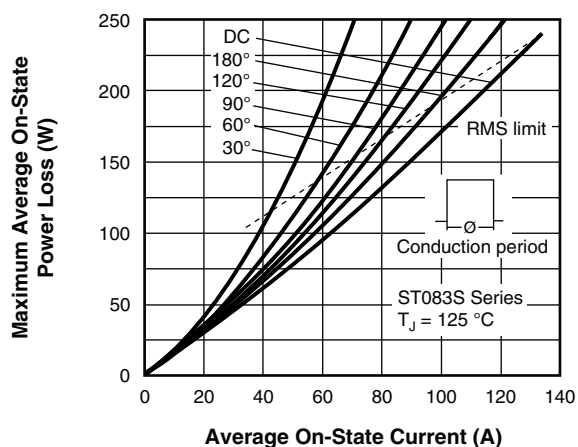
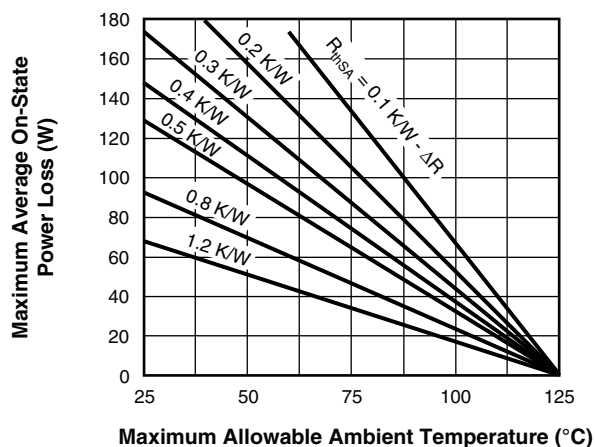
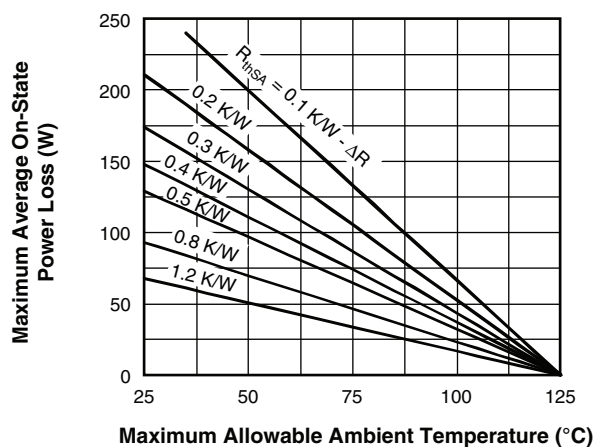


Fig. 4 - On-State Power Loss Characteristics



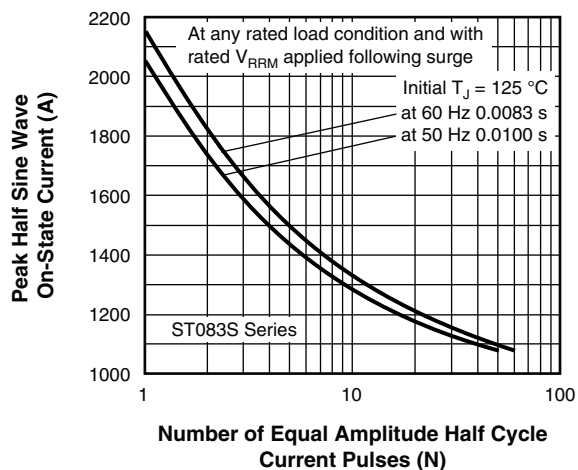


Fig. 5 - Maximum Non-Repetitive Surge Current

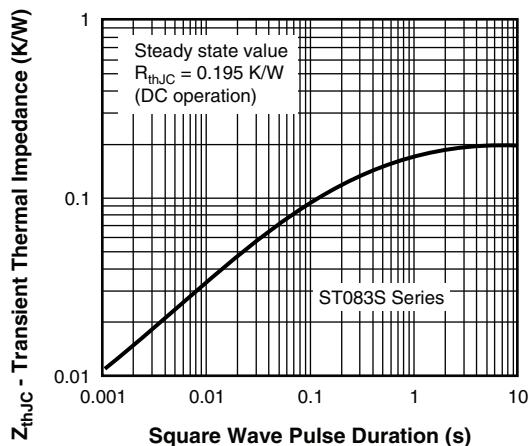
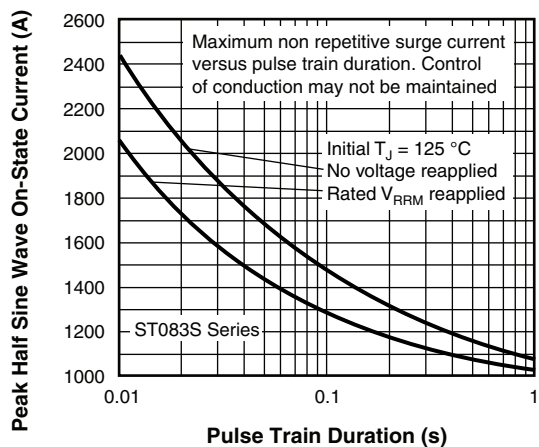

Fig. 8 - Thermal Impedance Z_{thJC} Characteristic


Fig. 6 - Maximum Non-Repetitive Surge Current

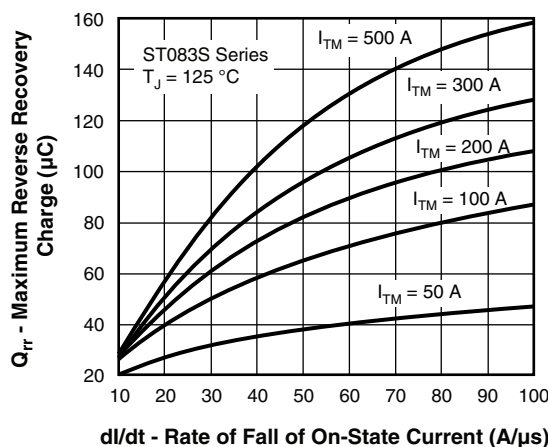


Fig. 9 - Reverse Recovered Charge Characteristics

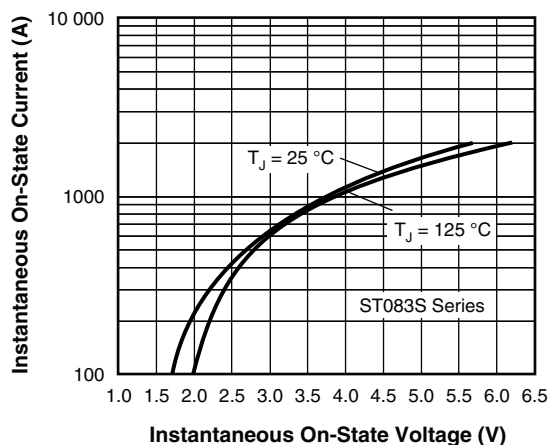


Fig. 7 - On-State Voltage Drop Characteristics

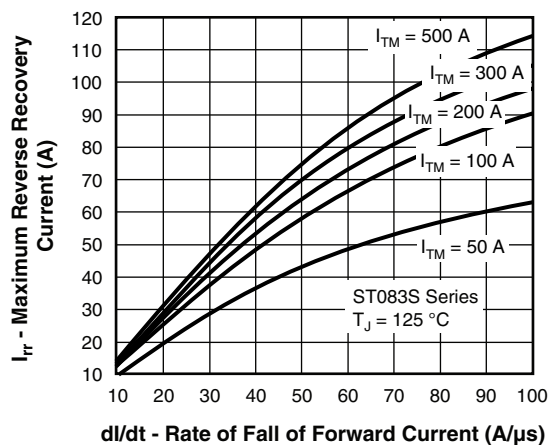


Fig. 10 - Reverse Recovery Current Characteristics

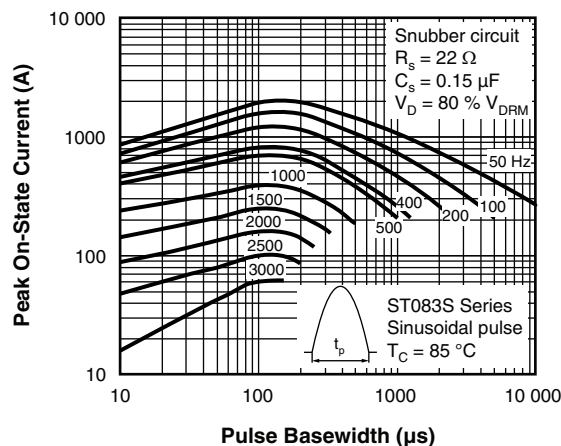
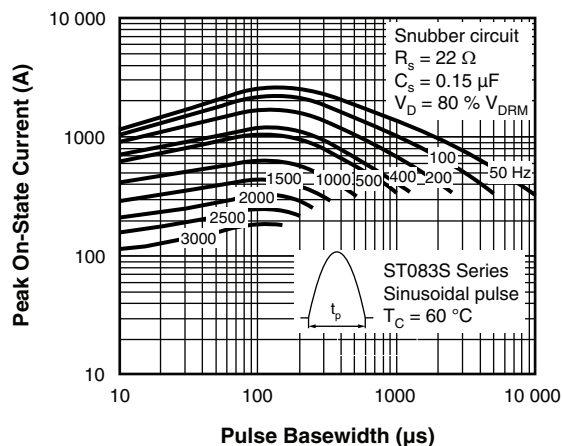


Fig. 11 - Frequency Characteristics

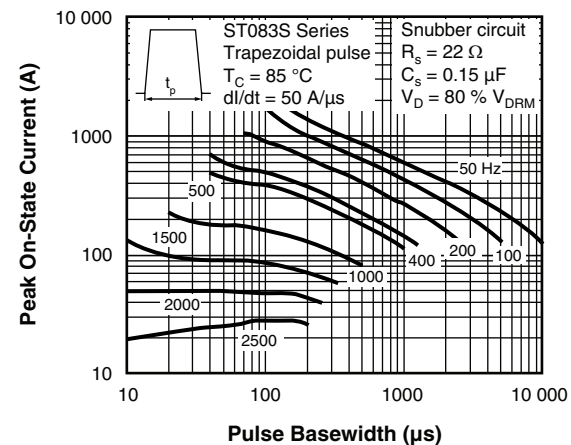
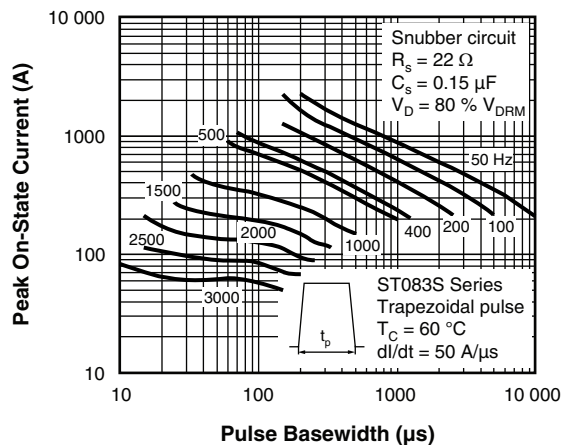


Fig. 12 - Frequency Characteristics

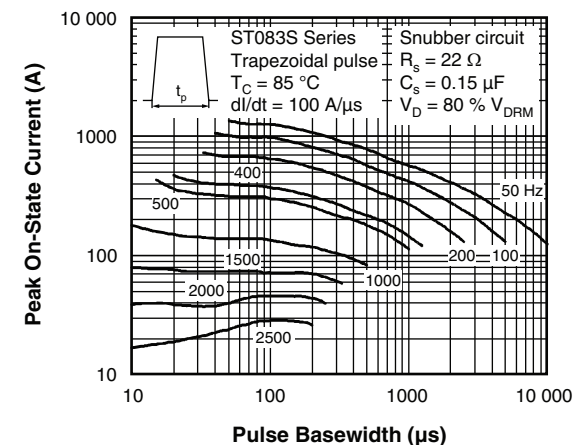
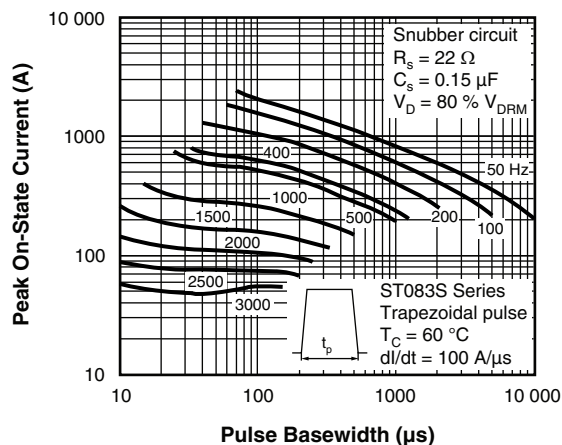


Fig. 13 - Frequency Characteristics

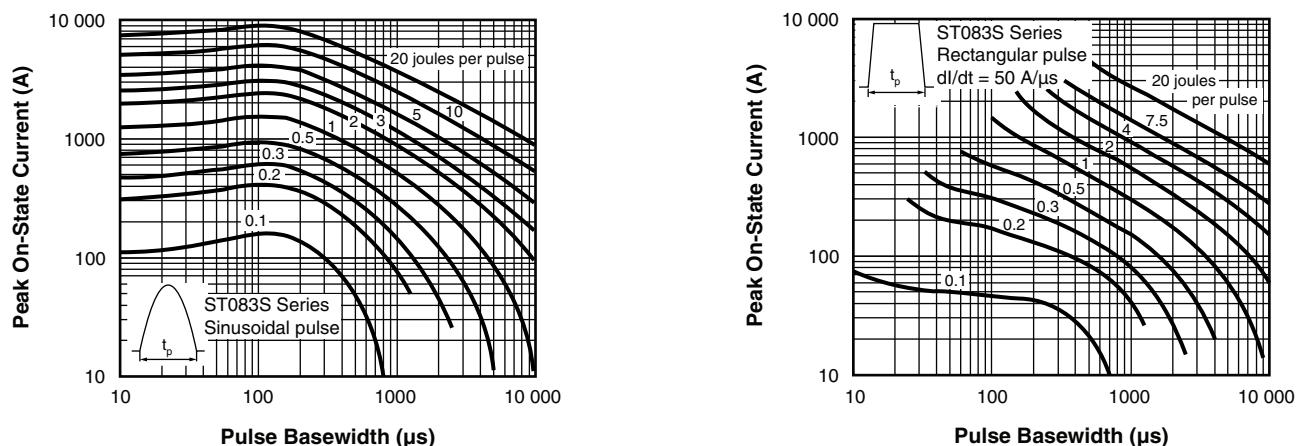


Fig. 14 - Maximum On-State Energy Power Loss Characteristics

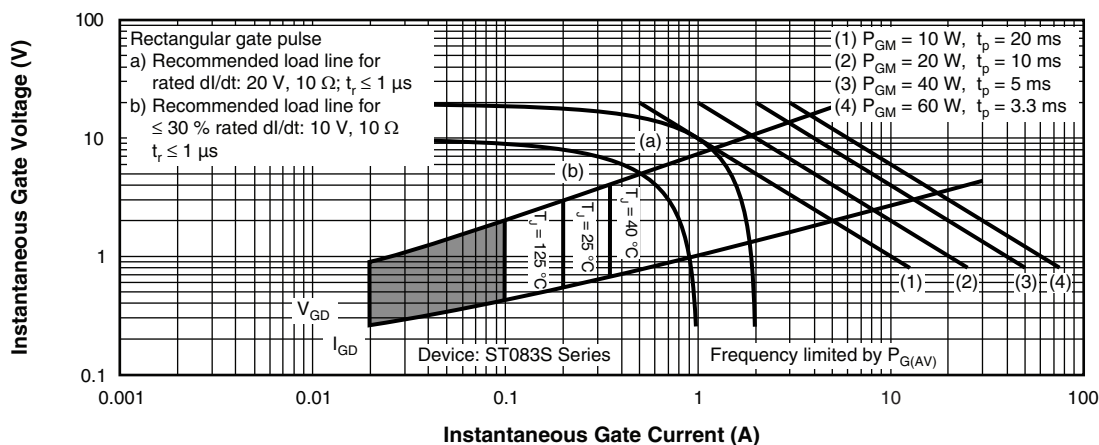


Fig. 15 - Gate Characteristics


ORDERING INFORMATION TABLE

Device code	VS-	ST	08	3	S	12	P	F	N	0	L	P
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫

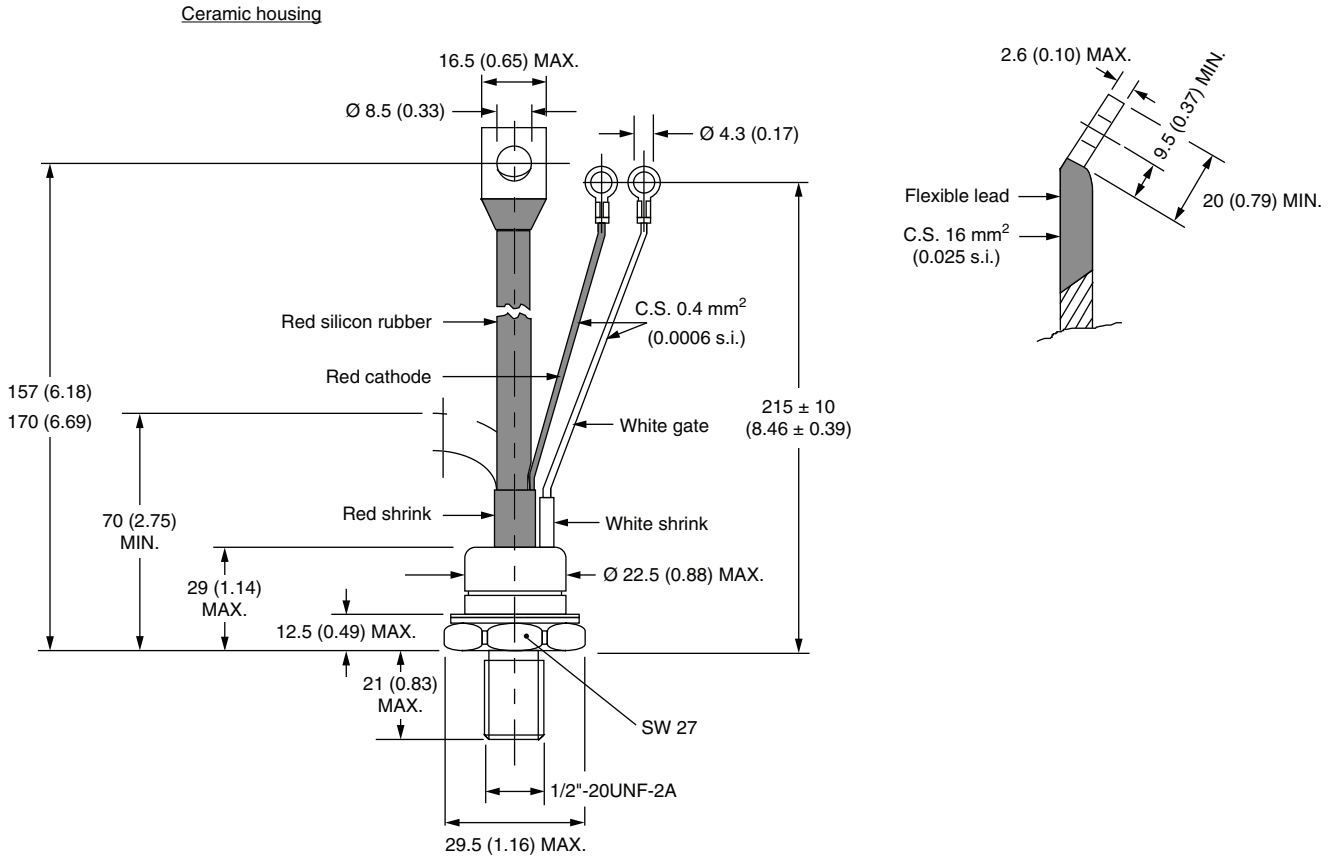
- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part number
- 4** - 3 = Fast turn-off
- 5** - S = Compression bonding stud
- 6** - Voltage code x 100 = V_{RRM} (see Voltage Ratings table)
- 7** - • P = Stud base 1/2"-20UNF-2A threads
• M = Metric M12, contact factory for availability
- 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 (gate and aux. cathode leads)
- 11** - Critical dV/dt:
 - None = 500 V/ μ s (standard value)
 - L = 1000 V/ μ s (special selection)
- 12** - None = Standard production; P = Lead (Pb)-free

dV/dt - t_q combinations available		
	dV/dt (V/μs)	200
t_q (μs) up to 800V	10 20	FN FK
t_q (μs) only for 1000/1200 V	20	FK

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95003

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

DIMENSIONS in millimeters (inches)





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