Inverter Grade Thyristors (Stud Version), 330 A

TO-118 (TO- 209AE)

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

Pb-free

RoHS COMPLIANT

TYPICAL APPLICATIONS

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

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	330 A
V_{DRM}/V_{RRM}	400 V, 800 V
V_{TM}	1.96 V
I_{TSM} at 50 Hz	11 000 A
I_{TSM} at 60 Hz	11 520 A
I_{GT}	200 mA
T_J	-40 °C to +125 °C
T_C	75 °C
Package	TO-118 (TO-209AE)
Circuit configuration	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		330	A
	T_C	75	°C
$I_{T(RMS)}$		518	A
I_{TSM}	50 Hz	11 000	
	60 Hz	11 520	
I^2t	50 Hz	605	kA^2s
	60 Hz	550	
V_{DRM}/V_{RRM}		400 to 800	V
t_q		15	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-ST333S	04	400	500	50
	08	800	900	

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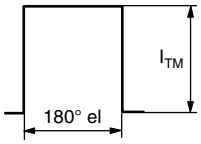
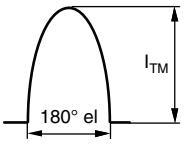
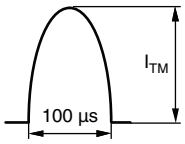
CURRENT CARRYING CAPABILITY

FREQUENCY							UNITS
50 Hz	840	600	1280	1040	5430	4350	A
400 Hz	650	450	1280	910	2150	1560	
1000 Hz	430	230	1090	730	1080	720	
2500 Hz	140	60	490	250	400	190	
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	50	75	50	75	50	75	°C
Equivalent values for RC circuit	10/0.47		10/0.47		10/0.47		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			330	A
					75	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 63 °C case temperature			518	A
Maximum peak, one half cycle, non-repetitive surge current	I_{TSM}	t = 10 ms	No voltage reapplied	Sinusoidal half wave, initial $T_J = T_J$ maximum	11 000	
		t = 8.3 ms			11 520	
		t = 10 ms	100 % V_{RRM} reapplied		9250	
		t = 8.3 ms			9700	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied		605	kA^2s
		t = 8.3 ms			550	
		t = 10 ms	100 % V_{RRM} reapplied		430	
		t = 8.3 ms			390	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied			6050	$kA^2\sqrt{s}$
Maximum peak on-state voltage	V_{TM}	I_{TM} = 1810 A, $T_J = T_J$ maximum, t_p = 10 ms sine wave pulse			1.96	V
Low level value of threshold voltage	$V_{T(TO)1}$	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum			0.91	
High level value of threshold voltage	$V_{T(TO)2}$	(I > π x $I_{T(AV)}$), $T_J = T_J$ maximum			0.92	
Low level value of forward slope resistance	r_{t1}	(16.7 % x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ maximum			0.58	mΩ
High level value of forward slope resistance	r_{t2}	(I > π x $I_{T(AV)}$), $T_J = T_J$ 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} = Rated V_{DRM} I_{TM} = 2 x dI/dt	1000	A/µs
Typical delay time	t_d	T_J = 25 °C, V_{DM} = Rated V_{DRM}, I_{TM} = 50 A DC, t_p = 1 µs Resistive load, gate pulse: 10 V, 5 Ω source	1.0	µs
Maximum turn-off time	t_q	$T_J = T_J$ maximum, I_{TM} = 550 A, commutating dI/dt = 40 A/µs V_R = 50 V, t_p = 500 µs, dV/dt = 200 V/µs	15	

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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/µs
Maximum peak reverse and off-state leakage current	I_{RRM}, I_{DRM}	$T_J = T_J$ maximum, rated V_{DRM}/V_{RRM} applied	50	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	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} 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 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	0.10	K/W
Maximum thermal resistance, case to heatsink	R_{thCS}	Mounting surface, smooth, flat and greased	0.03	
Mounting torque, ± 10 %		Non-lubricated threads	48.5 (425)	N · m (lbf · in)
Approximate weight			535	g
Case style		See dimensions - link at the end of datasheet	TO-118 (TO-209AE)	

$\Delta R_{thJ\text{-}hs}$ CONDUCTION				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.011	0.008	$T_J = T_J$ maximum	K/W
120°	0.013	0.014		
90°	0.017	0.018		
60°	0.025	0.026		
30°	0.041	0.042		

Note

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

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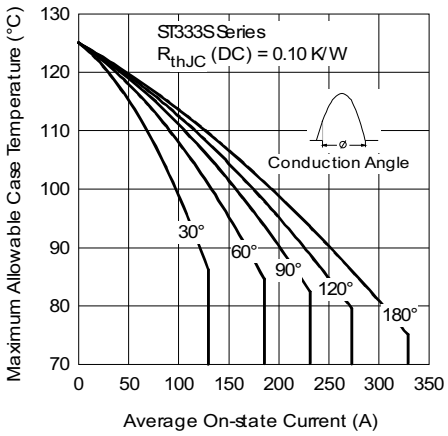

Fig. 1 - Current Ratings Characteristics

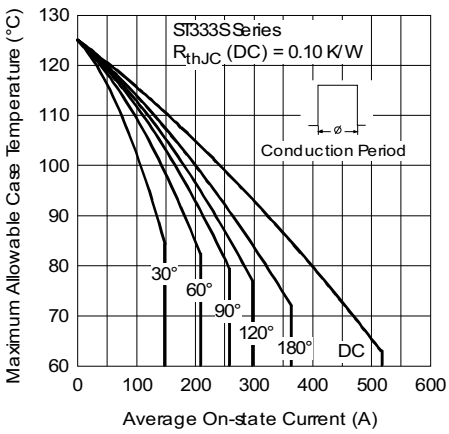

Fig. 2 - Current Ratings Characteristics

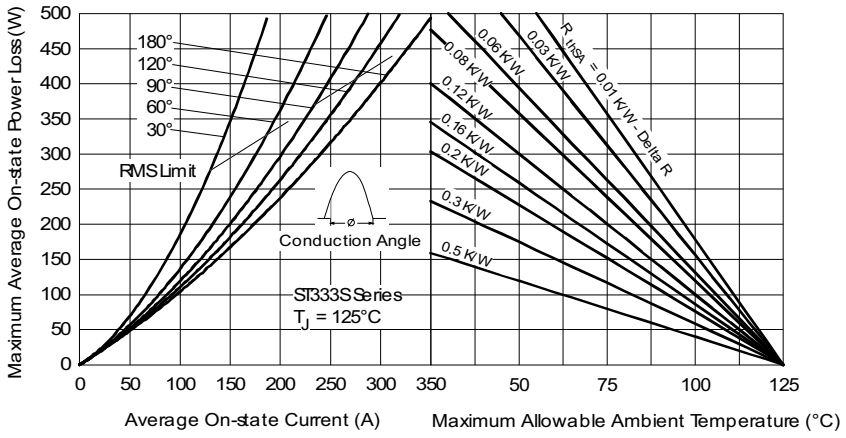

Fig. 3 - On-State Power Loss Characteristics

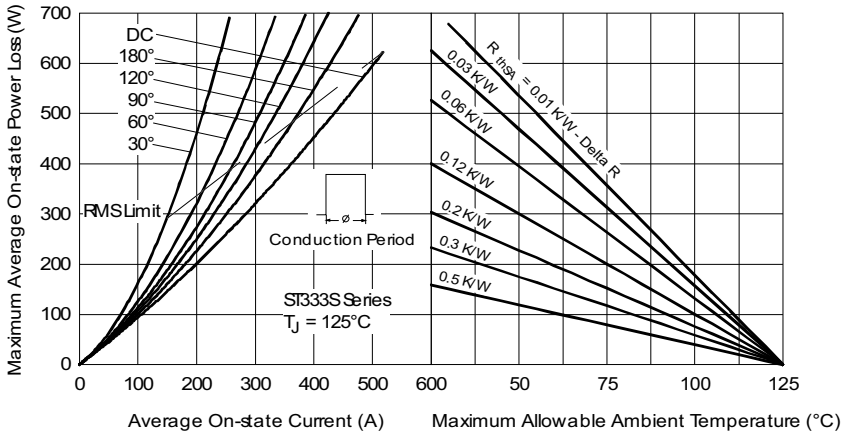

Fig. 4 - On-State Power Loss Characteristics

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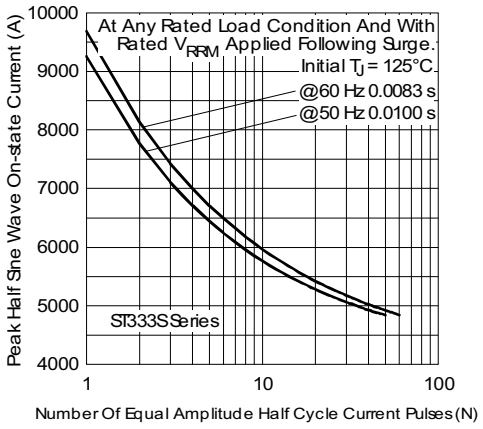

Fig. 5 - Maximum Non-Repetitive Surge Current

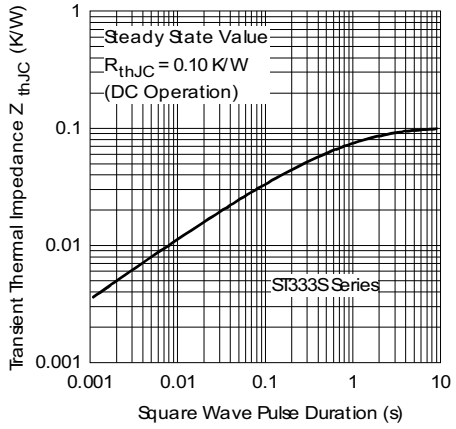

Fig. 8 - Thermal Impedance Z_{thJC} Characteristics

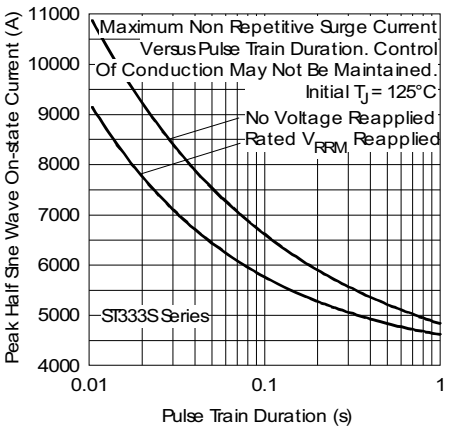

Fig. 6 - Maximum Non-Repetitive Surge Current

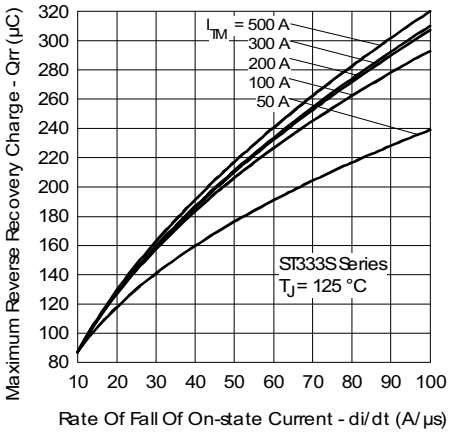

Fig. 9 - Reverse Recovered Charge Characteristics

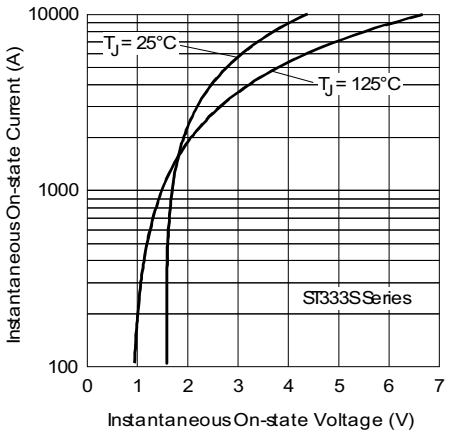

Fig. 7 - On-State Voltage Drop Characteristics

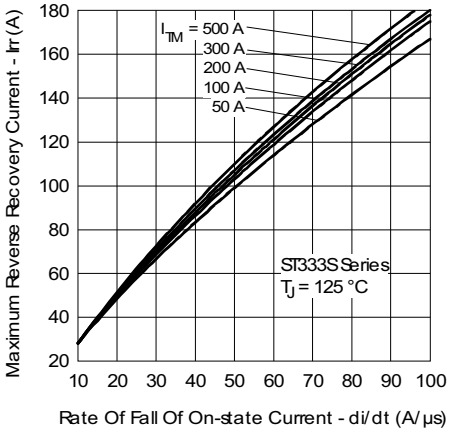

Fig. 10 - Reverse Recovery Current Characteristics

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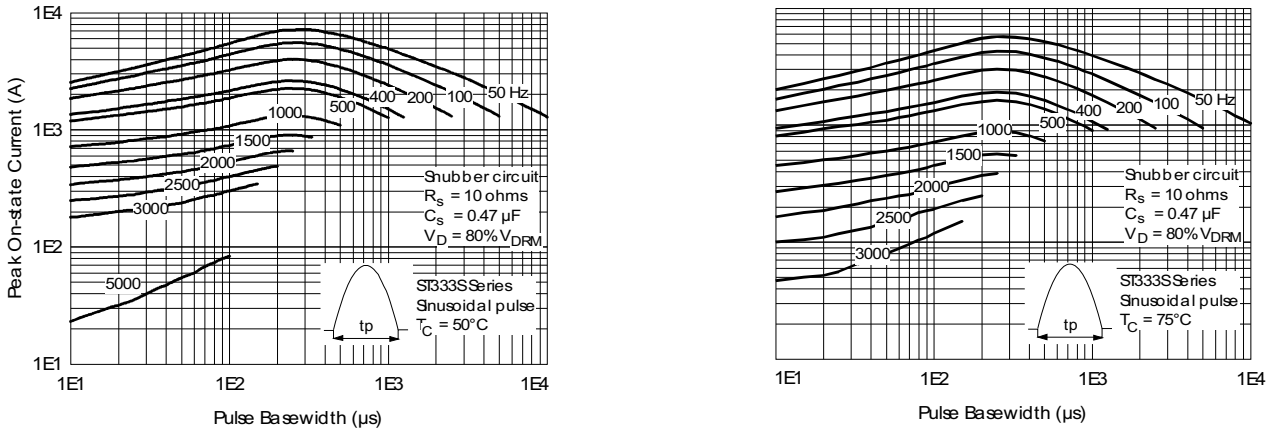

Fig. 11 - Frequency Characteristics

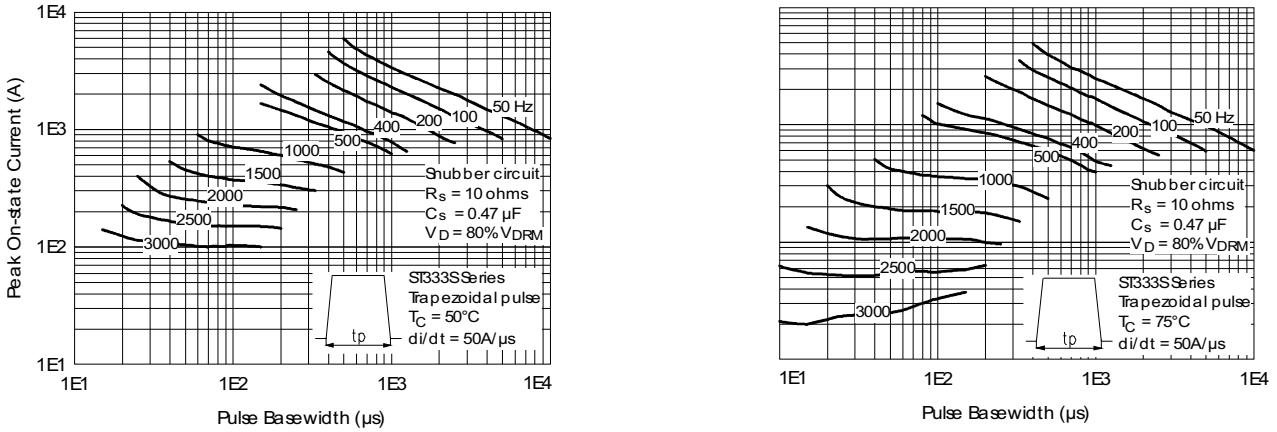

Fig. 12 - Frequency Characteristics

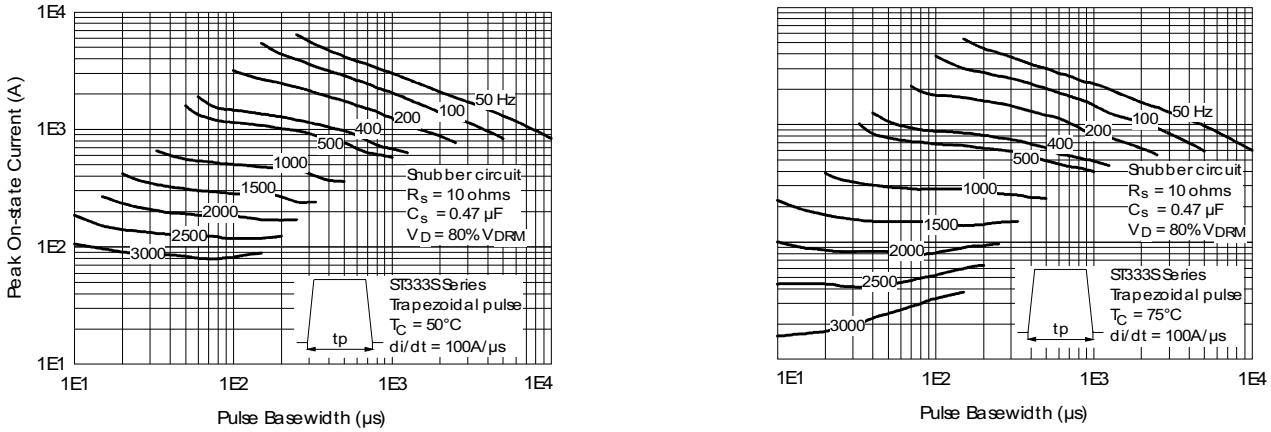

Fig. 13 - Frequency Characteristics

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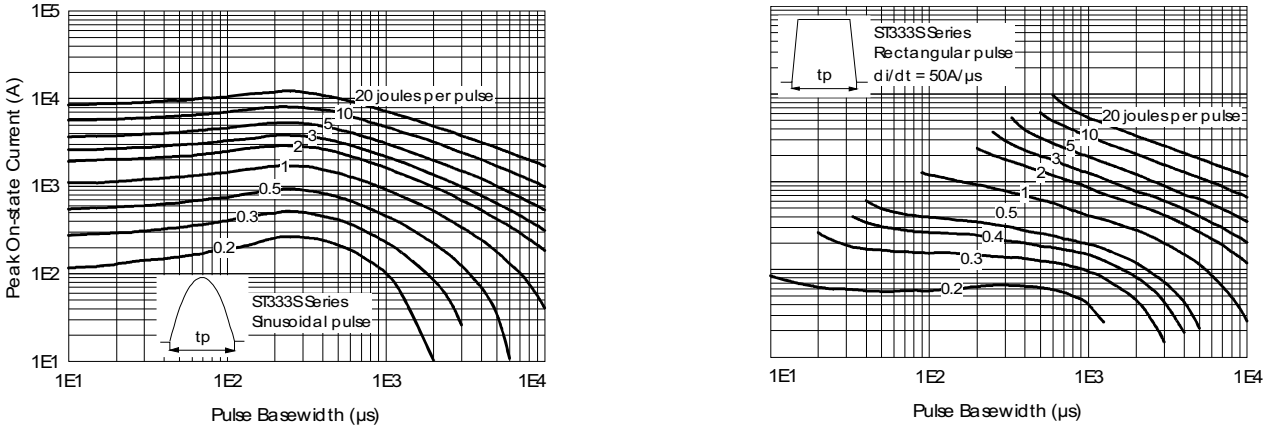

Fig. 14 - Maximum On-State Energy Power Loss Characteristics

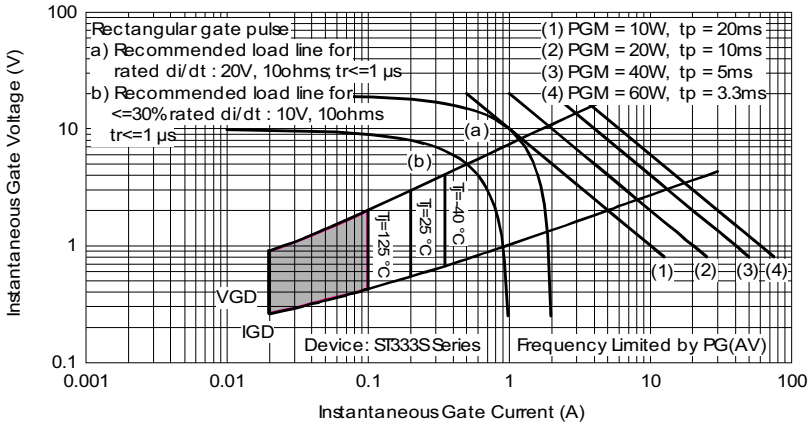

Fig. 15 - Gate Characteristics

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ORDERING INFORMATION TABLE

Device code

VS-	ST	33	3	S	08	P	F	L	0	P
1	2	3	4	5	6	7	8	9	10	11

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 = metric device
8	-	Reapplied dV/dt code (for t_q test condition) F = 200 V/µs
9	-	t_q code (L = 15 µs) M = 12 µs
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

Note: For metric device M24 x 1.5 contact factory

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95080

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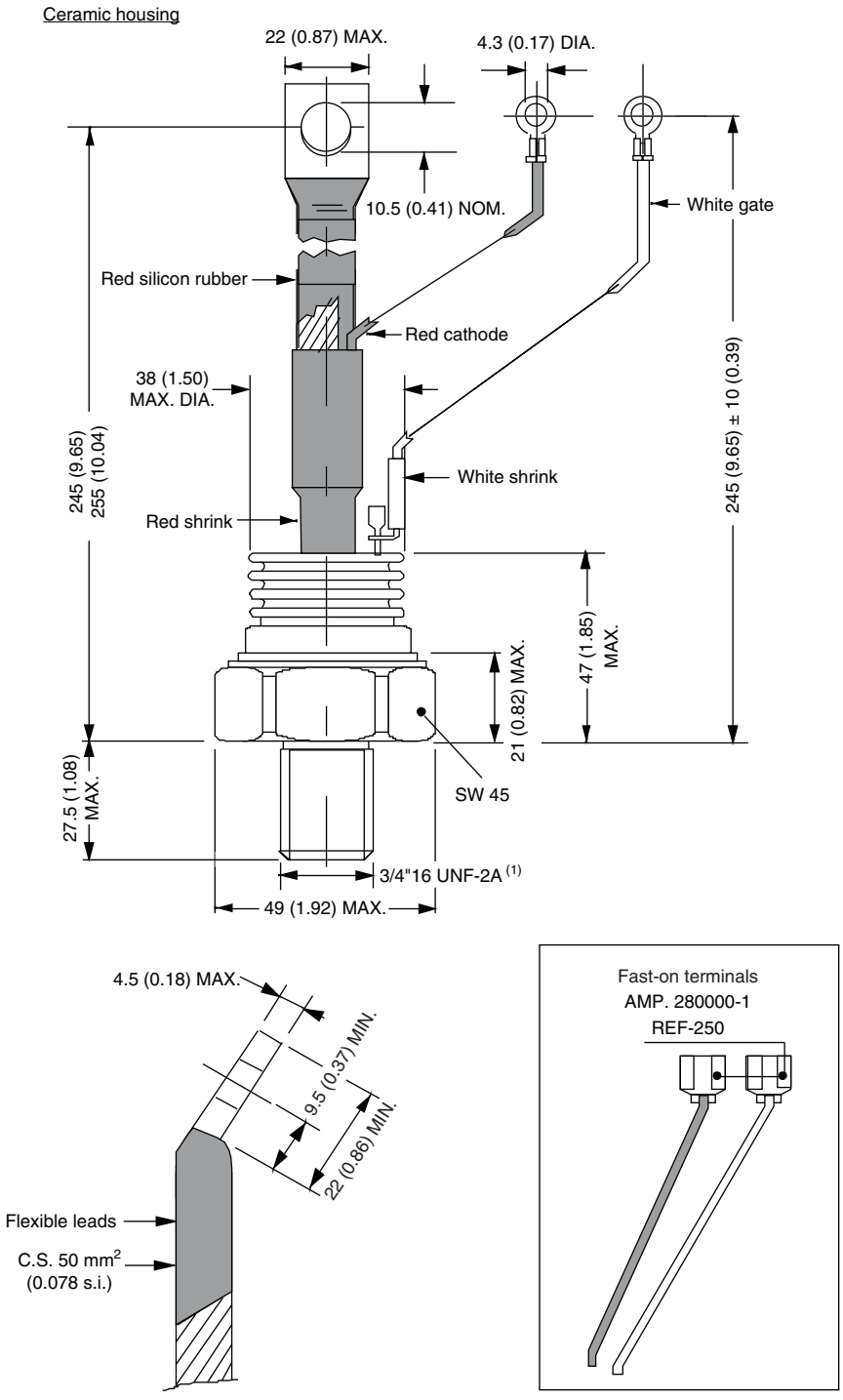
TO-209AE (TO-118)

DIMENSIONS in millimeters (inches)



Note

(1) For metric device: M24 x 1.5 - length 21 (0.83) maximum

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