



Phase Control Thyristors (Stud Version), 110 A



TO-94 (TO-209AC)

FEATURES

- Center gate
- International standard case TO-94 (TO-209AC)
- Compression bonded encapsulation for heavy duty operations such as severe thermal cycling
- Hermetic glass-metal case with ceramic insulator (Glass-metal seal over 1200 V)
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS
COMPLIANT

PRIMARY CHARACTERISTICS

$I_{T(AV)}$	110 A
V_{DRM}/V_{RRM}	400 V, 800 V, 1200 V, 1600 V
V_{TM}	1.52 V
I_{GT}	150 mA
T_J	-40 °C to +125 °C
Package	TO-94 (TO-209AC)
Circuit configuration	Single SCR

TYPICAL APPLICATIONS

- DC motor controls
- Controlled DC power supplies
- AC controllers

MAJOR RATINGS AND CHARACTERISTICS

PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		110	A
	T_C	90	°C
$I_{T(RMS)}$		175	A
I_{TSM}	50 Hz	2700	
	60 Hz	2830	
I^2t	50 Hz	36.4	kA ² s
	60 Hz	33.2	
V_{DRM}/V_{RRM}		400 to 1600	V
t_q	Typical	100	μs
T_J		-40 to +125	°C

ELECTRICAL SPECIFICATIONS

VOLTAGE RATINGS

TYPE NUMBER	VOLTAGE CODE	V_{DRM}/V_{RRM} , MAXIMUM REPETITIVE PEAK AND OFF-STATE VOLTAGE V	V_{RSM} , MAXIMUM NON-REPETITIVE PEAK VOLTAGE V	I_{DRM}/I_{RRM} MAXIMUM AT $T_J = T_J$ MAXIMUM mA
VS-ST110S	04	400	500	20
	08	800	900	
	12	1200	1300	
	16	1600	1700	

**ABSOLUTE MAXIMUM RATINGS**

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum average on-state current at case temperature	$I_{T(AV)}$	180° conduction, half sine wave	110 90	A °C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 85 °C case temperature	175	
Maximum peak, one-cycle non-repetitive surge current	I_{TSM}	<div> <div> $t = 10\text{ ms}$ $t = 8.3\text{ ms}$ </div> <div> No voltage reappplied 100 % V_{RRM} reappplied </div> </div> Sinusoidal half wave, initial $T_J = T_J$ maximum	2700 2830 2270 2380	A
Maximum I^2t for fusing	I^2t	<div> <div> $t = 10\text{ ms}$ $t = 8.3\text{ ms}$ </div> <div> No voltage reappplied 100 % V_{RRM} reappplied </div> </div>	36.4 33.2 25.8 23.5	kA ² s
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	$t = 0.1$ to 10 ms , no voltage reappplied	364	kA ² √s
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	0.90	V
High level value of threshold voltage	$V_{T(TO)2}$	$(I > \pi \times I_{T(AV)})$, $T_J = T_J$ maximum	0.92	
Low level value of on-state slope resistance	r_{t1}	$(16.7\% \times \pi \times I_{T(AV)} < I < \pi \times I_{T(AV)})$, $T_J = T_J$ maximum	1.79	mΩ
High level value of on-state slope resistance	r_{t2}	$(I > \pi \times I_{T(AV)})$, $T_J = T_J$ maximum	1.81	
Maximum on-state voltage	V_{TM}	$I_{pk} = 350\text{ A}$, $T_J = T_J$ maximum, $t_p = 10\text{ ms}$ sine pulse	1.52	V
Maximum holding current	I_H	$T_J = 25\text{ °C}$, anode supply 12 V resistive load	600	mA
Typical latching current	I_L		1000	

SWITCHING

PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum non-repetitive rate of rise of turned-on current	di/dt	Gate drive 20 V, 20 Ω, $t_r \leq 1\text{ μs}$ $T_J = T_J$ maximum, anode voltage $\leq 80\%$ V_{DRM}	500	A/μs
Typical delay time	t_d	Gate current 1 A, $di_g/dt = 1\text{ A/μs}$ $V_d = 0.67\%$ V_{DRM} , $T_J = 25\text{ °C}$	2.0	μs
Typical turn-off time	t_q	$I_{TM} = 100\text{ A}$, $T_J = T_J$ maximum, $di/dt = 10\text{ A/μs}$, $V_R = 50\text{ V}$, $dV/dt = 20\text{ V/μs}$, gate 0 V 100 Ω, $t_p = 500\text{ μs}$	100	

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 % rated V_{DRM}	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	20	mA

**TRIGGERING**

PARAMETER	SYMBOL	TEST CONDITIONS		VALUES		UNITS
				TYP.	MAX.	
Maximum peak gate power	P _{GM}	T _J = T _J maximum, t _p ≤ 5 ms		5		W
Maximum average gate power	P _{G(AV)}	T _J = T _J maximum, f = 50 Hz, d% = 50		1		
Maximum peak positive gate current	I _{GM}	T _J = T _J maximum, t _p ≤ 5 ms		2.0		A
Maximum peak positive gate voltage	+ V _{GM}			20		V
Maximum peak negative gate voltage	- V _{GM}			5.0		
DC gate current required to trigger	I _{GT}	T _J = -40 °C	Maximum required gate trigger/ current/voltage are the lowest value which will trigger all units 6 V anode to cathode applied	180	-	mA
		T _J = 25 °C		90	150	
		T _J = 125 °C		40	-	
DC gate voltage required to trigger	V _{GT}	T _J = -40 °C		2.9	-	V
		T _J = 25 °C		1.8	3.0	
		T _J = 125 °C		1.2	-	
DC gate current not to trigger	I _{GD}	T _J = T _J maximum	Maximum gate current/voltage not to trigger is the maximum value which will not trigger any unit with rated V _{DRM} anode to cathode applied	10		mA
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	0.195	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)	Nm (lbf · in)
		Lubricated threads	14 (120)	
Approximate weight			130	g
Case style		See dimensions - link at the end of datasheet	TO-94 (TO-209AC)	

 ΔR_{thJC} CONDUCTION

CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.035	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

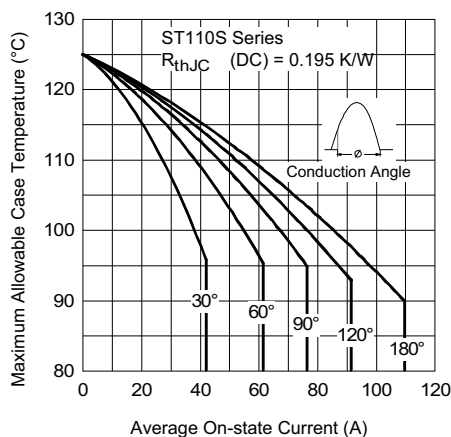


Fig. 1 - Current Ratings Characteristics

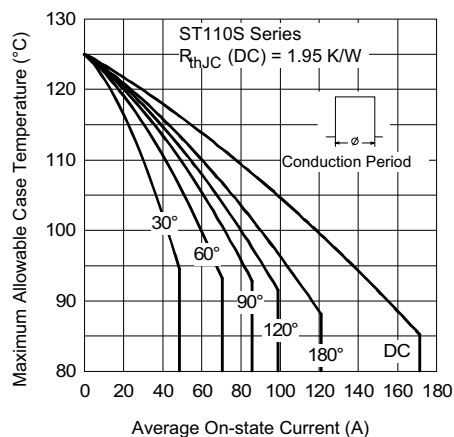


Fig. 2 - Current Ratings Characteristics

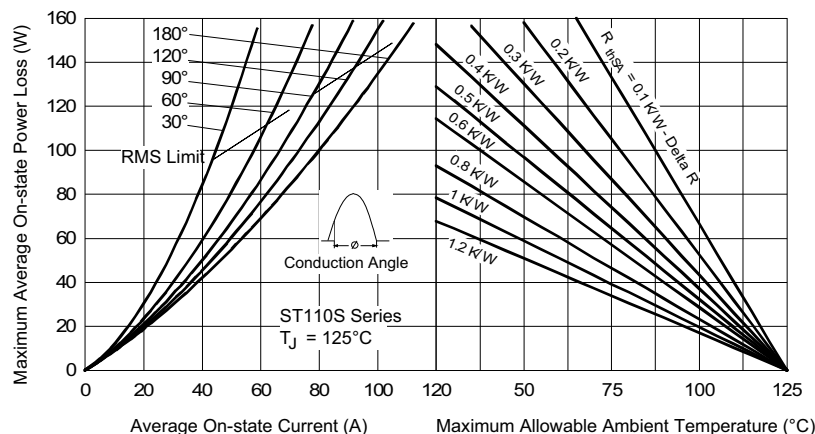


Fig. 3 - On-State Power Loss Characteristics

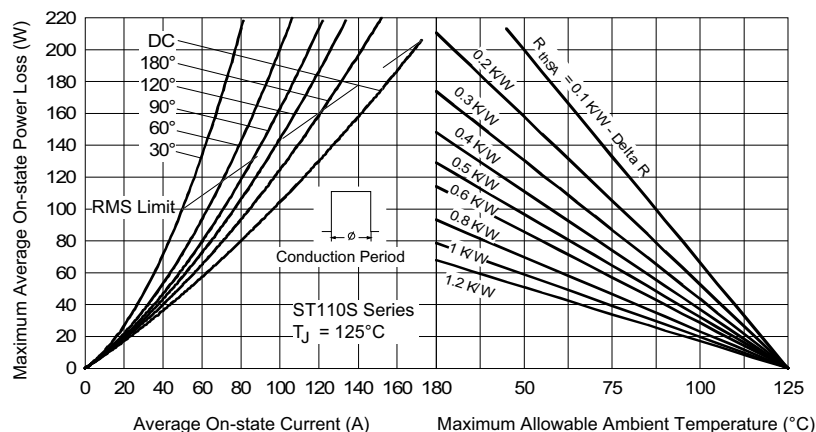


Fig. 4 - On-State Power Loss Characteristics

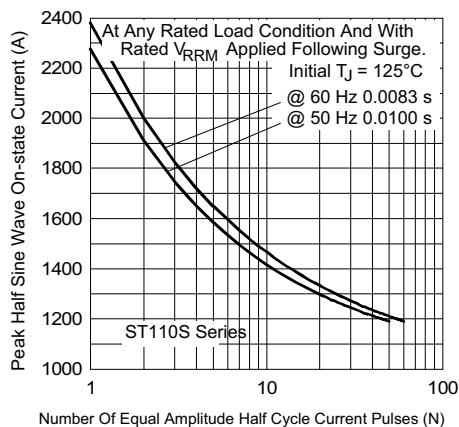


Fig. 5 - Maximum Non-Repetitive Surge Current

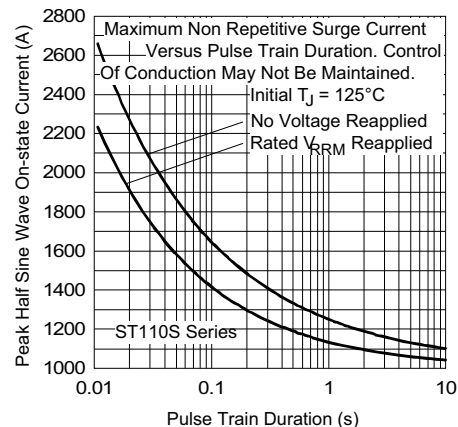


Fig. 6 - Maximum Non-Repetitive Surge Current

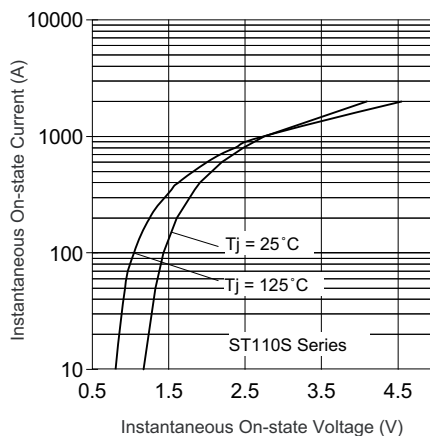
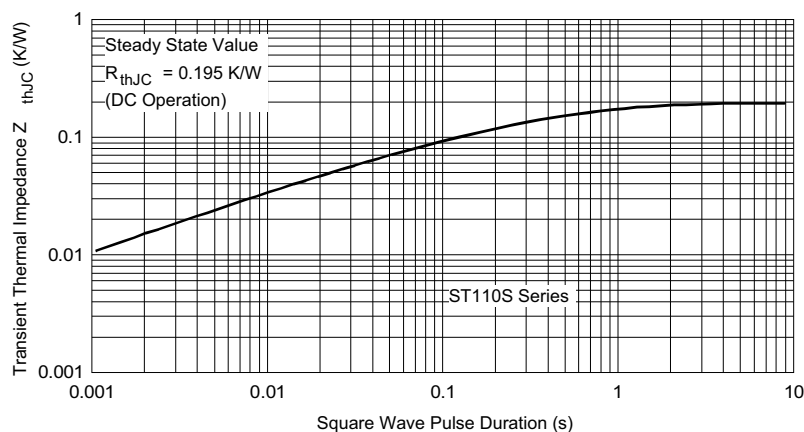


Fig. 7 - On-State Voltage Drop Characteristics

Fig. 8 - Thermal Impedance Z_{thJC} Characteristic

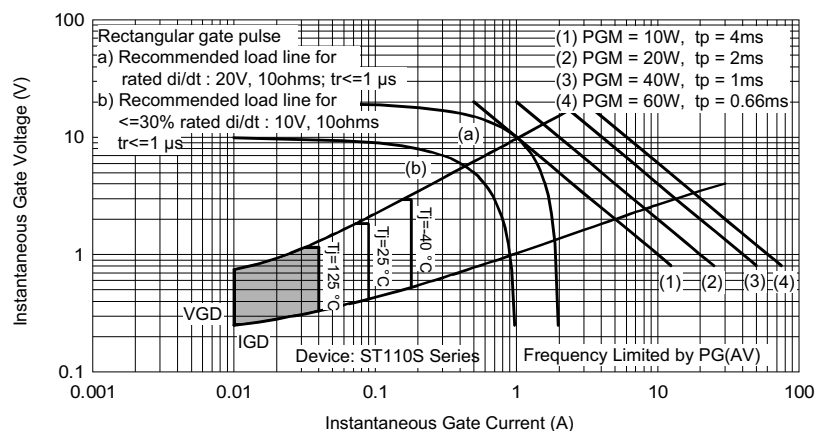


Fig. 9 - Gate Characteristics

ORDERING INFORMATION TABLE

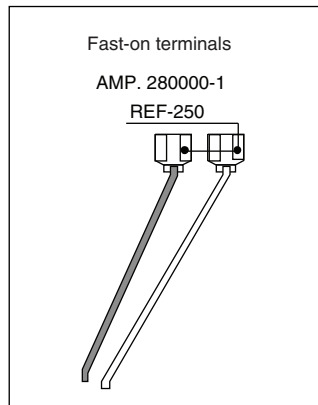
Device code	VS-	ST	11	0	S	16	P	0	V	L	PbF
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

- 1** - Vishay Semiconductors product
- 2** - Thyristor
- 3** - Essential part marking
- 4** - 0 = converter grade
- 5** - S = compression bonding stud
- 6** - Voltage code x 100 = V_{RRM} (see Voltage Ratings table)
- 7** - P = stud base 20UNF threads
- 8** - 0 = eyelet terminals (gate and auxiliary cathode leads)
1 = fast-on terminals (gate and auxiliary cathode leads)
2 = flag terminals (for cathode and gate terminals)
- 9** - • V = glass-metal seal (only up to 1200 V)
• None = ceramic housing (over 1200 V)
- 10** - Critical dV/dt:
• None = 500 V/ μ s (standard value)
• L = 1000 V/ μ s (special selection)
- 11** - None = standard production
PbF = lead (Pb)-free

LINKS TO RELATED DOCUMENTS

Dimensions	www.vishay.com/doc?95078
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DIMENSIONS in millimeters (inches)

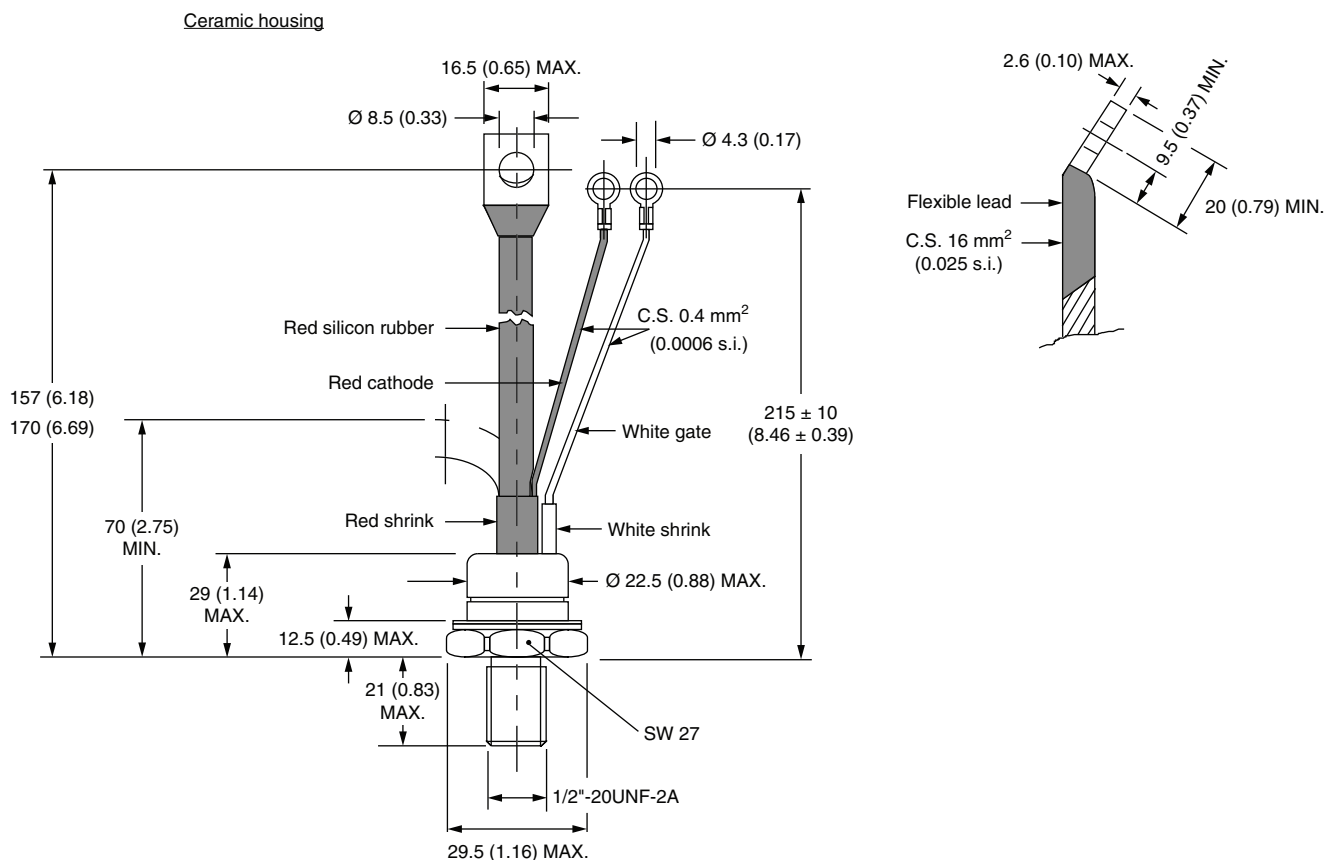


Outline Dimensions

Vishay Semiconductors TO-209AC (TO-94) for ST110S Series



DIMENSIONS in millimeters (inches)





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