

Phase Control Thyristors (Stud Version), 110 A



TO-209AC (TO-94)

FEATURES

- Center gate
- International standard case TO-209AC (TO-94)
- 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)
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level


**RoHS
COMPLIANT**
PRODUCT SUMMARY

$I_{T(AV)}$	110 A
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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
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	A
				90	°C
Maximum RMS on-state current	$I_{T(RMS)}$	DC at 85 °C case temperature		175	A
Maximum peak, one-cycle non-repetitive surge current	I_{TSM}	t = 10 ms	No voltage reapplied	2700	
		t = 8.3 ms	No voltage reapplied	2830	
		t = 10 ms	100 % V_{RRM} reapplied	2270	
		t = 8.3 ms	100 % V_{RRM} reapplied	2380	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied	36.4	kA ² s
		t = 8.3 ms	No voltage reapplied	33.2	
		t = 10 ms	100 % V_{RRM} reapplied	25.8	
		t = 8.3 ms	100 % V_{RRM} reapplied	23.5	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 to 10 ms, no voltage reapplied		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}	$I_{pk} = 350$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		1.52	V
Maximum holding current	I_H	$T_J = 25$ °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, $t_r \leq 1$ μs $T_J = T_J$ maximum, anode voltage ≤ 80 % V_{DRM}		500	A/μs
Typical delay time	t_d	Gate current 1 A, $di_g/dt = 1$ A/μs $V_d = 0.67$ % V_{DRM} , $T_J = 25$ °C		2.0	μs
Typical turn-off time	t_q	$I_{TM} = 100$ A, $T_J = T_J$ maximum, $di/dt = 10$ A/μs, $V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 100 Ω, $t_p = 500$ 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, $t_p \leq 5$ 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, $t_p \leq 5$ ms		2.0		A
Maximum peak positive gate voltage	$+V_{GM}$			20		
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-209AC (TO-94)	

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	ST	11	0	S	16	P	0	V	L	PbF
	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

- 1** - Thyristor
- 2** - Essential part marking
- 3** - 0 = Converter grade
- 4** - S = Compression bonding stud
- 5** - Voltage code x 100 = V_{RRM} (see Voltage Ratings table)
- 6** - P = Stud base 20UNF threads
- 7** - 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)
- 8** - • V = Glass-metal seal (only up to 1200 V)
• None = Ceramic housing (over 1200 V)
- 9** - Critical dV/dt:
• None = 500 V/ μ s (standard value)
• L = 1000 V/ μ s (special selection)
- 10** - Lead (Pb)-free

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95078

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

DIMENSIONS in millimeters (inches)



Outline Dimensions

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



DIMENSIONS in millimeters (inches)





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