



Phase Control Thyristors (Stud Version), 110 A



TO-94 (TO-209AC)

FEATURES

- High current and high surge ratings
- Hermetic ceramic housing
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

TYPICAL APPLICATIONS

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

PRIMARY CHARACTERISTICS	
$I_{T(AV)}$	110 A
V_{DRM}/V_{RRM}	400 V, 800 V, 1200 V
V_{TM}	1.57 V
I_{GT}	80 mA
T_J	-40 °C to +140 °C
Package	TO-94 (TO-209AC)
Circuit configuration	Single SCR

MAJOR RATINGS AND CHARACTERISTICS			
PARAMETER	TEST CONDITIONS	VALUES	UNITS
$I_{T(AV)}$		110	A
	T_C	90	°C
$I_{T(RMS)}$		172	A
I_{TSM}	50 Hz	2080	
	60 Hz	2180	
I^2t	50 Hz	21.7	kA ² s
	60 Hz	19.8	
V_{DRM}/V_{RRM}		400 to 1200	V
t_q	Typical	110	µs
T_J		-40 to +140	°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-110RKI VS-111RKI	40	400	500	20
	80	800	900	
	120	1200	1300	



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 83 °C case temperature		172	
Maximum peak, one-cycle non-repetitive surge current	I_{TSM}	t = 10 ms	No voltage reapplied	2080	A
		t = 8.3 ms		2180	
		t = 10 ms	100 % V_{RRM} reapplied	1750	
		t = 8.3 ms		1830	
Maximum I^2t for fusing	I^2t	t = 10 ms	No voltage reapplied	21.7	kA ² s
		t = 8.3 ms		19.8	
		t = 10 ms	100 % V_{RRM} reapplied	15.3	
		t = 8.3 ms		14.0	
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	t = 0.1 ms to 10 ms, no voltage reapplied		217	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)		0.82	V
High level value of threshold voltage	$V_{T(TO)2}$	(I $> \pi \times I_{T(AV)}$, $T_J = T_J$ maximum)		1.02	
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)		2.16	mΩ
High level value of on-state slope resistance	r_{t2}	(I $> \pi \times I_{T(AV)}$, $T_J = T_J$ maximum)		1.70	
Maximum on-state voltage	V_{TM}	$I_{pk} = 350$ A, $T_J = T_J$ maximum, $t_p = 10$ ms sine pulse		1.57	V
Maximum holding current	I_H	$T_J = 25$ °C, anode supply 6 V resistive load		200	mA
Typical latching current	I_L			400	

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}		300	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		1	μs
Typical turn-off time	t_q	$I_{TM} = 50$ A, $T_J = T_J$ maximum, $di/dt = -5$ A/μs $V_R = 50$ V, $dV/dt = 20$ V/μs, gate 0 V 25 Ω		110	

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		12		W
Maximum average gate power	$P_{G(AV)}$	$T_J = T_J$ maximum, $f = 50$ Hz, $d\% = 50$		3.0		
Maximum peak positive gate current	I_{GM}	$T_J = T_J$ maximum, $t_p \leq 5$ ms		3.0		A
Maximum peak positive gate voltage	$+V_{GM}$			20		V
Maximum peak negative gate voltage	$-V_{GM}$			10		
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 12 V anode to cathode applied	180	-	mA
		$T_J = 25$ °C		80	120	
		$T_J = 140$ °C		40	-	
DC gate voltage required to trigger	V_{GT}	$T_J = -40$ °C		2.5	-	V
		$T_J = 25$ °C		1.6	2	
		$T_J = 140$ °C		1	-	
DC gate current not to trigger	I_{GD}			6.0		mA
DC gate voltage not to trigger	V_{GD}	$T_J = T_J$ maximum		0.25		V

THERMAL AND MECHANICAL SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUES	UNITS
Maximum operating junction temperature range	T_J		-40 to +140	°C
Maximum storage temperature range	T_{Stg}		-40 to +150	
Maximum thermal resistance, junction to case	R_{thJC}	DC operation	0.27	K/W
Maximum thermal resistance, case to heatsink	R_{thCS}	Mounting surface, smooth, flat and greased	0.1	
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-94 (TO-209AC)	

ΔR_{thJC} CONDUCTION				
CONDUCTION ANGLE	SINUSOIDAL CONDUCTION	RECTANGULAR CONDUCTION	TEST CONDITIONS	UNITS
180°	0.043	0.031	$T_J = T_J$ maximum	K/W
120°	0.052	0.053		
90°	0.066	0.071		
60°	0.096	0.101		
30°	0.167	0.169		

Note

- The table above shows the increment of thermal resistance R_{thJC} when devices operate at different conduction angles than DC

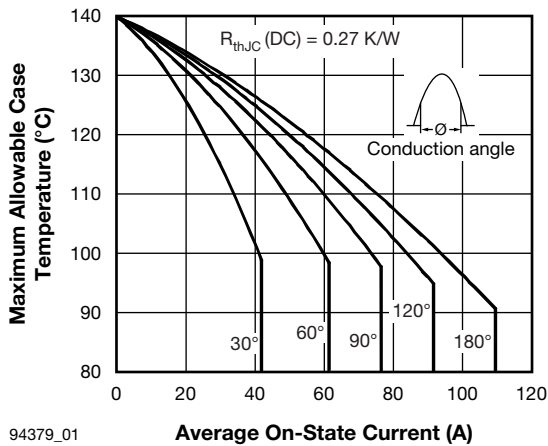


Fig. 1 - Current Ratings Characteristics

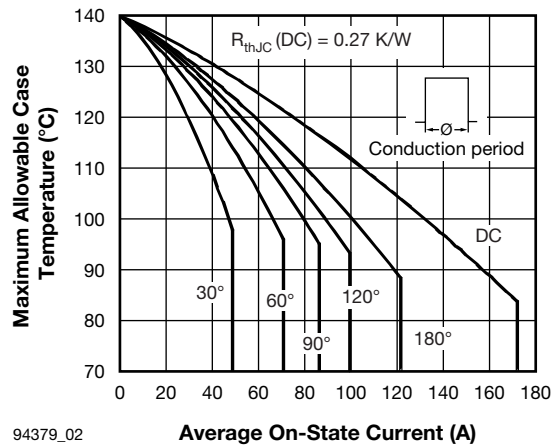


Fig. 2 - Current Ratings Characteristics

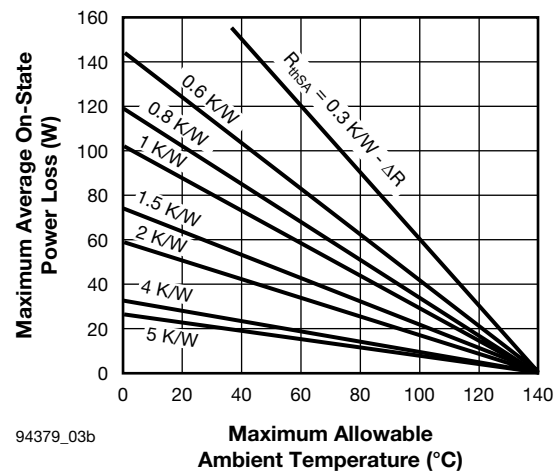
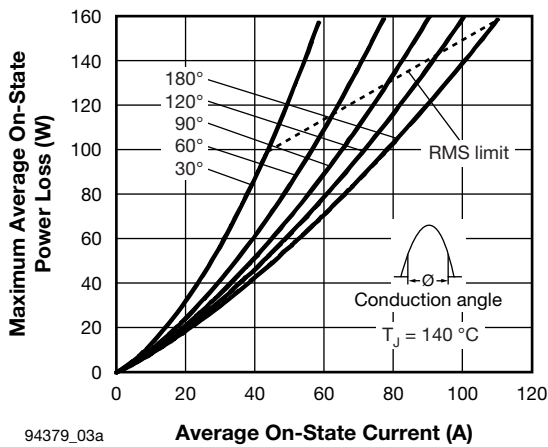


Fig. 3 - On-State Power Loss Characteristics

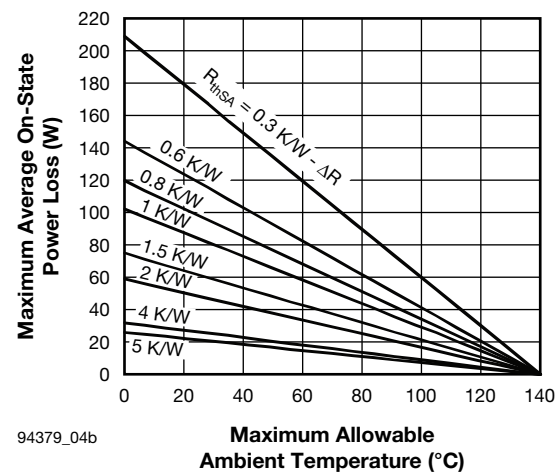
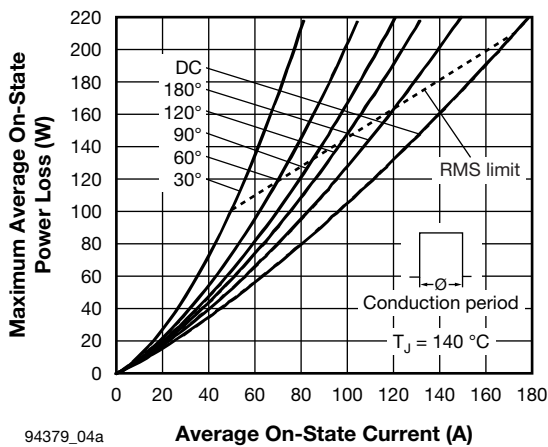


Fig. 4 - On-State Power Loss Characteristics

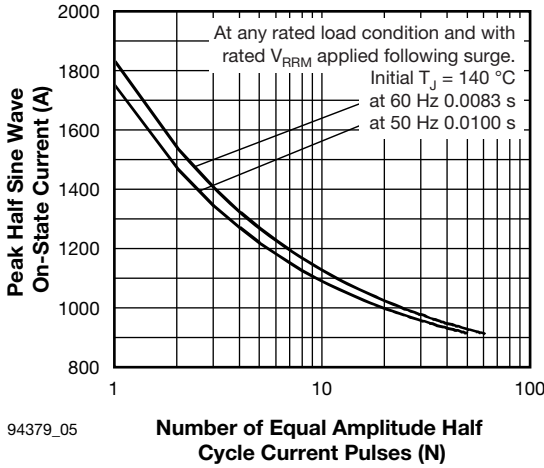


Fig. 5 - Maximum Non-Repetitive Surge Current

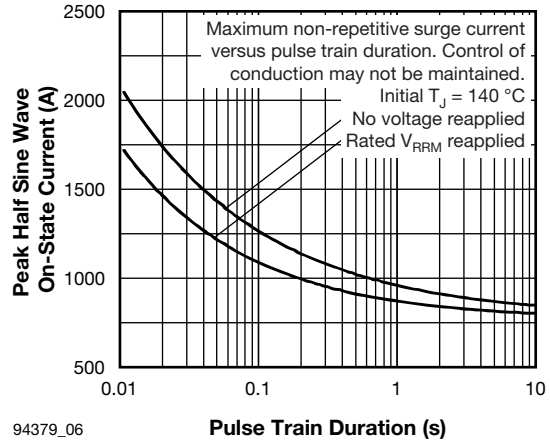


Fig. 6 - Maximum Non-Repetitive Surge Current



Fig. 7 - On-State Voltage Drop Characteristics

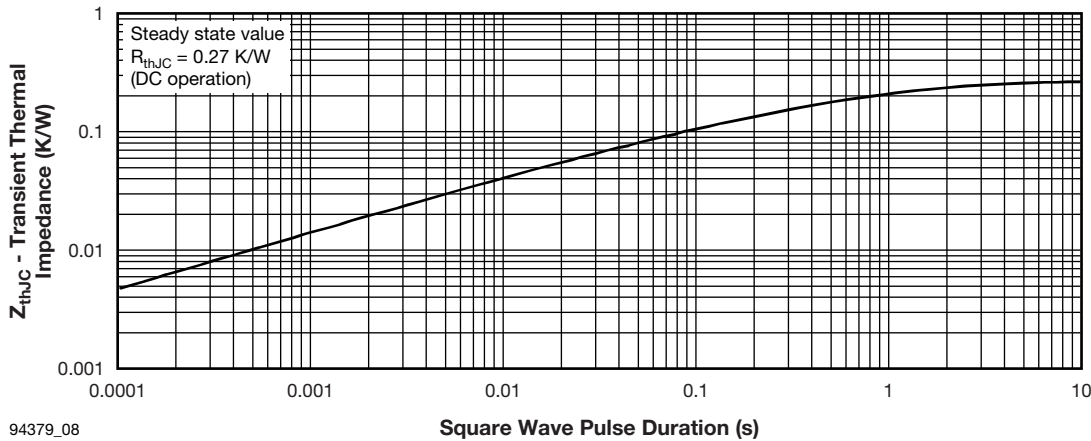


Fig. 8 - Thermal Impedance Z_{thJC} Characteristic



Fig. 9 - Gate Characteristics

ORDERING INFORMATION TABLE

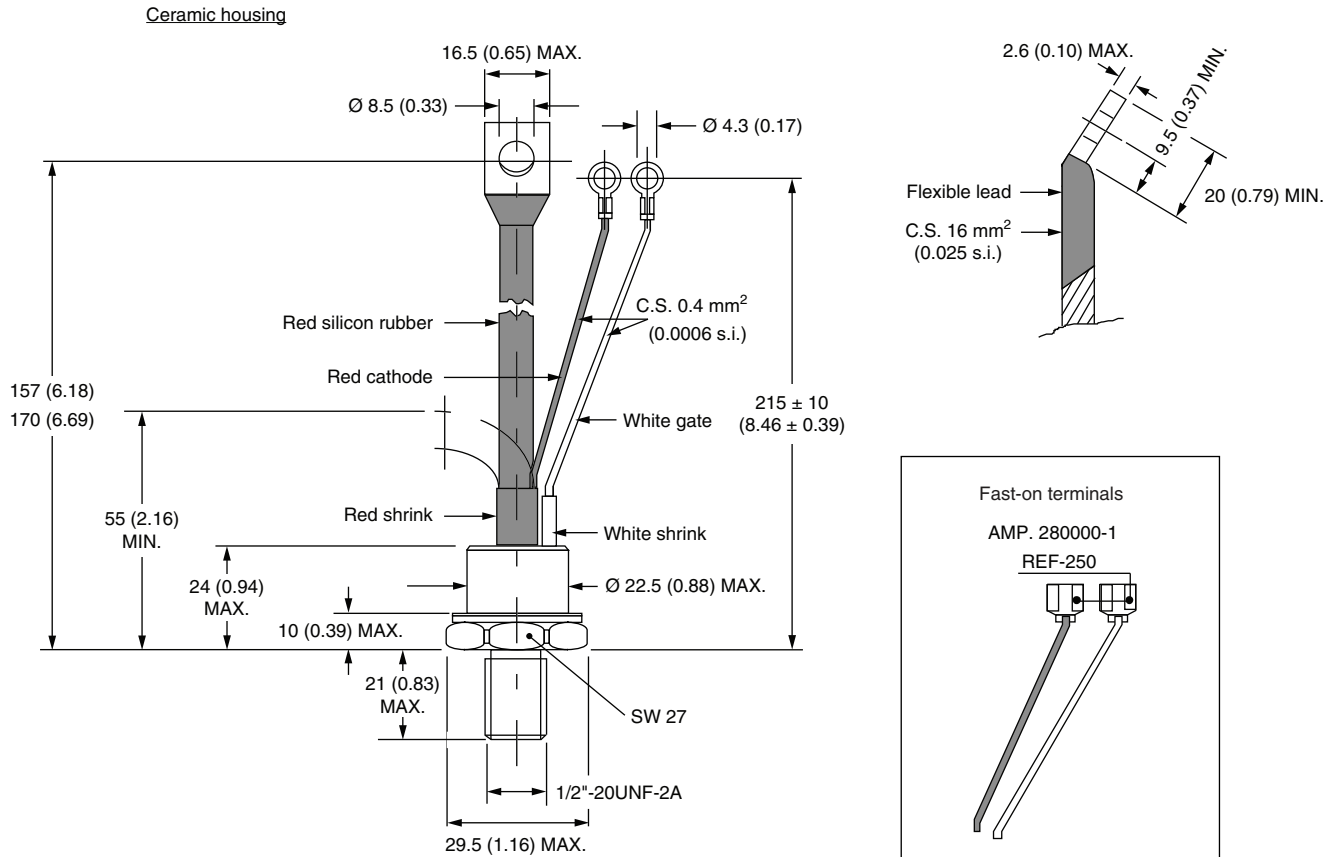
Device code	VS-	11	0	RKI	120	M	PbF
	①	②	③	④	⑤	⑥	⑦

- 1** - Vishay Semiconductors product
- 2** - $I_{T(AV)}$ rated average output current (rounded/10)
- 3** -
 - 0 = eyelet terminals (gate and auxiliary cathode leads)
 - 1 = fast-on terminals (gate and auxiliary cathode leads)
- 4** - Thyristor
- 5** - Voltage code x 10 = V_{RRM} (see Voltage Ratings table)
- 6** -
 - None = stud base 1/2"-20UNF-2A threads
 - M = stud base metric threads M12 x 1.75 E 6
- 7** -
 - None = standard production
 - PbF = lead (Pb)-free

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

TO-209AC (TO-94) for 110RKI and 111RKI Series

DIMENSIONS in millimeters (inches)



Note

- For metric device: M12 x 1.75 contact factory



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