

## 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](http://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 <sup>2</sup> 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	$I_{TSM}$	<div> <div> <math>t = 10\text{ ms}</math>  <math>t = 8.3\text{ ms}</math> </div> <div> No voltage reappplied  100 % <math>V_{RRM}</math> reappplied </div> </div>	2080 2180 1750 1830	A
		Sinusoidal half wave, initial $T_J = T_J$ maximum		
Maximum $I^2t$ for fusing	$I^2t$	<div> <math>t = 10\text{ ms}</math>  <math>t = 8.3\text{ ms}</math> </div> <div> No voltage reappplied  100 % <math>V_{RRM}</math> reappplied </div>	21.7 19.8 15.3 14.0	$kA^2s$
Maximum $I^2\sqrt{t}$ for fusing	$I^2\sqrt{t}$	$t = 0.1\text{ ms}$ to $10\text{ ms}$ , no voltage reappplied	217	$kA^2\sqrt{s}$
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	$m\Omega$
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	$V_{TM}$	$I_{pk} = 350\text{ A}$ , $T_J = T_J$ maximum, $t_p = 10\text{ ms}$ sine pulse	1.57	V
Maximum holding current	$I_H$	$T_J = 25\text{ °C}$ , 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 $\Omega$ , $t_r \leq 1\text{ }\mu s$ $T_J = T_J$ maximum, anode voltage $\leq 80\%$ $V_{DRM}$	300	A/ $\mu s$
Typical delay time	$t_d$	Gate current 1 A, $dI_g/dt = 1\text{ A}/\mu s$ $V_d = 0.67\%$ $V_{DRM}$ , $T_J = 25\text{ °C}$	1	$\mu s$
Typical turn-off time	$t_q$	$I_{TM} = 50\text{ A}$ , $T_J = T_J$ maximum, $dI/dt = -5\text{ A}/\mu s$ $V_R = 50\text{ V}$ , $dV/dt = 20\text{ V}/\mu s$ , gate 0 V 25 $\Omega$	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/ $\mu s$
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 <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms		12		W
Maximum average gate power	P <sub>G(AV)</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, f = 50 Hz, d% = 50		3.0		
Maximum peak positive gate current	I <sub>GM</sub>	T <sub>J</sub> = T <sub>J</sub> maximum, t <sub>p</sub> ≤ 5 ms		3.0		A
Maximum peak positive gate voltage	+ V <sub>GM</sub>			20		V
Maximum peak negative gate voltage	- V <sub>GM</sub>			10		
DC gate current required to trigger	I <sub>GT</sub>	T <sub>J</sub> = - 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 <sub>J</sub> = 25 °C		80	120	
		T <sub>J</sub> = 140 °C		40	-	
DC gate voltage required to trigger	V <sub>GT</sub>	T <sub>J</sub> = - 40 °C		2.5	-	V
		T <sub>J</sub> = 25 °C		1.6	2	
		T <sub>J</sub> = 140 °C		1	-	
DC gate current not to trigger	I <sub>GD</sub>	T <sub>J</sub> = T <sub>J</sub> maximum	Maximum gate current/ voltage not to trigger is the maximum value which will not trigger any unit with rated V <sub>DRM</sub> anode to cathode applied	6.0		mA
DC gate voltage not to trigger	V <sub>GD</sub>			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, $\pm 10$ %		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)	

$\Delta R_{thJC}$ 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

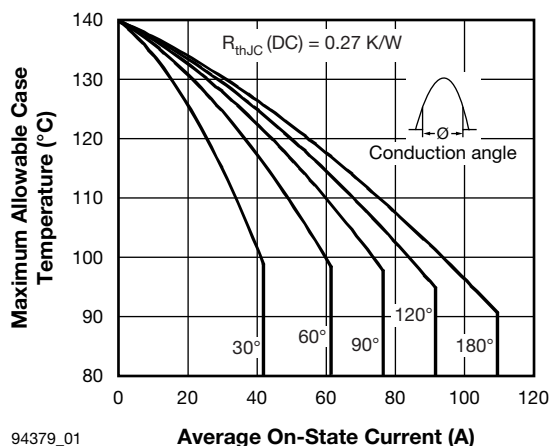


Fig. 1 - Current Ratings Characteristics

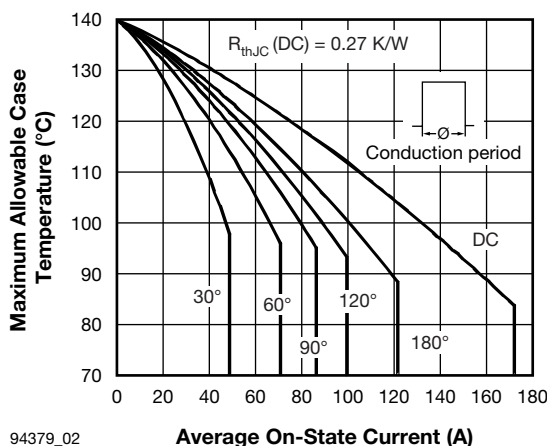


Fig. 2 - Current Ratings Characteristics

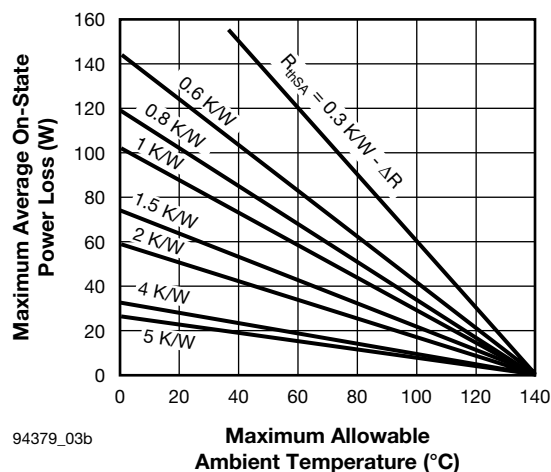
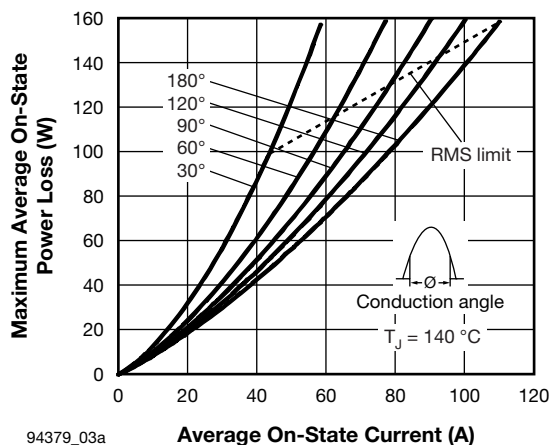


Fig. 3 - On-State Power Loss Characteristics

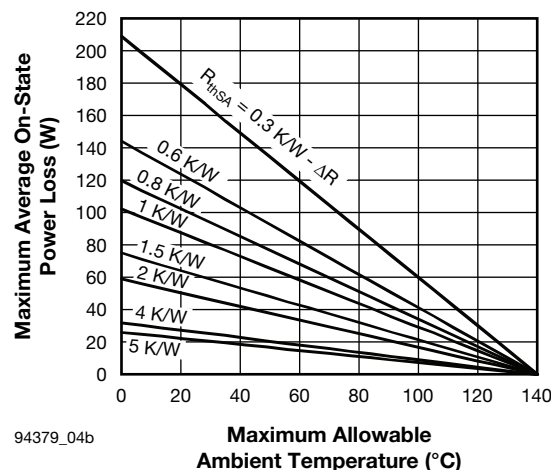
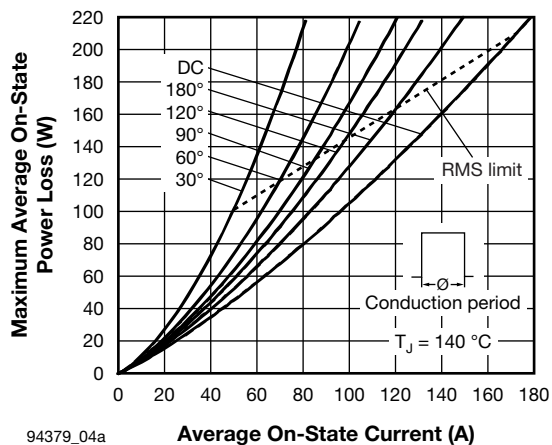


Fig. 4 - On-State Power Loss Characteristics

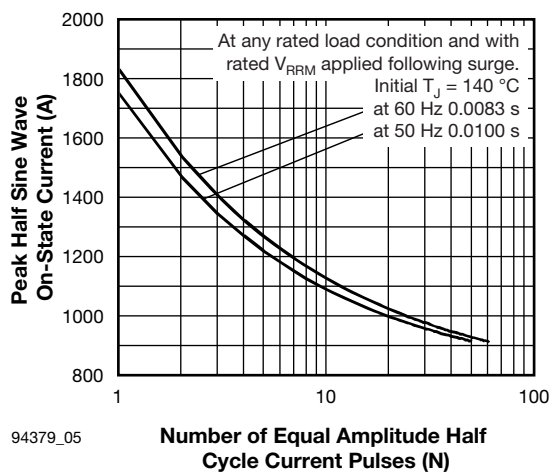


Fig. 5 - Maximum Non-Repetitive Surge Current

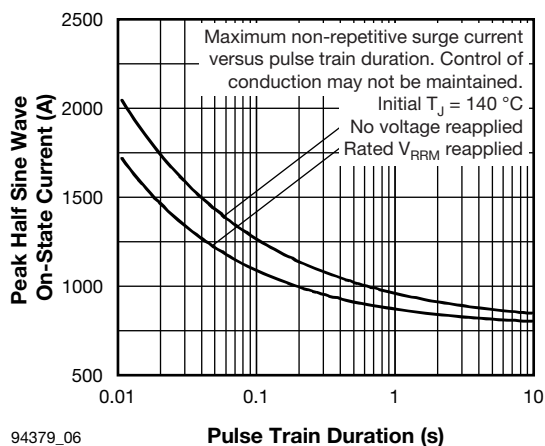


Fig. 6 - Maximum Non-Repetitive Surge Current

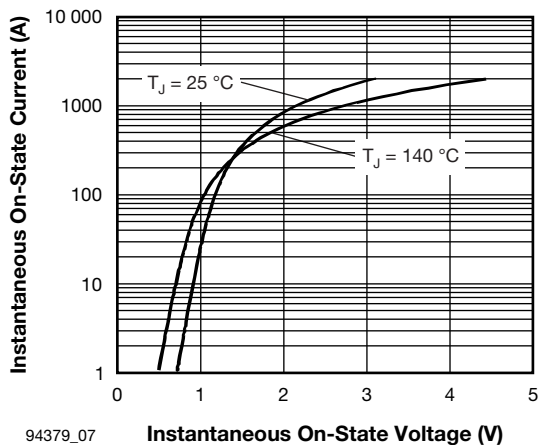


Fig. 7 - On-State Voltage Drop Characteristics

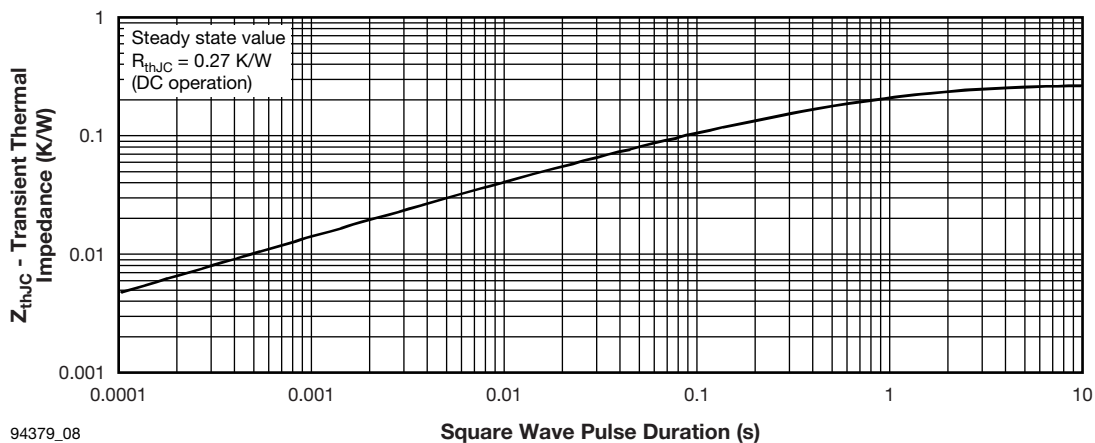


Fig. 8 - Thermal Impedance  $Z_{thJC}$  Characteristic

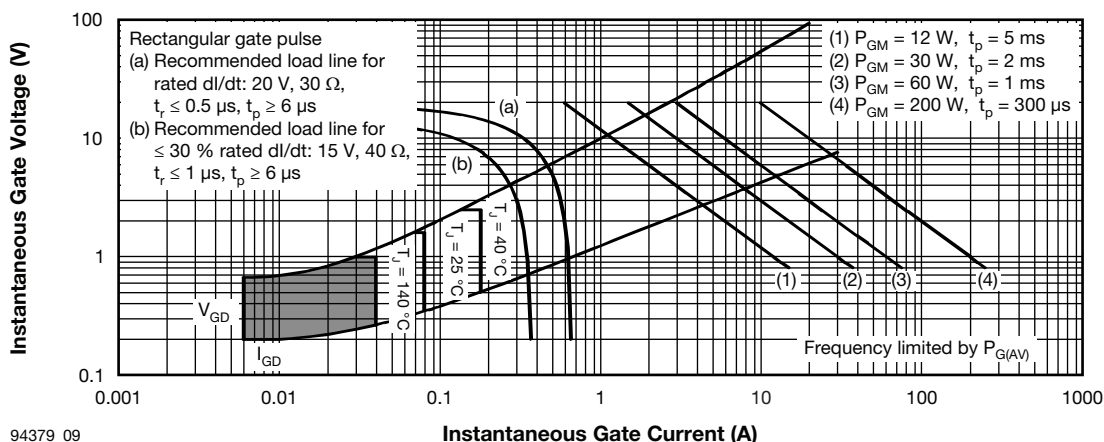


Fig. 9 - Gate Characteristics

## 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	<ul style="list-style-type: none"> <li>0 = eyelet terminals (gate and auxiliary cathode leads)</li> <li>1 = fast-on terminals (gate and auxiliary cathode leads)</li> </ul>						
4	Thyristor						
5	Voltage code x 10 = $V_{RRM}$ (see Voltage Ratings table)						
6	<ul style="list-style-type: none"> <li>None = stud base 1/2"-20UNF-2A threads</li> <li>M = stud base metric threads M12 x 1.75 E 6</li> </ul>						
7	<ul style="list-style-type: none"> <li>None = standard production</li> <li>PbF = lead (Pb)-free</li> </ul>						

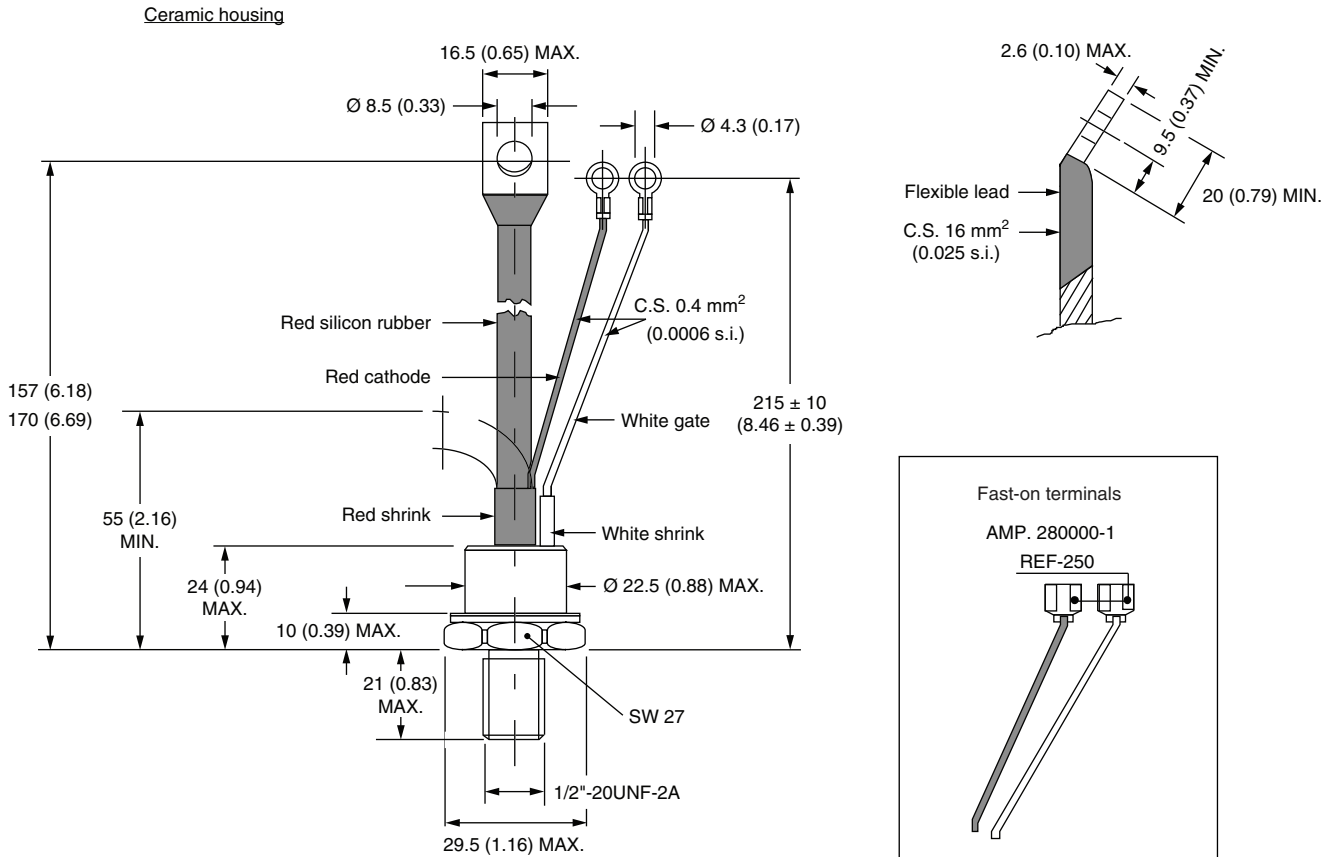
## LINKS TO RELATED DOCUMENTS

Dimensions

[www.vishay.com/doc?95003](http://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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