

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}	$t = 10\text{ ms}$ $t = 8.3\text{ ms}$ No voltage reapplied 100 % V_{RRM} reapplied	2080 2180 1750 1830	A
		Sinusoidal half wave, initial $T_J = T_J$ maximum		
Maximum I^2t for fusing	I^2t	$t = 10\text{ ms}$ $t = 8.3\text{ ms}$ No voltage reapplied 100 % V_{RRM} reapplied	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 ms , no voltage reapplied	217	$\text{kA}^2\sqrt{\text{s}}$
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	$\text{m}\Omega$
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 Ω , $t_r \leq 1\text{ }\mu\text{s}$ $T_J = T_J$ maximum, anode voltage $\leq 80\%$ V_{DRM}	300	A/ μs
Typical delay time	t_d	Gate current 1 A, $dI_g/dt = 1\text{ A}/\mu\text{s}$ $V_d = 0.67\%$ V_{DRM} , $T_J = 25\text{ °C}$	1	μs
Typical turn-off time	t_q	$I_{TM} = 50\text{ A}$, $T_J = T_J$ maximum, $dI/dt = -5\text{ A}/\mu\text{s}$ $V_R = 50\text{ V}$, $dV/dt = 20\text{ V}/\mu\text{s}$, 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



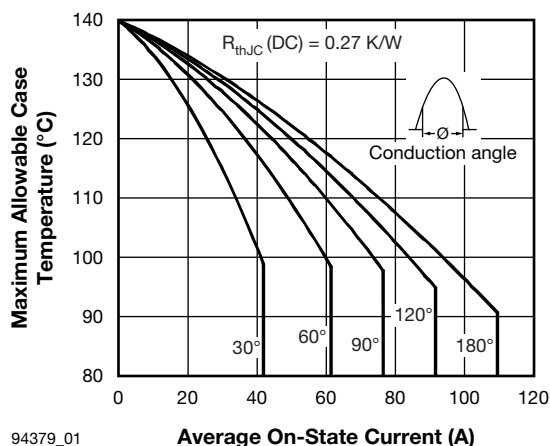
TRIGGERING						
PARAMETER	SYMBOL	TEST CONDITIONS		VALUES		UNITS
				TYP.	MAX.	
Maximum peak gate power	P _{GM}	T _J = T _J maximum, t _p ≤ 5 ms		12		W
Maximum average gate power	P _{G(AV)}	T _J = T _J maximum, f = 50 Hz, d% = 50		3.0		
Maximum peak positive gate current	I _{GM}	T _J = T _J maximum, t _p ≤ 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}	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	6.0		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 +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		

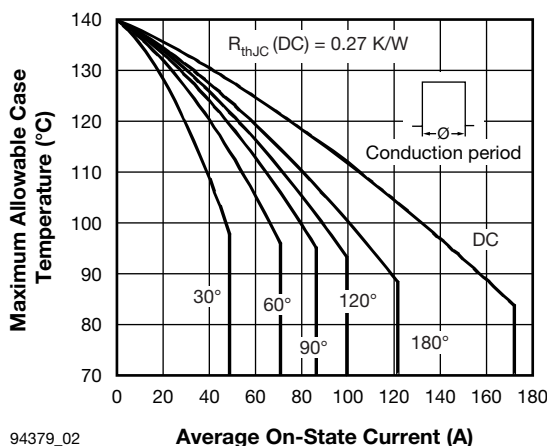
Note

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



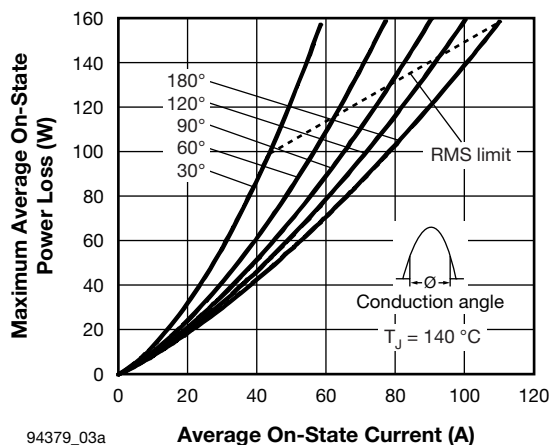
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Fig. 1 - Current Ratings Characteristics

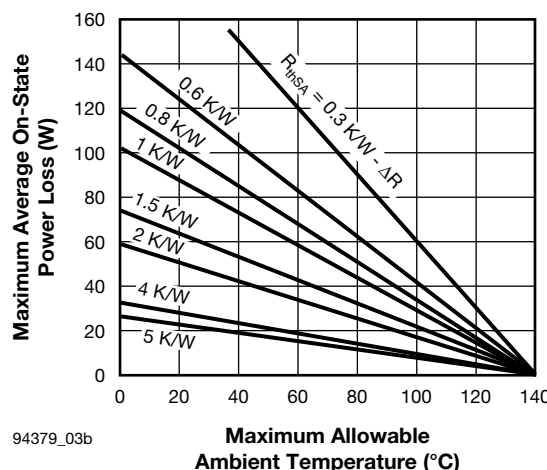


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Fig. 2 - Current Ratings Characteristics

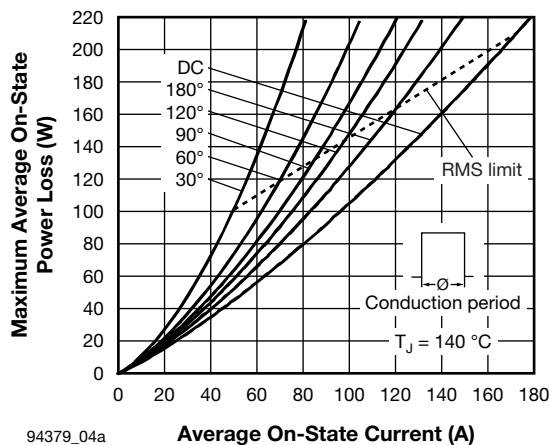


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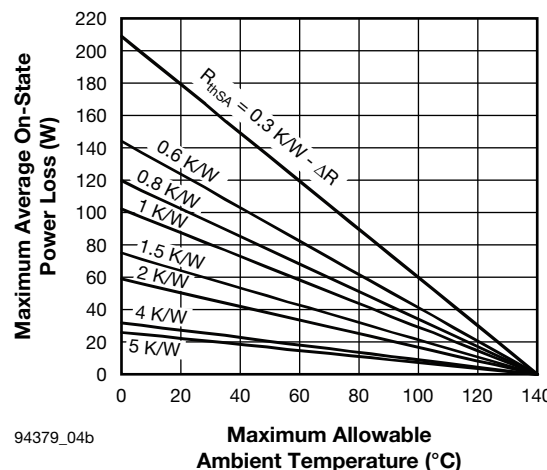


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Fig. 3 - On-State Power Loss Characteristics



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94379_04b

Fig. 4 - On-State Power Loss Characteristics

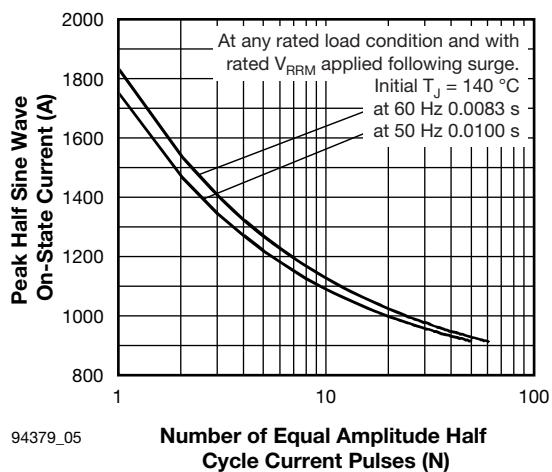


Fig. 5 - Maximum Non-Repetitive Surge Current

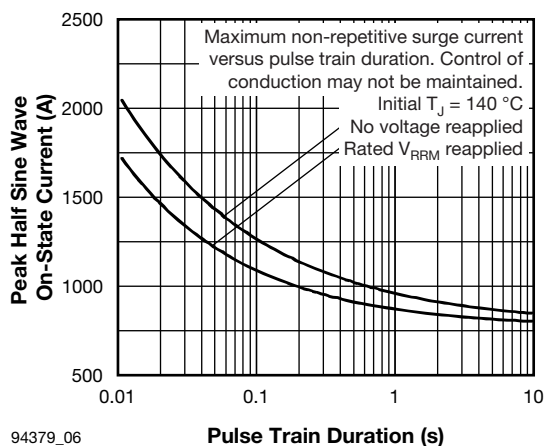


Fig. 6 - Maximum Non-Repetitive Surge Current

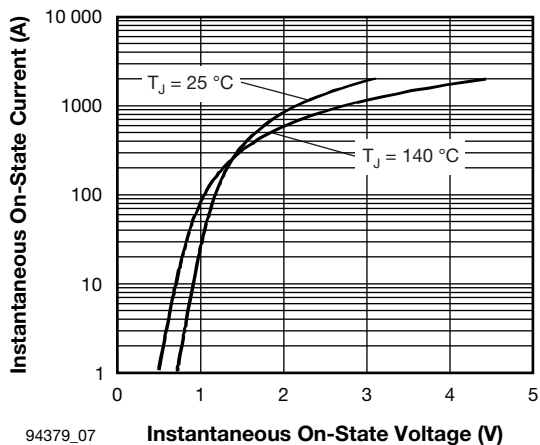


Fig. 7 - On-State Voltage Drop Characteristics

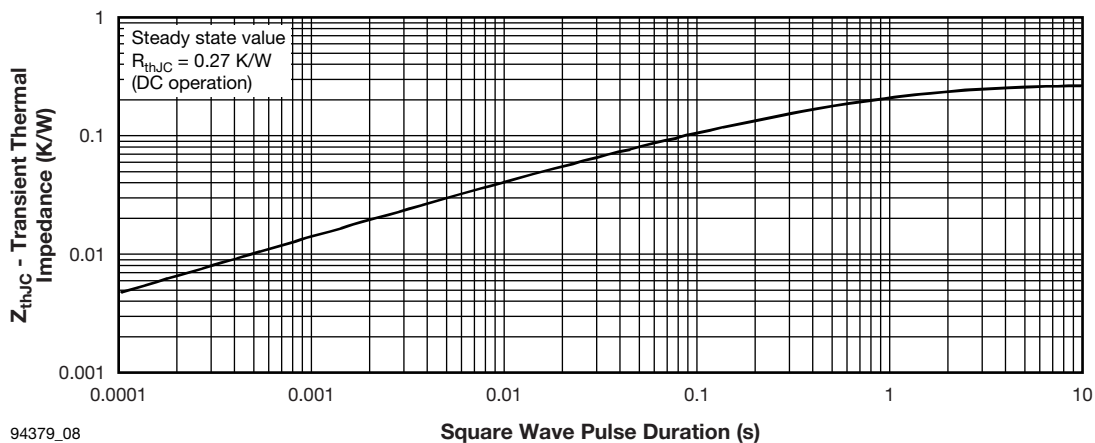


Fig. 8 - Thermal Impedance Z_{thJC} Characteristic

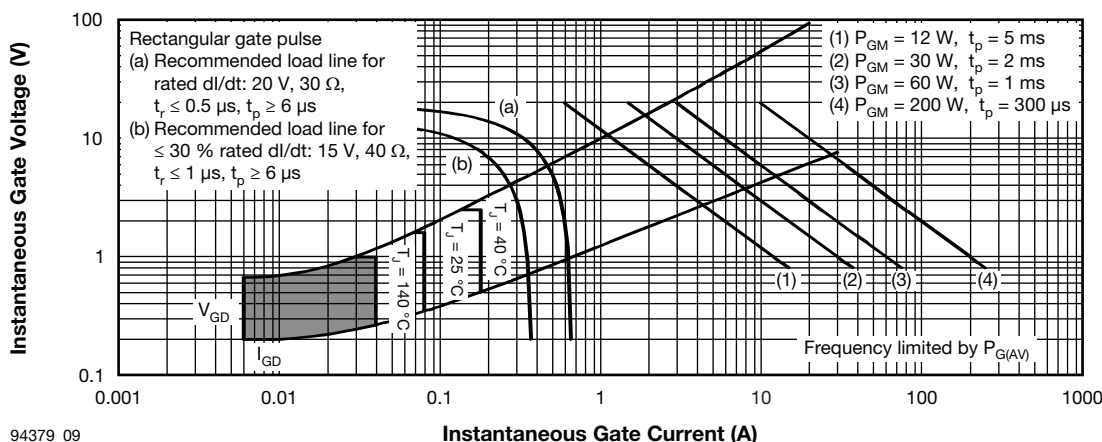


Fig. 9 - Gate Characteristics

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						

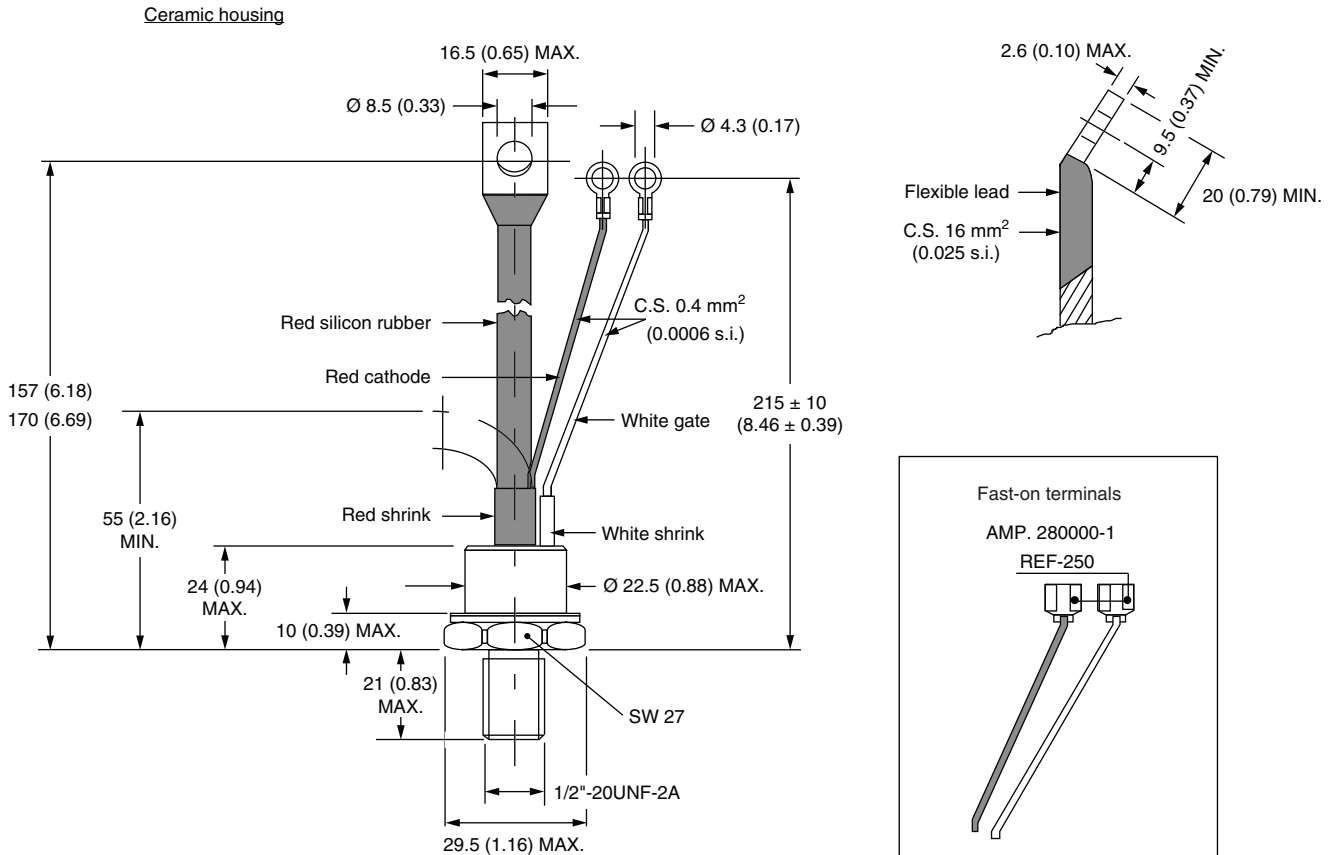
LINKS TO RELATED DOCUMENTS

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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