Bulletin I25152 rev. C 05/97

International
IOR Rectifier

111RKI SERIES

PHASE CONTROL THYRISTORS **Stud Version**

110A

Features

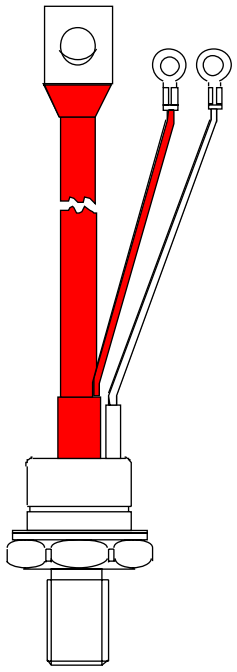
- High current and high surge ratings
- dv/dt = 1000V/µs option
- Ceramic housing
- Threaded studs UNF 1/2 - 20UNF2A
- Types up to 1200V V_{RRM}/V_{DRM}
- di/dt = 300A/µs

TypicalApplications

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

Major Ratings and Characteristics

Parameters		111RKI	Units
$I_{T(AV)}$		110	A
	@ T_C	90	°C
$I_{T(RMS)}$		172	A
I_{TSM}	@ 50Hz	2080	A
	@ 60Hz	2180	A
I^2t	@ 50Hz	21.7	KA^2s
	@ 60Hz	19.8	KA^2s
V_{DRM}/V_{RRM}		400 to 1200	V
t_q	typical	110	µs
T_J		- 40 to 140	°C



case style
TO-209AC (TO-94)

ELECTRICAL SPECIFICATIONS

Voltage Ratings

Type number	Voltage Code	V_{DRM}/V_{RRM}, max. repetitive peak and off-state voltage V	V_{RSM}, maximum non-repetitive peak voltage V	I_{DRM}/I_{RRM} max. @ $T_J = T_J$ max. mA
111RKI	40	400	500	20
	80	800	900	
	120	1200	1300	

On-state Conduction

	Parameter	111RKI	Units	Conditions		
$I_{T(AV)}$	Max. average on-state current	110	A	180° conduction, half sine wave		
	@ Case temperature	90	°C			
$I_{T(RMS)}$	Max. RMS on-state current	172	A	DC @ 83°C case temperature		
I_{TSM}	Max. peak, one-cycle non-repetitive surge current	2080	A	t = 10ms	No voltage reapplied	Sinusoidal half wave, Initial $T_J = T_J$ max.
		2180		t = 8.3ms		
		1750		t = 10ms	100% V_{RRM} reapplied	
		1830		t = 8.3ms		
I^2t	Maximum I^2t for fusing	21.7	KA^2s	t = 10ms	No voltage reapplied	
		19.8		t = 8.3ms		
		15.3		t = 10ms	100% V_{RRM} reapplied	
		14.0		t = 8.3ms		
$I^2\sqrt{t}$	Maximum $I^2\sqrt{t}$ for fusing	217	$KA^2\sqrt{s}$	t = 0.1 to 10ms, no voltage reapplied		
$V_{T(TO)1}$	Low level value of threshold voltage	0.82	V	(16.7% x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ max.		
$V_{T(TO)2}$	High level value of threshold voltage	1.02		(I > π x $I_{T(AV)}$), $T_J = T_J$ max.		
r_{t1}	Low level value of on-state slope resistance	2.16	mΩ	(16.7% x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ max.		
r_{t2}	High level value of on-state slope resistance	1.70		(I > π x $I_{T(AV)}$), $T_J = T_J$ max.		
V_{TM}	Max. on-state voltage	1.57	V	I_{pk}= 350A, $T_J = T_J$ max., t_p = 10ms sine pulse		
I_H	Maximum holding current	200	mA	T_J = 25°C, anode supply 6V resistive load		
I_L	Typical latching current	400				

Switching

	Parameter	111RKI	Units	Conditions
di/dt	Max. non-repetitive rate of rise of turned-on current	300	A/µs	Gate drive 20V, 20Ω, $t_r \leq$ 1µs $T_J = T_J$ max, anode voltage ≤ 80% V_{DRM}
t_d	Typical delay time	1	µs	Gate current 1A, di_g/dt = 1A/µs V_d = 0.67% V_{DRM}, T_J = 25°C
t_q	Typical turn-off time	110		I_{TM} = 50A, $T_J = T_J$ max., di/dt = -5A/µs, V_R = 50V dv/dt = 20V/µs, Gate 0V 25Ω

Blocking

	Parameter	111RKI	Units	Conditions
dv/dt	Maximum critical rate of rise of off-state voltage	500	V/µs	$T_J = T_J$ max. linear to 80% rated V_{DRM}
I_{RRM} I_{DRM}	Max. peak reverse and off-state leakage current	20	mA	$T_J = T_J$ max, rated V_{DRM}/V_{RRM} applied

Triggering

	Parameter	111RKI		Units	Conditions	
P_{GM}	Maximum peak gate power	12		W	$T_J = T_J$ max, $t_p \leq 5$ms	
$P_{G(AV)}$	Maximum average gate power	3.0			$T_J = T_J$ max, f = 50Hz, d% = 50	
I_{GM}	Max. peak positive gate current	3.0		A	$T_J = T_J$ max, $t_p \leq 5$ms	
$+V_{GM}$	Maximum peak positive gate voltage	20		V	$T_J = T_J$ max, $t_p \leq 5$ms	
$-V_{GM}$	Maximum peak negative gate voltage	10				
		TYP.	MAX.			
I_{GT}	DC gate current required to trigger	180	-	mA	T_J = - 40°C	Max. required gate trigger/ current/ voltage are the lowest value which will trigger all units 12V anode-to-cathode applied
		80	120		T_J = 25°C	
		40	-		T_J = 140°C	
V_{GT}	DC gate voltage required to trigger	2.5	-	V	T_J = - 40°C	
		1.6	2		T_J = 25°C	
		1	-		T_J = 140°C	
I_{GD}	DC gate current not to trigger	6.0		mA	$T_J = T_J$ max	Max. gate current/ voltage not to trigger is the max. value which will not trigger any unit with rated V_{DRM} anode-to-cathode applied
V_{GD}	DC gate voltage not to trigger	0.25		V		

Thermal and Mechanical Specification

	Parameter	111RKI	Units	Conditions
T_J	Max. operating temperature range	-40 to 140	°C	
T_{stg}	Max. storage temperature range	-40 to 150		
R_{thJC}	Max. thermal resistance, junction to case	0.27	K/W	DC operation
R_{thCS}	Max. thermal resistance, case to heatsink	0.1		Mounting surface, smooth, flat and greased
T	Mounting torque, ± 10%	15.5 (137)	Nm (lbf-in)	Non lubricated threads
		14 (120)		Lubricated threads
wt	Approximate weight	130	g	
	Case style	TO - 209AC (TO-94)		See Outline Table

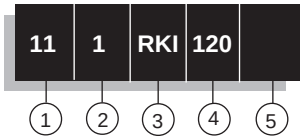
ΔR_{thJC} Conduction

(The following table shows the increment of thermal resistence R_{thJC} when devices operate at different conduction angles than DC)

Conduction angle	Sinusoidal conduction	Rectangular conduction	Units	Conditions
180°	0.043	0.031	K/W	$T_J = T_J$ max.
120°	0.052	0.053		
90°	0.066	0.071		
60°	0.096	0.101		
30°	0.167	0.169		

Ordering Information Table

Device Code



1 - $I_{T(AV)}$ rated average output current (rounded/10)

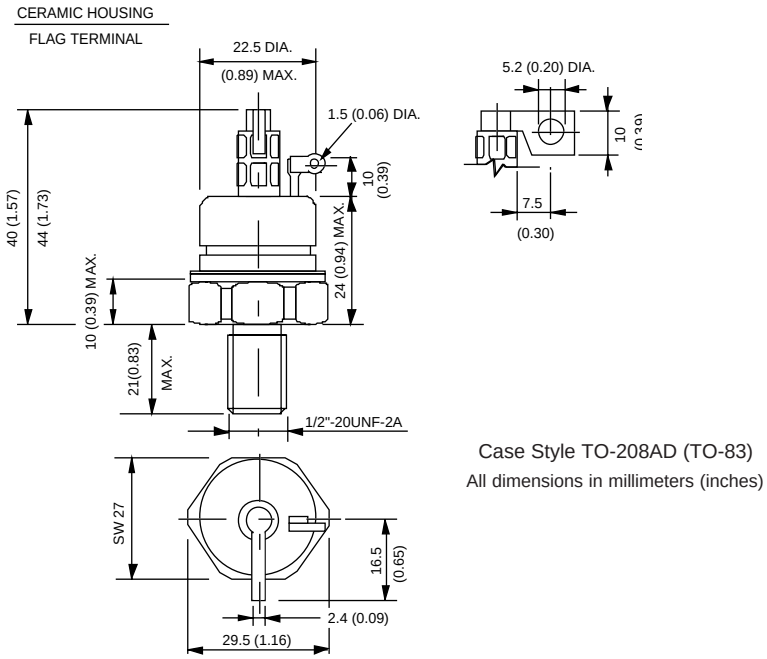
2 - 0 = Eyelet terminals (Gate and Auxiliary Cathode Leads)
1 = Fast - on terminals (Gate and Auxiliary Cathode Leads)
2 = Flag terminals (For Cathode and Gate Terminals)

3 - Thyristor

4 - Voltage code: Code x 10 = V_{RRM} (See Voltage Rating Table)

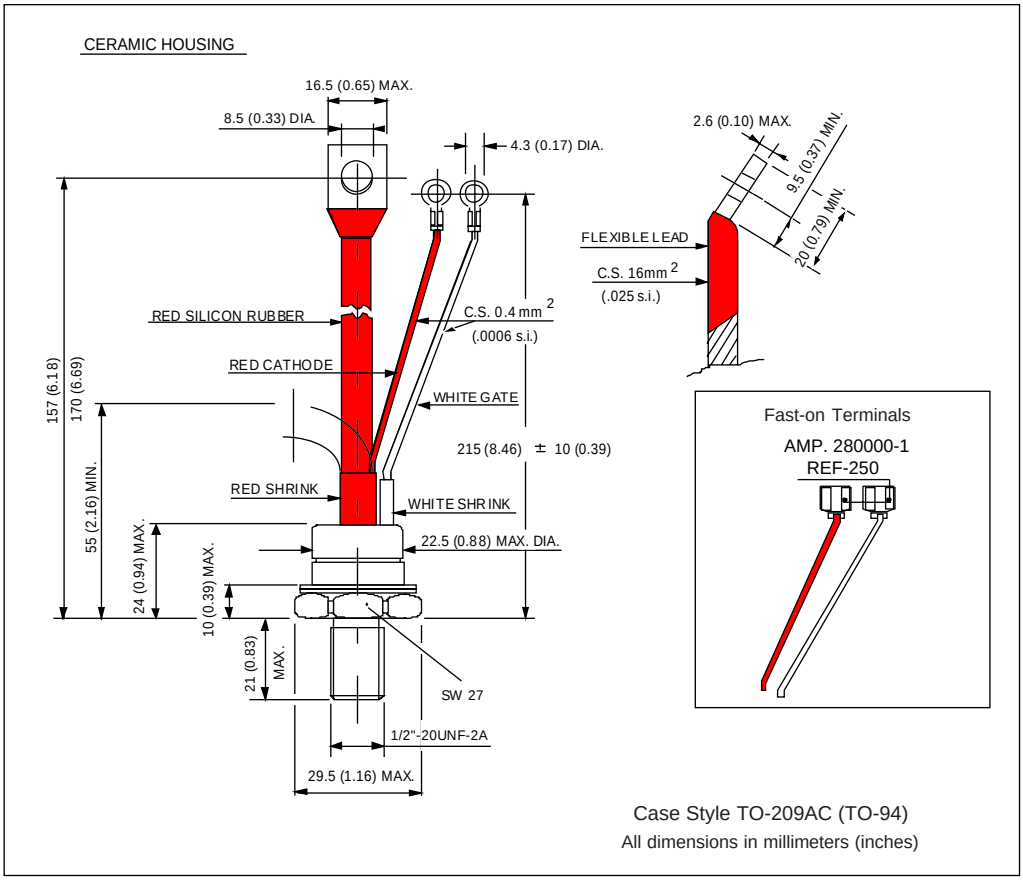
5 - Critical dv/dt: None = 500V/µsec
S90 = 1000V/µsec

Outline Table



Case Style TO-208AD (TO-83)
All dimensions in millimeters (inches)

Outline Table



Case Style TO-209AC (TO-94)

All dimensions in millimeters (inches)

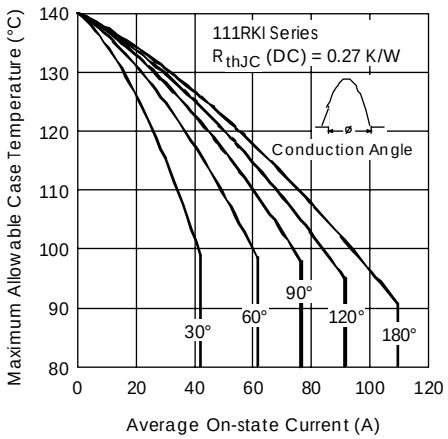


Fig. 1 - Current Ratings Characteristics

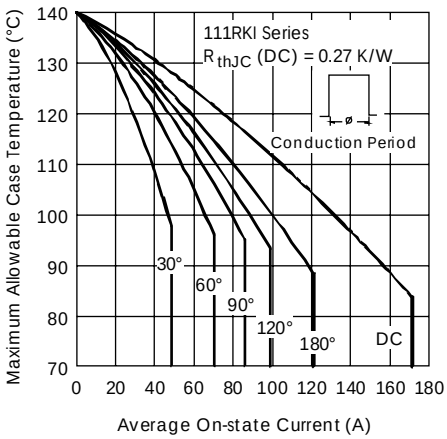


Fig. 2 - Current Ratings Characteristics

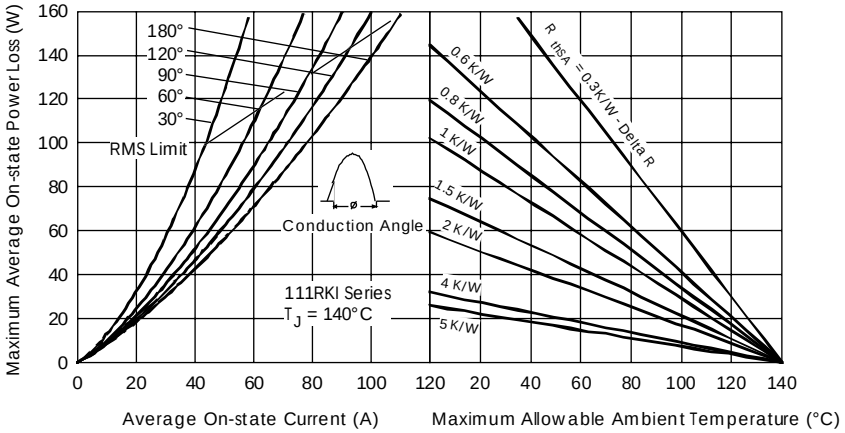


Fig. 3 - On-state Power Loss Characteristics

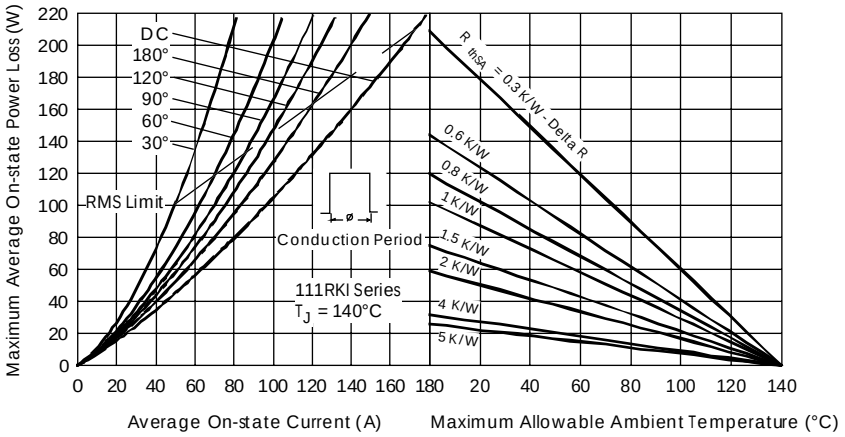


Fig. 4 - On-state Power Loss Characteristics

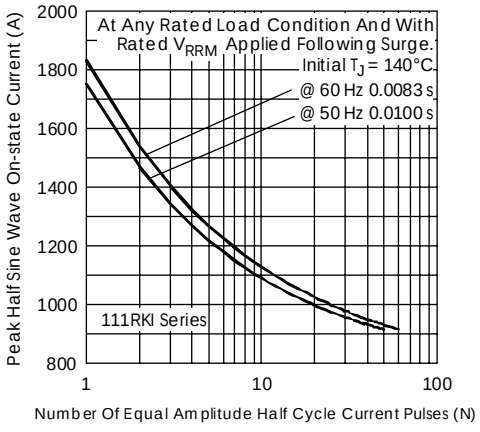


Fig. 5 - Maximum Non-Repetitive Surge Current

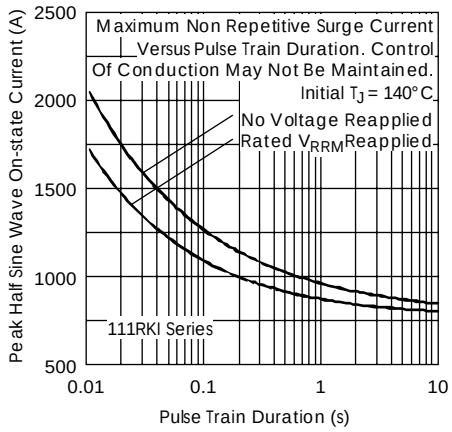


Fig. 6 - Maximum Non-Repetitive Surge Current

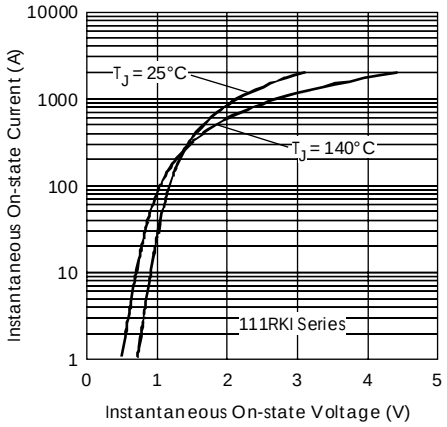


Fig. 7 - On-state Voltage Drop Characteristics

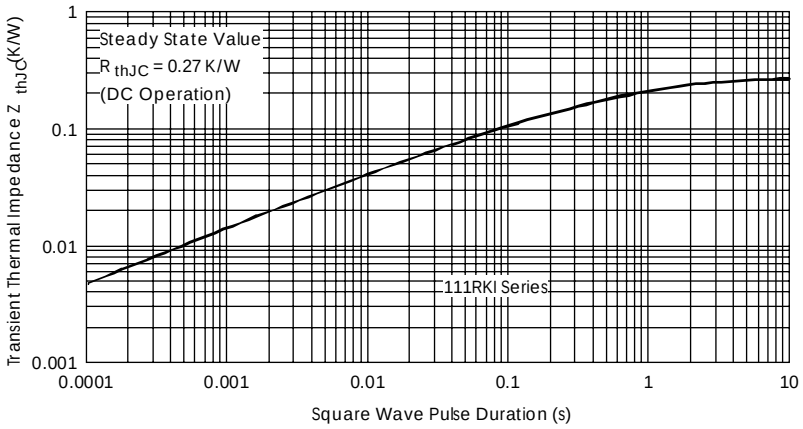


Fig. 8 - Thermal Impedance Z_{thJC} Characteristic

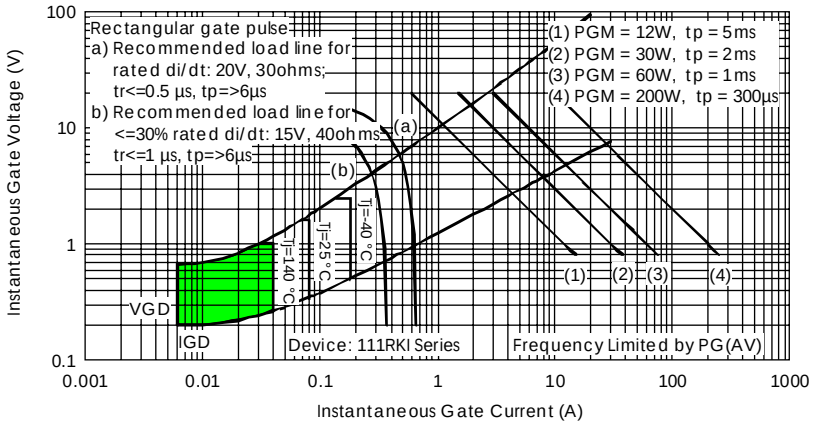


Fig. 9 - Gate Characteristics