Bulletin I27091 rev.A 09/97

International
IOR Rectifier

IRK.F112.. SERIES

FAST THYRISTOR/ DIODE and THYRISTOR/ THYRISTOR

INT-A-pak™ Power Modules

112 A

Features

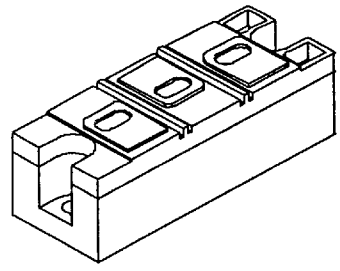
- Fast turn-off thyristor
- Fast recovery diode
- High surge capability
- Electrically isolated baseplate
- 3000 V_{RMS} isolating voltage
- Industrial standard package
- UL E78996 approved

Description

These series of INT-A-pak modules are intended for applications such as self-commutated inverters, DC choppers, electronic welders, induction heating and others where fast switching characteristics are required.

Major Ratings and Characteristics

Parameters		IRK.F112..	Units
$I_{T(AV)}$		112	A
	@ T_C	90	°C
$I_{T(RMS)}$		250	A
I_{TSM}	@ 50Hz	3090	A
	@ 60Hz	3237	A
I^2t	@ 50Hz	47.8	KA^2s
	@ 60Hz	43.6	KA^2s
$I^2\sqrt{t}$		478	$KA^2\sqrt{s}$
t_q		10 and 15	µs
t_{rr}		2	µs
V_{DRM}/V_{RRM}		up to 800	V
T_J	range	-40 to 125	°C



ELECTRICAL SPECIFICATIONS

Voltage Ratings

Type number	Voltage Code	V_{RRM}/V_{DRM}, maximum repetitive peak reverse voltage V	V_{RSM}, maximum non-repetitive peak rev. voltage V	I_{RRM}/I_{DRM} max. @ T_J = 125°C mA
IRK.F112.. Series	04	400	400	30
	08	800	800	

Current Carrying Capacity

Frequency f	180°el I_{TM}		180°el I_{TM}		100µs I_{TM}		Units
50Hz	220	220	350	550	2060	2900	A
400Hz	285	285	425	695	1230	1785	A
2500Hz	205	205	350	550	460	552	A
5000Hz	175	170	295	448	295	448	A
10000Hz	125	120	230	337	-	-	A
Recovery voltage Vr	50	50	50	50	50	50	V
Voltage before turn-on Vd	80%V_{DRM}		80%V_{DRM}		80%V_{DRM}		V
Rise of on-state current di/dt	50	50	-	-	-	-	A/µs
Case temperature	90	60	90	60	90	60	°C
Equivalent values for RC circuit	47Ω / 0.22µF		47Ω / 0.22µF		47Ω / 0.22µF		

On-state Conduction

	Parameter	IRK.F112..	Units	Conditions		
$I_{T(AV)}$	Maximum average on-state current	112	A	180° conduction, half sine wave		
	@ Case temperature	90	°C			
$I_{T(RMS)}$	Maximum RMS current	250	A	T_C = 90°C, as AC switch		
I_{TSM}	Maximum peak, one-cycle, non-repetitive surge current	3090	A	t = 10ms	No voltage reapplied	Sinusoidal half wave, Initial T_J = 125°C
		3237		t = 8.3ms		
		2600		t = 10ms	100% V_{RRM} reapplied	
		2720		t = 8.3ms		
I^2t	Maximum I^2t for fusing	47.8	KA^2s	t = 10ms	No voltage reapplied	
		43.6		t = 8.3ms		
		33.8		t = 10ms	100% V_{RRM} reapplied	
		30.8		t = 8.3ms		
$I^2\sqrt{t}$	Maximum $I^2\sqrt{t}$ for fusing	478	$KA^2\sqrt{s}$	t = 0 to 10ms, no voltage reapplied		
$V_{T(TO)1}$	Low level value of threshold voltage	1.19	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	1.43		(I > π x $I_{T(AV)}$), T_J = T_J max.		
r_{t1}	Low level value of on-state slope resistance	1.67	mW	(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	1.12		(I > π x $I_{T(AV)}$), T_J = T_J max.		
V_{TM}	Maximum on-state voltage drop	1.77	V	I_{pk} = 350A, T_J = T_J max., t_p = 10ms sine pulse		
I_H	Maximum holding current	600	mA	T_J = 25°C, I_T > 30 A		
I_L	Typical latching current	1000	mA	T_J = 25°C, V_A = 12V, Ra = 6Ω, Ig = 1A		

Switching

	Parameter	IRK.F112..		Units	Conditions
di/dt	Maximum non-repetitive rate of rise	800		A/µs	Gate drive 20V, 20Ω, tr ≤ 1ms, V_D= 80% V_{DRM} T_J = 125°C
t_{rr}	Maximum recovery time	2		µs	I_{TM} = 350A, di/dt = -25A/µs, V_R = 50V, T_J = 25°C
t_q	Maximum turn-off time	N	L		I_{TM} = 350A, T_J = 125°C, dI/dt = -25A/µs,
		10	15	µs	V_R = 50V, dv/dt = 400V/µs linear to 80% V_{DRM}

Blocking

	Parameter	IRK.F112..	Units	Conditions
dv/dt	Maximum critical rate of rise of off-state voltage	1000	V/µs	T_J = 125°C., exponential to 67% V_{DRM}
V_{INS}	RMS isolation voltage	3000	V	50 Hz, circuit to base, T_J = 25°C, t = 1 s
I_{RRM} I_{DRM}	Maximum peak reverse and off-state leakage current	30	mA	T_J = 125°C, rated V_{DRM}/V_{RRM} applied

Triggering

	Parameter	IRK.F112..	Units	Conditions
P_{GM}	Maximum peak gate power	60	W	f = 50 Hz, d% = 50
$P_{G(AV)}$	Maximum peak average gate power	10	W	T_J = 125°C, f = 50Hz, d% = 50
I_{GM}	Maximum peak positive gate current	10	A	T_J = 125°C, $t_p \leq$ 5ms
- V_{GM}	Maximum peak negative gate voltage	5	V	
I_{GT}	Max. DC gate current required to trigger	200	mA	T_J = 25°C, V_{ak} 12V, Ra = 6
V_{GT}	DC gate voltage required to trigger	3	V	
I_{GD}	DC gate current not to trigger	20	mA	T_J = 125°C, rated V_{DRM} applied
V_{GD}	DC gate voltage not to trigger	0.25	V	

Thermal and Mechanical Specifications

	Parameter		IRK.F112..	Units	Conditions
T_J	Max. junction operating temperature range		-40 to 125	°C	
T_{stg}	Max. storage temperature range		-40 to 150		
R_{thJC}	Max. thermal resistance, junction to case		0.17	K/W	Per junction, DC operation
R_{thC-hs}	Max. thermal resistance, case to heatsink		0.035	K/W	Mounting surface flat and greased Per module
T	Mounting torque ± 10%	IAP to heatsink	4 - 6 (35 - 53)	Nm	A mounting compound is recommended. The torque should be rechecked after a period of 3 hours to allow for the spread of the compound. Use of cable lugs is not recommendd, busbars should be used and restrained during tightening. Threads must be lubricated with a compound
		busbar to IAP	4 - 6 (35 - 53)	(lb*in)	
wt	Approximate weight		500 (17.8)	g (oz)	

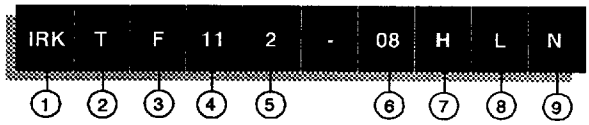
ΔR_{thJC} Conduction

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

Conduction angle	Sinusoidal conduction	Rectangular conduction	Units	Conditions
180°	0.015	0.012	K/W	T_J = 125°C
120°	0.018	0.020		
90°	0.024	0.027		
60°	0.036	0.037		
30°	0.060	0.060		

Ordering Information Table

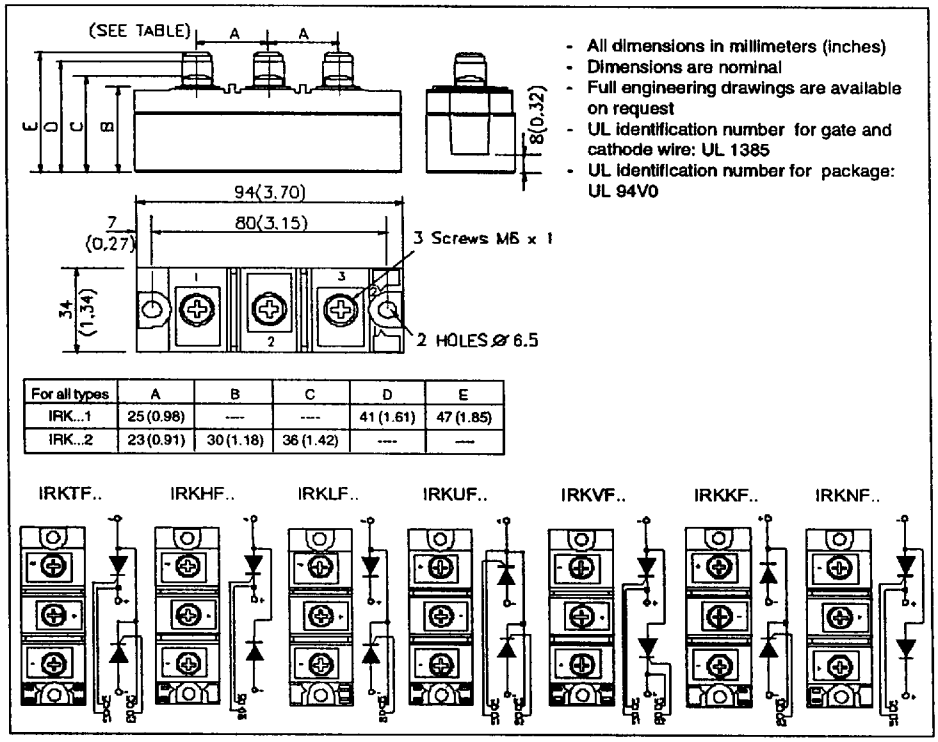
Device Code



1 - Module type
2 - Circuit configuration
3 - Fast SCR
4 - Current rating: $I_{T(AV)}$ x 10 rounded
5 - 1 = option with spacers and longer terminal screws
    2 = option with standard terminal screws
6 - Voltage code: Code x 100 = V_{RRM} (See Voltage Ratings Table)
7 - dv/dt code: H ≤ 400V/µs
8 - t_q code: N ≤ 10µs
    L ≤ 15µs
9 - None = Standard devices
    N = Aluminum nitrade substrate

NOTE: To order the Optional Hardware see Bulletin I27900

Outline Table



For all types	A	B	C	D	E
IRK...1	25 (0.98)	----	----	41 (1.61)	47 (1.85)
IRK...2	23 (0.91)	30 (1.18)	36 (1.42)	----	----

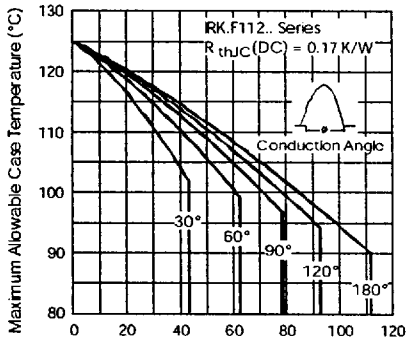


Fig. 1 - Current Ratings Characteristics

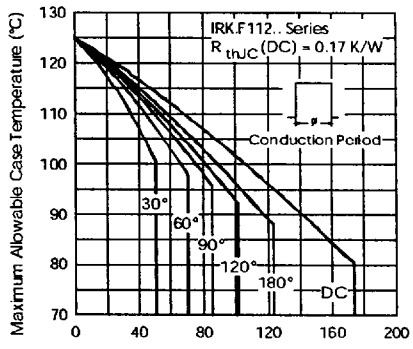


Fig. 2 - Current Ratings Characteristics

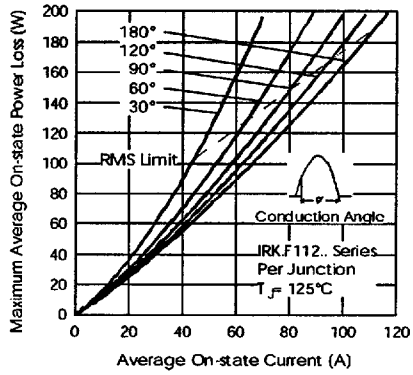


Fig. 3 - On-state Power Loss Characteristics

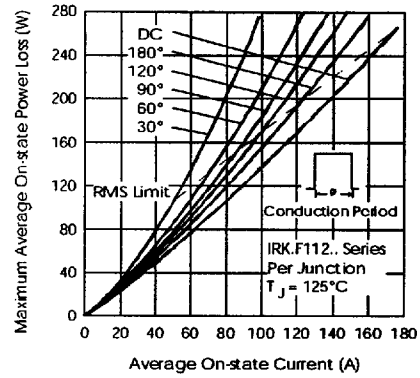


Fig. 4 - On-state Power Loss Characteristics

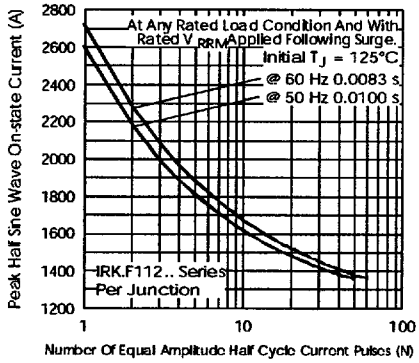


Fig. 5 - Maximum Non-Repetitive Surge Current

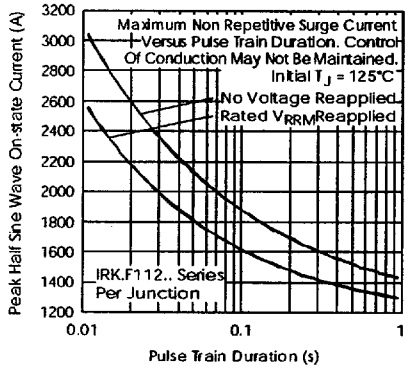


Fig. 6 - Maximum Non-Repetitive Surge Current

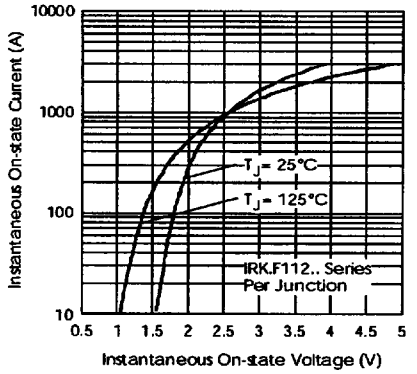


Fig. 7 - On-state Voltage Drop Characteristics

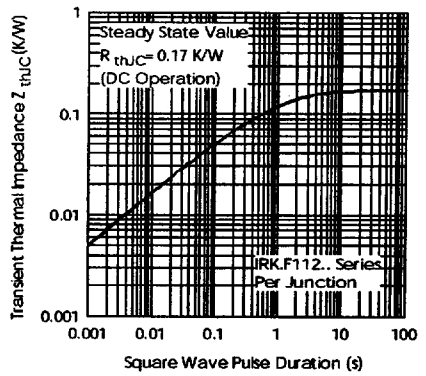


Fig. 8 - Thermal Impedance Z_{thJC} Characteristic

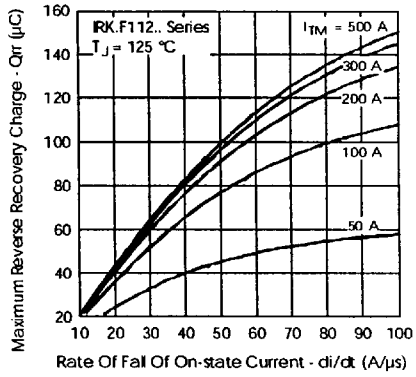


Fig. 9 - Reverse Recovery Charge Characteristics

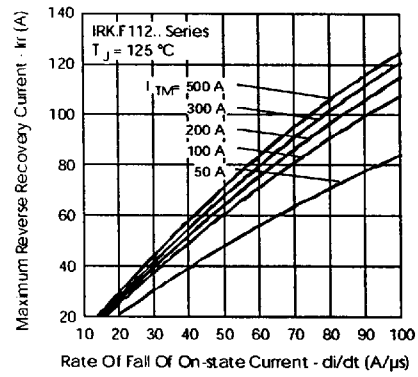


Fig. 10 - Reverse Recovery Current Characteristics

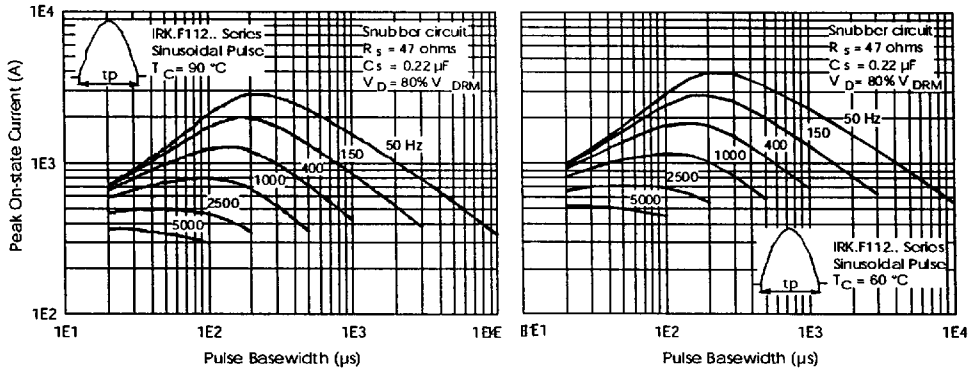


Fig. 11 - Frequency Characteristics

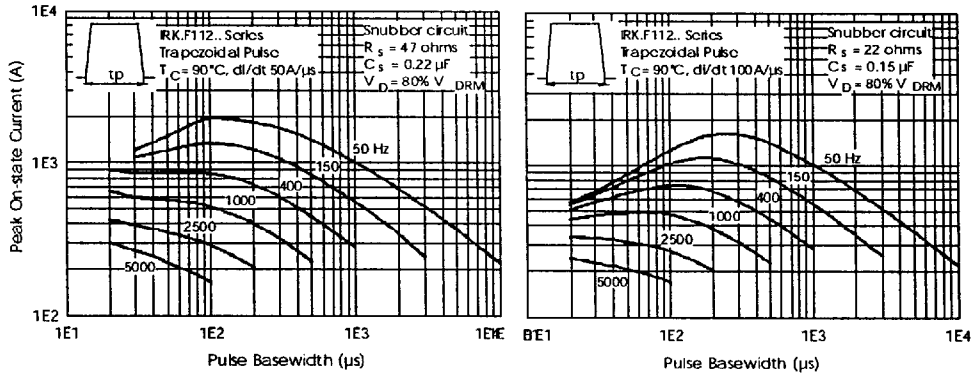


Fig. 12 - Frequency Characteristics

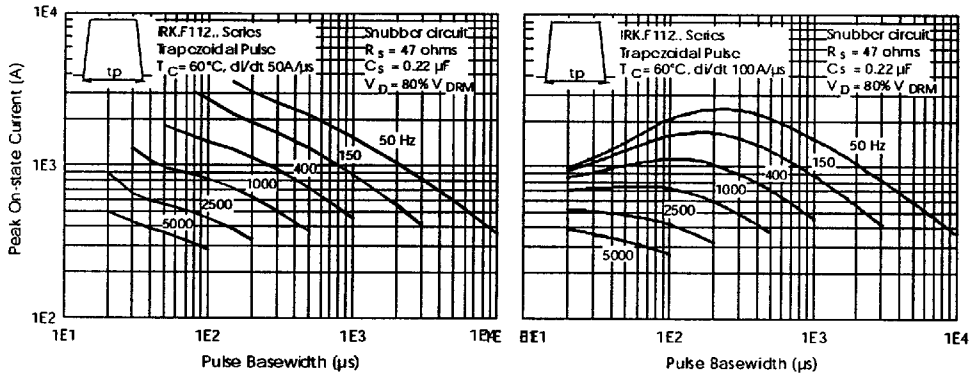


Fig. 13 - Frequency Characteristics

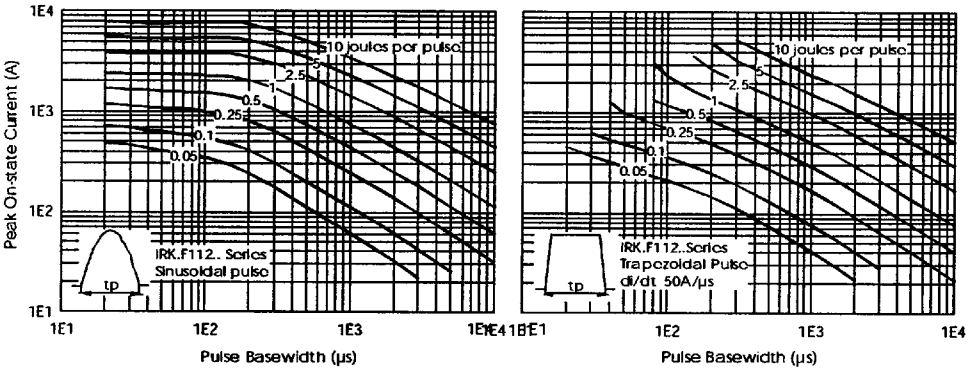


Fig. 14 - Maximum On-state Energy Power Loss Characteristics

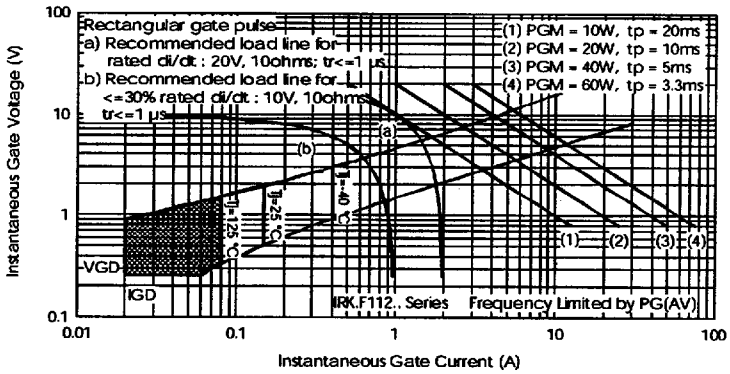


Fig. 15 - Gate Characteristics