Bulletin I27102 rev. C 05/02

International Rectifier

IRK. SERIES

SCR / SCR and SCR / DIODE **MAGN-A-pak™ Power Modules**

Features

- High voltage
- Electrically isolated base plate
- 3000 V_{RMS} isolating voltage
- Industrial standard package
- Simplified mechanical designs, rapid assembly
- High surge capability
- Large creepage distances
- UL E78996 approved

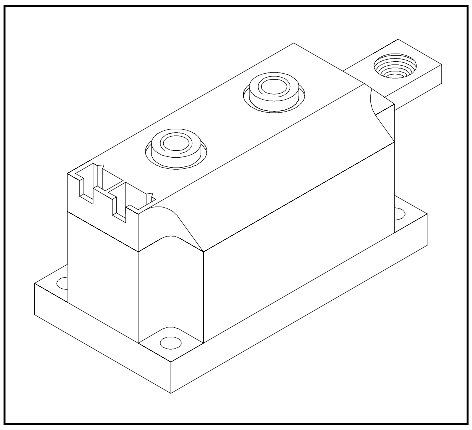
170A
230A
250A

Description

This new IRK serie of MAGN-A-paks modules uses high voltage power thyristor/thyristor and thyristor/diode in seven basic configurations. The semiconductors are electrically isolated from the metal base, allowing common heatsinks and compact assemblies to be built. They can be interconnected to form single phase or three phase bridges or as AC-switches when modules are connected in anti-parallel mode.
These modules are intended for general purpose applications such as battery chargers, welders and plating equipment and where high voltage and high current are required (motor drives, U.P.S., etc.).

Major Ratings and Characteristics

Parameters		IRK.170..	IRK.230..	IRK.250..	Units
$I_{T(AV)}$ @ 85°C		170	230	250	A
$I_{T(RMS)}$		377	510	555	A
I_{TSM}	@ 50Hz	5100	7500	8500	A
	@ 60Hz	5350	7850	8900	A
I^2t	@ 50Hz	131	280	361	KA^2s
	@ 60Hz	119	256	330	KA^2s
$I^2\sqrt{t}$		1310	2800	3610	$KA^2\sqrt{s}$
V_{DRM} / V_{RRM}		Up to1600	Up to 2000	Up to1600	V
T_J	range	-40 to 130			°C



ELECTRICAL SPECIFICATIONS

Voltage Ratings

Type number	Voltage Code	$V_{RRM}V_{DRM}$, maximum repetitive peak reverse and off-state blocking voltage V	V_{RSM} , maximum non-repetitive peak reverse voltage V	I_{RRM} I_{DRM} max @ 130°C m A
IRK.170- IRK.250-	04	400	500	50
	08	800	900	
	12	1200	1300	
	14	1400	1500	
	16	1600	1700	
IRK.230-	08	800	900	50
	12	1200	1300	
	16	1600	1700	
	18	1800	1900	
	20	2000	2100	

On-state Conduction

	Parameters	IRK.170	IRK.230	IRK.250	Units	Conditions		
$I_{T(AV)}$	Maximum average on-state current	170	230	250	A	180° conduction, half sine wave		
	@ Case temperature	85	85	85	°C			
$I_{T(RMS)}$	Maximum RMS on -state current	377	510	555	A	as AC switch		
I_{TSM}	Maximum peak, one-cycle on-state, non-repetitive surge current	5100	7500	8500	A	t = 10ms	No voltage	
		5350	7850	8900		t = 8.3ms	reapplied	
		4300	6300	7150		t = 10ms	100% V_{RRM}	
		4500	6600	7500		t = 8.3ms	reapplied	Sinusoidal half wave,
I^2t	Maximum I^2t for fusing	131	280	361	KA^2s	t = 10ms	No voltage	initial $T_J = T_J$ max
		119	256	330		t = 8.3ms	reapplied	
		92.5	198	255		t = 10ms	100% V_{RRM}	
		84.4	181	233		t = 8.3ms	reapplied	
$I^2\sqrt{t}$	Maximum $I^2\sqrt{t}$ for fusing	1310	2800	3610	$KA^2\sqrt{s}$	t = 0.1 to 10ms, no voltage reapplied		
$V_{T(TO)1}$	Low level value of threshold voltage	0.89	1.03	0.97	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	1.12	1.07	1.00		(I > π x $I_{T(AV)}$), $T_J = T_J$ max.		
r_{t1}	Low level on-state slope resistance	1.34	0.77	0.60	mΩ	(16.7% x π x $I_{T(AV)}$ < I < π x $I_{T(AV)}$), $T_J = T_J$ max.		
r_{t2}	High level on-state slope resistance	0.96	0.73	0.57		(I > π x $I_{T(AV)}$), $T_J = T_J$ max.		
V_{TM}	Maximum on-state voltage drop	1.60	1.59	1.44	V	$I_{TM} = \pi$ x $I_{T(AV)}$, $T_J = T_J$ max., 180° conduction Av. power = $V_{T(TO)}$ x $I_{T(AV)}$ + r_f x $(I_{T(RMS)})^2$		
I_H	Maximum holding current	500	500	500	mA	Anode supply=12V, initial I_T=30A, T_J=25°C		
I_L	Maximum latching current	1000	1000	1000		Anode supply=12V, resistive load=1Ω gate pulse: 10V, 100µs, T_J = 25°C		

Switching

	Parameters	IRK.170	IRK.230	IRK.250	Units	Conditions
t_d	Typical delay time	1.0			µs	T_J = 25°C, Gate Current=1A $dI_{g/dt}$=1A/µs
t_r	Typical rise time	2.0				Vd = 0,67% V_{DRM}
t_q	Typical turn-off time	50 - 150			µs	I_{TM} = 300 A ; -dI/dt=15 A/µs; $T_J = T_J$ max ; Vr = 50 V; dV/dt = 20 V/µs ; Gate 0 V, 100 ohm

Blocking

	Parameters	IRK.170	IRK.230	IRK.250	Units	Conditions
I_{RRM} I_{DRM}	Max. peak reverse and off-state leakage current		50		mA	$T_J = T_J$ max.
V_{INS}	RMS isolation voltage		3000		V	50Hz, circuit to base, all termin. shorted, 25°C, 1s
$dv/_{dt}$	Critical rate of rise of off-state voltage		1000		V/µs	$T_J = T_J$ max, exponential to 67% rated V_{DRM}

Triggering

	Parameters	IRK.170	IRK.230	IRK.250	Units	Conditions	
P_{GM}	Maximum peak gate power		10.0		W	tp ≤ 5ms, $T_J = T_J$ max.	
$P_{G(AV)}$	Maximum average gate power		2.0		W	f = 50Hz, $T_J = T_J$ max.	
$+I_{GM}$	Maximum peak gate current		3.0		A	tp ≤ 5ms, $T_J = T_J$ max.	
$-V_{GT}$	Max. peak negative gate voltage		5.0		V	tp ≤ 5ms, $T_J = T_J$ max.	
V_{GT}	Maximum required DC gate voltage to trigger		4.0 3.0 2.0		V V V	T_J = - 40°C T_J = 25°C $T_J = T_J$ max.	Anode supply = 12V, resistive load ; Ra = 1Ω
I_{GT}	Maximum required DC gate current to trigger		350 200 100		mA mA mA	T_J = - 40°C T_J = 25°C $T_J = T_J$ max.	Anode supply = 12V, resistive load ; Ra = 1Ω
V_{GD}	Maximum gate voltage that will not trigger		0.25		V	@ $T_J = T_J$ max., rated V_{DRM} applied	
I_{GD}	Maximum gate current that will not trigger		10.0		mA	@ $T_J = T_J$ max., rated V_{DRM} applied	
$di/_{dt}$	Max rate of rise of turned-on current		500		A/µs	@ $T_J = T_J$ max., I_{TM} = 400 A rated V_{DRM} applied	

Thermal and Mechanical Specifications

	Parameters	IRK.170	IRK.230	IRK.250	Units	Conditions
T_J	Junction operating temperature		-40 to 130		°C	
T_{stg}	Storage temperature range		-40 to 150		°C	
R_{thJC}	Maximum thermal resistance junction to case	0.17	0.125	0.125	K/W	Per junction, DC operation
R_{thC-S}	Thermal resistance, case to heatsink	0.02	0.02	0.02	K/W	Mounting surface flat, smooth and greased (per module)
T	Mounting tourque ±10% MAP to heatsink		4 to 6		Nm	A mounting compound is recommended and the tourque should be rechecked after a period of about 3 hours to allow for the spread of the compound
	Busbar to MAP		4 to 6		Nm	
wt	Approximate weight		500		g	
			17.8		oz	
	Case style		MAGN-A-pak			

ΔR Conduction (per Junction)

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

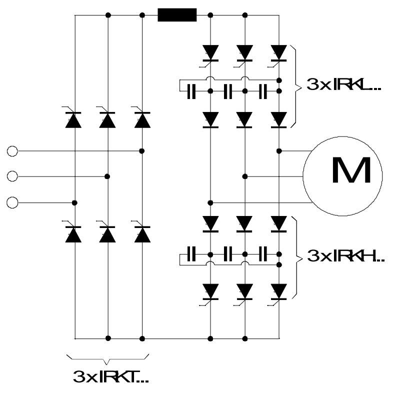
Devices	Sinusoidal conduction @ T_J max.					Rectangular conduction @ T_J max.					Units
	180°	120°	90°	60°	30°	180°	120°	90°	60°	30°	
IRK.170-	0.009	0.010	0.010	0.020	0.032	0.007	0.011	0.015	0.020	0.033	K/W
IRK.230-	0.009	0.010	0.010	0.020	0.032	0.007	0.011	0.015	0.020	0.033	
IRK.250-	0.009	0.010	0.014	0.020	0.032	0.007	0.011	0.015	0.020	0.033	

MAGN-A-paks Suitable for Current Source Inverters

Thyristor		Diode	$I_{T(AV)}$ / $I_{F(AV)}$ @ T_C		
V_{DRM} V_{RRM}	V_{RSM}	V_{RRM} V_{RSM}	170A @ 85°C	230A @ 85°C	250A @ 85°C
1400	1500	2000	IRKH170-14D20	IRKH230-14D20	IRKH250-14D20
1400	1500	2000	IRKL170-14D20	IRKL230-14D20	IRKL250-14D20
1600	1700	2500	IRKH170-16D25	IRKH230-16D25	IRKH250-16D25
1600	1700	2500	IRKL170-16D25	IRKL230-16D25	IRKL250-16D25
1800	1900	2800	Not Available	IRKH230-18D28	Not Available
1800	1900	2800	Not Available	IRKL230-18D28	Not Available
2000	2100	3200	Not Available	IRKH230-20D32	Not Available
2000	2100	3200	Not Available	IRKL230-20D32	Not Available

For all other parameters and characteristics refer to standard IRKH... and IRKL... modules.

Application Notes



Current Source Inverter using 9 MAGN-A-paks

Current Source Inverters

Current-Source Inverters (also known as Sequentially Commutated Inverters) use Phase Control (as opposed to Fast) Thyristors and Diodes.

The advantages of Current Source Inverters lie in their ease control, absence of large commutation inductances and limited fault currents.
Their simple construction, illustrated by the circuit on the left, is further enhanced by the use of MAGN-A-paks which allow the power circuit of an Inverter to be realised with 6 capacitors and 9 MAGN-A-paks all mounted on just one heatsink.

The optimal design of Current Source Inverters requires the use of Diodes with blocking voltages greater than those of the thyristors .
This departure from conventional half-bridge modules is catered for by MAGN-A-pak range with Thyristors up to 2000V and Diodes up to 3200V.

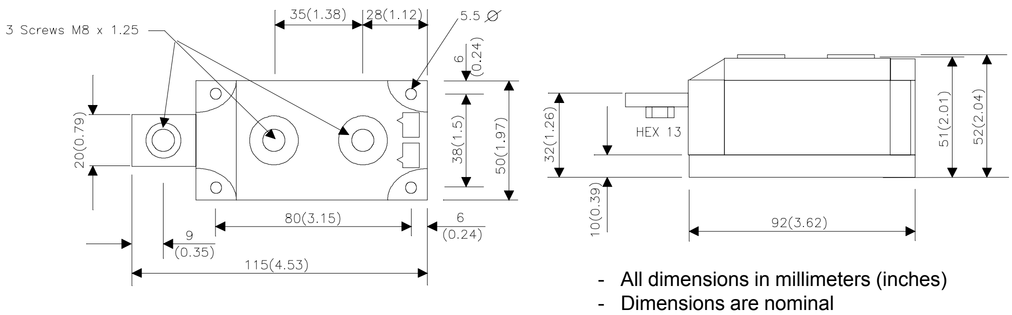
Ordering Information Table

Device Code

IRK	T	250	-	14	D20
1	2	3		4	5

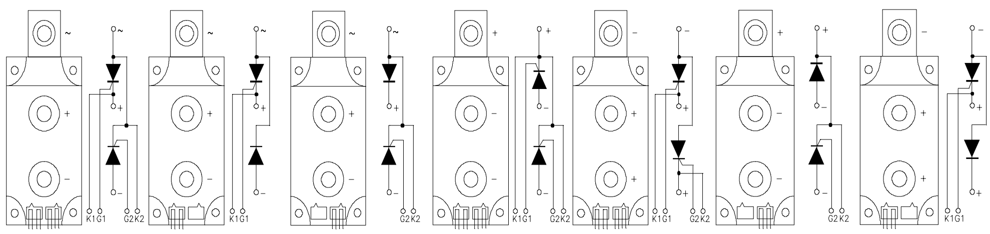
1 - Module type
2 - Circuit configuration (See Outline Table)
3 - Current rating
4 - Voltage code: Code x 100 = V_{RRM} (See Voltage Ratings Table)
5 - Current Source Inverters Types

Outline Table



- All dimensions in millimeters (inches)
- Dimensions are nominal
- Full engineering drawings are available on request
- UL identification number for gate and cathode wire: UL 1385
- UL identification number for package: UL 94V0

IRKT... IRKH... IRKL... IRKU... IRKV... IRKK... IRKN...



NOTE: To order the Optional Hardware see Bulletin I27900

Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial Level.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier

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