International
IOR Rectifier

IRAMS10UP60B
iMOTION™ Series
10A, 600V
with Internal Shunt Resistor

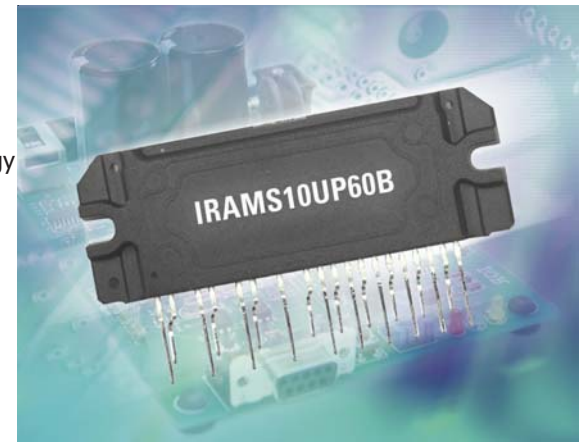
Integrated Power Hybrid IC for
Appliance Motor Drive Applications.

Description

International Rectifier's IRAMS10UP60B is an Integrated Power Module developed and optimized for electronic motor control in appliance applications such as washing machines and refrigerators. Plug N Drive technology offers an extremely compact, high performance AC motor-driver in a single isolated package for a very simple design. An internal shunt is also included and offers easy current feedback and overcurrent monitor for precise and safe operation. A built-in temperature monitor and over-current protection, along with the short-circuit rated IGBTs and integrated under-voltage lockout function, deliver high level of protection and fail-safe operation. The integration of the bootstrap diodes for the high-side driver section, and the single polarity power supply required to drive the internal circuitry, simplify the utilization of the module and deliver further cost reduction advantages. UL Certified.

Features

- Internal Shunt Resistor
- Integrated Gate Drivers and Bootstrap Diodes
- Temperature Monitor
- Fully Isolated Package
- Low $V_{CE(on)}$ Non Punch Through IGBT Technology
- Undervoltage lockout for all channels
- Matched propagation delay for all channels
- Schmitt-triggered input logic
- Cross-conduction prevention logic
- Lower di/dt gate driver for better noise immunity
- Motor Power range 0.4~0.75kW / 85~253 Vac
- Isolation 2000V_{RMS} /1min
- UL certificate number: E252584



Absolute Maximum Ratings

Parameter	Description	Value	Units
V_{CES} / V_{RRM}	IGBT/Diode Blocking Voltage	600	V
V^+	Positive Bus Input Voltage	450	
I_O @ T_C=25°C	RMS Phase Current (Note 1)	10	A
I_O @ T_C=100°C	RMS Phase Current (Note 1)	5	
I_O	Pulsed RMS Phase Current (Note 2)	15	
F_{PWM}	PWM Carrier Frequency	20	kHz
P_D	Power dissipation per IGBT @ T_C =25°C	27	W
V_{ISO}	Isolation Voltage (1min)	2000	V_{RMS}
T_J (IGBT & Diodes)	Operating Junction temperature Range	-40 to +150	°C
T_J (Driver IC)	Operating Junction temperature Range	-40 to +150	
T	Mounting torque Range (M3 screw)	0.5 to 1.0	Nm

Note 1: Sinusoidal Modulation at V^+=400V, T_J=150°C, F_{PWM}=20kHz, Modulation Depth=0.8, PF=0.6, See Figure 3.
Note 2: t_P<100ms; T_C=25°C; F_{PWM}=20kHz. Limited by $I_{BUS-ITRIP}$, see Table "Inverter Section Electrical Characteristics"

Absolute Maximum Ratings (Continued)

Symbol	Parameter	Min	Max	Units	Conditions
I_{BDF}	Bootstrap Diode Peak Forward Current	---	4.5	A	t_P= 10ms, T_J = 150°C, T_C=100°C
$P_{BR\ Peak}$	Bootstrap Resistor Peak Power (Single Pulse)	---	80	W	t_P=100µs, T_C =100°C ESR / ERJ series
$V_{S1,2,3}$	High side floating supply offset voltage	$V_{B1,2,3}$ - 25	$V_{B1,2,3}$ +0.3	V	
$V_{B1,2,3}$	High side floating supply voltage	-0.3	600	V	
V_{CC}	Low Side and logic fixed supply voltage	-0.3	20	V	
V_{IN}, V_{EN}, V_{ITRIP}	Input voltage LIN, HIN, EN, I_{Trip}	-0.3	Lower of (V_{SS}+15V) or V_{CC}+0.3V	V	

Inverter Section Electrical Characteristics @T_J= 25°C

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	---	---	V	V_{IN}=5V, I_C=250µA
$\Delta V_{(BR)CES}$ / ΔT	Temperature Coefficient of Breakdown Voltage	---	0.57	---	V/°C	V_{IN}=5V, I_C=1.0mA (25°C - 150°C)
$V_{CE(ON)}$	Collector-to-Emitter Saturation Voltage	---	1.70	2.00	V	I_C=5A, V_{CC}=15V
		---	2.00	2.40		I_C=5A, V_{CC}=15V, T_J=150°C
I_{CES}	Zero Gate Voltage Collector Current	---	5	80	µA	V_{IN}=5V, V^+=600V
		---	10	---		V_{IN}=5V, V^+=600V, T_J=150°C
V_{FM}	Diode Forward Voltage Drop	---	1.80	2.35	V	I_C=5A
		---	1.30	1.70		I_C=5A, T_J=150°C
V_{BDFM}	Bootstrap Diode Forward Voltage Drop	--	--	1.25	V	I_F=1A
		---	---	1.10		I_F=1A, T_J=150°C
R_{BR}	Bootstrap Resistor Value	---	2	---	Ω	T_J=25°C
$\Delta R_{BR}/R_{BR}$	Bootstrap Resistor Tolerance	---	---	±5	%	T_J=25°C
I_{BUS_TRIP}	Current Protection Threshold (positive going)	13.1	---	16.4	A	T_J=-40°C to 125°C See fig. 2

Inverter Section Switching Characteristics @ T_J= 25°C

Symbol	Parameter	Min	Typ	Max	Units	Conditions
E_{ON}	Turn-On Switching Loss	---	200	235	µJ	I_C=5A, V^+=400V V_{CC}=15V, L=2mH Energy losses include "tail" and diode reverse recovery See CT1
E_{OFF}	Turn-Off Switching Loss	---	75	100		
E_{TOT}	Total Switching Loss	---	275	335		
E_{REC}	Diode Reverse Recovery energy	---	15	25		
t_{RR}	Diode Reverse Recovery time	---	70	100	ns	
E_{ON}	Turn-On Switching Loss	---	300	360	µJ	I_C=5A, V^+=400V V_{CC}=15V, L=2mH, T_J=150°C Energy losses include "tail" and diode reverse recovery See CT1
E_{OFF}	Turn-off Switching Loss	---	135	165		
E_{TOT}	Total Switching Loss	---	435	525		
E_{REC}	Diode Reverse Recovery energy	---	30	40		
t_{RR}	Diode Reverse Recovery time	---	100	145	ns	
Q_G	Turn-On IGBT Gate Charge	---	29	44	nC	I_C=15A, V^+=400V, V_{GE}=15V
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J=150°C, I_C=5A, V_P=600V V^+= 450V V_{CC}=+15V to 0V See CT3
SCSOA	Short Circuit Safe Operating Area	10	---	---	µs	T_J=150°C, V_P=600V, V^+= 360V, V_{CC}=+15V to 0V See CT2
I_{CSC}	Short Circuit Collector Current	---	47	---	A	T_J=150°C, V_P=600V, t_{SC}<10µs V^+= 360V, V_{GE}=15V V_{CC}=+15V to 0V See CT2

Recommended Operating Conditions Driver Function

The Input/Output logic timing diagram is shown in Figure 1. For proper operation the device should be used within the recommende conditions. All voltages are absolute referenced to COM/I_{TRIP}. The V_S offset is tested with all supplies biased at 15V differential (Note 3)

Symbol	Definition	Min	Max	Units
$V_{B1,2,3}$	High side floating supply voltage	V_S+12	V_S+20	V
$V_{S1,2,3}$	High side floating supply offset voltage	Note 4	450	
V_{CC}	Low side and logic fixed supply voltage	12	20	V
V_{ITRIP}	I_{TRIP} input voltage	V_{SS}	V_{SS}+5	
V_{IN}	Logic input voltage LIN, HIN	V_{SS}	V_{SS}+5	V
V_{EN}	Logic input voltage EN	V_{SS}	V_{SS}+5	V

Note 3: For more details, see IR21363 data sheet

Note 4: Logic operational for V_s from COM-5V to COM+600V. Logic state held for V_s from COM-5V to COM-V_{BS}. (please refer to DT97-3 for more details)

Static Electrical Characteristics Driver Function

V_{BIAS} (V_{CC}, $V_{BS1,2,3}$)=15V, unless otherwise specified. The V_{IN} and I_{IN} parameters are referenced to COM/I_{TRIP} and are applicable to all six channels. (Note 3)

Symbol	Definition	Min	Typ	Max	Units
V_{INH} , V_{ENH}	Logic "0" input voltage	3.0	---	---	V
V_{INL} , V_{ENL}	Logic "1" input voltage	---	---	0.8	V
V_{CCUV+}, V_{BSUV+}	V_{CC} and V_{BS} supply undervoltage Positive going threshold	10.6	11.1	11.6	V
V_{CCUV-}, V_{BSUV-}	V_{CC} and V_{BS} supply undervoltage Negative going threshold	10.4	10.9	11.4	V
V_{CCUVH}, V_{BSUVH}	V_{CC} and V_{BS} supply undervoltage lock-out hysteresis	---	0.2	---	V
$V_{IN,Clamp}$	Input Clamp Voltage (HIN, LIN, I_{TRIP}) I_{IN}=10µA	4.9	5.2	5.5	V
I_{QBS}	Quiescent V_{BS} supply current V_{IN}=0V	---	---	165	µA
I_{QCC}	Quiescent V_{CC} supply current V_{IN}=0V	---	---	3.35	mA
I_{LK}	Offset Supply Leakage Current	---	---	60	µA
I_{IN+}, I_{EN+}	Input bias current V_{IN}=5V	---	200	300	µA
I_{IN-}, I_{EN-}	Input bias current V_{IN}=0V	---	100	220	µA
I_{TRIP+}	I_{TRIP} bias current V_{ITRIP}=5V	---	30	100	µA
I_{TRIP-}	I_{TRIP} bias current V_{ITRIP}=0V	---	0	1	µA
V(I_{TRIP})	I_{TRIP} threshold Voltage	440	490	540	mV
V(I_{TRIP}, HYS)	I_{TRIP} Input Hysteresis	---	70	---	mV
$R_{ON,FLT}$	Fault Output ON Resistance	---	50	100	ohm

Dynamic Electrical Characteristics

Driver only timing unless otherwise specified.)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
T_{ON}	Input to Output propagation turn-on delay time (see fig.11)	---	590	---	ns	V_{CC}=V_{BS}= 15V, I_C=10A, V^+=400V
T_{OFF}	Input to Output propagation turn-off delay time (see fig. 11)	---	700	---	ns	
T_{FLIN}	Input Filter time (HIN, LIN)	100	200	---	ns	V_{IN}=0 & V_{IN}=5V
$T_{BLT-Trip}$	I_{TRIP} Blancking Time	100	150		ns	V_{IN}=0 & V_{IN}=5V
D_T	Dead Time (V_{BS}=V_{DD}=15V)	220	290	360	ns	V_{BS}=V_{CC}=15V
M_T	Matching Propagation Delay Time (On & Off)	---	40	75	ns	V_{CC}= V_{BS}= 15V, external dead time> 400ns
T_{ITrip}	I_{Trip} to six switch to turn-off propagation delay (see fig. 2)	---	---	1.75	µs	V_{CC}=V_{BS}= 15V, I_C=10A, V^+=400V
$T_{FLT-CLR}$	Post I_{Trip} to six switch to turn-off clear time (see fig. 2)	---	7.7	---	ms	T_C = 25°C
		---	6.7	---		T_C = 100°C

Thermal and Mechanical Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$R_{th(J-C)}$	Thermal resistance, per IGBT	---	4.2	4.7	°C/W	Flat, greased surface. Heatsink compound thermal conductivity 1W/mK
$R_{th(J-C)}$	Thermal resistance, per Diode	---	5.5	6.5		
$R_{th(C-S)}$	Thermal resistance, C-S	---	0.1	---		
C_D	Creepage Distance	3.2	---	---	mm	See outline Drawings

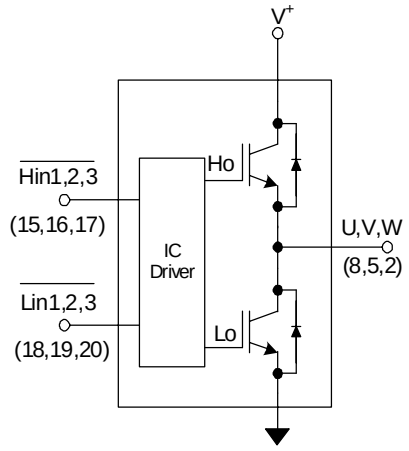
Internal Current Sensing Resistor - Shunt Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Conditions
R_{Shunt}	Resistance	33.0	33.3	33.7	mΩ	T_C = 25°C
T_{Coeff}	Temperature Coefficient	0	---	200	ppm/°C	
P_{Shunt}	Power Dissipation	---	---	2.2	W	-40°C< T_C <100°C
T_{Range}	Temperature Range	-40	---	125	°C	

Internal NTC - Thermistor Characteristics

Parameter	Definition	Min	Typ	Max	Units	Conditions
R_{25}	Resistance	97	100	103	kΩ	T_C = 25°C
R_{125}	Resistance	2.25	2.52	2.80	kΩ	T_C = 125°C
B	B-constant (25-50°C)	4165	4250	4335	k	$R_2 = R_1 e^{[B(1/T2 - 1/T1)]}$
Temperature Range		-40		125	°C	
Typ. Dissipation constant			1		mW/°C	T_C = 25°C

Input-Output Logic Level Table



FLT- EN	I_{TRIP}	$\overline{HIN1,2,3}$	$\overline{LIN1,2,3}$	U,V,W
1	0	0	1	V^+
1	0	1	0	0
1	0	1	1	Off
1	1	X	X	Off
0	X	X	X	Off