International
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IRADK-S10UP60 User's Guide

IRAM Evaluation Kit with the IRMCF341 Motor Controller

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February 2006
Version 1.0RC

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1 Introduction

The IRADK-S10UP60 is an Evaluation kit for the 6A and 10A IRAM Integrated Power Modules in SIP1 packages. These modules are optimized for electronic control of 3-phase motors in a variety of industrial and appliance applications in the 400W to 750W power range. Plug N Drive technology offers an extremely compact, high performance AC motor-driver in a single isolated package for a very simple design. This kit uses the IRMCF341 Motor Controller to allow easy access and control of system parameters. The IRMCF341 is configured to run an induction motors in open loop volts per hertz mode.

2 Hardware Overview

2.1 IRAM Module

The IRADK-S10UP60 Evaluation Kit shown below uses the IRAMS10UP60B power module with a maximum current rating of 10A. The circuit can also accept the IRAMS06UP60B, which has a 6 Arms maximum current rating. The continuous current rating is 3 Arms with the supplied heatsink but this can be increased by improving the airflow or increasing the heat sink size.

An internal shunt is also included and offers easy current feedback and over-current 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 in a cost effective solution.

2.2 Board Features

Figure 1. IRAM Evaluation Board

2.2.1 Board Layout and Power Capability

This board features a 2-layer design, which integrated the IRAM module, DC rectification, and controller in a single compact design. As currently configured, this board is able to sustain a power consumption of 400W in a room temperature environment. No fans or additional equipment is needed to ensure this power capacity.

2.2.2 Input and Output Power Connections

At the base of the board are the power connectors for AC power and the 3-phase motor connections, as well as DC bus connection points. There are defined as follows.

- E – Earth Ground, this is connected to the heatsink
- L – Line signal
- N – Neutral
- GND – DC bus ground
- DC – Positive DC bus
- U – U phase to motor
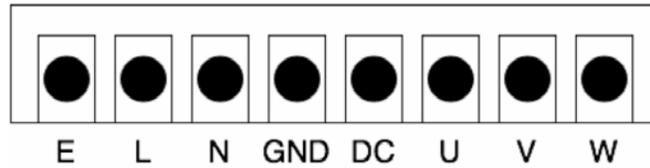- V – V phase to motor
- W – W phase to motor

Figure 2. Input Power Connections

2.2.3 COM Port

The serial COM port on the board allows for communication between the computer and IRMCF341 allowing for configuring parameters and getting system feedback.

2.2.4 Indicator LEDs

Two indicator LEDs are present in the evaluation board. The first, LED1, indicates that the board is active and properly configured. Red indicates that the IRMCF341 is on, but not properly configured, while a slowly flashing green indicates the system is configured. LED2 is connected to the dc voltage bus to indicate that the capacitors are still charged.

3 Software Integration

The IRAM Evaluation Kit includes IRIS (International Rectifier IRAM Evaluation Software) intended for the evaluation of IRAM modules with induction motors using open loop V/F control. This GUI allows for the specification of motor, inverter, and system parameters to closely meet application specifications.

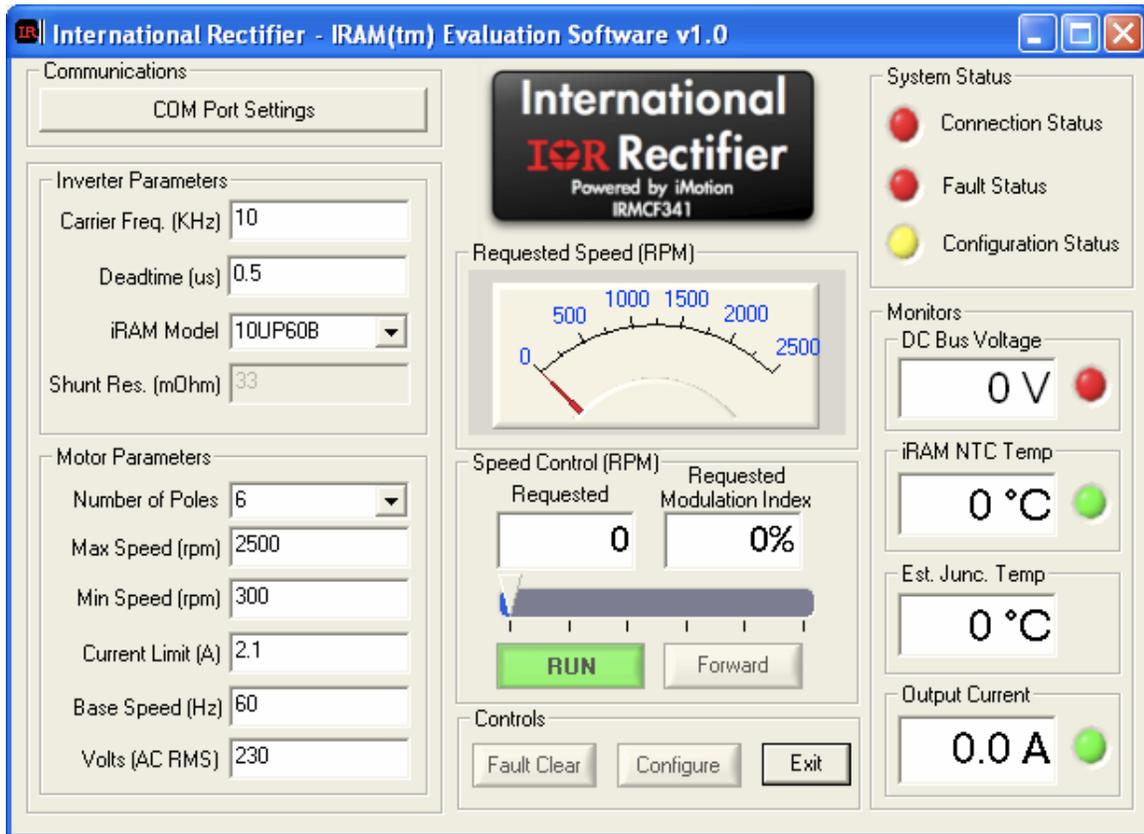## 3.1 GUI Overview

Figure 3. Main IRIS Window

3.2 COM Ports

The COM Port dialog allows the user to select which COM port is used for IRMCF341 communication. By default COM port 4 is selected.
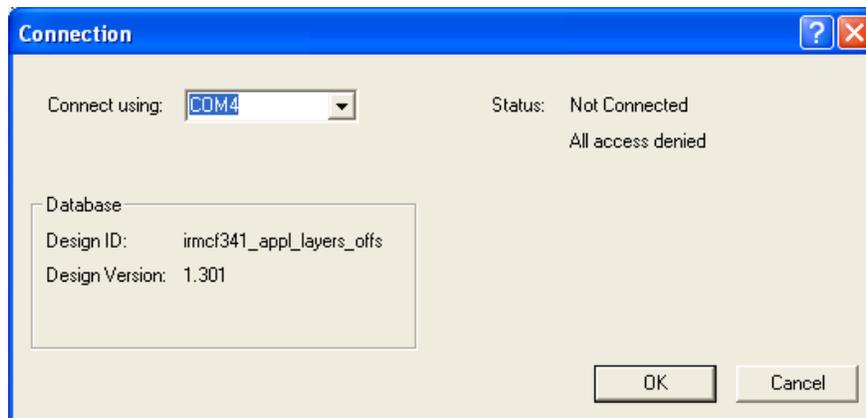

Figure 4. COM Port Selection Dialog

3.3 Loading .irc Files

Upon starting IRIS a dialog window will appear and request an .irc file. (Figure 5) This .irc is specific for IRIS and cannot be a standard MCEDesigner .irc file. This file, called 'IRAM Demo.irc" is included on the disk this manual is on.
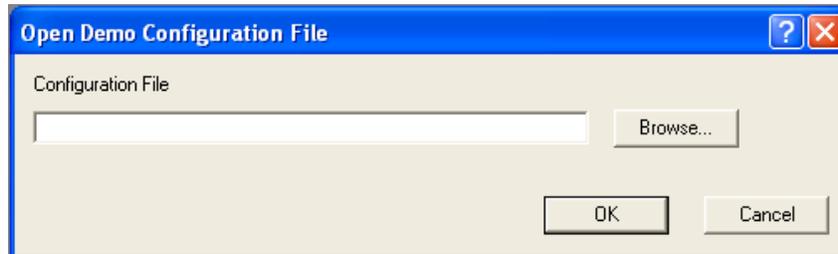

Figure 5. Demo Configuration File Dialog

3.4 Parameter Customization

3.4.1 Inverter Parameters

- Carrier Frequency

  User selectable input of what carrier frequency will be used to control the induction motor. This is entered in Kilohertz.

- Deadtime

  The deadtime that will be present between switching low and high IGBTs in the IRAM module. This parameter should not be decreased below the recommended minimums of the IRAM datasheet. This is entered in microseconds.

- IRAM Model

  The model name of the IRAM module being evaluated. This model name determines the shunt resistor of the system. Selecting 'Custom' allows for the shunt resistor value to be user definable.

- Shunt Resistor

  The value of the shunt resistor used in the system. If a model was selected in the previous menu then this value is not user definable. Only when custom is selected in 'IRAM Model' will this value be customizable. This is entered in mili-ohms.

3.4.2 Motor Parameters

- Number of Poles

  The number of motor poles, which define the ratio of the electrical to mechanical frequency.

- Max Speed

    The maximum speed that the motor can spin. A speed cannot be set faster than this value. This is entered in revolution per minute (RPM).

- Min Speed

    The minimum speed that the motor can spin. A speed cannot be set slower than this value. This is entered in revolutions per minute (RPM).

- Current Limit

    This is the maximum current that the system will allow before triggering a fault and stopping the motor. This is entered in amperes.

- Volts

    This is the rated voltage (L-L) of the induction motor. This parameter is the voltage used in the Volts/Hz control algorithm. When the configure button is pressed this value is sampled along with the current DC bus. The DC bus must remain constant after pressing the configure button, otherwise the control scheme will not operate as expected.

- Hertz

    This is the rated frequency of the induction motor. This parameter is the hertz value used in the Volts/Hz control algorithm.

3.5 System Status and Control

- Connection Status

    Indicates if the connection between IRIS and the iMotion control IC (IRMCF341) is working and active.

- Fault Status

    Indicates if any faults are present is the system. If faults are present they can be cleared with the 'Fault Clear' button. If a fault remains after pressing the 'Fault Clear' button then there may be a hardware problem. If this fault indicator is lit, and none of the other indicators show a fault, then a 'Gatekill' issued by the IRAM has occurred. Please verify your connections before attempting to run motor again.

- Configure Status

    Indicates if any parameters have been modified since the last configure. Will also trigger if the voltage has changed more that 10% since the last configure (as the Volts/Hz control is dependant on bus voltage). If this indicator is yellow, the configuration button should be pressed again prior to running the motor.

- Fault Clear

    This button will clear all of the faults present in the system. If a fault remains after pressing this button then there may be a hardware problem. This button will be grey when a connection is not present and when the motor is running.

- Configure

    This button will configure the motor with the parameters that have been selected in the GUI. **This step is <u>not</u> done automatically.** This button will be grey when a connection is not present and when the motor is running

3.6 Speed Control

The system has two speed controls, a RUN/STOP button and a slider to control the motor speed. A Forward/Reverse button is present, but will always be grey as this feature is not available for induction motors. The speed can be adjusted both while the motor is idle and while running. An acceleration control is included to gently accelerate to the requested speed and is not user definable.

A modulation index is shown just above the speed slider. This index will not go beyond 100%, nor can a speed that will cause a modulation index greater than 100% be selected. This will cause the slider to 'lock' before reaching its maximum speed. If a greater speed is required, increase the DC Bus Voltage and press 'configure'. This will decrease the associated modulation index for a given speed.

System Monitors

- DC Bus Voltage

    The instantaneous voltage of the DC Bus. There is a fault indicator for if the DC Bus voltage increases beyond 400V.
- IRAM NTC Temperature

    The instantaneous temperature of the NTC resistor internal to the the IRAM module. This value is used to obtain an estimate of the IGBT junction temperature. There is a fault indicator for if the NTC temperature increases beyond 100°C.
- Estimated Junction Temperature

    The instantaneous estimated junction temperature of the IGBTs in the IRAM module. This value is for informational purposes only and may not be exact.
- Output Current

    The instantaneous rms motor current calculated by the iMotion Control Engine . It is dependent on the shunt resistor value defined in 'Inverter Parameters'.

4 Specifications

T_C = 25°C unless specified

Parameters	Values	Conditions
Input Power		
Voltage	115V-230Vrms, -20%, +10%	
Frequency	50/60 Hz	
Input current	7A rms @nominal output	TA=40°C, RthSA=1.0 °C/W
Input line impedance	4%~8% recommended	
Output Power		
Watts	400W continuous power	Vin=230V AC, f_{PWM}=10kHz, f_O=60Hz, T_A=40°C, RthSA=1.0 °C/W, Vertically mounted to help air flow
Current	3 Arms nominal, 10 Arms Overload	RthSA limits ΔTC to 10°C during overload
Host interface (RS232C)		
TXD, RXD	10V	Typical 57.6 Kbps, single ended
DC bus voltage		
Maximum DC bus voltage	400V	Should not exceed 400V for > 30 sec
Minimum DC bus voltage	120V	
Current feedback		
Current sensing device	Single shunt reconstruction	
Resolution	12-bit	Actual resolution is 10-bit
Latency	1 pwm cycle	
Protection		
Output current trip level	28A peak, ±10%	Detection from shunt on negative DC bus
Short circuit delay time	Maximum 3.75 µsec	line-to-line short, line-to-DC bus (-) short
Critical over voltage trip	380V	
Over voltage trip	360V	
Under voltage trip	120V	
Power Device		
IRAMS10UP60B	6 IGBT/FRED + IR2136 gate driver +3 bootstrap diode + shunt resistor + NTC	Integrated over-current protection
System environment		
Ambient temperature	0 to 40°C	95% RH max. (Non-condensing)

Table 1. IRADK-S10UP60 Electrical Specification