Two-Phase Interleaved PFC Converter w/ Power Metering Quick Start Guide

1 Features

- Input Voltage (AC Line): 100V (Min) to 260V (Max), 47~63Hz
- Rated Output Voltage: 390Vdc
- Rated Output Power: 700 Watts @220V input, 550 Watts @110V input (forced cooling required)
- Rated Load efficiency: 96%@220V input, 93% @110V input
- Power factor at 50% or greater load – 0.98 (Min)
- PWM frequency 200kHz

2 2Ph ILPFC GUI Overview

The ILPFC GUI provides a simple interface to evaluate some of the functionalities of the ILPFC EVM Kit. The GUI is written in C# using Microsoft Visual Studio .NET with the source code located at:

```
..\controlSUITE\development_kits\ILPFC\~GUI\~Source\
```

The ILPFC GUI features:

- Monitor some of the IL PFC EVM parameters such as DC bus voltage (Vbus), RMS AC input voltage (Vrms), RMS input current, RMS input power, and the frequency of the AC input voltage.
- Ability to setup startup configuration.

3 Getting Started

3.1 Setting up the Hardware

> **CAUTION**
>
> There are high voltages present on the ILPFC board. It should only be handled by experienced power supply professionals in a lab environment. To safely evaluate this board an **isolated AC source should be used** to power up the unit. Before AC power is applied to the board a voltmeter and an **appropriate resistive load** should be attached to the output. This will discharge the bus capacitor quickly when the AC power is turned off. The board has not been tested with electronic load and so the use of such load is not recommended. There is no **output overcurrent protection** implemented on the board and so the user should take appropriate measures for preventing any output short circuit condition.

1. Connect an USB cable to the Piccolo (CC2803x) controller card for emulation. Connect the other end of the cable to the PC USB port.
2. Connect the external +12Vdc supply (provided with the ILPFC EVM package) at JP1 to power up all the control circuit for now. By default, Piccolo controller is enabled to boot from FLASH and run the ILPFC code. The user should not use the RAM to program or run the ILPFC code

3. Turn on the switch SW1 by placing it towards the electrolytic caps (C5, C6 and C7). This will apply the external +12V supply to the ILPFC board. Piccolo controller will now boot from the FLASH and start executing the ILPFC code. Following this one of the LEDs (LED3 on the CC2803x control card) will start flashing periodically. The flashing LED is an indication of the code being executed from the FLASH memory. However, the PFC bus will remain at 0V since at this point we haven't yet applied the AC input voltage.

4. Now select an appropriate isolated AC power supply (100Vac to 260Vac, 47Hz~63Hz, 1000VA min) to provide input power to the ILPFC EVM. Connect the ac supply to the ILPFC EVM input connector P1 but **do not turn on the AC power at this time.**

5. Connect an appropriate resistive load to the ILPFC DC output terminals (PFC-Out & GND terminals). Resistive loads within the range of 10W ~ 700W are recommended. Set the initial load to about 50W~80W. A 2K ohm resistor will provide about 80W load at 400V dc bus. **This board has not been tested with electronic load.**

3.2 Running the Application

By default the hardware is configured to boot from a pre-Flashed code. The GUI only works with the F2803x_FLASH configuration in the corresponding CCS project.

Note that the General Purpose GUI requires Microsoft .NET framework 2.0 or higher to run. Please ensure that this software is installed prior to running this program.

1. Browse to *..\controlSUITE\development_kits\ILPFC\~GUI* and double-click on ILPFC-GUI.exe. The following figure shows a screen shot for the ILPFC GUI when connected to the ILPFC EVM.
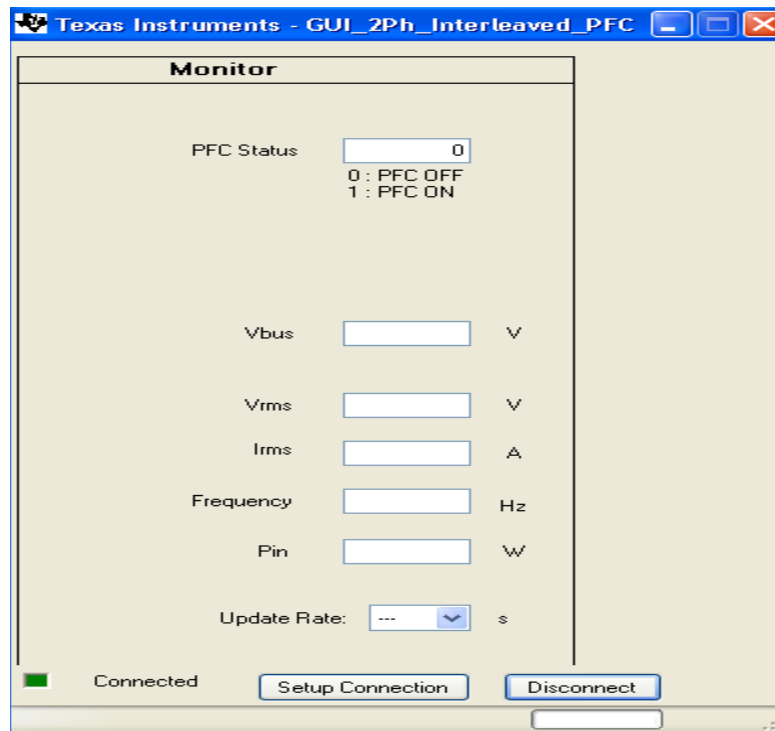
2. Click "Setup Connection" on the GUI
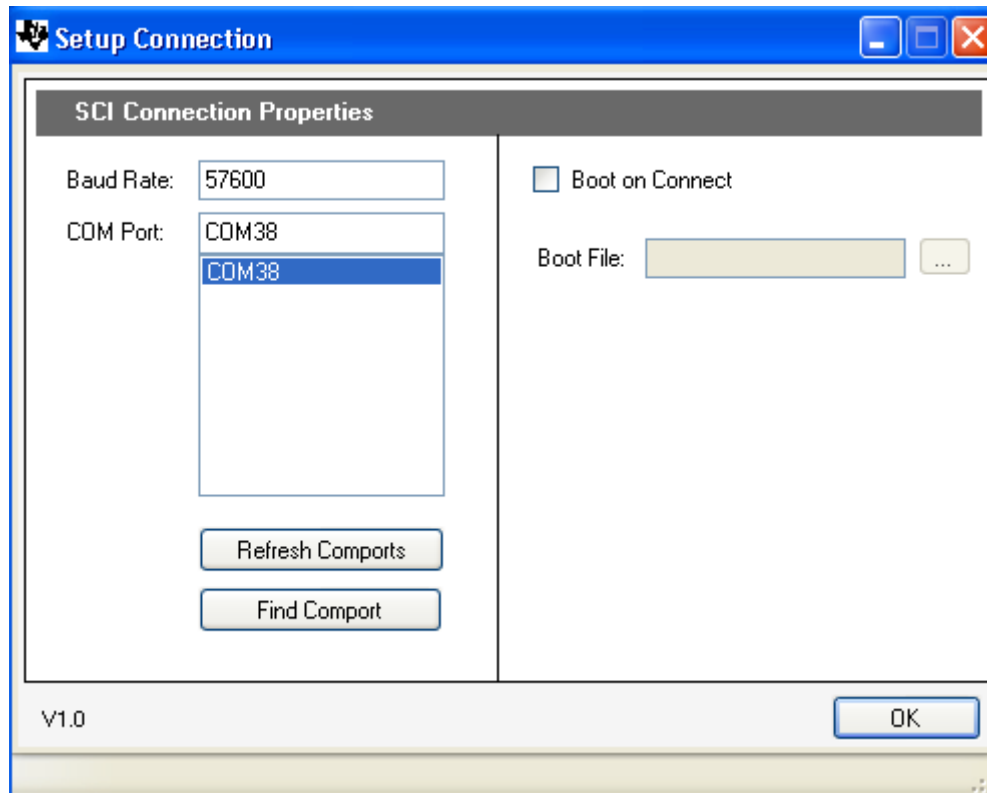
3. Ensure the Baud Rate is set to 57600.

4. Next, you will need to select your serial COM port

(a) If the COM port that the target is connected to is known, please select it.

(b) Otherwise, use the "Find Comport" tool to find the serial port connection that is connected to the EVM board.

   (i) Ensure the target F2803x MCU is setup to boot from a pre-Flashed code (see related control card documentation for setting up boot up configuration)

   (ii) Click "Find Comport", then follow the instructions shown at the bottom of the window. This will run through a short automated test to find the COM port that is connected to the EVM board.

   (iii) Following the test, you should see "Comport Found: COMXX" appear near the bottom of the window. If the GUI is unable to find a valid comport after fixing or checking all errors received, then retry this process to find the proper comport using option c.

(c) Manually find the comport by going to:

   Control Panel -> System -> Hardware tab -> Device Manager -> Ports (COM and LPT).

   If using a serial port directly connected to a PC, look for a comport that shows up as "Communications Port" and select this comport in the Setup Connection window.

5. Ensure "Boot on Connect" is unchecked.

6. Click "OK"

7. On the Main Window, click "Connect". The GUI should now connect to the target and be ready for use.
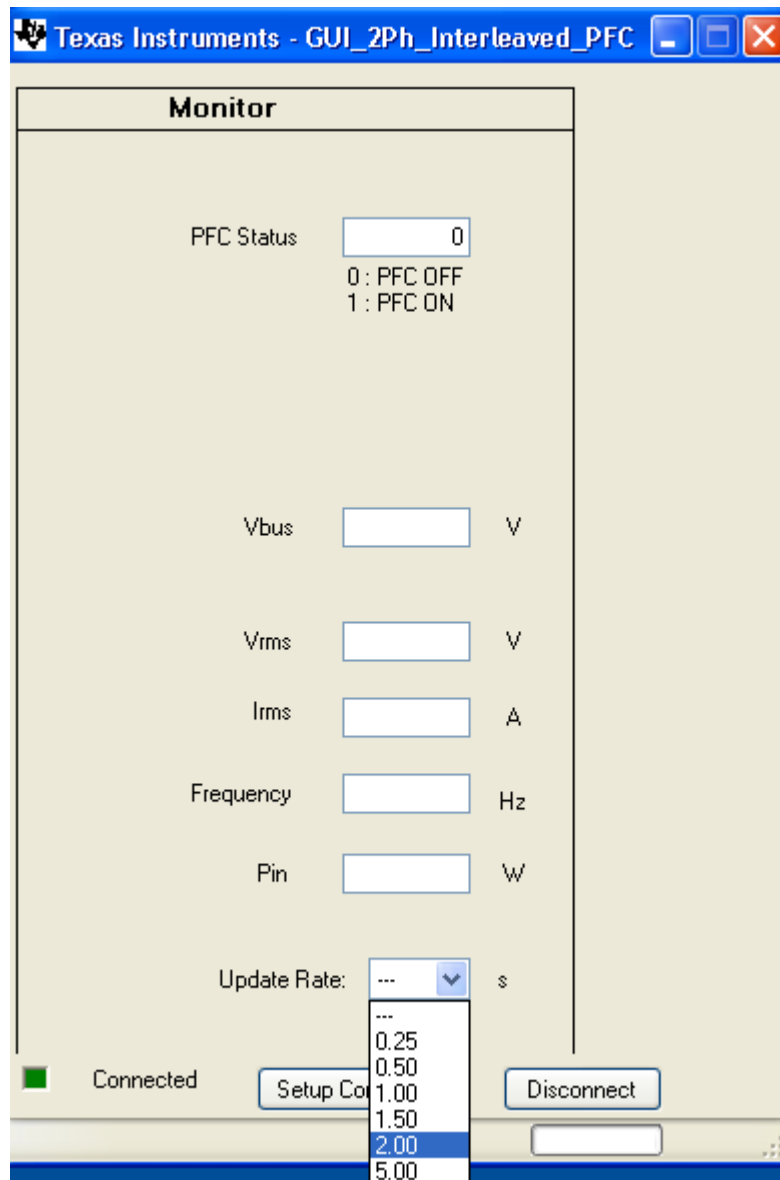
8.   Select the parameter update rate as shown in Figure 1

Figure 1. Select Parameters

GUI Structure

    Monitor— Section displays various system parameter values. These include PFC status, input AC RMS voltage, input current, input power, input AC line frequency and PFC output voltage.

    Update Rate — Changes the rate at which the GUI updates the parameters in the Monitor section.

    Setup Connection — Opens a new window that contains the serial port and boot settings.

    Connect/Disconnect — Begins serial port communication with the target boars.

3.3   Using the GUI

- Once the hardware is set-up correctly and the application program (pre-flashed code) is tested to run with the GUI, then close the GUI, turn OFF the switch SW1 and disconnect the external +12Vdc supply

- Turn off the switch SW1 by placing it away from the electrolytic caps (C5, C6 and C7). This will allow the isolated bias supply (the small bias supply board mounted at location M2 close to the PFC AC input connector P1) provide +12Vdc output when the AC power is turned on.

- Set the AC input voltage to around 60Vac, 60Hz. Now turn on the AC power source. This will allow the isolated bias supply to turn on (after some delay) and provide +12V output. Piccolo controller will now boot from the FLASH and start executing the ILPFC code. LED3 on the CC2803x control card will start flashing periodically. With the AC input set to 60Vac, the PFC DC bus voltage will not ramp up to rated output.

- Bring up the ILPFC GUI (as described before) and monitor the PFC parameters. At this point all the PFC parameters except the "PFC Status" bit should be available.

- Now increase the AC input voltage to around 120Vac, 60Hz. The unit will detect this minimum input voltage and the corresponding DC bus voltage (160Vdc minimum). **This condition must be met in order to soft-start the PFC.**

- The PFC output will now ramp according to the slew rate to the rated bus voltage (~390Vdc).

- When the soft-start is complete, the "PFC Status" bit on the GUI will change to 1 indicating that the PFC is on.

- Now verify the effect on the dc bus voltage and on the input power factor when the input voltage (100Vrms ~ 260Vrms) or the load power (0~550W @110Vin, 0~700W @220Vin,) is varied. The dc bus should be regulated at 390V under all conditions. Depending on the load(10% and higher) and line conditions, the power factor for the input current will vary from 0.95 to 0.999. The first set of waveform below shows the PFC input voltage and current when the input voltage is about 110V and the PFC load is about 550W load. The second one shows the input current and PFC DC bus response for step load between 240W ~ 400W when the input voltage is set to 120Vrms.

- Monitor the PFC parameters on the GUI and verify the reported values.

- When turning off ac power, ensure that the AC power is turned off first. Then wait for a few minutes before disconnecting the GUI.
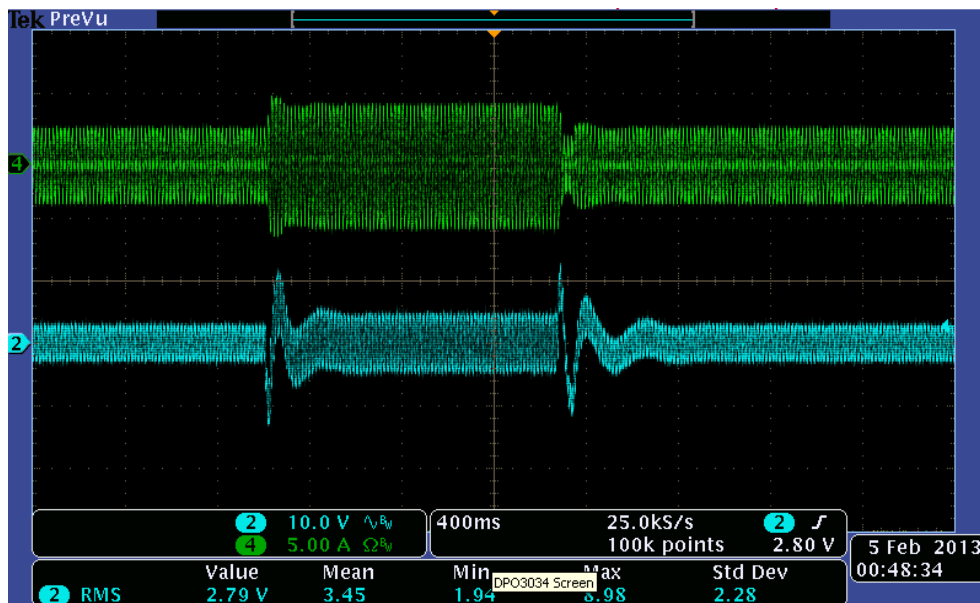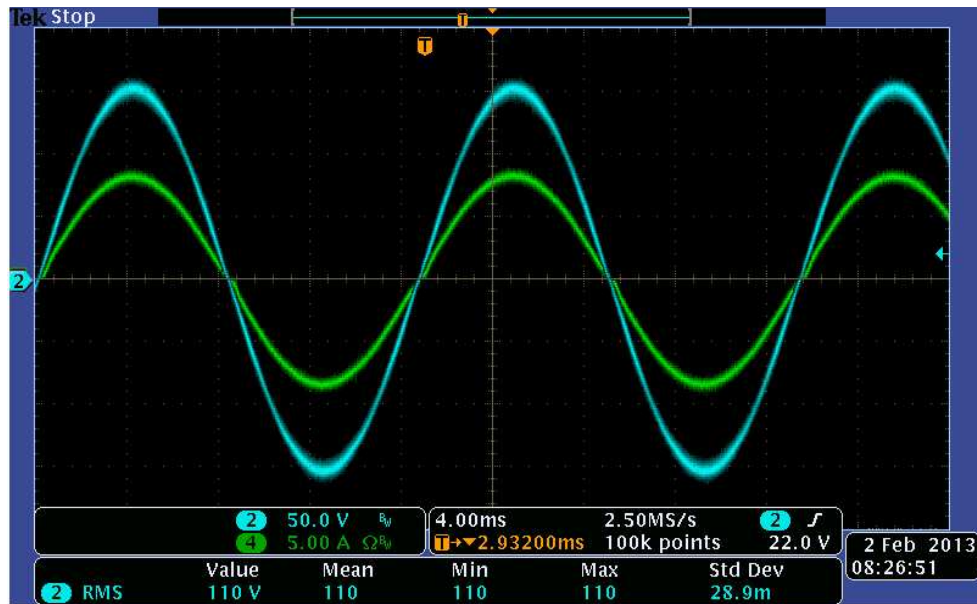
4 References

For more information please refer to the following guides:

ILPFC User Guide — provides detailed information on the ILPFC project within an easy to use lab-style format.

> *..\controlSUITE\development_kits\ILPFC\~Docs\ILPFC.pdf*

ILPFC_Rel-1.0-HWdevPkg — a folder containing various files related to the Piccolo-A controller card schematics.

> *..\controlSUITE\development_kits\ILPFC\ILPFC_HWDevPkg*

F28xxx User's Guides —

> http://www.ti.com/f28xuserguides

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