

Digitally Controlled Bridgeless Power Factor Correction (BL PFC) Converter Quick Start Guide

1 BLPFC GUI Overview

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

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

The BLPFC GUI features:

- Monitor and/or control some of the BL PFC EVM parameters such as, DC bus voltage V_{bus} , RMS ac input voltage V_{rms} and the frequency of the AC input voltage.
- Allows user to change the voltage and current loop control parameters for on-line tuning of the control loops.
- Ability to setup startup configuration.



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General Texas Instruments High Voltage Evaluation (TI HV EVM) User Safety Guidelines



Always follow TI's setup and application instructions, including use of all interface components within their recommended electrical rated voltage and power limits. Always use electrical safety precautions to help ensure your personal safety and those working around you. Contact TI's Product Information Center <http://support.ti.com> for further information.

Save all warnings and instructions for future reference.

Failure to follow warnings and instructions may result in personal injury, property damage, or death due to electrical shock and burn hazards.

The term TI HV EVM refers to an electronic device typically provided as an open framed, unenclosed printed circuit board assembly. It is **intended strictly for use in development laboratory environments, solely for qualified professional users having training, expertise and knowledge of electrical safety risks in development and application of high voltage electrical circuits. Any other use and/or application are strictly prohibited by Texas Instruments.** If you are not suitable qualified, you should immediately stop from further use of the HV EVM.

1. Work Area Safety

- (a) Keep work area clean and orderly.
- (b) Qualified observer(s) must be present anytime circuits are energized.
- (c) Effective barriers and signage must be present in the area where the TI HV EVM and its interface electronics are energized, indicating operation of accessible high voltages may be present, for the purpose of protecting inadvertent access.
- (d) All interface circuits, power supplies, evaluation modules, instruments, meters, scopes and other related apparatus used in a development environment exceeding 50Vrms/75VDC must be electrically located within a protected Emergency Power Off EPO protected power strip.
- (e) Use stable and nonconductive work surface.
- (f) Use adequately insulated clamps and wires to attach measurement probes and instruments. No freehand testing whenever possible.

2. Electrical Safety

As a precautionary measure, it is always a good engineering practice to assume that the entire EVM may have fully accessible and active high voltages.

- (a) De-energize the TI HV EVM and all its inputs, outputs and electrical loads before performing any electrical or other diagnostic measurements. Revalidate that TI HV EVM power has been safely de-energized.
- (b) With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment connection, and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
- (c) After EVM readiness is complete, energize the EVM as intended.

WARNING: WHILE THE EVM IS ENERGIZED, NEVER TOUCH THE EVM OR ITS ELECTRICAL CIRCUITS AS THEY COULD BE AT HIGH VOLTAGES CAPABLE OF CAUSING ELECTRICAL SHOCK HAZARD.

3. Personal Safety

- (a) Wear personal protective equipment (for example, latex gloves or safety glasses with side shields) or protect EVM in an adequate lucent plastic box with interlocks to protect from accidental touch.

Limitation for safe use:

EVMs are not to be used as all or part of a production unit.

2 Getting Started

2.1 Hardware Setup

CAUTION

The board has not been tested with electronic load and so it should not be used with such load. 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. The BLPFC board should always be started with 110Vac (60Hz). Once the board is up and running the input voltage can be changed to any other voltage within the specification.

Connect USB connector to the Piccolo (CC2803x) controller card for emulation. Use an external +12Vdc supply at JP1 to power up all the control circuit for now. By default, Piccolo controller is enabled to boot from FLASH and run the BLPFC code. The user should not use the RAM to program or run the BLPFC code. 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 BL PFC board.

Use an appropriate isolated AC power supply (100Vac to 250Vac, 47Hz~63Hz, 350W min) to provide input power to the BLPFC EVM. Connect the ac supply to the BLPFC EVM but do not turn on the AC power at this time. Connect an appropriate resistive load (only) to the BLPFC DC output terminals (PFC-Out & GND terminals). Resistive loads within the range of 10W ~ 300W are recommended. Do not use electronic load with this board.

2.2 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\BLPFC\~GUI and double-click on BLPFC-GUI.exe. The following figure shows a screen shot for the BLPFC GUI.

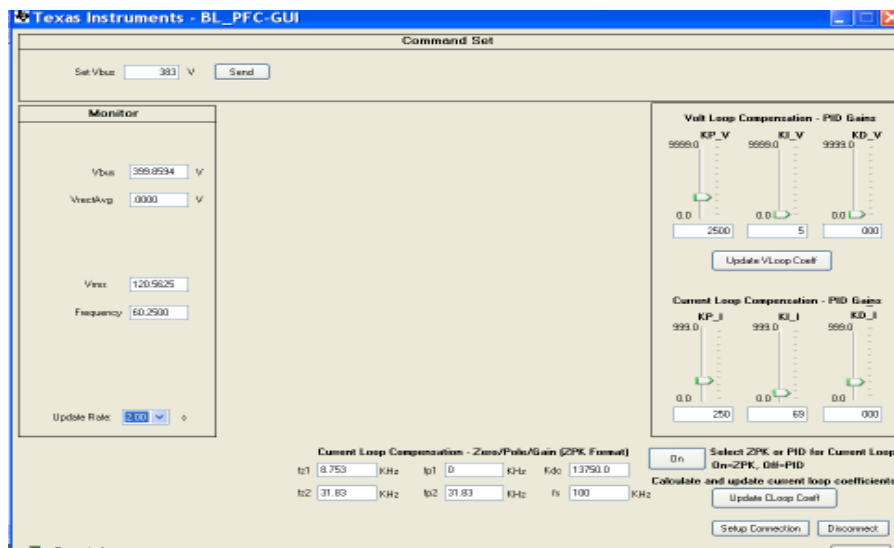


Figure 1.

2. Click "Setup Connection" on the GUI

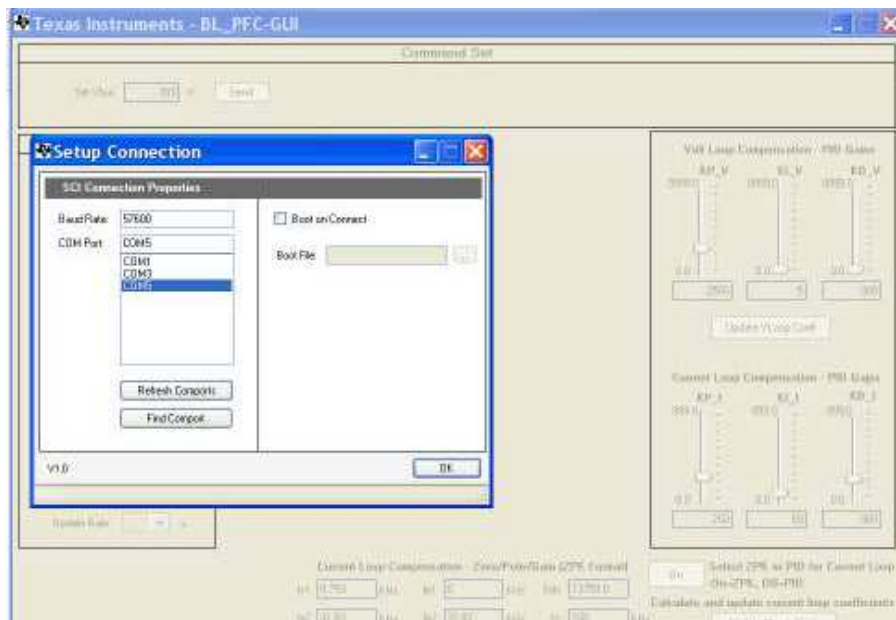


Figure 2.

3. Ensure the Baud Rate is set to 57600.
4. Next you will need to select your serial comport.
 - (a) If the comport 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 that 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/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 & LPT).
If using a serial port directly connected to a PC, look for a comport which 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 below:

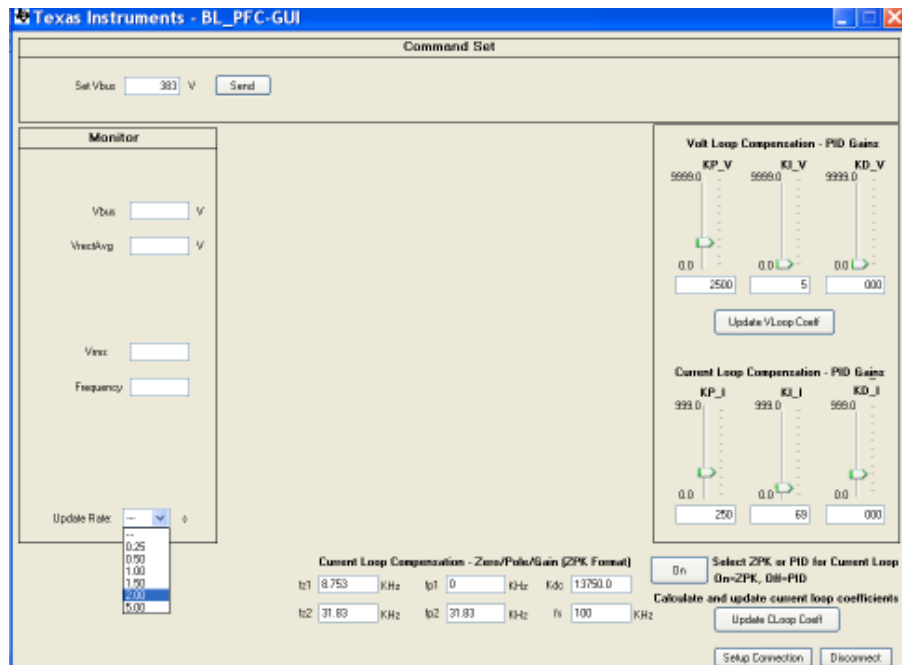


Figure 3.

2.3 GUI Structure

Command Set — Section allows the user to set the PFC output voltage via a text box **Set Vbus**.

Monitor — section displays various system parameter values. These include, the input AC RMS voltage, the average value of the input AC rectified voltage, the input AC line frequency and the PFC output voltage.

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

Loop Tuning — The PID gains for the current and voltage loop can be adjusted from the GUI environment while the PFC is running. However, the user needs to be careful in changing the controller gains appropriately. Incorrect gain values may result in unstable PFC operation. Acceptable range for the PID gain parameters are 0 ~ 9999 for the voltage loop, and 0 ~ 999 for the current loop. The current loop compensation can also be adjusted by using the controller in Pole/Zero/Gain format (ZPK format). To use this feature click on the button labeled as “Select ZPK or PID for Current Loop On=ZPK, Off=PID”. If this button is ON then ZPK format can be used. If this button is OFF then PID format will be activated.

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

Connect/Disconnect — Begins or ends serial port communication with the target board.

2.4 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.
- Verify that the jumper at J8 is connected so that isolated bias supply (small bias supply board mounted at location M2 close to the PFC output capacitors C5, C6 and C16) can now provide the +12Vdc output when the AC power is turned on.
- Now turn on the AC power with voltage set around 110Vac.
- The PFC output should ramp according to the slew rate to the desired set value (~400Vdc).
- Verify the effect on the dc bus voltage and on the input power factor when the input voltage (100Vrms ~ 240Vrms) or the load power (0~300W) is varied. The dc bus should be regulated at 400V under all conditions. Depending on the load and line conditions, the power factor for the input current will vary from 0.94 to 0.999.
- Bring up the BLPFC GUI (as described before) and monitor the PFC parameters. Change the DC bus voltage from the GUI (400V ~ 350V). The DC bus voltage should be set close to 400V when high line input voltage (220Vrms ~ 240Vrms) is applied.
- When turning off ac power, ensure that the AC power is turned off first. Then wait for a few minutes before disconnecting the GUI.

2.5 References

For more information please refer to the following guides:

BLPFC User Guide — Provides detailed information on the BLPFC project within an easy to use labstyle format.

..\controlSUITE\development_kits\BLPFC\~Docs\BLPFC.pdf

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

..\controlSUITE\development_kits\BLPFC\BLPFC_HWDevPkg

F28xxx User's Guides— <http://www.ti.com/f28xuserguides>

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