Two Phase Interleaved PFC (ILPFC) EVM Specification

Quick Start Guide

TEXAS INSTRUMENTS

Two Phase Interleaved PFC (ILPFC) EVM Specification

1 Introduction

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

2 Getting Started

2.1 Setting up the Hardware

WARNING

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 discharges 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 +12 Vdc supply (provided with the ILPFC EVM package) at JP1 to power up all the control circuit for now. By default, the Piccolo controller is enabled to boot from FLASH and run the ILPFC code. Do 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 applies the external +12 V supply to the ILPFC board. The 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) starts flashing periodically. The flashing LED is an indication of the code being executed from the FLASH memory. However, the PFC bus remains at 0 V since the AC input voltage has not been applied yet.
4. Select an appropriate isolated AC power supply (100 Vac to 260 Vac, 47Hz to approximately 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 and GND terminals). Resistive loads within the range of 10W to approximately 700W are recommended. Set the initial load to about 50W to approximately 80W. A 2K Ω resistor provides about 80W load at 400V dc bus. This board has not been tested with electronic load.

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

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

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

9. Increase the AC input voltage to around 130 Vac, 60Hz. The unit detects this minimum input voltage and the corresponding DC bus voltage (160 Vdc minimum). This condition must be met in order to soft-start the PFC

10. The PFC output ramps according to the slew rate to the rated bus voltage (approximately 390 Vdc).

11. Verify the effect on the dc bus voltage and on the input power factor when the input voltage (100 Vrms to approximately 260 Vrms) or the load power (0 W to approximately 550W @110Vin, 0W - to approximately 700W @ 220 Vin,) is varied. The dc bus should be regulated at 390 V 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. Figure 1 shows the PFC input voltage and current when the input voltage is about 110 V and the PFC load is about 550W load. Figure 2 shows the input current and PFC DC bus response for step load between 240W to approximately 400W when the input voltage is set to 120 Vrms.

12. Ensure that the AC power is turned off, then wait for a few minutes for the high voltage PFC dc bus capacitor to discharge completely.
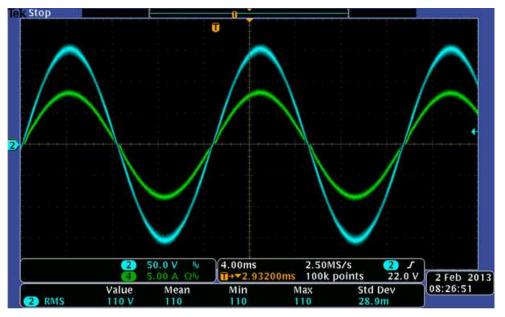

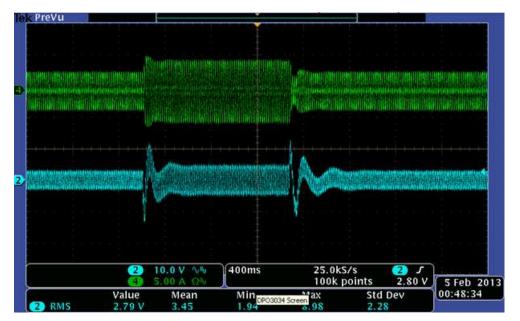**Figure 1. PFC Input Voltage and Current**

Figure 2. Input Current and PFC DC Bus Response for Step Load

3 References

- ILPFC User's Guide located in http://www.ti.com/tool/controlsuite at (..\controlSUITE\development_kits\ILPFC\~Docs\ILPFC.pdf)
- ILPFC_Rel-1.0-HWdevPkg located in http://www.ti.com/tool/controlsuite at (..\controlSUITE\development_kits\ILPFC\ILPFC_HWDevPkg)
- *TMS320F28030, TMS320F28031, TMS320F28032 TMS320F28033, TMS320F28034, TMS320F28035 Piccolo Microcontrollers Data Manual* (SPRS584)

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have *not* been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		