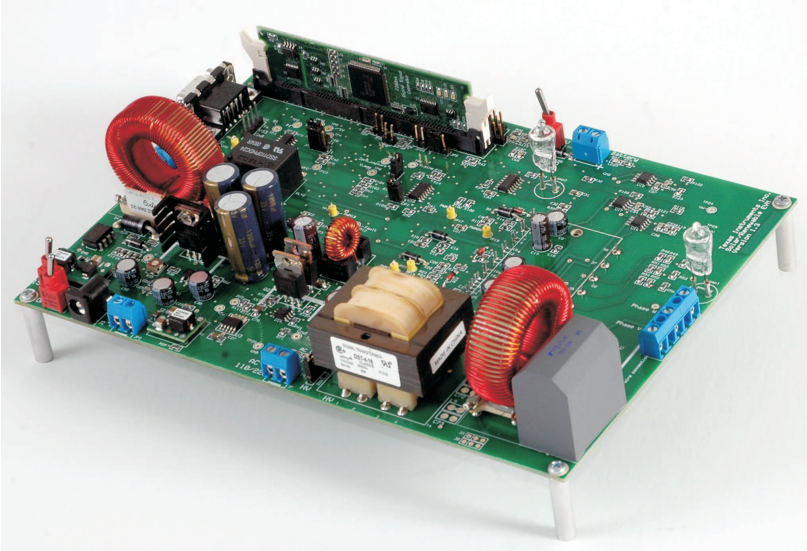
Renewable Energy Developer's Kit Overview



This document describes the Renewable Energy Developer's Kit evaluation board designed to work with Texas Instruments C2000™ microcontrollers. This kit is a part of TI's digital power tools package designed to give customers an opportunity to quickly evaluate TI C2000 products for power conversion applications at a safe input voltage and power level.

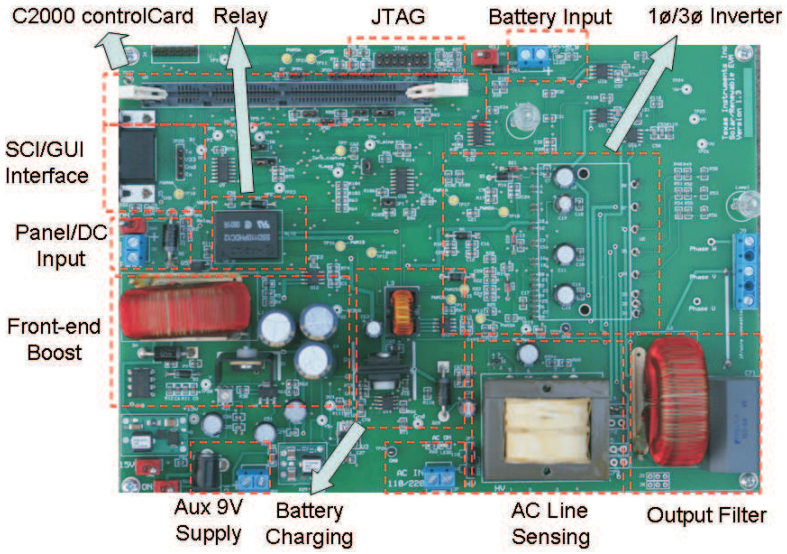
The Renewable Energy Developer's Kit contains a motherboard which accepts any of the plug-in controlCARDs™. This system allows implementing all the major functions of a solar and/or a renewable energy system. These functions include front-end DC to DC conversion, three or single phase inverter operation, synchronizing inverter output with the AC line, and DC to DC buck operation for possible battery charging. This board offers all the voltage and current measurement hooks so that one can create and test new topologies, techniques etc.

Features of the Renewable Energy Developer's Kit include:

- Compatibility with any of the plug-in C2000 controlCARDs.
- Front-end DC/DC boost converter.
- Three-phase or single-phase inverter output.
- DC/DC buck converter for battery charging.
- Hardware relay to switch between panel/DC source and battery supply.
- AC line (110 V or 220 V) synchronization for the inverter output.
- Voltage and current measurements via ADC.
- Closed loop digital control with feedback using F28x on-chip ePWM and ADC.
- UART communications header available for host control.
- A learning platform allowing the user to easily probe the most significant wave forms within a board that is laid out conservatively and contains many test points.
- Hardware Developer's Package is available and includes schematics, bill of materials, Gerber files,…etc.

1 Hardware Overview

Shown below is a picture of the Renewable Energy board that identifies the key components.



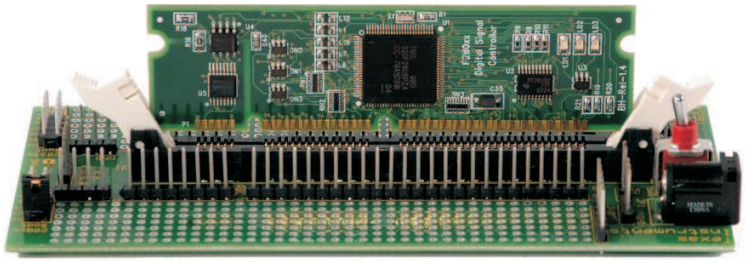
Auxiliary Supply	A 9 V auxiliary supply (included) connection at J1 to power the control and drive circuit. Optional 5-V supply connection at J1 to only power the control circuit
DC-DC Boost Section	Front-end single phase DC/DC boost converter
Panel/DC Input	Input Panel/DC voltage up to 20 V at J2.
12-V Battery	12-V Battery connection at J6.
Charging Section	DC/DC buck converter for battery charging.
Inverter Section	Single-phase or three-phase inverter operation. Output filter provided for single phase output.
110/220-V AC I/P	110/220-V_{ac} input for line sensing/synchronization at connector J7. Default jumper setting at JP7 selects 110-V_{ac} input configuration.
Boot Jumpers	Controls how the F280x will boot. (J34) • If no jumpers are placed the target will boot from flash. • If a jumper is placed the target will boot from the SCI.

2 Hardware Setup

To be able to run the various software builds for the projects included in this package, a 12/20-V DC regulated bench power supply and an emulator are required apart from the hardware included in this package (suggested emulators are listed near the end of this document). The application-specific motherboard provided in this kit can be used through Code Compuser Studio.

Please follow these steps to set up the hardware and software development platform:

1. Unpack the DIMM style controlCARD.
2. Spread open the winged retaining clips on controlCARD U5 connector.
3. Set the DIMM card loosely in the connector slot. Make sure to align the two keyed notches and position the card bottom corners inside the retaining clips (see picture below).
4. Push vertically down, using even pressure from both ends of the card until the clips snap and lock (Note: To remove or eject the card, simply spread open the retaining clips with thumbs).



CCStudio Software Development Platform Emulation

1. Connect the JTAG emulator cable to the JTAG connector.
2. See Software Setup CCS-Development.

Note: For full details (schematics, pin-out table, etc) of the hardware please refer to the Hardware Developer's Package, Renewable-HWdevPkg. See Section 3 for download location.

3 Software Installation

To run any of the application-specific software in CCStudio IDE, you will need to install Code Composer Studio v3.3, the baseline software package for C2000 kits, and the board-specific software Package. A 32KB-limited version of the Code Composer IDE has been included with this kit. The baseline software package contains the header files, libraries, etc., necessary for the Code Composer project to compile. This baseline installer is common to all C2000 development kits and may not need to be downloaded if it is already installed on your computer.

1. To install baseline soft collateral and hardware:
   - On an Internet browser type: http://www.ti.com/c2000tools
   - At the C2000 collateral page search for the "Renewable Energy Developer's Kit and download the Baseline Software" for this kit.
   - Save the .zip file to the directory of your choice.
   - Unzip the file and run the install program, Baseline Software Setup.
   - The installer will create the following default directories:

     C:\TI_F28xxx_SysSW
     ~Docs----contains general software documentation
     ~SupportFiles-----contains C2000 header files, key libraries, etc.
     C:\TI_F28xxx_SysHW------contains schematics, etc. for all controlCARDs.
2. Install Code Composer Studio v3.3
   - Place the Code Composer trial version CD into your CD-ROM drive
   - Follow the automated installer through the rest of the install
   - See the document "QSG-CodeComposerC2000.pdf" for more information (C:\TI_F28xxx_SysSW\~Docs)
3. To Install Renewable Energy Kit soft collateral and hardware documents
   - On an Internet browser type: http://www.ti.com/c2000tools
   - Then choose the "Renewable Energy Kit Board Specific Software" link.
   - Save the .zip file to the directory of your choice.
   - Unzip the file and run the install program Renewable Energy Software Setup.
   - The installer will create the following default directories:

     C:\TI_F28xxx_SysSW
     ~SupportFiles
     lib
     PowerLib
     Renewable
     ~Docs
     ~GUI

C:\TI_F28xxx_SysHW
Renewable-HWdevPkg

4 Running the Application

If you have emulation tools and Code Composer Studio (CCS) already installed and active, load the project file “Renewable.pjt” found in: C:\TI_F28xxx_SysSW\Renewable\

Please refer to the corresponding (Renewable.pdf) user guide for a step-by-step guide of how to compile and run the various labs. This document can be found in the corresponding documents folder for the project ...\~Docs\.

5 Emulators

The following companies provide low cost, full featured emulators designed specifically for C2000 controllers:

Blackhawk™

USB2000 Controller (Blackhawk part number BH-USB-2000, TI part number TMDSEMU2000U)

http://www.blackhawk-dsp.com

http://www.ti.com/c2000tools

$299

Spectrum Digital

XDS510LC JTAG Emulator (part number 701902)

http://www.spectrumdigital.com

$249

6 References

For more information please see the following guides:

Renewable – provides detailed information on the Renewable Energy project within an easy to use lab-style format.
C:\TI_28xxx_SysSW\ Renewable\~Docs\ Renewable.pdf

QSG-Renewable-GUI – gives an overview on how to quickly demo the Renewable Energy project using an intuitive GUI interface.
C:\TI_28xxx_SysSW\ Renewable\~Docs\QSG-Renewable-GUI.pdf

Renewable-HWdevPkg – a folder containing various files related to the hardware on the Renewable Energy Kit board (schematics, bill of materials, Gerber files, PCB layout, etc).
C:\TI_28xxx_SysHW\ Renewable-HWdevPkg\

System Framework Overview Guide – presents more information on the system framework found in F28xxx EVM projects.
C:\TI_28xxx_SysSW\~Docs\SystemFrameworkOverview.pdf

F28xxx User’s Guides
http://www.ti.com/f28xuserguides

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