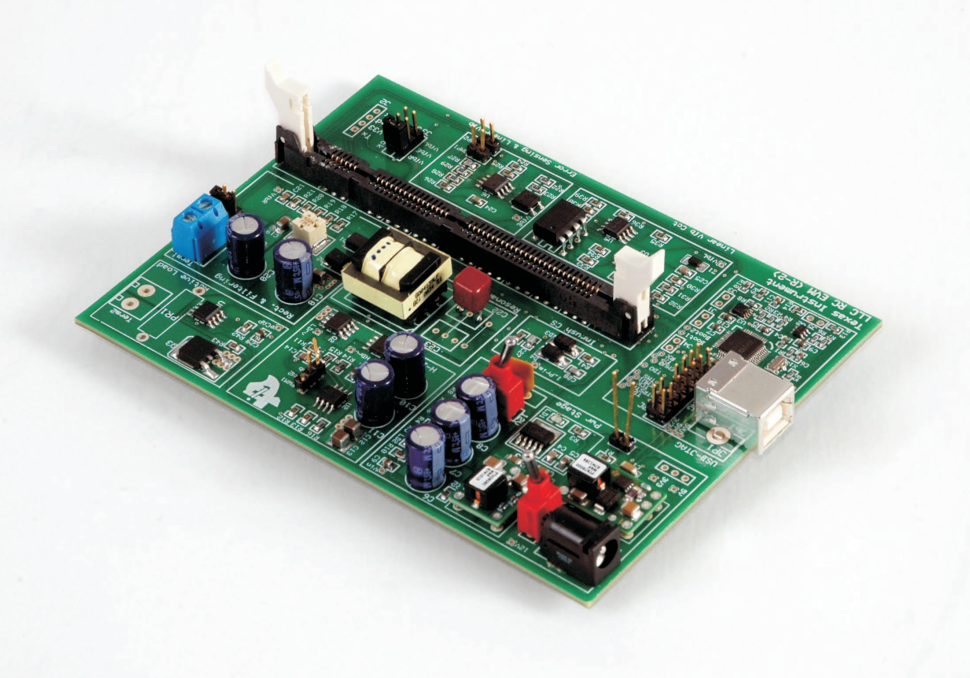
Resonant DC/DC Developer's Kit Overview



A great way to experiment and learn about digital power control is TI's C2000™ digital power kits which accept any of the plug-in controlCARDs.

The Resonant DC/DC Developer's kit is an LLC-type resonant converter designed to help users practice digital power conversion and soft switching techniques as well as to evaluate various feedback types and system protection methods. It contains a resonant tank based on an integrated magnetic module with embedded virtual inductors that is controlled by the F28xxx MCU. The EVM is self contained, providing an active (switched) load unit to tune the transient behavior of the system. The board takes a single 16-22 V DC supply and has a separate switched and fused rail as the input voltage bus allowing safe, convenient software experimentation and debug without hardware damage.

Features of the LLC Resonant Converter EVM include:

- 12-V DC target output voltage with optional variable DC power supply configuration
- Resonant tank containing an integrated magnetic with virtual inductors
- Active load for transient response testing (switching timing controlled by ECAP peripheral)
- Input voltage measurement via ADC for brownout and over-voltage protections
- Four different types of output voltage measurements via ADC through optocouplers to evaluate feedback alternatives
- A simple primary current monitoring circuit for short circuit protection, two-level overload protection and burst mode applications
- Over-load protection flag detection via LED indicator
- Closed loop digital control with voltage feedback using F28xxx on-chip ePWM and ADC
- Optional looped back ePWM signals, allowing ADC inputs to provide a simple scope to view waveforms in Code Composer Studio
- UART communications header available for host control
- On board USB-JTAG emulator
- Host GUI, a friendly way to control / demo the application, based on open source C# freeware
- Hardware Developer's Package that includes schematics, bill of materials, and Gerber files.

1 Hardware Overview

The Resonant Converter EVM board is intended to be a learning tool – not a turn-key solution. It demonstrates the functionality of a larger systems at a safe input voltage and power level. It is not intended to demonstrate any extreme in electrical design (smallest size, highest efficiency). Since the EVM board is a learning platform, it has a conservative board layout and multiple test points allowing the user to easily probe the most significant waveforms. Figure 1 is a diagram of the EVM board and some key features.

Figure 1. Key Features of EVM Board

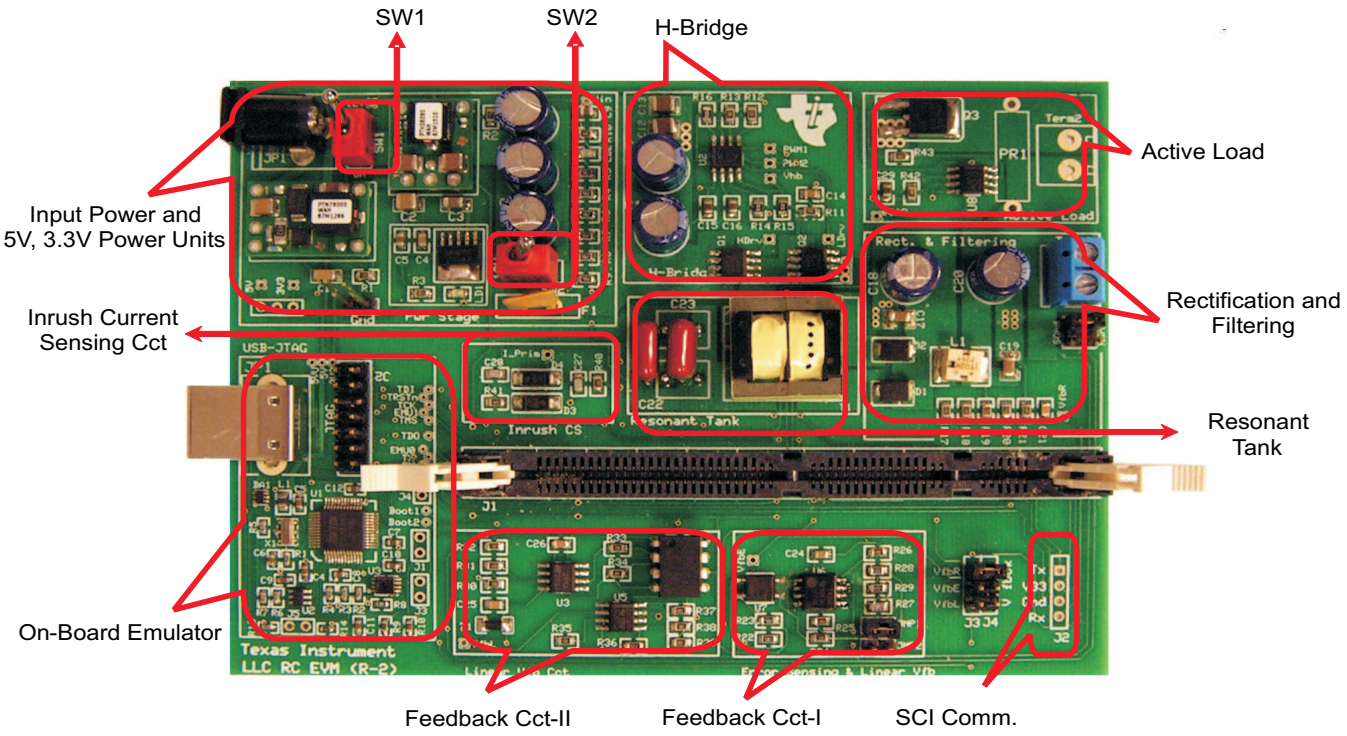


Table 1. Hardware Components

Component	Description
Input Power	DC power supply from plug pack. 20 V is preferred but 16-22-V supply can be used as well (8-22 V @ Light Loads, 16-40 V @Full Load and 16-22 V for all loads).
SW1 (Main Pwr)	SW1 - Master power switch for entire EVM
SW2 (DC Bus)	SW2 - Power switch for Vin to buck stages only. When off the F2808 DIMM controller card will still operate (next to the DC bus switch is a resettable fuse)
H-bridge	High frequency MOSFET driver including bootstrap diode and H-bridge MOSFET
Feedback Cct-I	Shunt regulator and optocoupler based isolated feedback circuit for variable and constant output voltage regulation
Feedback Cct-II	Linear optocoupler based isolated feedback circuit for variable and constant output voltage regulation
Active Load	Software controlled switched load (load needs to be connected to the terminals or populated on the board)
Inrush Current Sensing Cct	A simple circuit to sense approximate primary side current for various types of protections and burst mode
On-board Emulator	XDS100, USB / JTAG emulator
SCI-Comm	Serial communications UART (connects to an optional GUI, not used in lab exercises)
J1	If a jumper is placed on J1 the F2808/F28044 MCU boots from SCI when power is applied. If not placed, the F2808/F28044 boots from FLASH.
J3	If a jumper is placed on J3 the F28335, MCU boots from SCI when power is applied. If not placed the F28335 boots from FLASH.
J5	On-board emulation enable/disable jumper. If a jumper is placed on J5, the on-board emulator is disabled allowing an external JTAG emulator to be used on the board.

2 Hardware Set Up

All the hardware needed to get started is included in this package. The application specific motherboard provided in this kit can be used in one of two ways:

1. Test Drive – Using the provided GUI application, you do not need Code Composer Studio™ or emulation tools. This provides a great way to run or demo the application code quickly and see what functionality the hardware offers. Note: exactly the same functionality can be achieved by using the Code Composer Studio Watch Window and slider features during emulation in the second mode.
2. Code Composer Studio Software Development Platform – With the project code provided, the application can be modified, compiled, loaded and run in a development environment. Code Composer Studio and Emulation HW tools are required for this.

Follow these steps to set up the hardware for either the GUI or Software Development Platform:

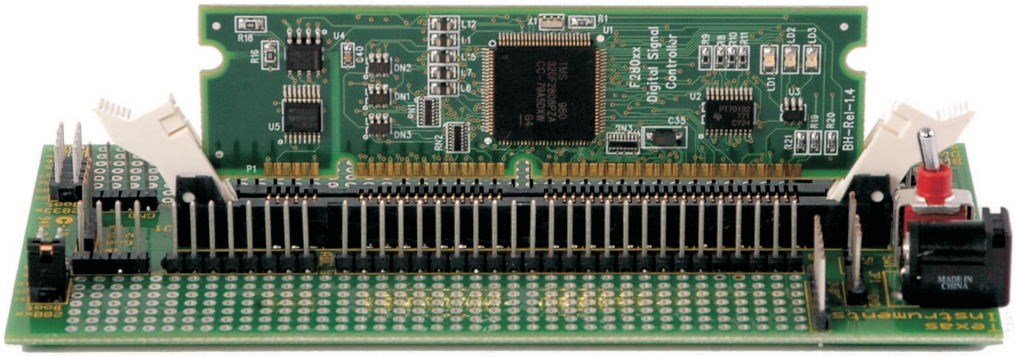
Step 1. Unpack the DIMM style controlCARD.

Step 2. Spread open the winged retaining clips on connector J6.

Step 3. Sit the DIMM card loosely in the connector slot. Make sure to align the 2 keyed notches and position the card bottom corners inside the retaining clips (see picture below).

Step 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, spread open the retaining clips with thumbs).

Step 5. Ensure switch 1 (SW1) is in the off position and connect the included power supply to the power jack.



2.1 Test drive with GUI – (skip if you need only emulation support)

1. Plug in the serial cable provided to connector J9 making sure the red wire aligns with the Rx pin on EVM.
2. Insert a jumper at J1.
3. Plug the DB9 connector into your PC using either a serial port or a serial-to-USB converter dongle.
4. After the TI software download is finished turn on the power to the board, see Software Setup GUI-TestDrive section.

2.2 Code Composer Studio Software Development Platform Emulation - Additional Steps

Step 1. Connect the USB orJTAG emulator cable to connector J1 or J2 respectively (optional).

Step 2. After the TI software download is finished turn on the power to the board, see Software Setup Code Composer Studio-Development.

Note: For full details (schematics, pin-out table) of the hardware see the Hardware Developer's Package. See Software Setup for download location.

3 Software Set Up

The Resonant DC/DC Developer's Kit application software, TestDrive-GUI, step-by-step lab style documentation, schematics and other useful soft collateral can all be found on the TI website. As explained in the HW setup section, the target mother board can be run either with the GUI or Code Composer Studio. The GUI executable file is found as part of the main software download. Follow the steps below for either case.

To run any of the application specific software in Code Composer Studio, you must first install the baseline code that contains the header files, libraries, etc. The baseline software is the same for all of TI's development kits. If the baseline software is already installed, skip the baseline install steps and go to the Resonant DC/DC Developer's Kit section.

To download the free TI soft collateral follow these steps:

Step 1. Baseline soft collateral and hardware documents (skip this if you already have this software installed)

a. On an Internet browser type: http://www.ti.com/f28xkits
b. At the C2000 DSP collateral page, choose the Resonant DC/DC Developer's Kit "baseline" download link
c. If prompted, fill in the TI customer registration details and click ok
d. Save the .zip file to the directory of your choice
e. Unzip the file and run the install program Baseline Software Set Up
f. The installer will create the following default directories:

C:\TI_F28xxx_SysSW

~Docs

~GeneralPurposeGUI

~SupportFiles

FlashingLeds

C:\TI_F28xxx_SysHW

CC280xxHWdevKit.zip

DockingStnHWdevKit.zip

Step 2. Resonant DC/DC Developer's Kit soft collateral and hardware documents

a. On an Internet browser type: http://www.ti.com/f28xkits
b. Then choose the Resonant DC/DC Developer's "Board Specific" download link.
c. When prompted, fill in the TI customer registration details and click ok.
d. Save the .zip file to the directory of your choice.
e. Unzip the file and run the install program ResonantConv Software Set Up.
f. The installer will create the following default directories:

C:\TI_F28xxx_SysSW

ResonantConv

~Docs (this directory contains the ResonantConv GUI QSG)

~GUI (this directory contains the ResonantConv GUI executable)

~SupportFiles (this directory contains files needed by the GUI)

C:\TI_F28xxx_SysHW

ResonantConv-HWdevKit.zip (contains hardware schematics, pin-out table, etc)

4 Running the Application

To run the application specific hardware, choose either “TestDrive-GUI” or “Code Composer Studio-Development” options and follow the appropriate steps.

Step 1. TestDrive-GUI

a. Open the GUI Quick Start Guide in *C:\TI_F28xxxSysSW\ ResonantConv\~Docs\ ResonantConv-QSG.pdf*

b. Go to directory *C:\TI_F28xxxSysSW\ ResonantConv\~GUI*

c. Open ResonantConv-GUI.exe

d. Follow the step-by step instructions found in the Quick Start Guide

Step 2. Code Composer Studio-Development

a. If you have emulation tools and Code Composer Studio (Code Composer Studio™) already installed and active, load the project file “ResonantConv.pjt” found in:
C:\TI_F28xxxSysSW\ ResonantConv

b. See the ResonantConv Lab document for a step-by-step walk through of how to compile and run the various labs. This document can be found in *C:\TI_F28xxxSysSW\ ResonantConv\Docs*

5 Using the Onboard USB JTAG Emulation

The onboard USB JTAG emulation is based on TI’s XDS100 emulation technology and provides an easy way to connect to the board and begin Code Composer Studio development. To setup the onboard USB JTAG emulation follow these steps:

- Install the include 32KB limited version of Code Composer Studio V3.3. If Code Composer Studio is already installed, run update advisor and update to the latest version. This will install the XDS100 drivers and Code Composer Studio support files.
- Connect the Resonant DC/DC board to an available USB port.
- When prompted do not allow Windows to go online to search for drivers, but allow Windows to search your computer for drivers.
- Open Setup Code Composer Studio V3.3 and add the F2808 XDS100 USB Emulator board configuration to your System Configuration.
- Save the configuration and launch Code Composer Studio on exit.

6 References

For more information, see the following guides:

- ResonantConv – provides detailed information on the ResonantConv project within an easy to use lab-style format.
  C:\TI_28xxxSysSW\TwoChannelBuck\~Docs\ ResonantConv.pdf
- QSG- ResonantConv-GUI – gives an overview on how to quickly demo the ResonantConvProject using an intuitive GUI interface.
  C:\TI_28xxxSysSW\ ResonantConv\~Docs\QSG- ResonantConv-GUI.pdf
- ResonantConv-HWdevKit – a .zip file that provides various files related to the hardware on the EVM board (schematics, bill of materials, Gerber files, PCB layout, etc). All schematics and PCB files created with the freeware ExpressPCB package.
  C:\TI_28xxxSysHW\TwoChBuck-HWdevKit.zip
- F28xxx User’s Guides -
  http://www.ti.com/f28xuserguides

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