

Renewable Energy Kit GUI Overview

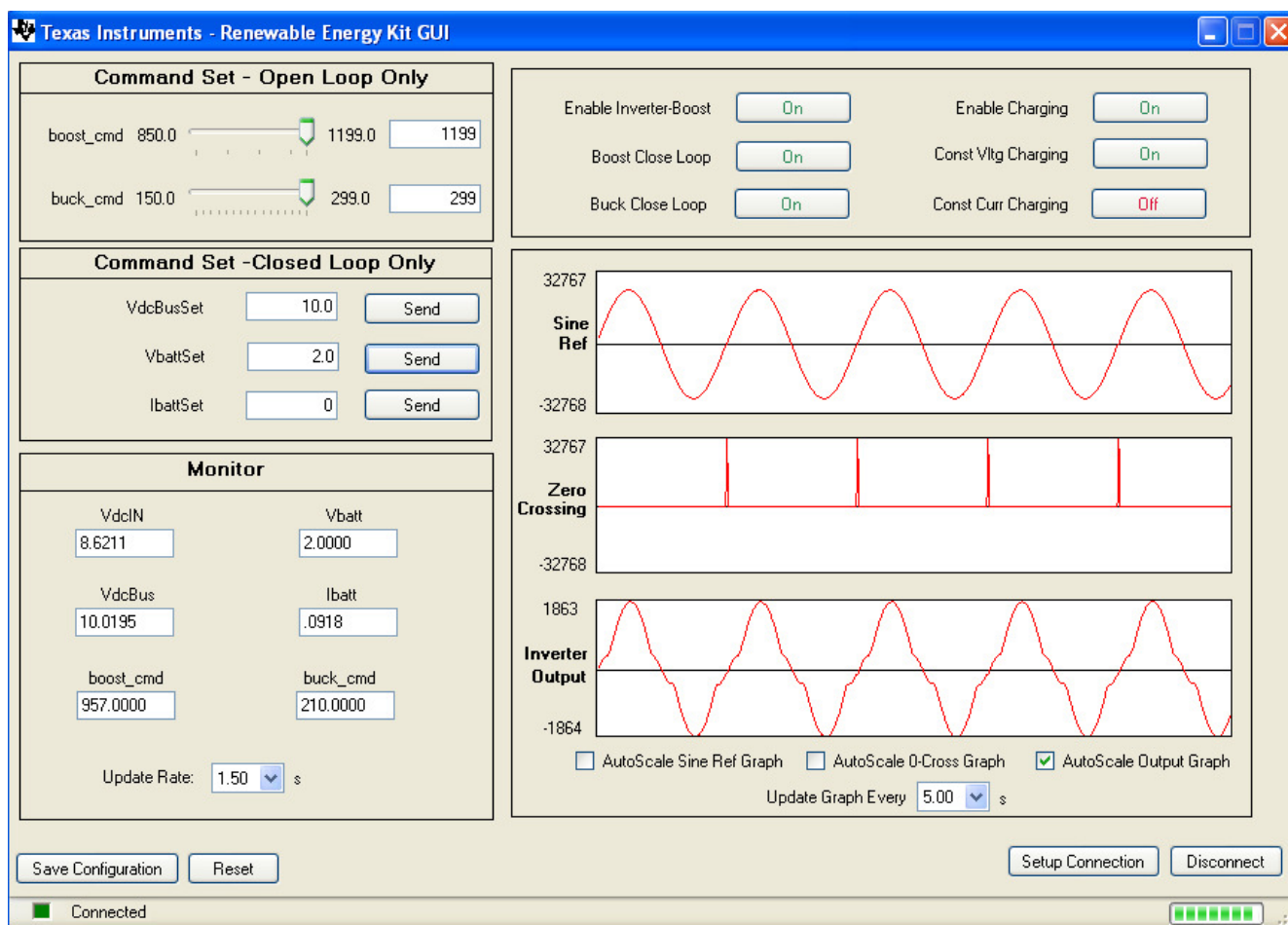
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The Renewable Energy kit GUI provides a convenient way to evaluate the functionality of the Renewable Energy development Kit and the TMS320F280x/ F2802x and F2803x devices without having to learn and configure the underlying project software. It is written in C# using Microsoft Visual Studio .NET with the source code located at:

C:\TI_F28xxx_SysSW\Renewable\~GUI\~Source\

This GUI features:

- Interactive interface using sliders, buttons, textboxes and graphs to easily control/demo the Renewable Energy system.
- GUI variables directly tied to framework variables, allowing simplified software development
- Ability to boot the F28xxx with a .a00 file or connect to a preprogrammed project via a Serial Port (RS-232) connection
- Ability to save connection settings and startup configuration



Getting Started

The document details the steps for using Piccolo-B control card with the GUI. The same steps can be used for Piccolo-A though hardware setup would change. For F280x device the values of the GUI variables changes because of the operating frequency difference. This difference is highlighted in the document.

Setting up the Hardware

- Make sure the Switches SW1, SW2, SW3 and SW4 are in “OFF” Position.
- Make sure the following jumpers are plugged in: JP34, JP6, pins 2 and 3 of JP4, pins 2 and 3 of JP3, pins 1 and 2 of JP5, pins 2 and 3 of JP25 (pin1 of JP25 is the nearest to the silkscreen name JP25), Jumper JP1, and appropriate jumper setting at JP7 (please refer to Table 5 of the document titled Renewable.pdf). (**Note for F2802x**, jumpers are plugged in pins 1 and 2 of JP4, pins 1 and 2 of JP3, and SW3 of the control card is set appropriately to route GPIO19 to GPIO24 of the DIM100)
- To load the code from the GUI, the switch on the control card must be set to boot from SCI. For F2803x device SW2 and for F2802x device SW1 of the control card– controls the boot option, and should be set to the SCI Mode. The table below describes the boot mode switch SW2 for the F2803x device control card.

Position 1 (GPIO-34)	Position 2 (TDO)	
0	0	Parallel I/O
0	1	Wait Mode
1	0	SCI
1	1	Default (Get Mode; the default mode is to boot from FLASH)

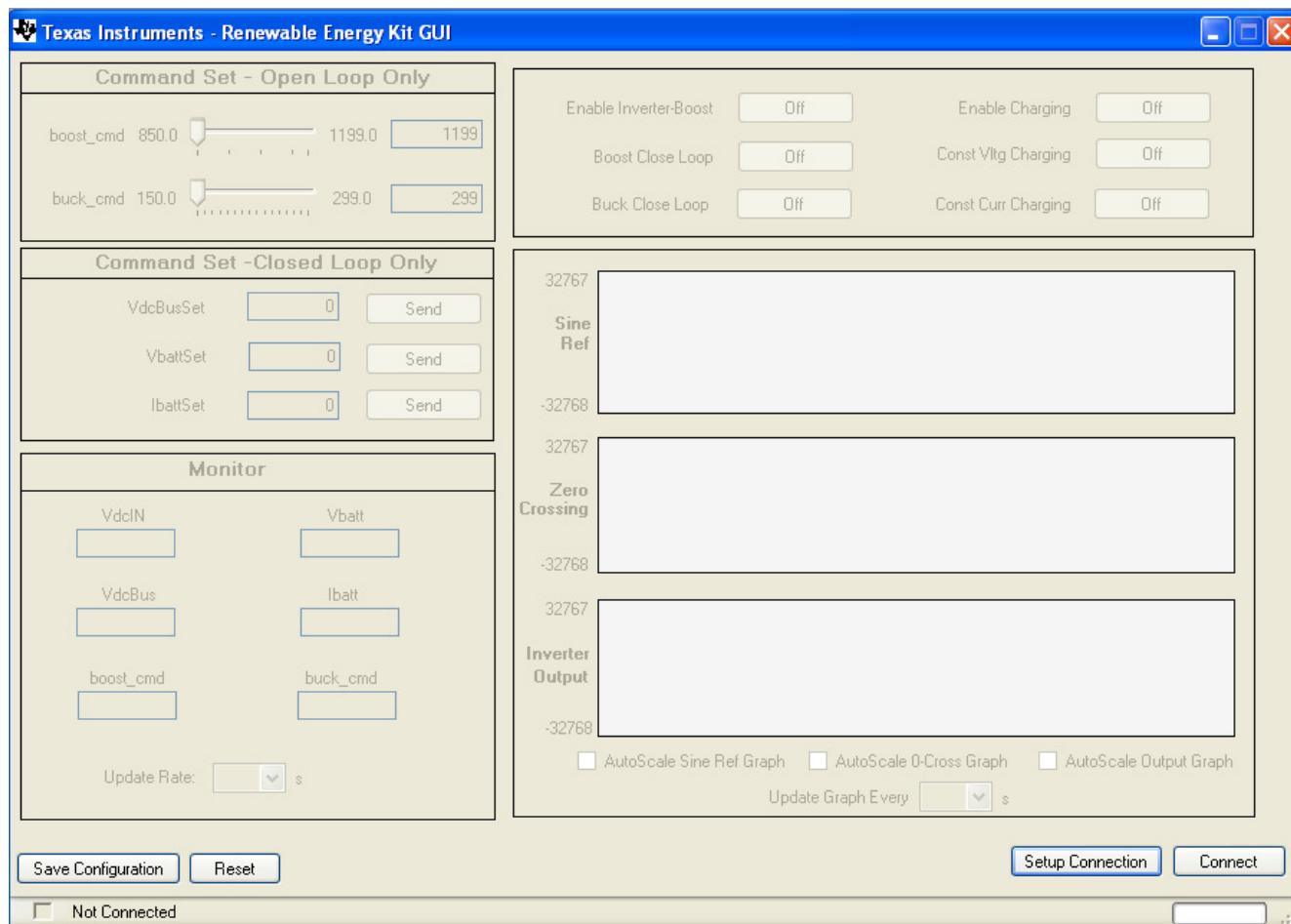
- Plug in the serial cable provided to connector JP28 making sure the red wire aligns with the pin marked ‘Rx’ on the board.
- Connect one bulb (lamp load) at J9 between pins 2 and 3 (i.e. between Phase V and Phase U). Connect the second bulb at J6.
- Now make sure that switch SW4 is in the OFF position and connect a 9-12V DC bench power supply at J2. The positive terminal must be connected to the positive pin of J2.
- Connect a 9V DC supply at J1.
- Connect a suitable power cable at J7 for the AC mains input. Plug-in the other end to the AC input. The AC ON (LED2) should light up. Use extreme caution when this voltage is connected in the circuit.
- Once the hardware is set-up correctly, turn ON SW1.

Running the Application

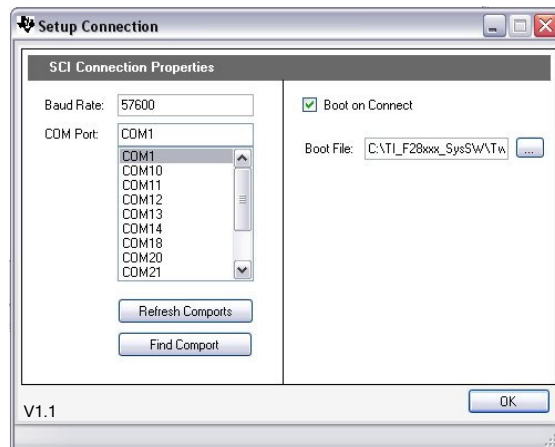
The GUI connects to the hardware by booting a controlCARD with a .a00 file, connecting to a flashed controlCARD target, or connecting to a controlCARD running from RAM via an emulator. This guide discusses booting the controlCARD using a .a00 file.

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

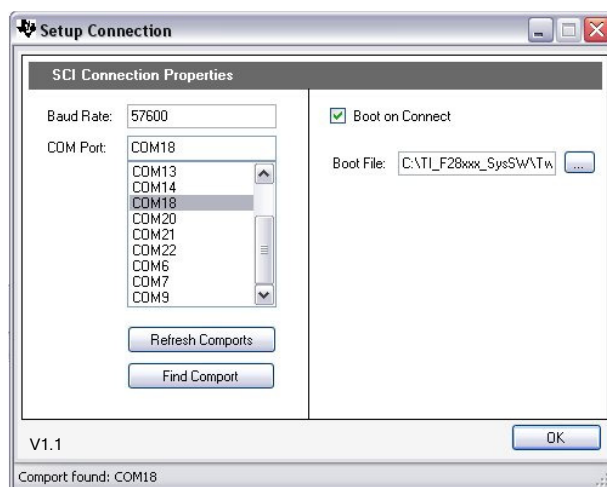
- 1) Browse to C:\TI_F28xxx_SysSW\Renewable\~GUI and double-click on Renewable-Piccolo-GUI.exe



- 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 comport.
 - a. If the comport that the target is connected to is known please select it.
 - b. Use the “Find Comport” tool to find the serialport connection that is connected to the EVM board.
 1. Disconnect the emulator from the target board's JTAG (if applicable).
 2. Ensure that the target F280x MCU is preflashed or that a jumper is located at JP34.
 3. 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.
 4. Once complete 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 retrying this process try 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. If using a USB to Serial adapter look for the com port which shows “USB-to-Serial Bridge”, then select this comport in the Setup Connection window.



- 5) Ensure “Boot on Connect” is checked. If you wish to use the GUI in conjunction with the Renewable energy project running from RAM in Code Composer Studio, please uncheck the checkbox and ensure the code is running.

- 6) Click “...” to select a boot file.

If you are using a F2803x controlCARD, please browse to:

C:\TI_F28xxx_SysSW\Renewable\~GUI then select Renewable-F2803xRAM.a00.

This .a00 file is a hexadecimal conversion of a .out file and was created with the Hex2000.exe utility. Please see the *TMS320x2803x Boot ROM Reference Guide* for more information on this topic.

- 7) Click “OK”
- 8) On the Main Window click “Connect”. When asked to power cycle the board, turn the main power off (SW1), wait for about 1 min and then turn it back on.
- 9) When complete press “Connect” again when the GUI asks. A progress bar in the bottom right hand corner of the main window will show the progress of the boot procedure. Once the boot procedure is finished the program will connect to the target and the GUI is ready for use.

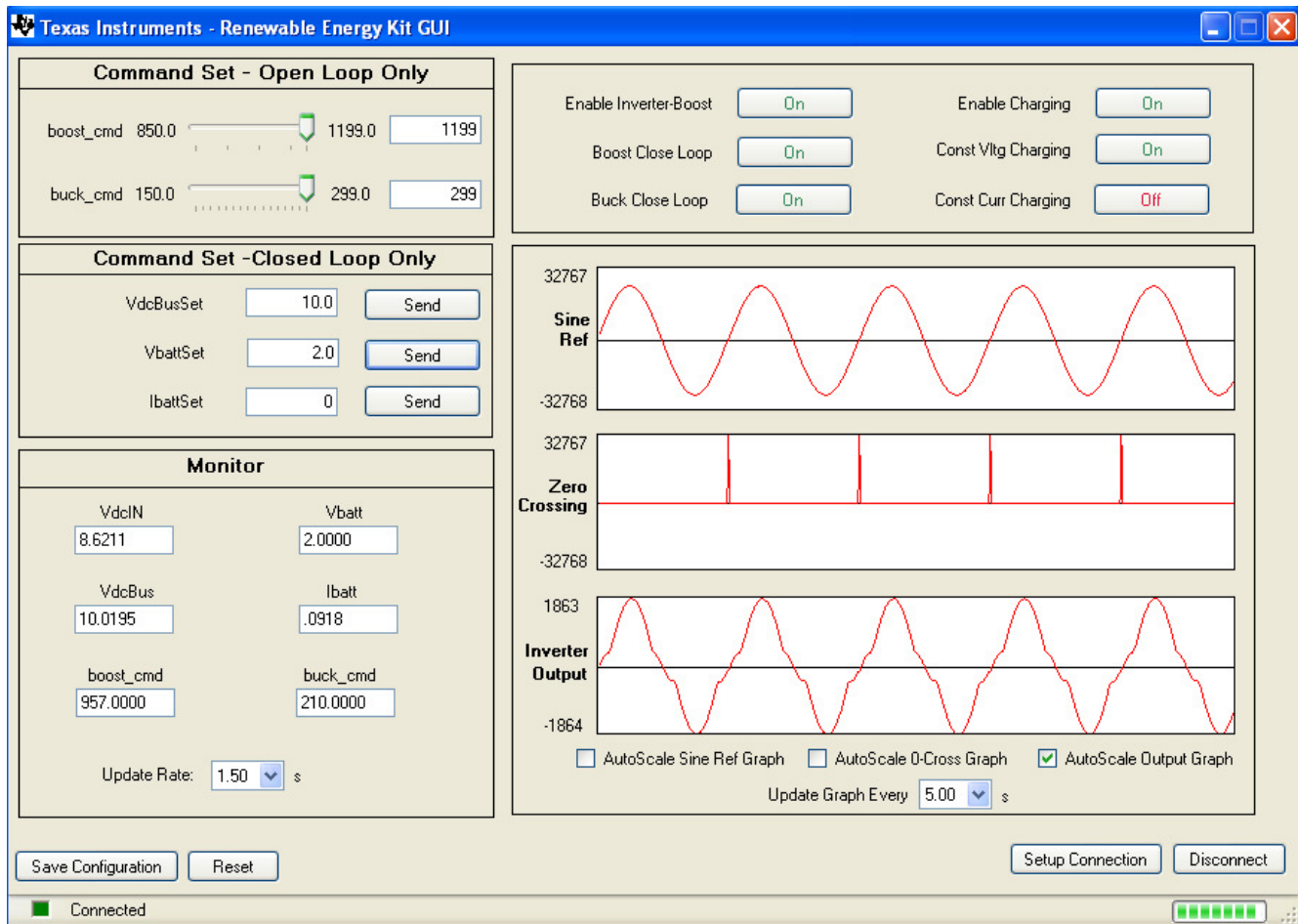
(Note: If GUI displays an error saying Program Did Not Load, Please Try Again, but the LED starts blinking on the F2803x control card. In this case, go back to setup connection without power cycling the board and uncheck boot on connect. Now from the GUI window click connect again. The GUI should now connect to the device and work appropriately)

Reference Guide

- *Save Configuration* – saves the current values of all settable attributes. The next time the application runs these settings will be used as the default settings.
- *Reset* – reloads the application with the last saved configuration.
- *Setup Connection* – opens a new window which contains the serial port and boot settings.
- *Connect/Disconnect* – begins serial port communication with the target board. If “Boot on Connect” has been checked in the Setup Connection window the GUI will boot the target with the .a00 file specified.

GUI Structure

- *Command Set – Open Loop Only* – window allows the user to directly set boost stage duty cycle and the buck stage duty cycle in open loop.
- *Command Set – Closed Loop Only* – window allows the user to set the DC bus voltage and battery charging current in CC charging mode and battery charging voltage in CV charging mode, all in closed loop operation.
- *Monitor* – window displays various system parameter values being monitored.
- *Update Rate* – changes the rate at which the GUI updates the parameters in the Monitor window.
- *Three graph windows* – plot the sine reference command, the zero crossing detection signal of the input line voltage and inverter output waveform making it easy to visualize the system operation.
- *Update Graph Every* – changes the rate at which the GUI updates the three graph windows.
- *AutoScale* – windows let you auto-scale the graphs individually.
- *Various Push-buttons* – to enable/disable different parts of the hardware and software.



Using the GUI

- Once the hardware is set-up correctly and the application is running with the GUI connected, make sure the *boost_cmd* is set to 1199. This sets command for the DC boost stage in open loop operation with an increasing command with a decreasing *boost_cmd* value. Also make sure that the *buck_cmd* is set to 299. This sets command for the DC battery charging stage in open loop operation with an increasing command with a decreasing *buck_cmd* value.
- Using the *Update Graph Every* drop down menu, select an option to update the graph windows at a certain time interval. With the AC input connected at J7, you should now see the *Sine Ref* and *Zero Crossing detect* waveforms being displayed.
- Now turn ON switch SW4 (with the bench DC power supply connected at J2).
- You should now see a *VdcBus* voltage that is close to the supply voltage at J2.
- Now enable the PWM drive to the Inverter and boost stages by using the push-button *Enable Inverter-Boost*.
- The lamp load at the inverter output (J9) should now light up. You should also see the output voltage waveform displayed on the *Inverter Output* graph window. You may auto-scale the graphs by checking the box next to the “*AutoScale*” window corresponding to each graph.

- Notice that the *boost_cmd* variable is set to 1199 by default. This directly controls the compare value for the PWM driving the boost stage and thus controls the duty cycle and the amount of boost imparted. A value of 1199 implies zero duty cycle while a value of 0 implies 100% duty cycle.
- Now change the *boost_cmd* value using the slider and observe the change in the amount of boost by observing *VdcBus* value in the Monitor window for different *boost_cmd* values.
- Now enable the synchronous buck PWM drive for the battery charging by using the push-button *Enable Charging*.
- Change the *buck_cmd* value using the slider and observe the change in the amount of charging voltage *Vbatt* and charging current *Ibatt*.
- Change the *boost_cmd* back to 1199 and *buck_cmd* back to 299 before going to the next step.
- Close the boost stage voltage loop by using *Boost Close Loop* push-button. You may now set the desired DC bus voltage directly by using *VdcBusSet*. An important thing to note here is that there is slew limit implemented in the software on this *VdcBus* reference command. Once the loop is closed and the first time the *VdcBusSet* value is changed from 0 to a value greater than *VdcBus*, the reference command to the controller will slowly ramp up from 0 to this value. Therefore it will take a good amount of time for the *VdcBus* to reach the set reference command.
- At this stage you may observe the effect of varying the input voltage at J2. There should be virtually no effect on the *VdcBus* for modest variations in the input voltage.
- Make sure that the *Enable Charging* push-button is still ON.
- Select close loop operation for the battery charging stage by using *Buck Close Loop* push-button. The battery charging stage could operate in one of two modes: constant voltage (CV) charging, and constant current (CC) charging. According to the mode selected either of the voltage loop or the current loop is closed and controls the output.
- Close the battery charging voltage loop by using *Const Vltg Charging* push-button. You may now set the desired output voltage directly by using *VbattSet*. An important thing to note here is that there is slew limit implemented in the software on this *Vbatt* reference command. Once the loop is closed and the first time the *VbattSet* value is changed to a non-zero value, the reference command to the controller will slowly ramp up from 0 to this value. Therefore it will take a good amount of time for the *Vbatt* to reach the set reference command. With the lamp load connected at J6, do not make the *VbattSet* value greater than 6V.
- At this stage you may observe the effect of varying the input voltage at J2. There should be virtually no effect on the *Gui_Vbatt* value for modest variations in the input voltage.
- Change the *VbattSet* to 0 and wait for *Vbatt* to go close to 0 before going to the next step.
- Take the battery charging out of the voltage loop by using the *Const Vltg Charging* push-button again. Now close the battery charging current loop by using the *Const Curr Charging* push-button. You may now set the desired output charging current directly by using *IbattSet* variable in the watch window. An important thing to note here is that there is slew limit implemented in the software on this *Ibatt* reference command. Once the loop is closed and the first time the *IbattSet* value is changed to a non-zero value, the reference command to the controller will slowly ramp up from 0 to this value. Therefore it will take a good amount of time for *Ibatt* to reach the set reference command. With the lamp load connected at J6, do not

make the *IbattSet* value greater than 0.4A. For *Ibatt* values close to 0.8/1A, the sensed *Ibatt* value is closer to the actual value.

- Change the *IbattSet* to 0 and wait for *Ibatt* to go close to 0 before going to the next step.
- Change the *VdcBusSet* to 0 and wait for *VdcBus* to go close to *VdcIN* value before going to the next step.
- Disable the PWM drive to the battery charging stage and to the Inverter and boost stage by using the corresponding push-buttons.
- Both lamp loads must now be turned off. Turn Off SW4.

References

For more information please refer to the following guides:

- **Renewable** – provides detailed information on the Renewable energy kit.
C:\TI_F28xxx_SysSW\Renewable\~Docs\Renewable.pdf
- **Renewable-Calculations, Renewable-Calculations-Piccolo** – a spreadsheet showing some of the key calculations made within the *Renewable* project.
C:\TI_F28xxx_SysSW\Renewable\Renewable-Calculations.xls
C:\TI_F28xxx_SysSW\Renewable\Renewable-Calculations-Piccolo.xls
- **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_F28xxx_SysHW\Renewable-HWdevPkg
- **System Framework Overview Guide** – presents more information on the system framework found in F28xxx EVM projects.
C:\TI_F28xxx_SysSW\~Docs\SystemFrameworkOverview.pdf
- **F28xxx User's Guides**
<http://www.ti.com/f28xuserguides>