Quick Start Guide for High Voltage Solar Inverter DC-AC Board EVM

TIDU401 - Version 1.3

Introduction

This document talks about the quick start principles for the high voltage solar inverter DC-AC board. From this document, the user can get how to run this DC-AC board independently. The following topics will be presented:

1. The board introduction and hardware setting.
2. Quick Start Running.
3. GUI Introduction

Notes: This DC-AC board can just realize the DC bus control and the grid-tie function. If the user wants to run the whole solar inverter kit, another DC-DC board which deals with MPPT and DC-DC control must be connected. Please refer to the solar inverter user guide for more information.

WARNING

This EVM is meant to be operated in a lab environment only and is not considered by TI to be a finished end-product fit for general consumer use.

This EVM must be used only by qualified engineers and technicians familiar with risks associated with handling high voltage electrical and mechanical components, systems and subsystems.

This equipment operates at voltages and currents that can result in electrical shock, fire hazard and/or personal injury if not properly handled or applied. Equipment must be used with necessary caution and appropriate safeguards employed to avoid personal injury or property damage.

It is the user's responsibility to confirm that the voltages and isolation requirements are identified and understood, prior to energizing the board and or simulation. When energized, the EVM or components connected to the EVM should not be touched.

1. Board Introduction

1.1 The Board Picture

The board picture of the DC-AC board is shown in Fig 1.1.

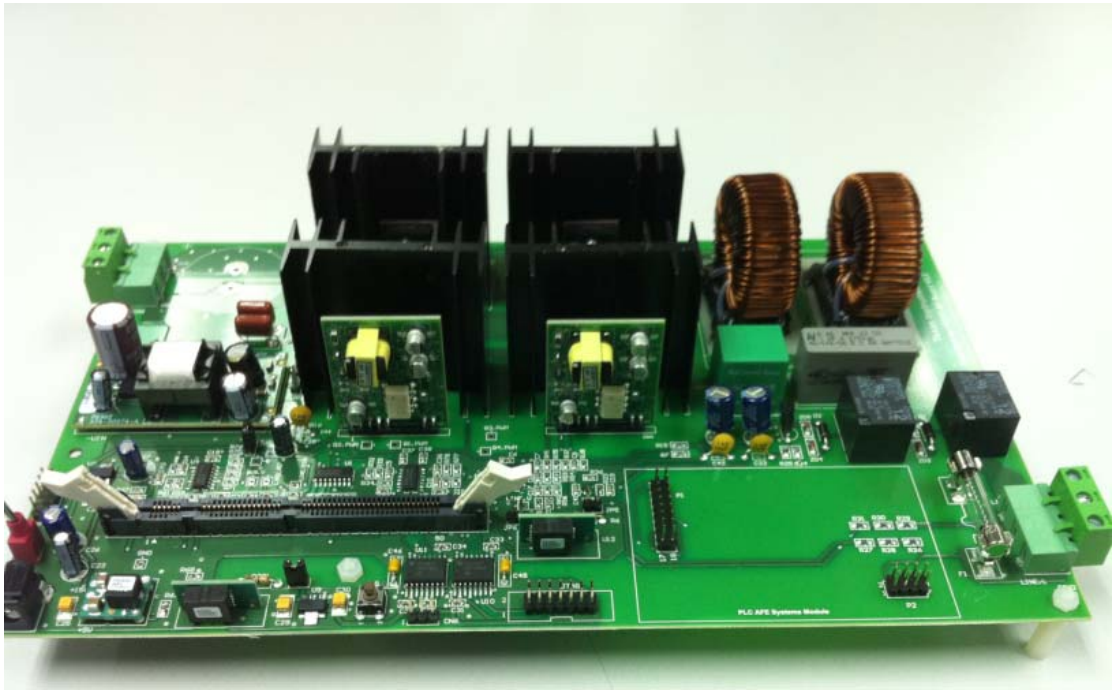


Figure1.1 Board Picture

1.2 The Key Points of the Board

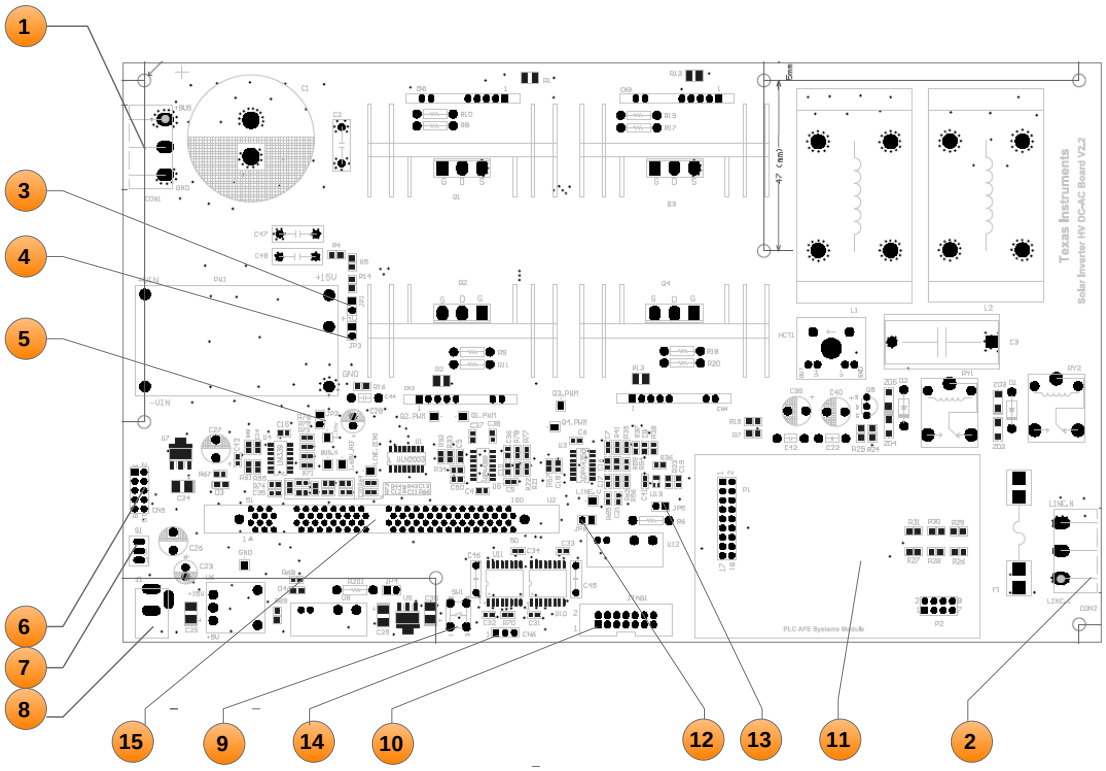


Fig 1.2 The Key Points of the Board

Item No	Points Name	Comment
1	CON1	The DC bus connector for the DC-DC input.
2	CON2	The Utility connector L and N.
3	JP1	Onboard +15V Jumper
4	JP3	Onboard +5V Jumper
5	JP2	IGBT Driver +15V Jumper
6	CN5	DC-DC board signal interface
7	S1	External +15V Adapter Switch
8	J1	External +15V input Jack
9	SW1	Operation Button
10	JTAG1	JTAG interface for external emulator
11	PLC AFE Systems Module	Not used in this version
12	JP6	TRST Jumper
13	JP5	-15V Power Jumper
14	CN6	RS232 Port
15	U2	The DIM100 28035 Control Card Port

Table 1.1 The Key Points

1.3 The Hardware Configuration

1.3.1 The main board setting

There are 2 ways to get the auxiliary power for the board, the one is using the external +15V adapter, the other is using the onboard auxiliary power supply. Besides, the user can run the board in the real time, or it can run the board by the program in the flash with the GUI support, the following table summarizes the configuration for different running requirement.

	External +15V Adapter	Onboard +15V	Real Time	GUI Support	
JP1	×	√	Unaffected	Unaffected	
JP2	√	√	√	√	
JP3	×	×	×	×	
JP4	√	√	√	√	
JP5	√	√	√	√	
JP6	Unaffected	×	√	×	

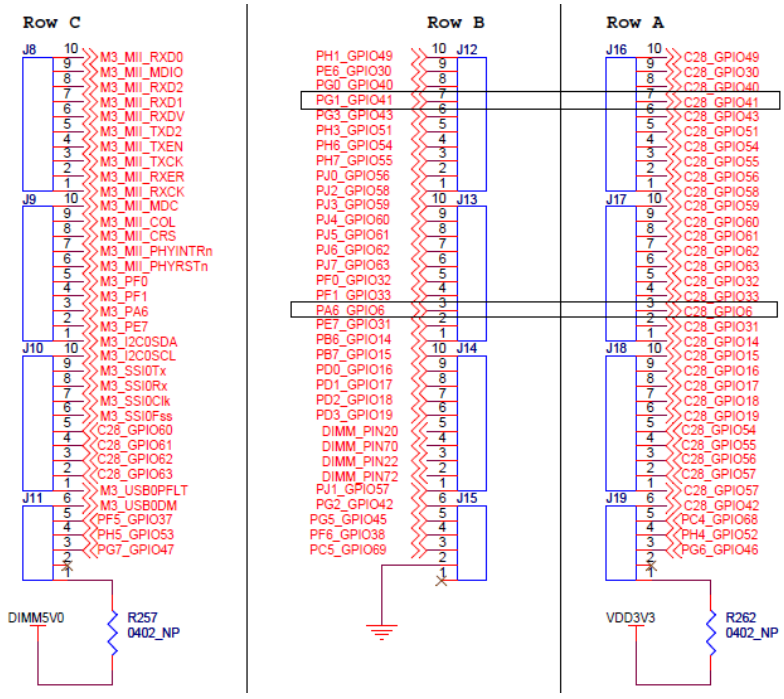
Table 1.2 The Jumper Setting for the board

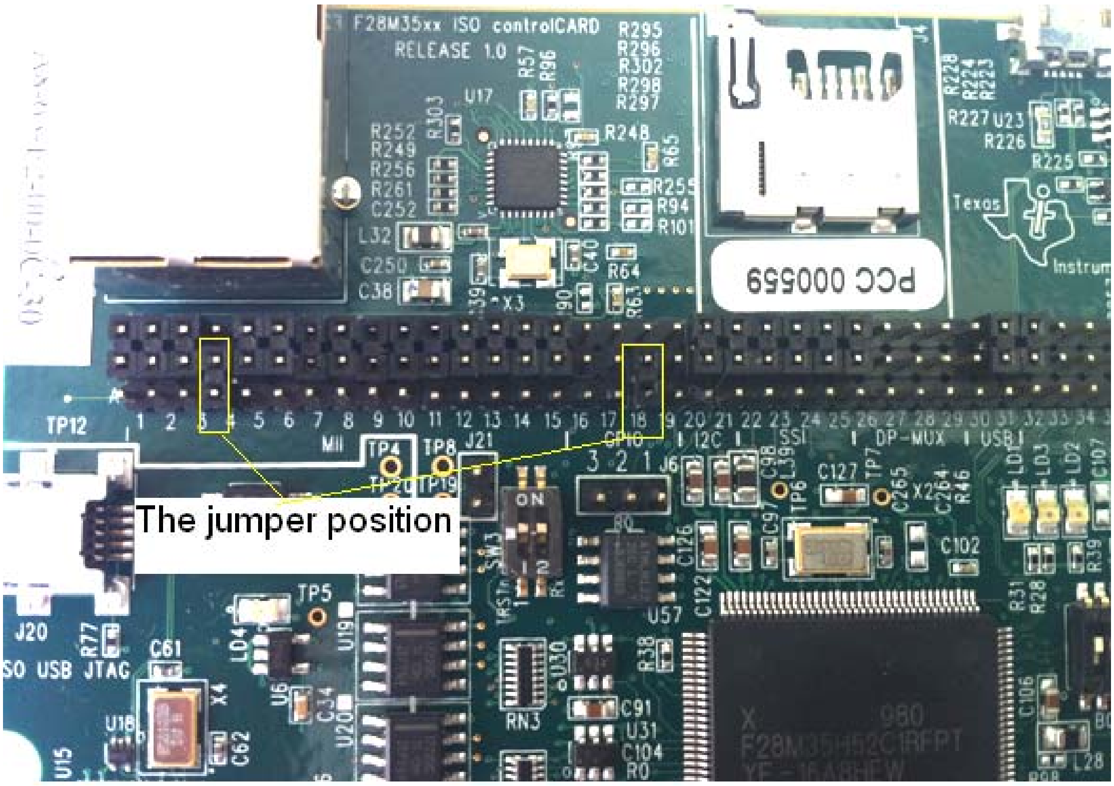
(Notes: The √ means the jumper need to be shorted, × means the jumper shoud be opened)

1.3.2 The Concerto Controller Card Configuration

If the control card is the concerto version, the user needs to short the jumper to enable the GPIO_PA6 to act as the GPIN which is used to detect the DC-DC board.

Short the No.18 pins of the Port A and Port B, besides, short the No.4 pins of the Port A and Port B. please see the picture below:




F28M35xx ISO controlCARD
RELEASE 1.0
PCC 000559
GPIO
I2C
SSI
DP-MUX
USB
The jumper position

2 Quick Running Guide

2.1 The equipments

In order to run the DC-AC board independently, the following equipments must be provided.

Equipment Name	Requirement	Comment
DC-Source	At least 400V/2A output capacity	Isolated output is better
AC-Source[1]	120V/5A or 220V/3A output capacity	The output be isolated
Transformer	1000VA, Isolation	
Resistor Load	20ohm~50ohm/1000W for 120V 80ohm~100ohm/1000W for 220V	Adjustable resistor load
Output Breaker	10A/250VAC	
Oscilloscope	With the current probe and high voltage probe	

Table 2.1 The quick running equipments

[1] If the user wants to do the grid-tie test, the AC source will act as the grid. We strongly suggest the user should use the AC source to simulate the grid condition with this board.

2.2 The connection of the board

The user must connect the test tool to the board like the following diagram.

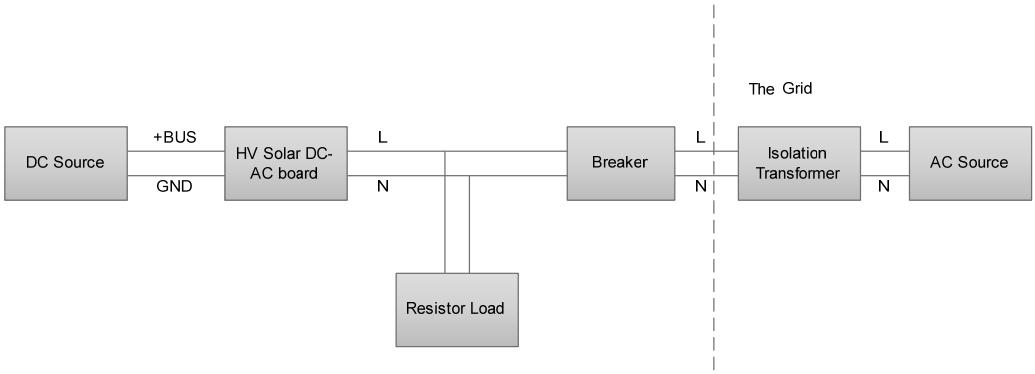


Fig 2.1 The connection of the test

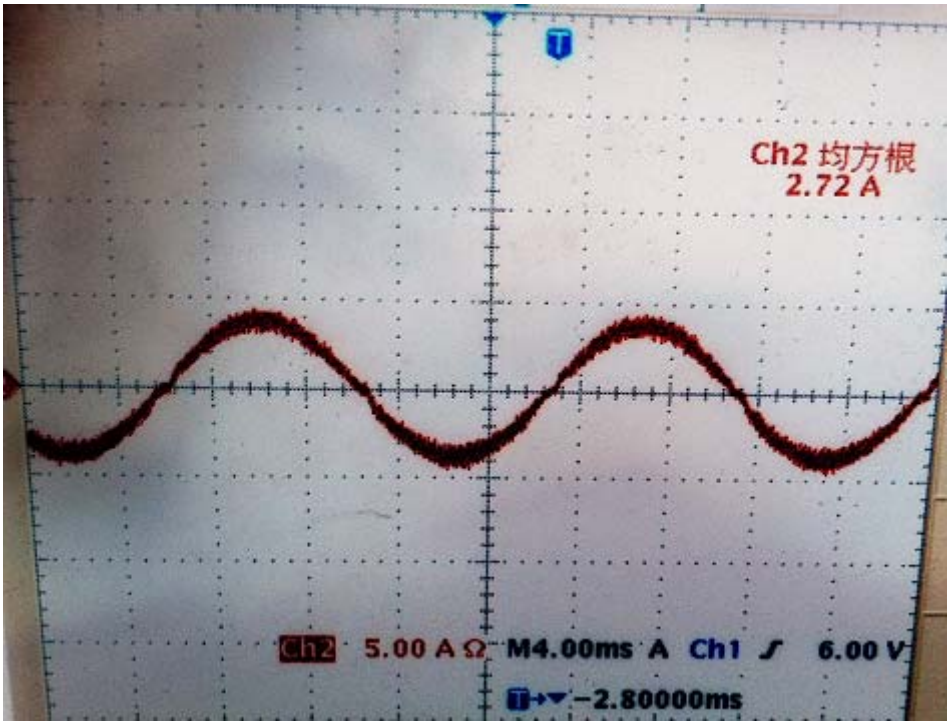
For the safety, we strongly sugget the user use a breaker between the grid and the inverter output.

2.3 Quick running guide in off-grid condition

The first test can be the off-grid test, then the breaker in Fig 2.1 will be opened. The inverter will take the resistor load without the grid support. The program will set the inverter output to be the constant frequency(60Hz) and constant current automatically when the grid is not connected to the inverter's output.

The user can start the test by following the steps below:

1. Connect all the equipment and the board as shown in Fig2.1.
2. Connect 44ohm resistor load to the output, and cut off the Breaker.
3. Open the JP1, JP3, if external +15V adapter is used. Short the JP1, open the JP3, if the on board power supply is used.
4. If the external +15V adapter is used, please power the adapter and turn on the S1 to power up the auxiliary power. If the on board power supply is used, turn on the S1 first, then power on the DC source, and regulate the DC source voltage to about 300V to let the power module work. After the successfully power up, the power LED on the board will be lightened.
5. Check if the LD2 on the control card is flashing in very 1 second. If yes, continue to do the next steps. If no, please check the auxiliary power, or please reload the program of the MCU.
6. Regulate the DC source voltage to 380V.
7. Press the SW1 for over 1 seconds to turn on the board, if turning on is successful, the LD2 will be always lightened. If failed, the LD3 will be lightened.
8. Test the output current waveform. If it is running normally, the output voltage will be about 120VAC, and the output current will be about 2.71A RMS. The reference current waveform is below.

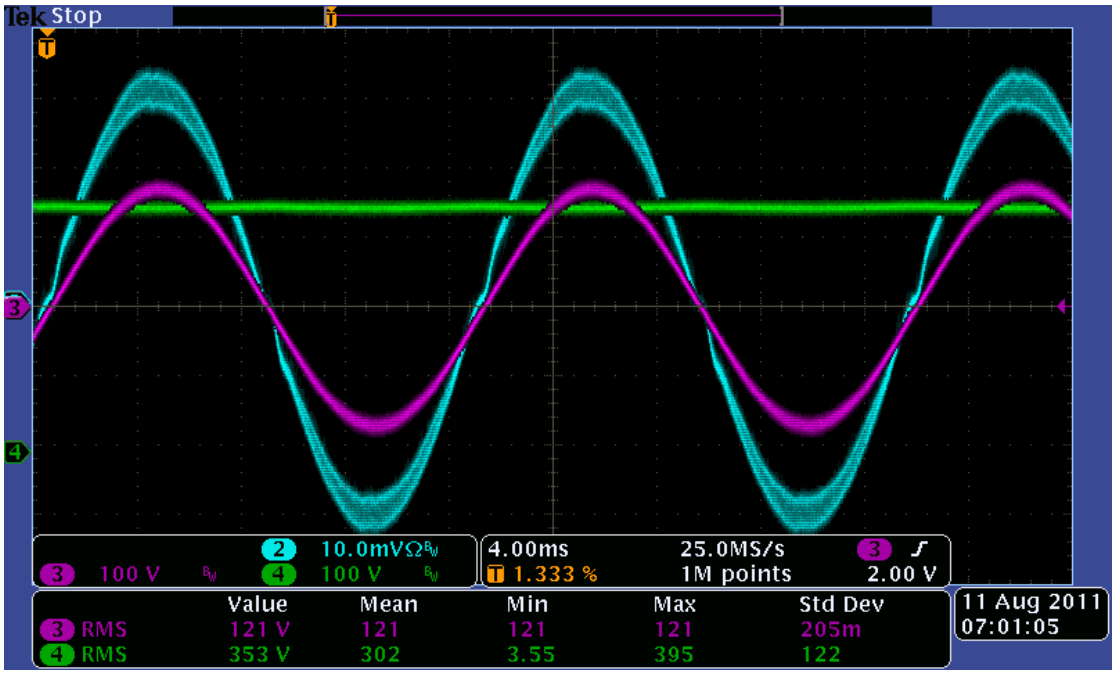


Notes: Whenever the LD3 is lightened, please cut off the power and check the connection again.

2.4 Quick running guide in grid-tie condition

If the user finish the test in 2.3, they can do the grid-tie test by following the steps below.

1. Connect all the equipment and the board as shown in Fig2.1.
2. Connect 25 ohm resistor load to the output . Cut off the breaker.
3. Open the JP1, JP3, if external +15V adapter is used. Short the JP1, open the JP3, if the on board power supply is used.
4. If the external +15V adapter is used, please power the adapter and turn on the S1 to power up the auxiliary power. If the on board power supply is used, turn on the S1 first, then power on the DC source, and regulate the DC source voltage to about 300V to let the power module work. After the successfully power up, the power LED on the board will be lightened.
5. Check if the LD2 on the control card is flashing in very 1 second. If yes, continue to do the next steps. If no, please check the auxiliary power, or please reload the program of the MCU.
6. Regulate the DC source voltage to 380V.
7. Regulate the AC source voltage to 120V/60Hz, Set the output current limit to 6A.
8. Close the Breaker, check the output current of the AC source is about 4.8A.
9. Press the SW1 for over 1 seconds to turn on the board, if turning on is successful, the LD2 will be always lightened. If failed, the LD3 will be lightened.
10. Test the output current waveform. If it is running normally, and the output current of the inverter will be about 2.7A RMS, then there will be 2.1A load current for the AC source.



Notes: Whenever the LD3 is lightened, please cut off the power and check the connection again.

3. The GUI introduction

3.1 The GUI overview

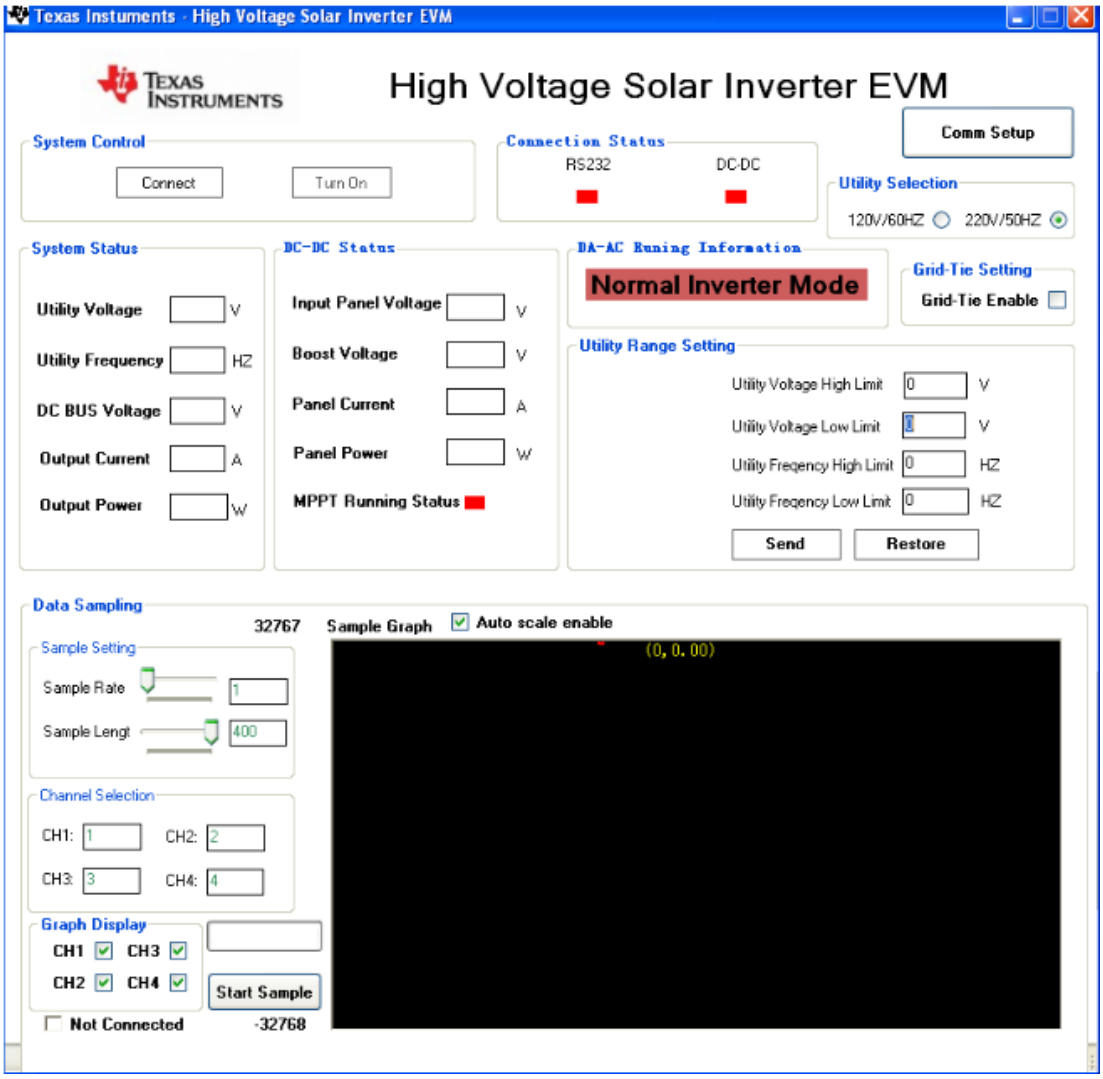


Fig 3.1 The GUI Overview

The GUI for the high voltage solar inverter EVM can be used to inquiry the status of the DC-DC and DC-AC board, execute the system turn on/off command, get the real time value of the DC-AC board.

3.2 Connect the GUI to the board

Step1>

Connect the USB cable to the DC-AC board. Power on the auxiliary power of the board. Set the communication by clicking the Comm Setup Button, then choose the COM port : COM51. Then click OK.

Note: the COM port will be different in different PC. You can check the COM port number in the PC hardware resources window.

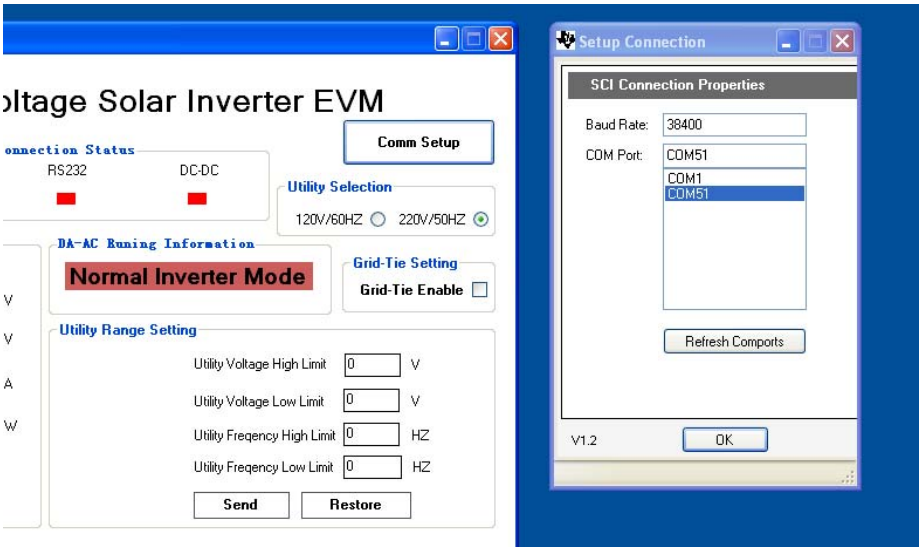


Fig 3.2 Setup the communication

Step2>

Connect the board and the GUI by clicking the Connect button. If the board is connected successfully, the connect status textbox will be shown as gree with the connected warning. Or the connect status textbox will be yellow with the disconnected warning.

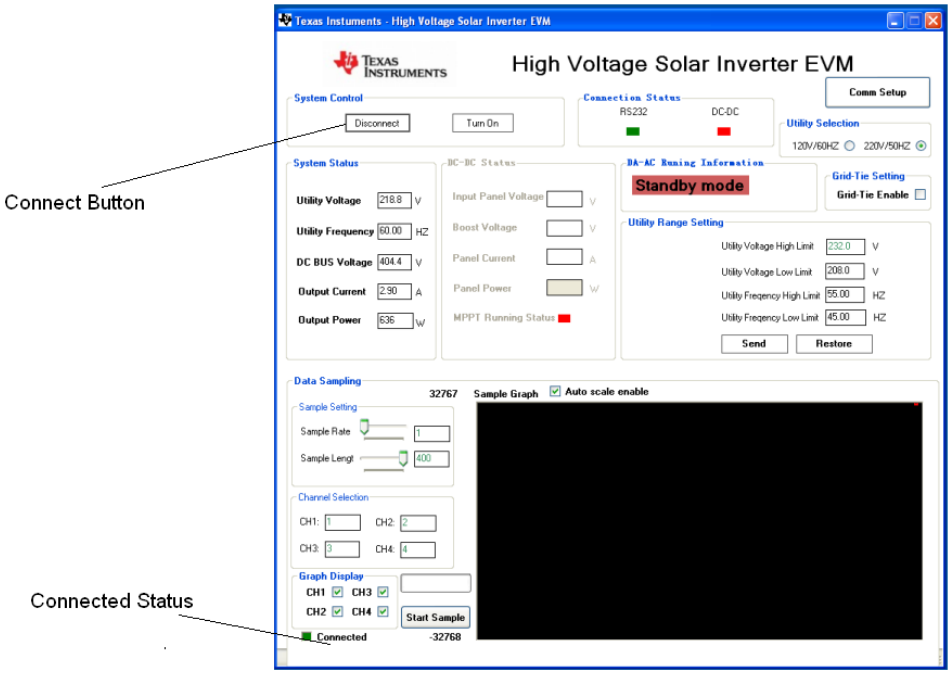


Fig 3.3 Connect the board

3.3 Check the status of the DC-AC board

If the DC-AC board is connected successfully, the GUI will show the DC-AC status in the DC-AC board status area.

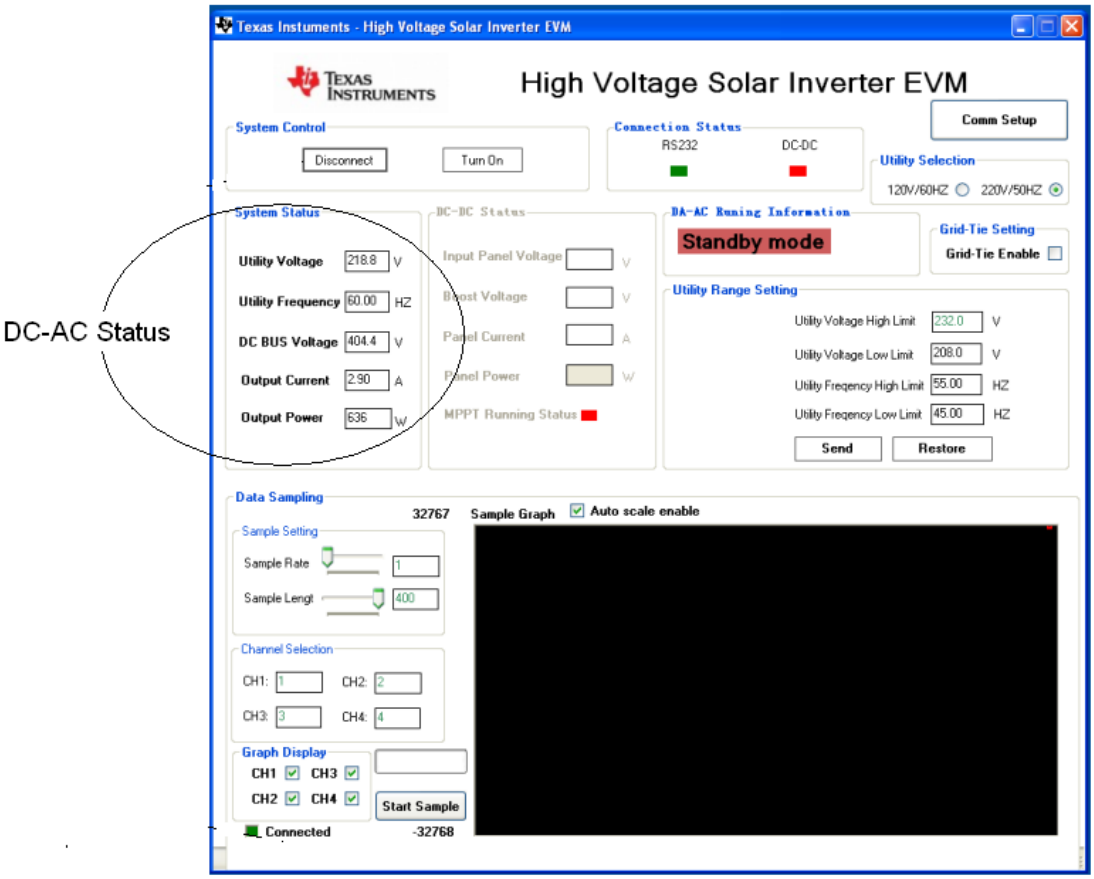


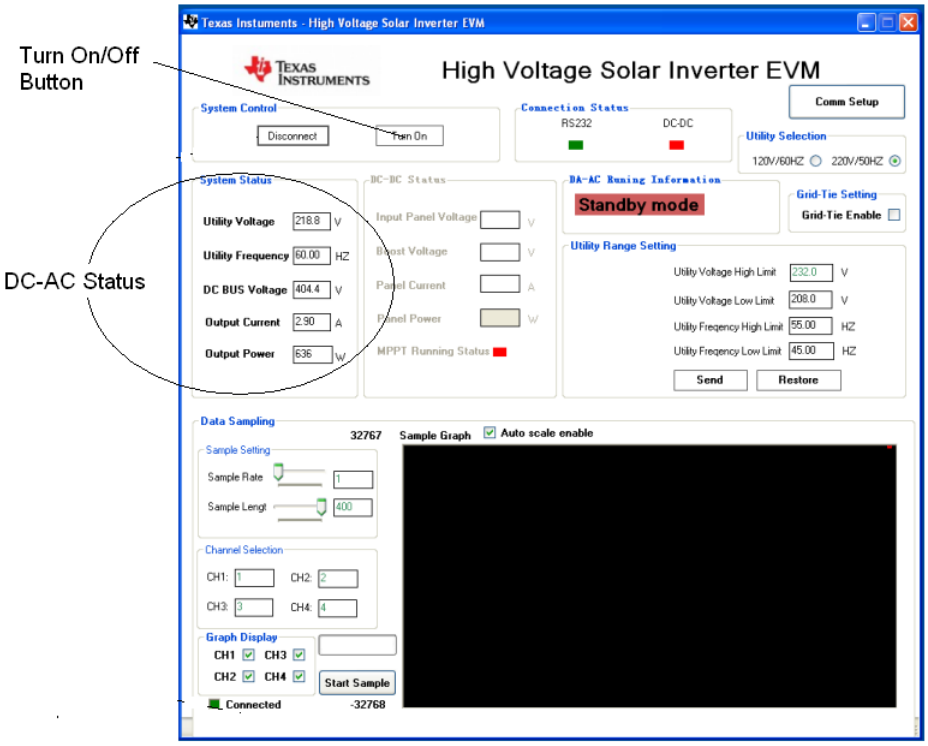
Fig 3.3 Check the DC-AC Status

3.4 Turn On and Turn Off

If the status of the DC-AC board is normal, the user can turn on the DC-AC by click the Turn On/Off Button.

3.4.1 Turn On

When the DC-AC running information shows the Standby Mode, the DC-AC can be turned on. When the Turn On button clicked the DC-AC running information will show the SoftStart Mode or Normal Inverter Mode. When it get the normal inverter mode, then the turning on is successful.



3.4.2 Turn Off

When the Turn On/Off button shows the Turn Off, then can click the button to turn off the DC-AC board.

3.5 Get the Real Time Data

The GUI has the real time data getting function. In the MCU, the data will be sampled at the PWM switching frequency. The user can click the “Start Sample” Button to sample the default real time values. The following is the default real time data meaning in different channels.

CH1: The inverter current; (Q24)

CH2: The Utility Voltage; (Q24)

CH3: The DC BUS voltage; (Q24)

CH4: The Bus voltage loop controller output; (Q24)

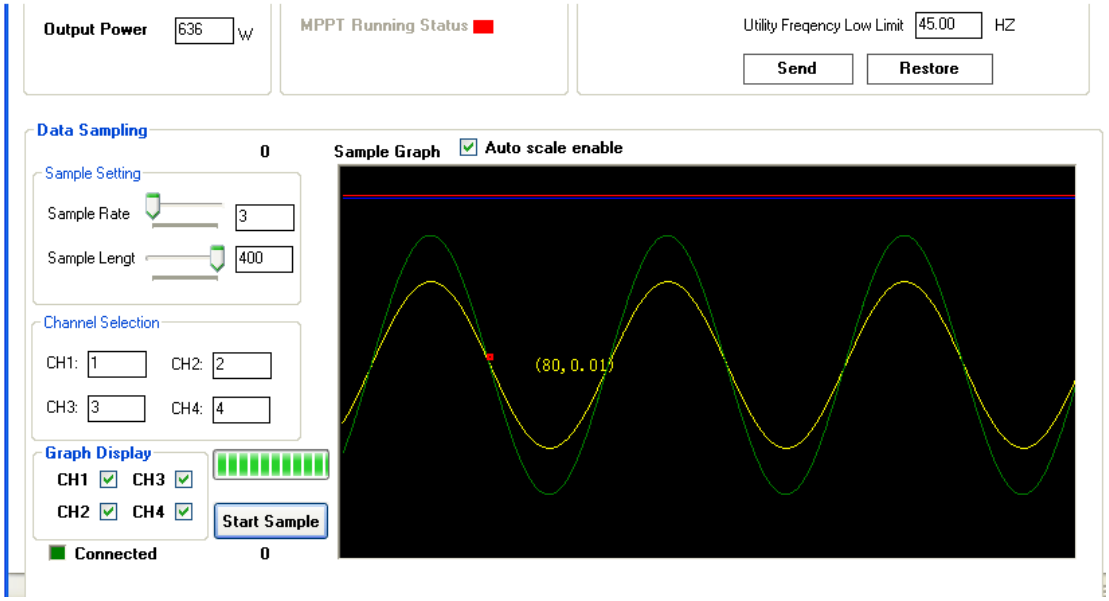


Fig 3.5 Get the real time data in the MCU

References and Files Structure

For more information, please refer to the following guides and folders:

Solar_HV_DCAC_Concerto_SCI_Rev_0 - The source code for the Concerto Control Card.
..\controlSUITE\development_kits\HV_SOLAR_DC_AC
Solar_HV_DCAC_Concerto_SCI_Rev_0

SolarHv_DCAC_PiccoloB_Rev_02 – The source code for the Piccolo B Control Card.
..\controlSUITE\development_kits\HV_SOLAR_DC_AC
Solar_HV_DCAC_PicB_SCI_Rev_0

Solar HV DC-AC Kit User Guide_Rev1.0.pdf – The user guide for the kit.
..\controlSUITE\development_kits\HV_SOLAR_DC_AC\docs\Solar_HV_DCAC_PicB_SCI_Rev_0

GUI – The GUI for the DC-AC kit and system running.
..\controlSUITE\development_kits\HV_SOLAR_DC_AC\GUI

SOLAR_HV_DC_AC_HWDevPkg – The folder for the hardware package, including the schematic, PCB, gerbers and BOM.
..\controlSUITE\development_kits\HV_SOLAR_DC_AC\SOLAR_HV_DC_AC_HWDevPkg

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