CC3100 SimpleLink™ Wi-Fi® and IoT Solution BoosterPack Hardware

User's Guide

Literature Number: SWRU371
May 2014

Contents

List of Figures

List of Tables

CC3100 SimpleLink™ Wi-Fi® and IoT Solution BoosterPack Hardware

1 Introduction

1.1 CC3100 BOOST

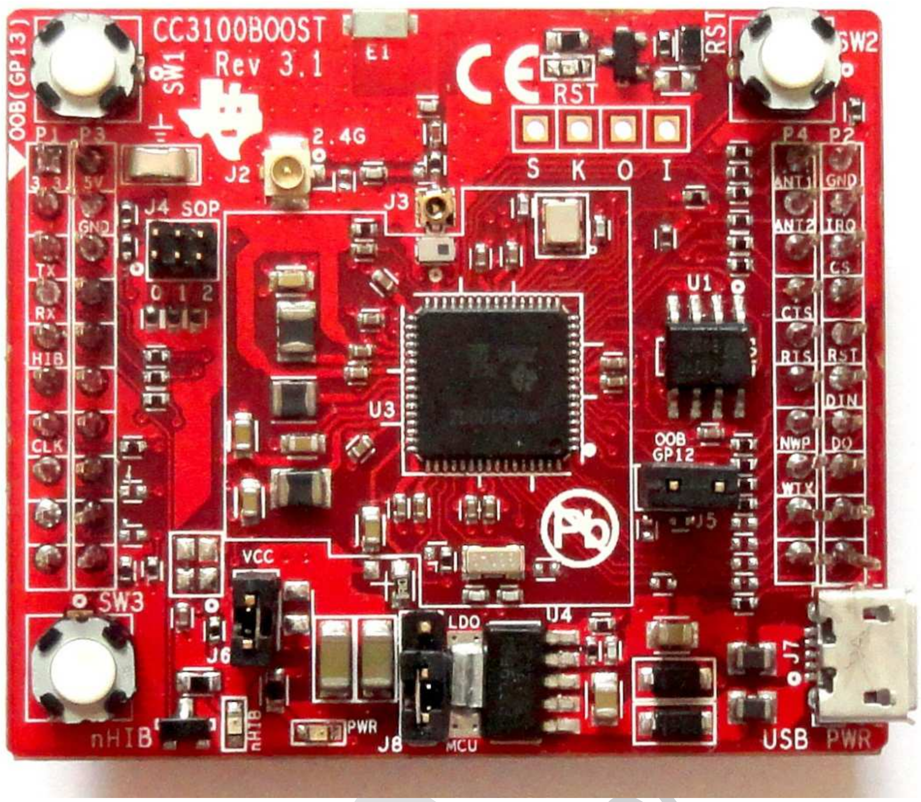
The CC3100 SimpleLink™™ Wi-Fi®™ solution provides the flexibility to add Wi-Fi to any microcontroller (MCU). This user guide explains the various configurations of the CC3100 hardware BoosterPack™. This internet on a chip solution contains all you need to easily create IoT solutions – security, quick connection, cloud support and more. The CC3100 Boosterpack can be used in several ways. First, it can be connected to a TI MCU Launchpad (software examples provided for MSP-EXP430F5529LP). Second, it can be plugged into a CC31XXEMUBOOST(1) board and connected to a PC for MCU Emulation. Finally, it can be connected onto an adapter board (MCU-ADAPT), which allows customers to use CC3100BOOST with additional platforms beyond TI Launchpads. The user can refer to the CC31xx programming guide for instructions on porting driver and sample code.

This kit comes in three configurations:

- CC3100BOOST + CC31XXEMUBOOST + MSP-EXP430F5529LP – to be able to run all software in SDK, to develop on MSP430F5529 MCU
- CC3100BOOST + CC31XXEMUBOOST – used for any CC3100 development
- CC3100BOOST – if you need extra CC3100 Boosterpacks and already have CC31XXEMUBOOST

NOTE: CC31XXEMUBOOST is an advanced emulation board that is required for flashing CC3100BOOST, using the radio tool (Radio performance testing or putting into certification modes), and for doing networking processing logs for advanced debug.

SimpleLink, Tiva, SimpleLink™ are trademarks of Texas Instruments.
Wi-Fi® is a trademark of Wi-Fi Alliance.
Wi-Fi is a registered trademark of Wi-Fi Alliance.



1.2 What Is Included

- 1x CC3100BOOST
- 1x Micro USB cable
- 1x Quick Start Guide

2 Hardware Description

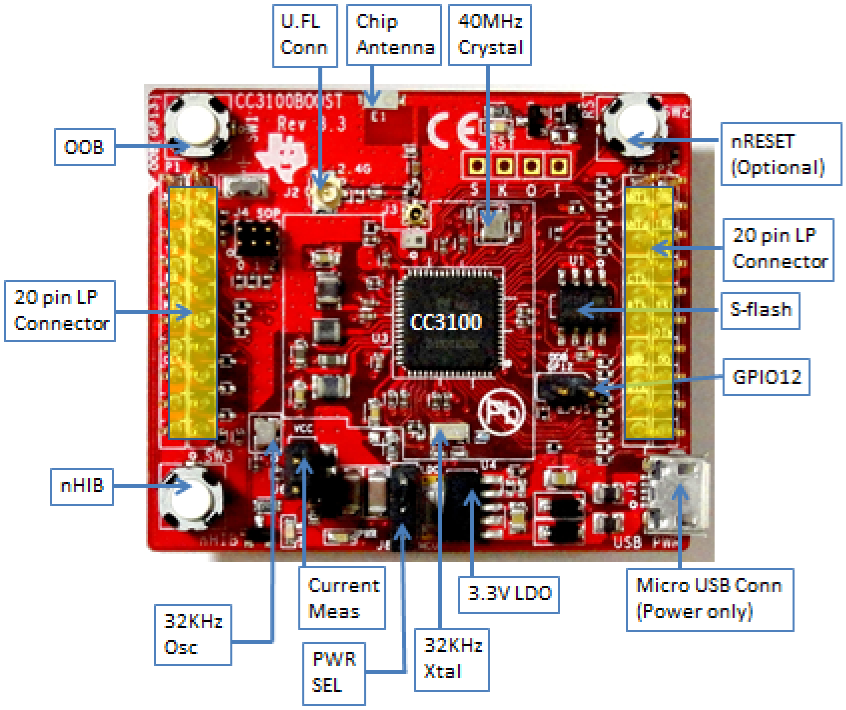


Figure 1. CC3100BOOST Front Side

2.1 Block Diagram

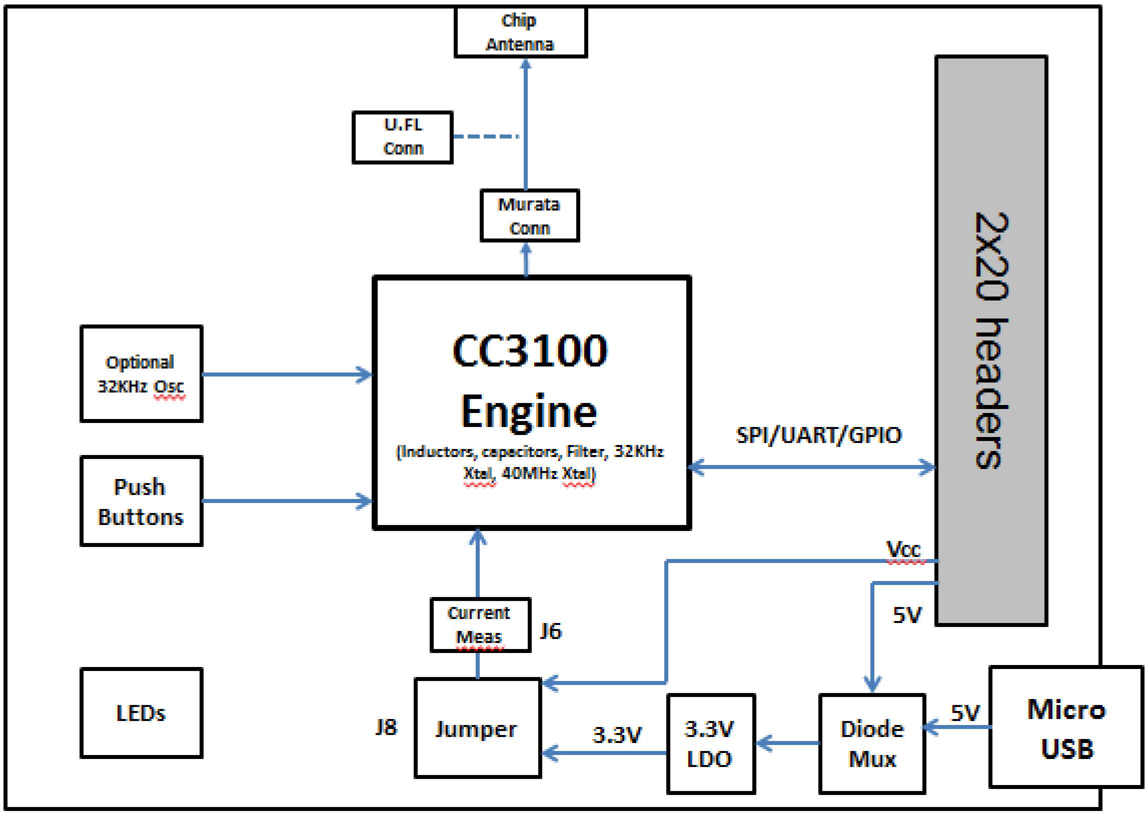


Figure 2. CC3100 Block Diagram

2.2 Hardware Features

- 2x20 pin stackable connectors
- On-board chip antenna with option for U.FL-based conducted testing
- Power from on-board LDO using USB or 3.3 V from MCU Launchpad
- Three push buttons
- Two LEDs
- Jumper for current measurement with provision to mount 0.1R resistor for measurement with voltmeter
- 8 Mbit serial flash (M25PX80 from Micron)
- 40 MHz crystal, 32 KHz crystal and optional 32 KHz oscillator
- 4-layer PCB with 6 mil spacing and track width

2.3 Connector and Jumper Descriptions

2.3.1 Push Buttons and LEDs

Table 1. Push Buttons

Reference	Usage	Comments
SW1	OOB Demo	This is used as an input for the OOB demo.
SW2	RESET	The use of this pin is optional. It can be used to reset the device to a known state.
SW3	nHIB	This can be used to boot the device to the bootloader mode for flashing the firmware over universal asynchronous receiver/transmitter (UART).

Table 2. LEDs

Reference	Colour	Usage	Comments
D5	RED	PWR indication	ON, when the 3.3 V power is provided to the board
D1	Yellow	nRESET	This LED is used to indicate the stated of nRESET pin. If this LED is glowing, the device is functional.
D6	Green	nHIB	This LED indicates the stated of nHIB pin. When the LED is OFF, the device is in hibernate state.

2.3.2 Jumper Settings

Table 3. Jumper Settings

Reference	Usage	Comments
J7	USB connector	For powering the BoosterPack when mated with a Launchpad. This is mandatory to use when using “Z” devices. For e.g. CC3100HZ
J8	Power selection	Choose the power supply from the Lauchpad or the on-board USB. J8 (1-2) power from MCU Launchpad J8 (2-3) power from on-board USB using 3.3 V LDO
J6	Current measurement	For Hibernate and LPDS currents, connect an ammeter across J26 : Range (< 500 µA) For Active current, mount a 0.1 Ω resistor on R42 and measure the voltage across the 0.1 Ω resistor using a voltmeter (range (< 50 mV peak-peak)).
J5	Reserved	Closed: GPIO_12 is hard pulled to VCC Open: GPIO_12 is pulled to GND using 33K resistor.
J10, J9	BoosterPack header	2x10 pins each connected to the Launchpad.
J3	RF Test	Murata connector (MM8030-2610) for production line tests.
J2	RF Test	U.FL connector for conducted testing in the lab.

2.3.3 2x20 Pin Connector Assignment

The signal assignment on the 2x20 pin connector is shown in Figure 3. The convention of J1..J4 is replaced with P1…P4 to avoid confusion with the actual board reference.

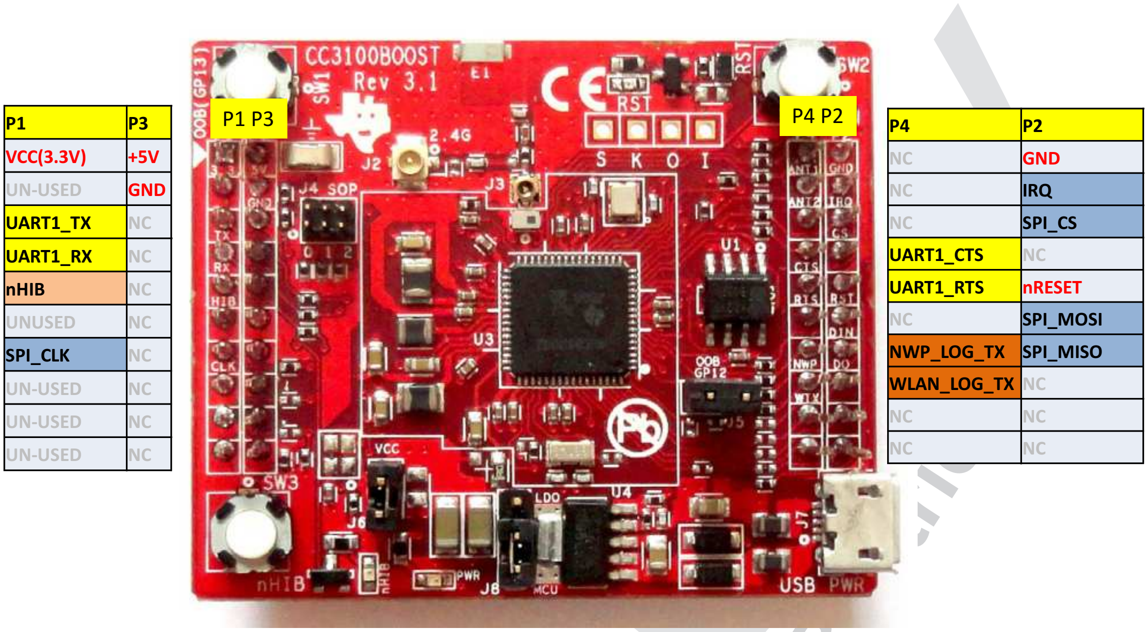


Figure 3. Signal Assignments

Table 4. Outer Row Connectors

Pin No	Signal Name	Direction	Pin No	Signal Name	Direction
P1.1	VCC (3.3 V)	IN	P2.1	GND	IN
P1.2	UNUSED	NA	P2.2	IRQ	OUT
P1.3	UART1_TX	OUT	P2.3	SPI_CS	IN
P1.4	UART1_RX	IN	P2.4	UNUSED	NA
P1.5	nHIB	IN	P2.5	nRESET	IN
P1.6	UNUSED	NA	P2.6	SPI_MOSI	IN
P1.7	SPI_CLK	IN	P2.7	SPI_MISO	OUT
P1.8	UNUSED	NA	P2.8	UNUSED	NA
P1.9	UNUSED	NA	P2.9	UNUSED	NA
P1.10	UNUSED	NA	P2.10	UNUSED	NA

Table 5. Inner Row Connectors

Pin No	Signal Name	Direction	Pin No	Signal Name	Direction
P3.1	+5 V	IN	P4.1	UNUSED	OUT
P3.2	GND	IN	P4.2	UNUSED	OUT
P3.3	UNUSED	NA	P4.3	UNUSED	NA
P3.4	UNUSED	NA	P4.4	UART1_CTS	IN
P3.5	UNUSED	NA	P4.5	UART1_RTS	OUT
P3.6	UNUSED	NA	P4.6	UNUSED	NA
P3.7	UNUSED	NA	P4.7	NWP_LOG_TX	OUT
P3.8	UNUSED	NA	P4.8	WLAN_LOG_TX	OUT
P3.9	UNUSED	NA	P4.9	UNUSED	IN
P3.10	UNUSED	NA	P4.10	UNUSED	OUT

NOTE: All signals are 3.3 V CMOS 400mA logic levels and are referred w.r.t. CC3100 IC. For example, UART1_TX is an output from the CC3100.
For the SPI lines, the CC3100 always acts like a slave.

2.4 Power

The board is designed to accept power from a mated Launchpad or from the CC3100EMUBOOST board. Some of the launchpads are not capable of sourcing the peak current requirements of the Wi-Fi. In such a case, the USB connector on the CC3100BOOST can be used to aid the peak current. The use of Schottky diodes ensure that the load sharing happens between the USB connectors on the Launchpad and the Boosterpack without any board modifications.

Also the 3.3 V power can be sourced from the Launchpad or from the 3.3 V LDO on the board. This is done by using jumper J8. In the case where the Launchpad is not able to source the 3.3 V up to 350mA, then the J8 needs to be configured to work from the on-board LDO

2.4.1 Power From the Launchpad or CC3100EMUBOOST

The most common scenario is to power the CC3100BOOST from the mated LaunchPad (TM). In this case, the Launchpad provides 3.3 V to the BoosterPack for its operation (see Figure 4). In addition to the 3.3 V, some launchpads provide a 5 V from the USB (see Figure 5), which is used to drive a 3.3 V LDO on the BoosterPack. In case the launchpad is not able to provide the 5V (for e.g. the launchpad with only 20 pins), then the USB connector on the CC3100BOOST should be used to provide the LDO input as shown below.

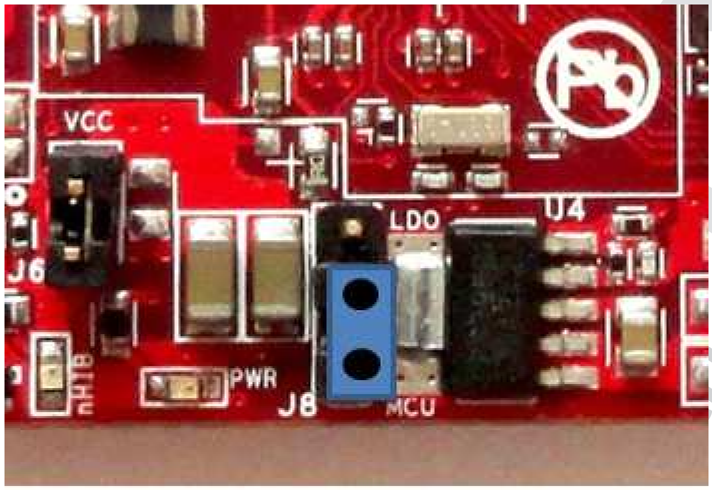


Figure 4. 3.3 V Power From MCU

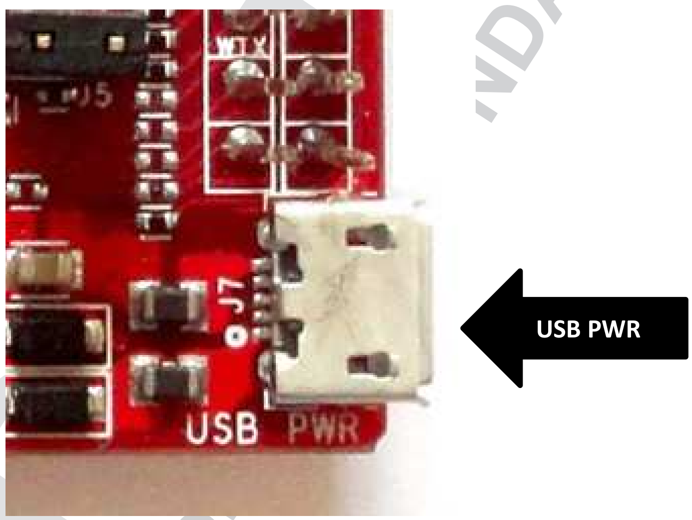


Figure 5. Feed USB on the BoosterPack (if the Launchpad cannot source 5 V on 20-pin connector)

2.4.2 On-Board LDO Power Supply

On some Launchpads, the 3.3 V is not capable of sourcing the 350 mA peak current needed for the CC3100BOOST. In such a case, the on-board 3.3 V LDO can be used (see Figure 6). This LDO would be sourced from the USB connector on the CC3100BOOST and the Launchpad in a shared load manner.

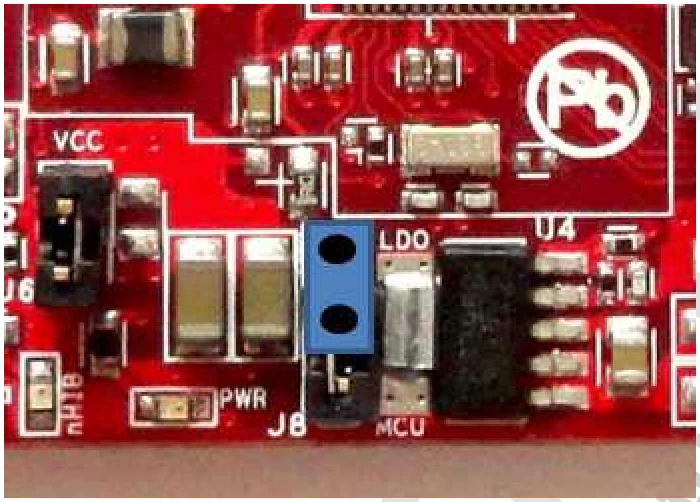


Figure 6. 3.3 V Power From LDO

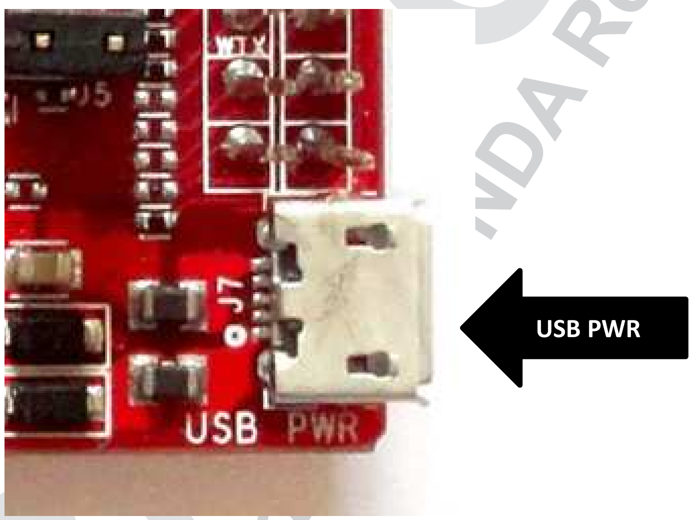


Figure 7. Feed USB on the BoosterPack (always while using the on-board LDO)

2.5 Measure the CC3100 Current Draw

2.5.1 Low Current Measurement (Hibernate and LPDS)

To measure the current draw of the CC3100 device, a jumper is provided on the board labeled J6. By removing this jumper, you can place an ammeter into this path and the current can be observed. This method is recommended for measuring LPDS and hibernate currents that are of the order of few 10s of micro amps.

The jumper is removed and an ammeter is added in series to measure the hibernate and LPDS currents (see Figure 8).

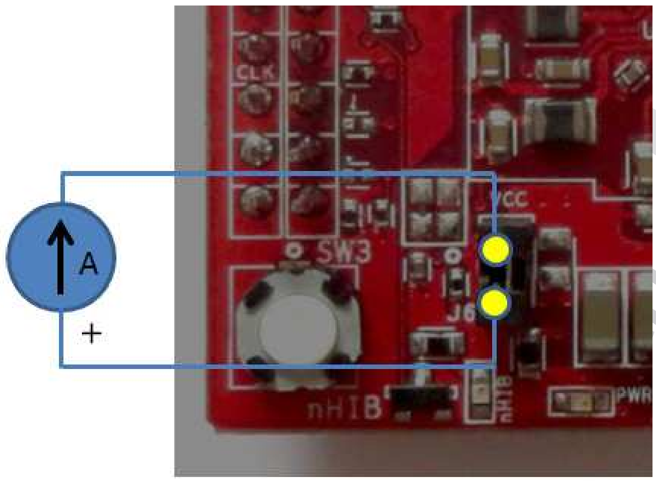


Figure 8. Low Current Measurement

2.5.2 Active Current Measurement

To measure active current in a profile form, it is recommended to use a 0.1 Ω 1% resistor on the board and measure the differential voltage across it. This can be done using a voltmeter or an oscilloscope for measuring the current profile.

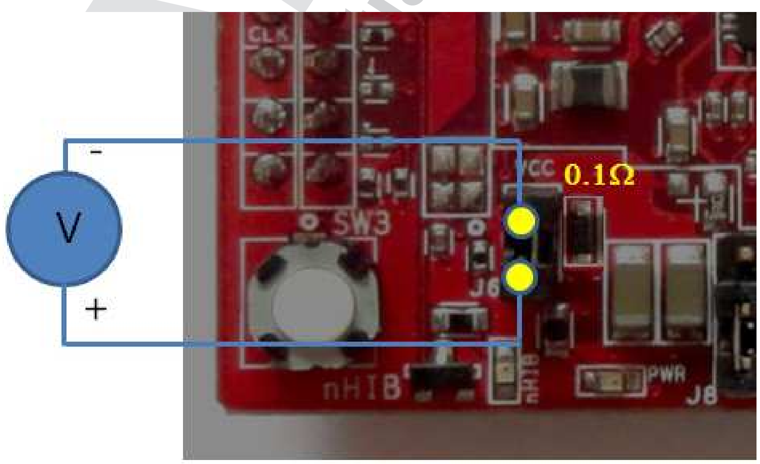


Figure 9. Active Current Measurement

2.6 Clocking

The board provides two crystals and one oscillator for the clocks to the device:

- Y1: a 40-MHz crystal
- Y2: a 32KHz oscillator
- Y3: a 32KHz crystal used as sleep clock

The 32-kHz crystal allows for lower LPDS sleep currents than other low-frequency clock sources. Therefore, the presence of the crystal allows the full range of low-power modes to be used.

2.7 Performing Conducted Testing

The BoosterPack by default ships with the RF signal connected to the on-board chip antenna. Figure 10 illustrates that there is a miniature UMC connector (Murata MM8030-2610) on the RF patch on the board that can be used for measuring the performance in a conducted mode.

In addition to the Murata connector, there is a U.FL connector on the board (see Figure 11) that can be used for conducted testing or to connect an external antenna. But, the use of this would require a board modification to be performed. The modifications needed are illustrated in the figures below.

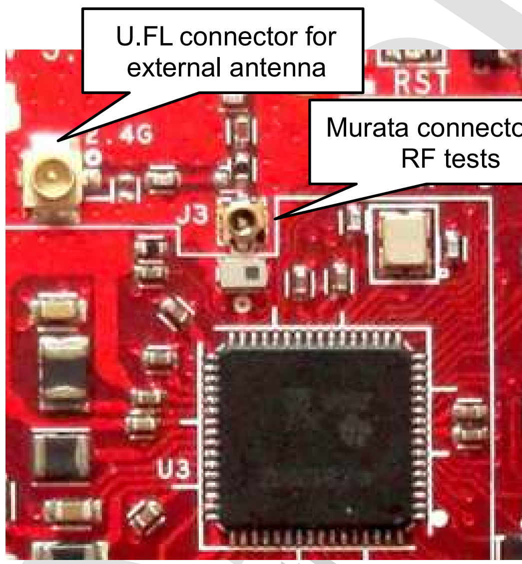


Figure 10. Connectors on the Board

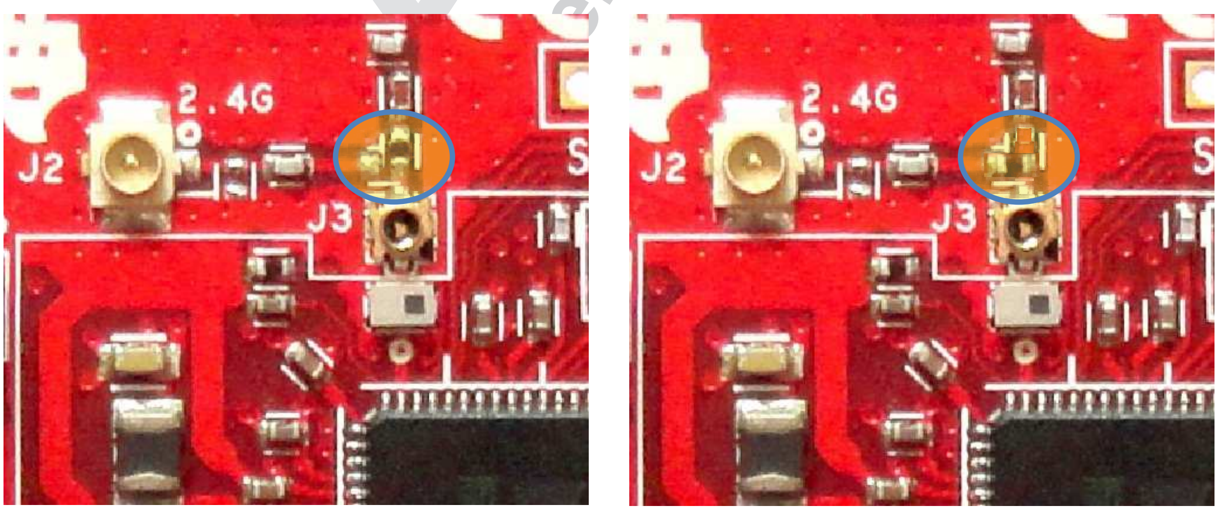


Figure 11. Radiated Mode (Left) vs Conducted Mode (Right)

3 Connecting to the PC Using EMUBOOST

3.1 CC31XXEMUBOOST

3.1.1 Overview

The CC31XXEMUBOOST is designed to connect the BoosterPack to a PC using a USB connection. This is used to update the firmware patches, which are stored in the serial Flash, on the BP using the “SL_Prog” utility and also in software development using SimpleLink Studio.

3.1.2 Hardware Details

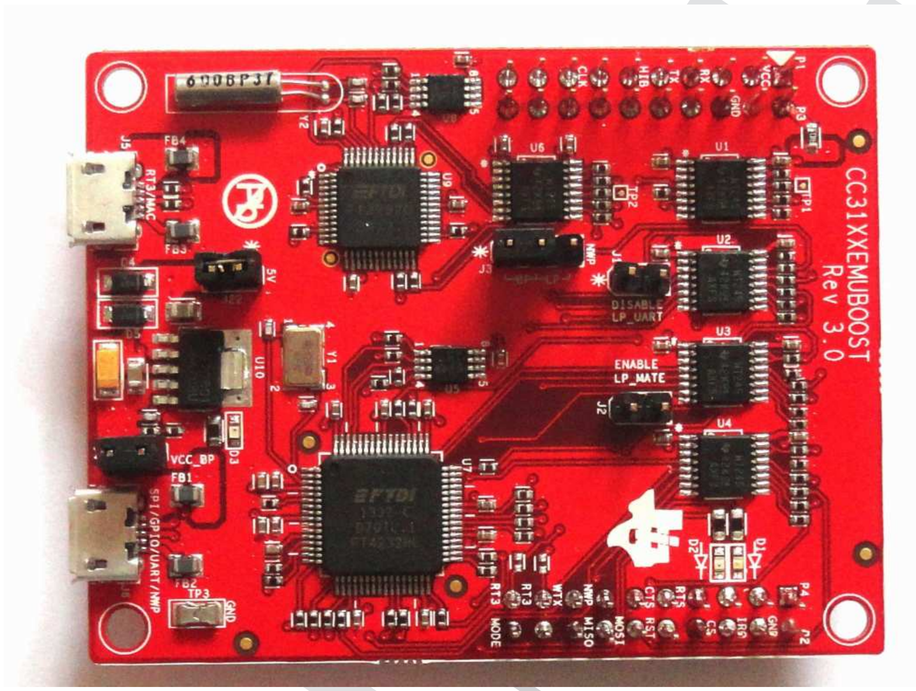


Figure 12. CC31XXEMUBOOST Board

The board has two FTDI ICs to enumerate multiple COM and D2XX ports. The details of the ports are given in Table 6.

Table 6. Ports Available on J6

Port Number	Port Type	Usage	Comments
1	D2XX	SPI port for SL Studio	
2	D2XX	GPIO for SL Studio	Control the nRESET, nHIB, IRQ
3	VCP	COM port for Flash programming	
4	VCP	NWP	Network processor logger output. Used with specific tools to analyze the network processor logs. For TI use only.

NOTE: On the PC, only two of the four ports would be visible on the Device Manager. The D2XX ports are not listed under the “Ports” tab.

The first COM port in the list is used for the Flash programming.

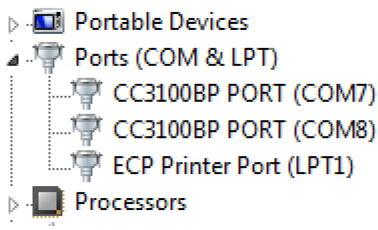


Figure 13. Portable Devices

Table 7. Ports Available on J5

Port Number	Port Type	Usage	Comments
1	VCP	RT3	Used for TI internal debug only.
2	VCP	MAC logger	Used for TI internal debug only.

3.1.3 Driver Requirements

The FTDI Debug board requires you to install the associated drivers on a PC. This package is available as part of the SDK release and would be located at:

`[Install-Path]\cc3100-sdk\tools\cc31xx_board_drivers\`.

The install path is usually C:\ti\cc3100SDK.

3.2 Mating the Boards

Figure 14 shows the connection of the CC3100 BoosterPack to the EMUBOOST Board. The connectors should be aligned carefully as it does not have polarity protection and the sFlash can be erased as a result.. The pins #1 of the connectors are marked on the board using a small triangle marking; these should be aligned while mating.

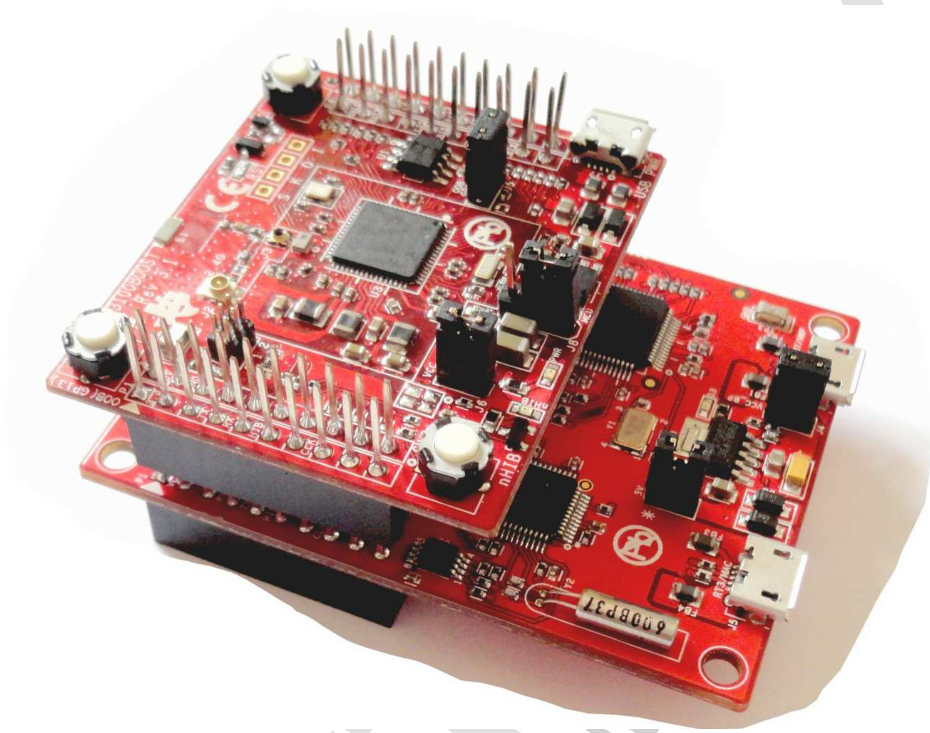


Figure 14. The CC3100BOOST Connected to the EMUBOOST

> **CAUTION**
>
> Align the pin-1 of the boards together using the triangle marking on the PCB. An incorrect mating can destroy the boards permanently.
>
> Ensure that none of the header pins are bent before mating the two boards. Jumper settings on the CC3100BOOST.

3.3 Jumper Settings on the CC3100BOOST

The following table specifies the jumpers to be installed while mating with the FTDI board.

Table 8. Jumpers to be Installed Before Mating With the FTDI Board - CC3100BOOST

No	Jumper Settings	Notes
1	J8 (1-2)	Power the BP from the EMU BOOST. The jumper shall be placed so that it is nearer to the edge of the PCB.
3	J6 (short)	No current measurement
4	J5 (short)	OOB demo jumper

3.4 Jumper Settings on the EMUBOOST

Table 9 specifies the jumpers to be installed while mating with the FTDI board.

Table 9. Jumpers to be Installed While Mating With the FTDI Board - EMUBOOST

No	Jumper Settings	Notes
1	J4 (short)	Provide 3.3 V to the BoosterPack
2	J22 (short)	Provide 5.0 V to the BoosterPack
3	J3 (1-2)	Route the NWP logs to the Dual port also

The rest of the jumpers can remain open.

With these done, the EMUBOOST would resemble the board in Section 4.

4 Connecting to a Launchpad

The CC3100 BoosterPack can be directly connected to a compatible Launchpad using the standard 2x20 pin connectors. The jumper settings needed for this connection are the same as that needed for the EMUBOOST board as described in Section 3.4.

Ensure that the Pin1 of the 2x20 pins are aligned correctly before mating. Figure 15 illustrates the mated setup. Note that the USB cable is directly connected to the BoosterPack to power it only. For debugging, the USB cable on the Launchpad is also required.

Figure 15. BoosterPack, Connected to Tiva™ Launchpad (TM4C123GXL)

4.1 Launchpad Current Limitation

Some of the launchpads, including the MSP430FRAM, do not provide enough current to power the CC3100 BoosterPack. The BoosterPack can consume up to 400 mA peak from the 3.3 V and it may be needed to power is separately.

For this, a USB connector is provided on the BoosterPack to provide the 3.3 V separately.

The power supply jumpers should be configured as shown in Figure 16 when the power is supplied from the on-board USB connector.

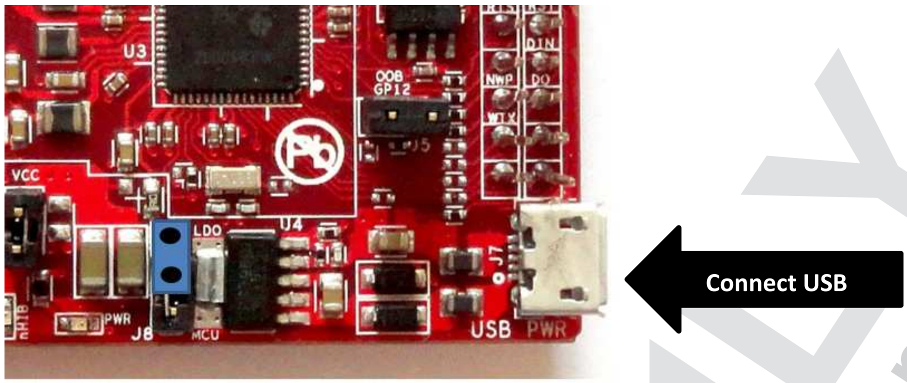


Figure 16. Jumper Settings When Used With Launchpad

NOTE: Since there are two power sources in this setup, it is important to follow the power-up sequence.

NOTE: Always power the BoosterPack before powering the Launchpad.

5 Additional Information

5.1 Design Files

All design files including schematics, layout, Bill of Materials (BOM), Gerber files, and documentation are made available in a zip folder that can be downloaded from the following URL: http://www.ti.com/lit/zip/swrc288.

5.2 Software

To be provided.

5.3 Hardware Change Log

Table 10. Hardware Change Log

PCB Revision	Date	Author	Description
Rev 3.1	21-Feb-14	Prajay M	Initial prototype run
Rev 3.2	10-Mar-14	Prajay M	Updated the grounding for the DC-DC input capacitors to reduce the loop area. Results in overall mask improvement by 1.5 to 2.0dB
Rev 3.3	20-Mar-14	Prajay M	Updated the silk screen to reflect the final markings.

5.4 Known Limitations

5.4.1 High Hibernate Currents

The serial flash used on the board does not have any pull-ups and pull-downs on the $\overline{CS}$, CLK and DATA lines. The CC3100 device does not hold them at valid logic levels, when the device goes to hibernate state (low power). This can cause some leakage current to flow into the serial flash during this mode. In order to measure the lowest possible hibernate current, it is recommended to add the following components on the board:

100K pull-up on CS#, 100K pull-downs on DATA in and CLK in for the Serial flash.

5.4.2 Floating Signals

When the CC3100 device goes into hibernate state, all the digital IOs would be floating; this includes all input and output pins. While the floating inputs on the CC3100 would not cause any leakage, the outputs need to be held at valid state so that the connected Launchpad or board does not have a glitch. For example, the UART_TX line needs to be pulled high on the board using an external pull-up (100K) so that the external MCU does not get triggered by a false start bit. Similar pulls are needed on all the output pins from the device, if these cannot be provided on the MCU.

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		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265