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

User's Guide

Literature Number: SWRU371
June 2014

Contents

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List of Figures

List of Tables

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SWRU371–June 2014

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 everything that 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.

This kit comes in three configurations:

- CC3100BOOST + CC31XXEMUBOOST + MSP-EXP430F5529LP – Able to run all software in SDK, and develop on MSP430F5529 MCU.
- CC3100BOOST + CC31XXEMUBOOST – Used for any CC3100 development.
- CC3100BOOST – If extra CC3100 BoosterPacks are needed, and the user already has CC31XXEMUBOOST.

NOTE: [1] 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.

NOTE: The antennas used for this transmitter must be installed to provide a separation distance of at least 20 cm from all people and must not be co-located or operate in conjunction with any other antenna or transmitter.

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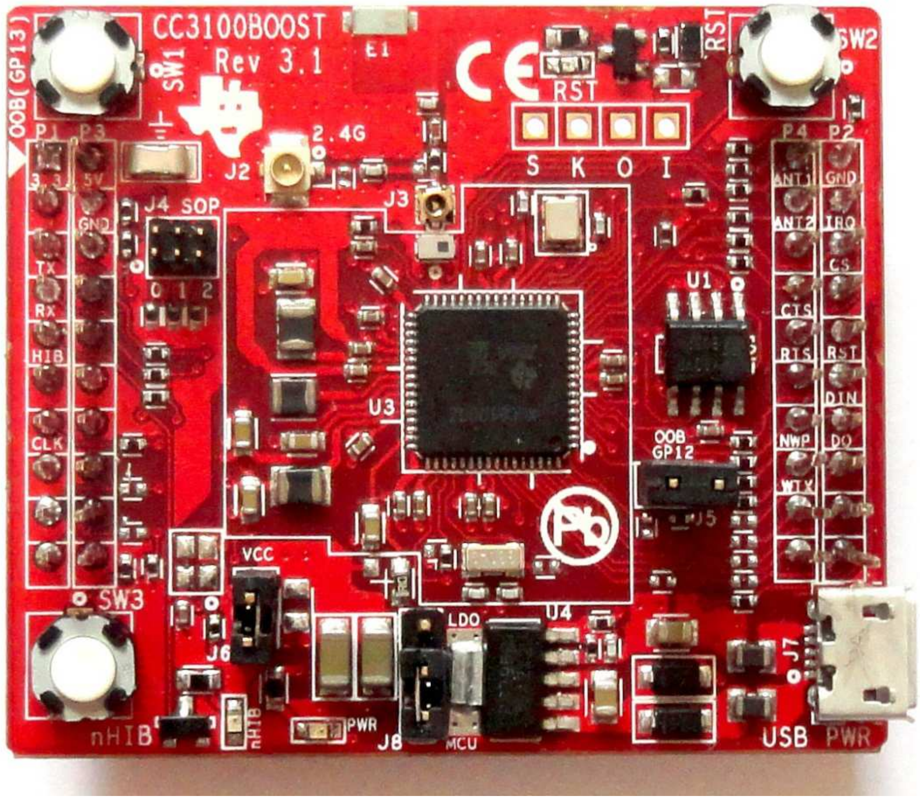

1.2 What Is Included

- 1x CC3100BOOST
- 1x Micro USB cable
- 1x Quick start guide

1.3 FCC/IC Regulatory Compliance

The CC3100 SimpleLink Wi-Fi and IoT Solution BoosterPack Hardware is FCC Part 15 and IC ICES-003 Class A Compliant.

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2 Hardware Description

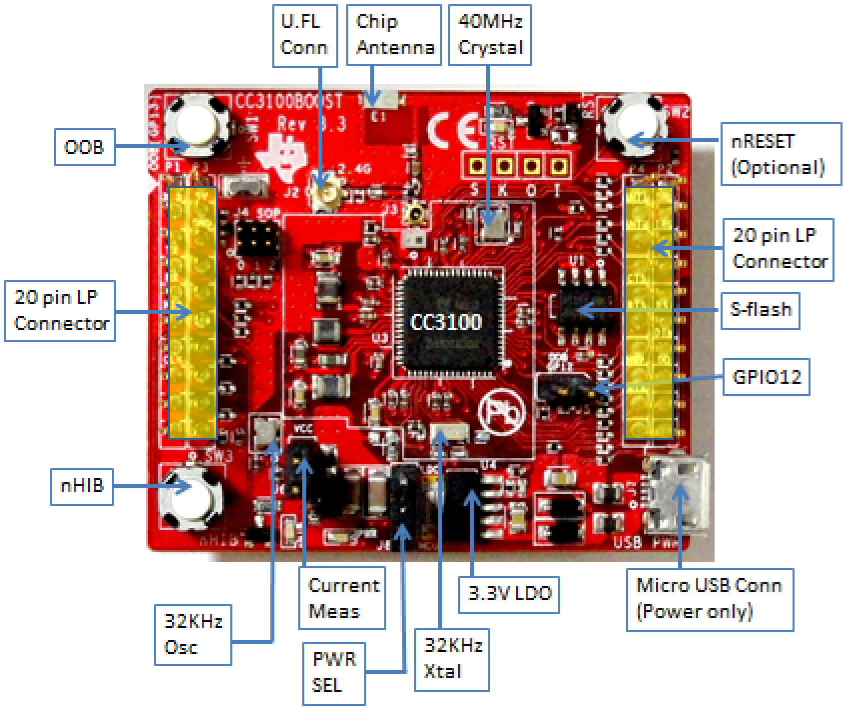

Figure 1. CC3100BOOST Front Side

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2.1 Block Diagram

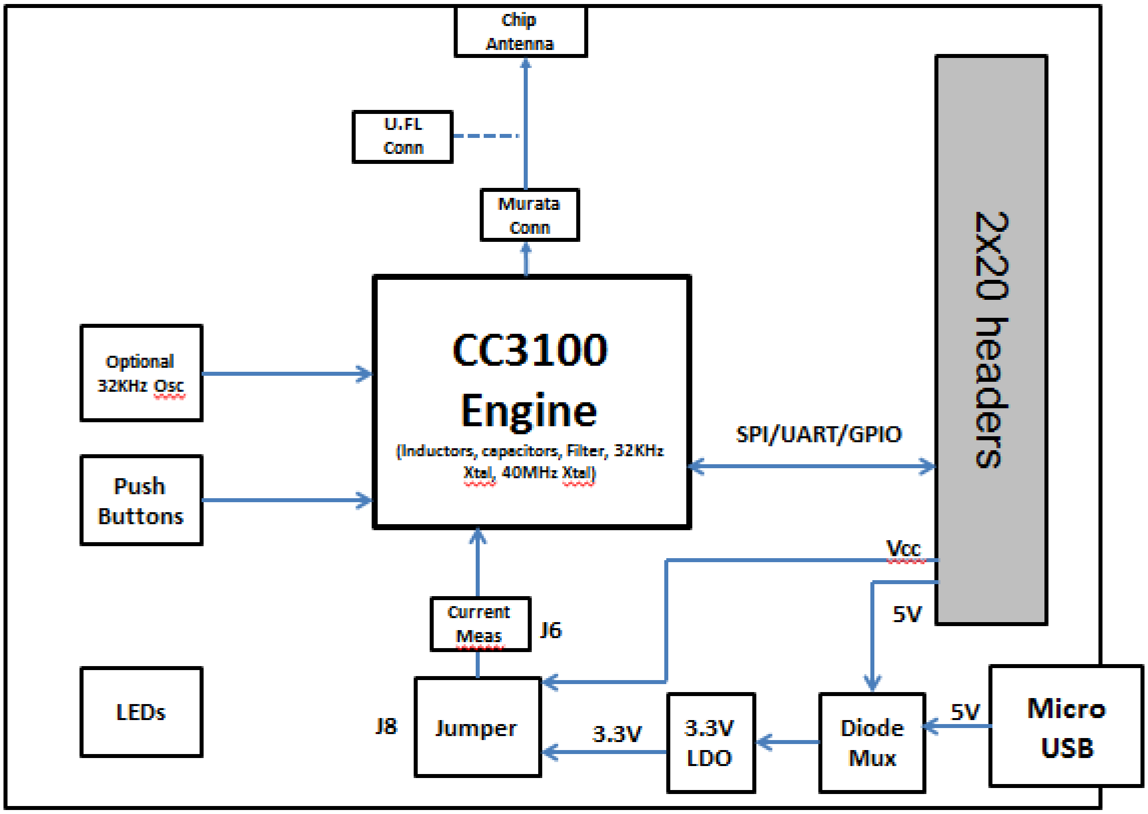

Figure 2. CC3100 Block Diagram

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

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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 resets the device to a known state.
SW3	nHIB	This boots the device to the bootloader mode for flashing the firmware over a 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 indicates the state of the nRESET pin. If this LED is glowing, the device is functional.
D6	Green	nHIB	This LED indicates the state of the 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 connected with a LaunchPad. This is mandatory when using “Z” devices (for example, 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.

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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.

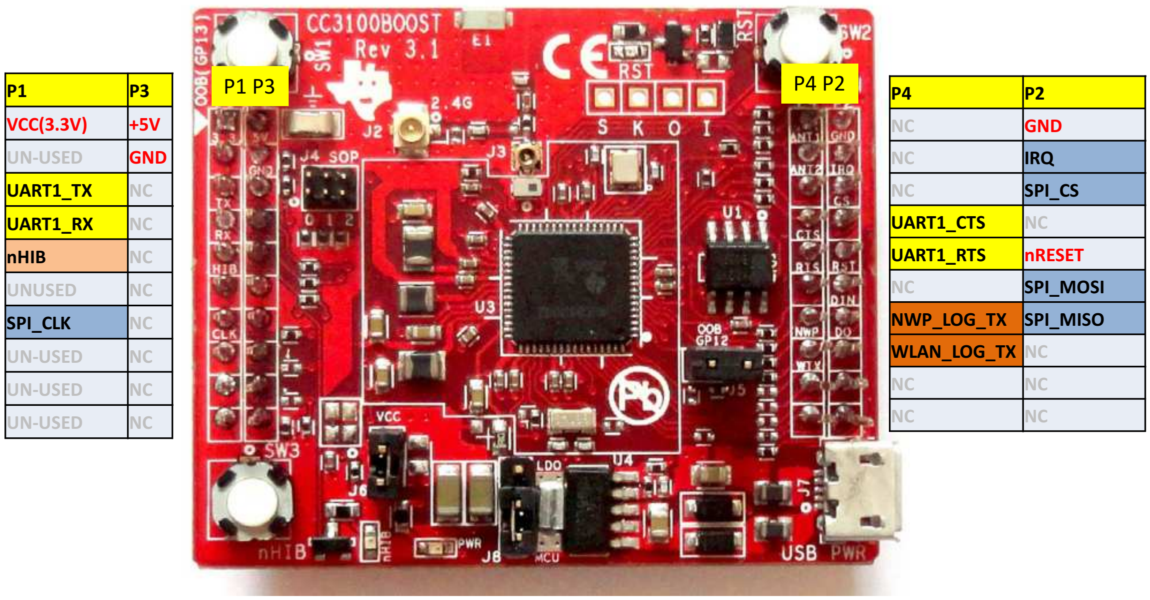

Figure 3. Signal Assignments

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

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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 connected LaunchPad or from the CC3100EMUBOOST board. Some of the LaunchPads are not capable of sourcing the peak current requirements of 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.

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2.4.1 Power From the LaunchPad or CC3100EMUBOOST

The most common scenario is to power the CC3100BOOST from the connected LaunchPad. 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.

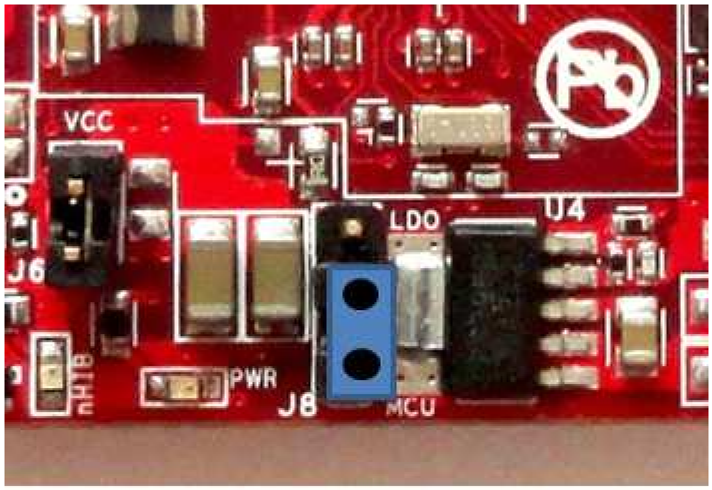

Figure 4. 3.3 V Power From MCU

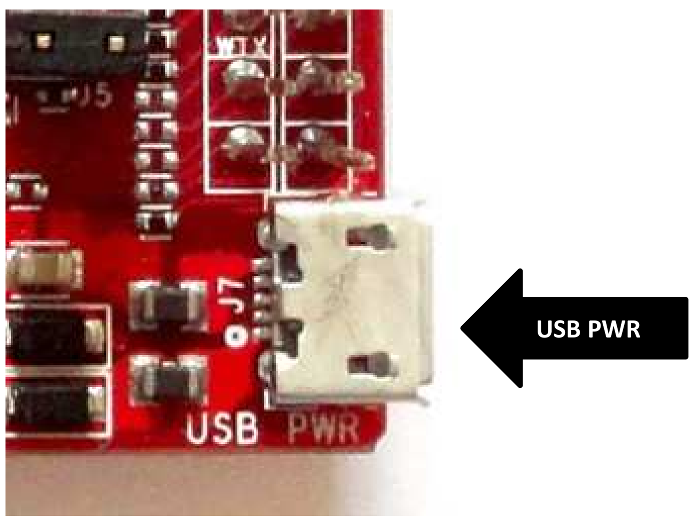

Figure 5. Feed USB on the BoosterPack (if the LaunchPad cannot source 5 V on 20-pin connector)

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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.

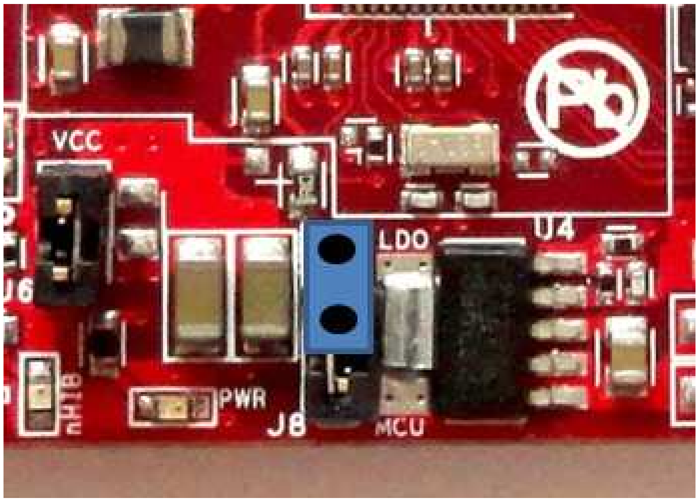

Figure 6. 3.3 V Power From LDO

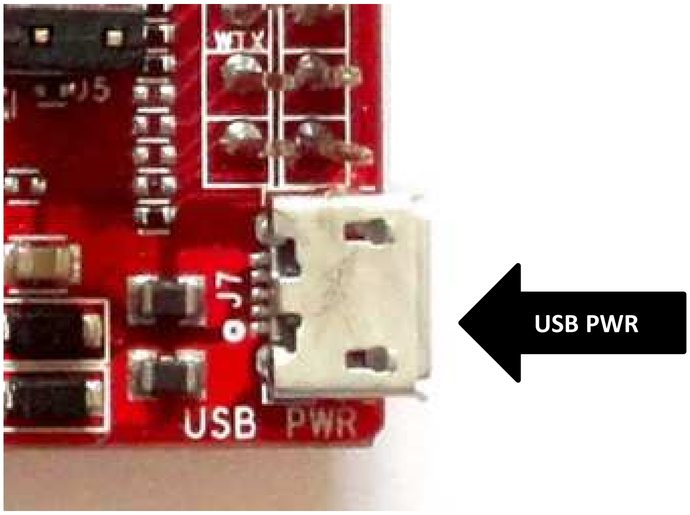

Figure 7. Feed USB on the BoosterPack (always while using the on-board LDO)

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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).

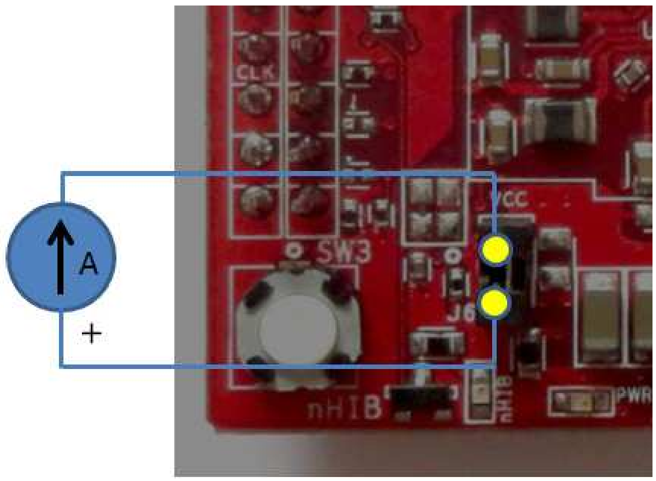

Figure 8. Low Current Measurement

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.

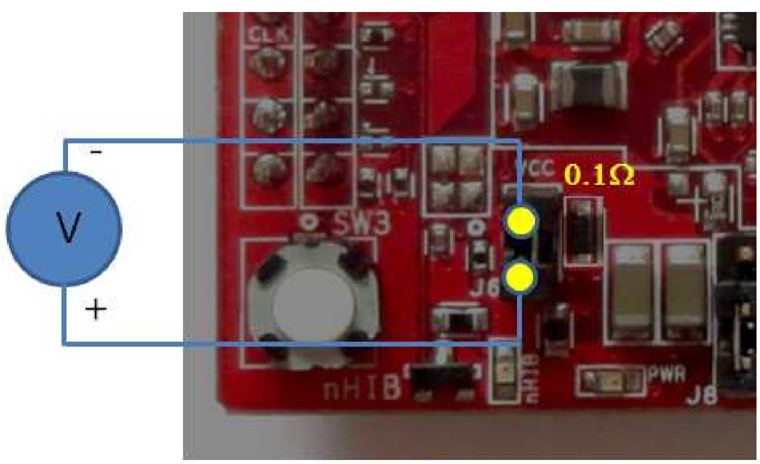

Figure 9. Active Current Measurement

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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 a sleep clock

The 32-kHz crystal allows for lower LPDS sleep currents than other low-frequency clock sources. 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 board's RF path 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 conducting testing or to connect an external antenna. This requires a board modification, as illustrated in the figures below.

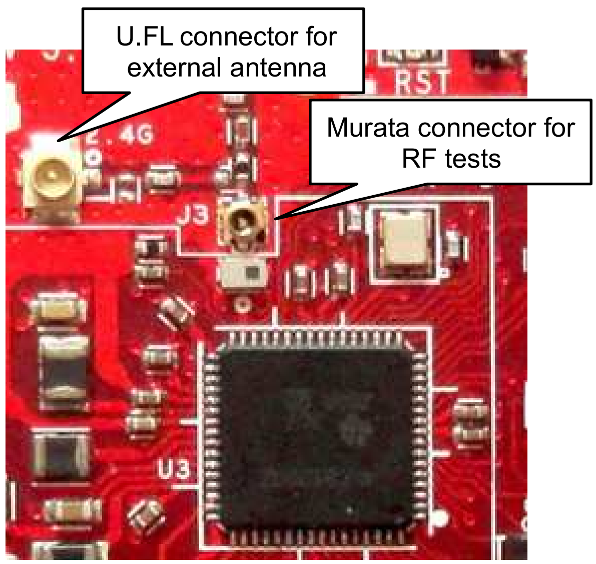

Figure 10. Connectors on the Board

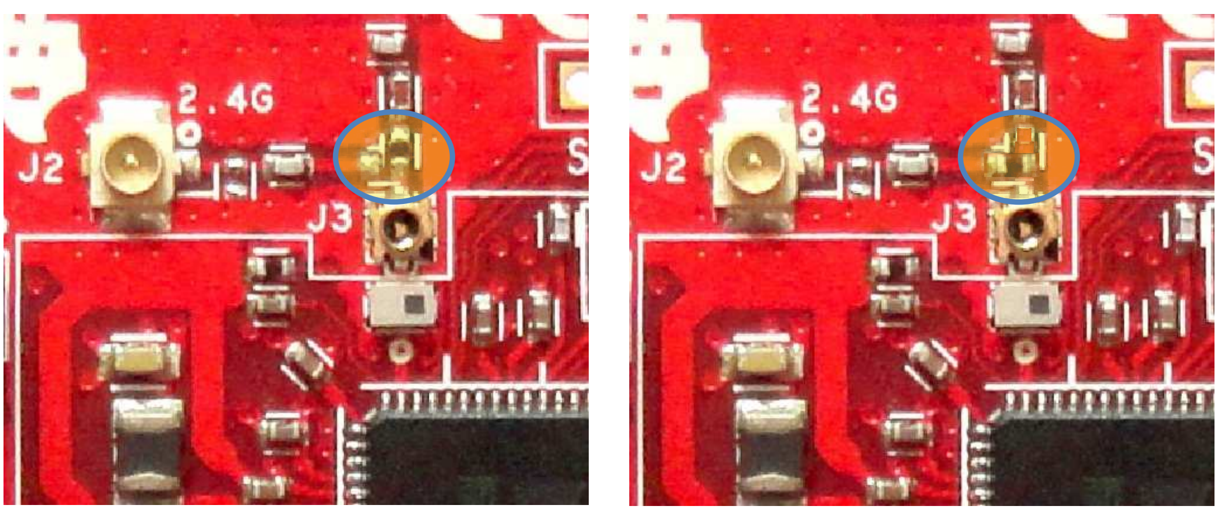

Figure 11. Radiated Mode (Left) vs Conducted Mode (Right)

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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 updates the firmware patches, which are stored in the serial flash, on the BoosterPack; and in software development using SimpleLink Studio.

3.1.2 Hardware Details

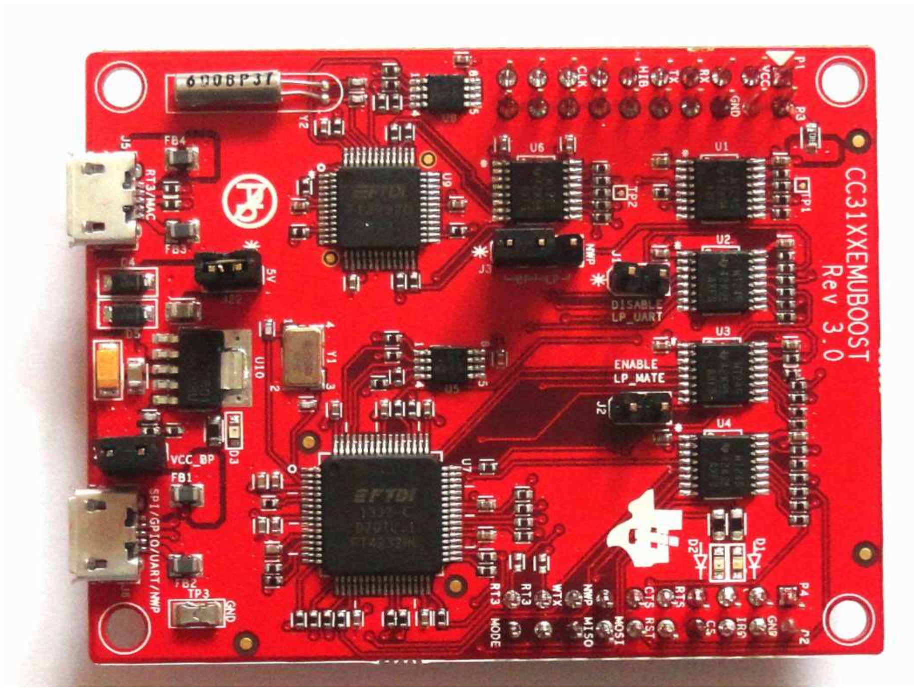

Figure 12. CC31XXEMUBOOST Board

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.

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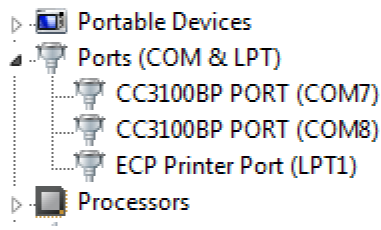

Figure 13. Portable Devices

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 is located at:

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

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

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3.2 Connecting 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 connecting.

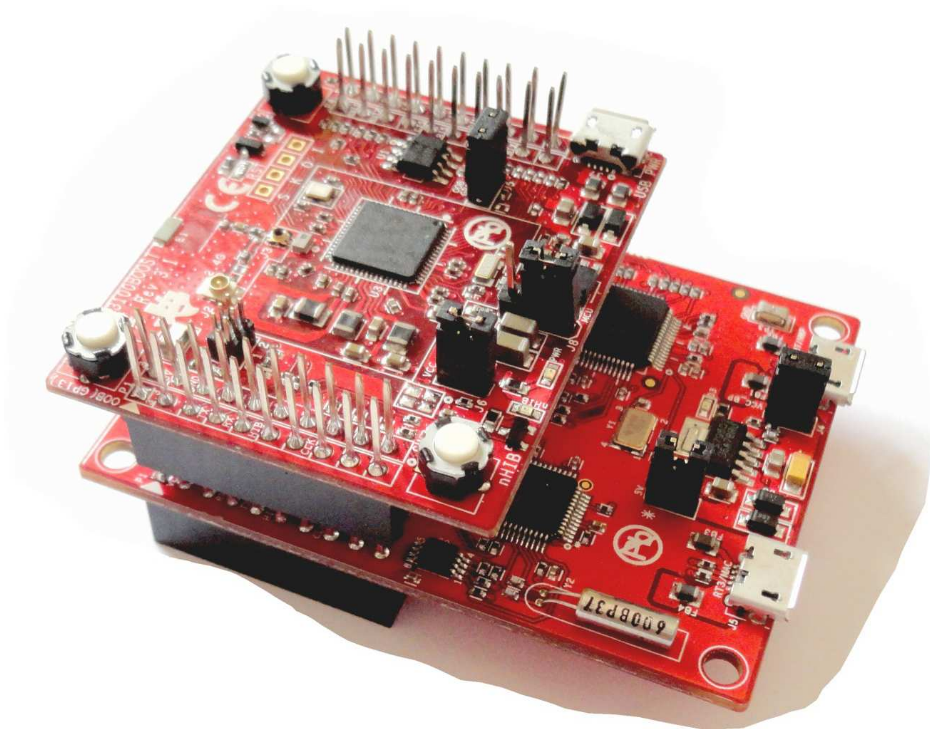

Figure 14. The CC3100BOOST Connected to the EMUBOOST

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

3.3 Jumper Settings on the CC3100BOOST

The following table specifies the jumpers to be installed on the CC3100BOOOST before pairing with the EMUBOOST board.

Table 8. CC3100BOOST Jumper Settings

No	Jumper Settings	Notes
1	J8 (1-2)	Power the BoosterPack 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.

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3.4 Jumper Settings on the EMUBOOST

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

Table 9. EMUBOOST Jumper Settings

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.

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 pairing. Figure 15 illustrates the connected 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.

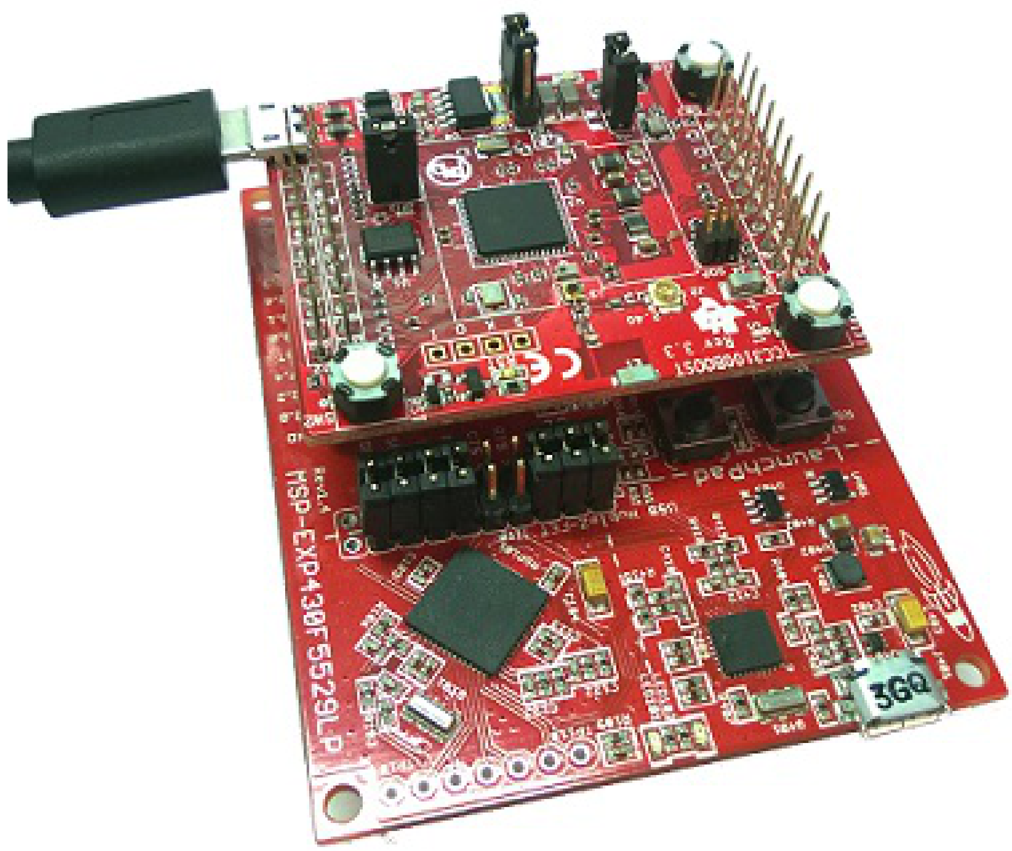

Figure 15. CC3100BP connected to MSP430F5529 LaunchPad

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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.

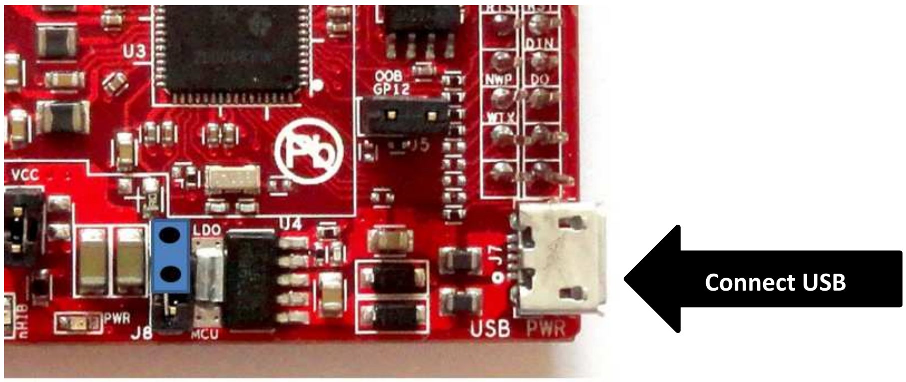

Figure 16. Jumper Settings When Used With LaunchPad

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.

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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

All design files including TI-TXT object-code firmware images, software example projects, and documentation are available from the CC3100 device’s product page.

The Software Development Kit (SDK) to use with the CC3100 BoosterPack is available from http://www.ti.com/tool/cc3100sdk.

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5.3 Hardware Change Log

Table 10. Hardware Change Log

PCB Revision	Description
Rev 2.0B	• First release
Rev 3.0A	• Added push button for nHIB • Added Murata Connector for RF test • Added LED for nRESET • Routed the VDD_FLASH to 3.3 V • Moved the 100uF cap from VCC_BRD to VBAT_CC. Changed cap to 100uF ceramic from Tantalum • Removed 0.1 Ohm resistor for current measurement by default • Removed RS232 UART connection by default
Rev 3.1	• Initial prototype run. • Changed the JTAG test points to Thru-hole from SMD
Rev 3.2	• Layout changes on L1 and L2 layers for mask improvement • 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	• Silk screen changes to mark different part number for the PCB

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 hibernation. 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 states 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.

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