CC3120 SimpleLink™ Wi-Fi® BoosterPack™ Plug-In Module and IoT Solution

The CC3120 device is part of the SimpleLink™ microcontroller (MCU) platform, which consists of Wi-Fi®, *Bluetooth*® low energy, Sub-1 GHz and host MCUs, which all share a common, easy-to-use development environment with a single core software development kit (SDK) and rich tool set. A one-time integration of the SimpleLink platform enables you to add any combination of the portfolio's devices into your design, allowing 100 percent code reuse when your design requirements change. For more information, visit www.ti.com/simplelink.

The SimpleLink Wi-Fi CC3120 wireless network processor from Texas Instruments™ provides users the flexibility to add Wi-Fi to any MCU. This user's guide explains the various configurations of the CC3120 BoosterPack™ Plug-In Module.

Contents

1 Introduction

1.1 CC3120BOOST

The SimpleLink Wi-Fi CC3120 wireless network processor provides users the flexibility to add Wi-Fi to any microcontroller (MCU). This user's guide explains the various configurations of the CC3120 BoosterPack™ Plug-in Module. This Internet-on-a chip™ integrated circuit solution contains everything needed to easily create Internet of Things (IoT) solutions, including enhanced security features, quick connection establishment, cloud support, and more. The CC3120 BoosterPack module can be used in the following ways:

- The module can be connected to a TI MCU LaunchPad™ Development Kit (software examples provided for MSP-EXP430F5529LP).
- The module can be plugged into a CC31XXEMUBOOST1 board, and connected to a PC for MCU emulation.
- The module can be connected to an adapter board (MCU-ADAPT), which allows customers use the CC3120BOOST with additional platforms beyond TI LaunchPad kits.

The CC3120 BoosterPack kit comes in three configurations:

- CC3120BOOST plus CC31XXEMUBOOST board plus MSP-EXP432P401R LaunchPad
  Can run all software in the software design kit (SDK), and develop on the MSP430F5529 MCU
- CC3120BOOST plus CC31XXEMUBOOST board
  Used for any CC3120 development
- CC3120BOOST
  If extra CC3120 BoosterPack modules are needed, and the user already has the CC31XXEMUBOOST board

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NOTE: The CC31XXEMUBOOST is an advanced emulation board that is required for flashing the CC3120BOOST, using the radio tool (radio performance testing or putting into certification modes), and doing networking processing logs for advanced debugging.

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 colocated or operate in conjunction with any other antenna or transmitter.

NOTE: The pictures used in this document refer to the Rev A board, but the contents also apply to any higher revisions unless otherwise stated. For changes across the various revisions of the board, refer to Section 5.3.

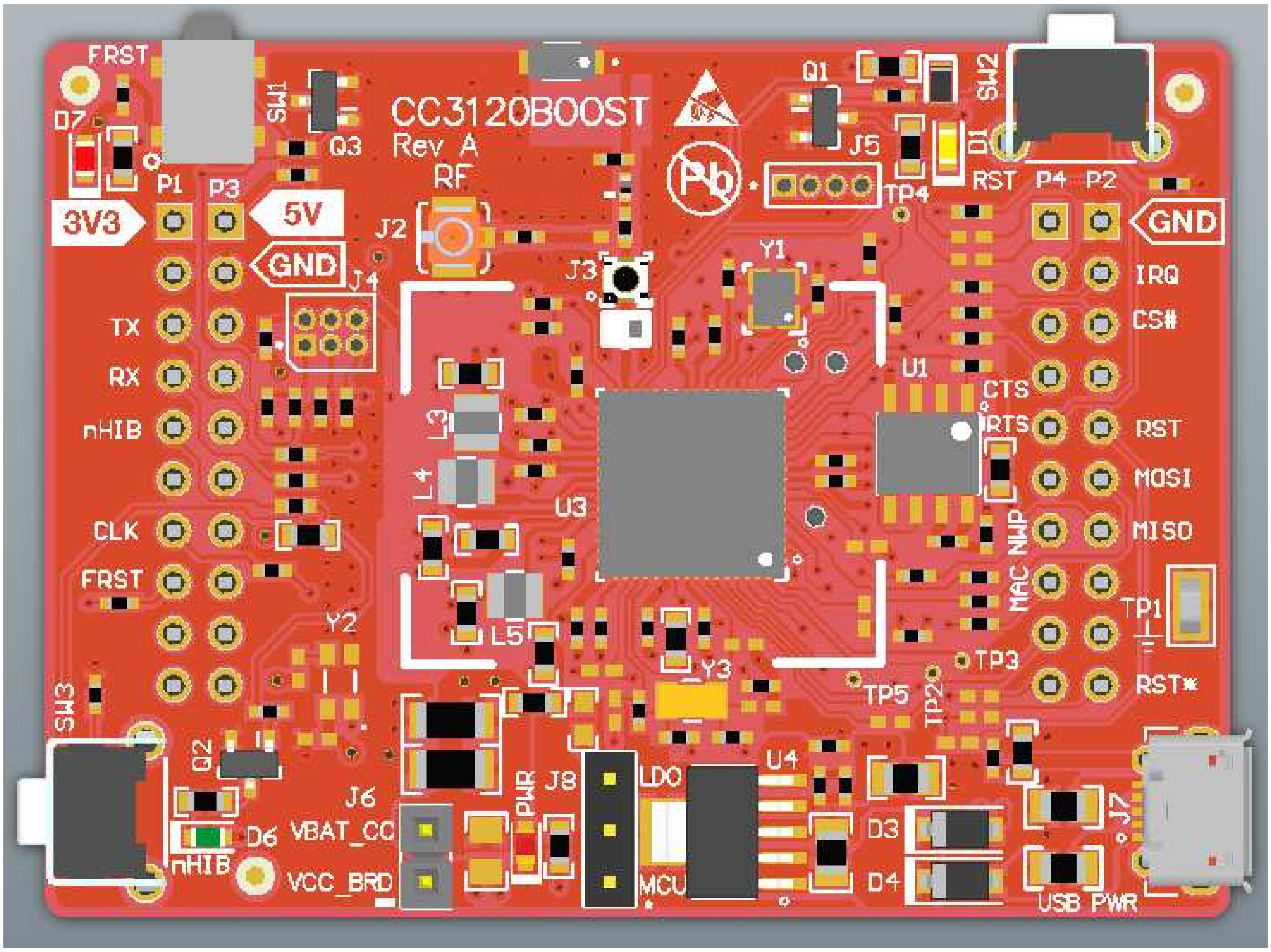

Figure 1. CC3120BOOST Board

1.2 What is Included

- One CC3120BOOST board
- One micro USB cable
- One quick start guide

1.3 FCC/IC Regulatory Compliance

The CC3120 SimpleLink Wi-Fi and IoT Solution BoosterPack Hardware is tested for and found to be in compliance with R&TTE and FCC regulations regarding unlicensed intentional radiators.

2 Hardware Description

Figure 2 shows the front side of the CC3120BOOST.

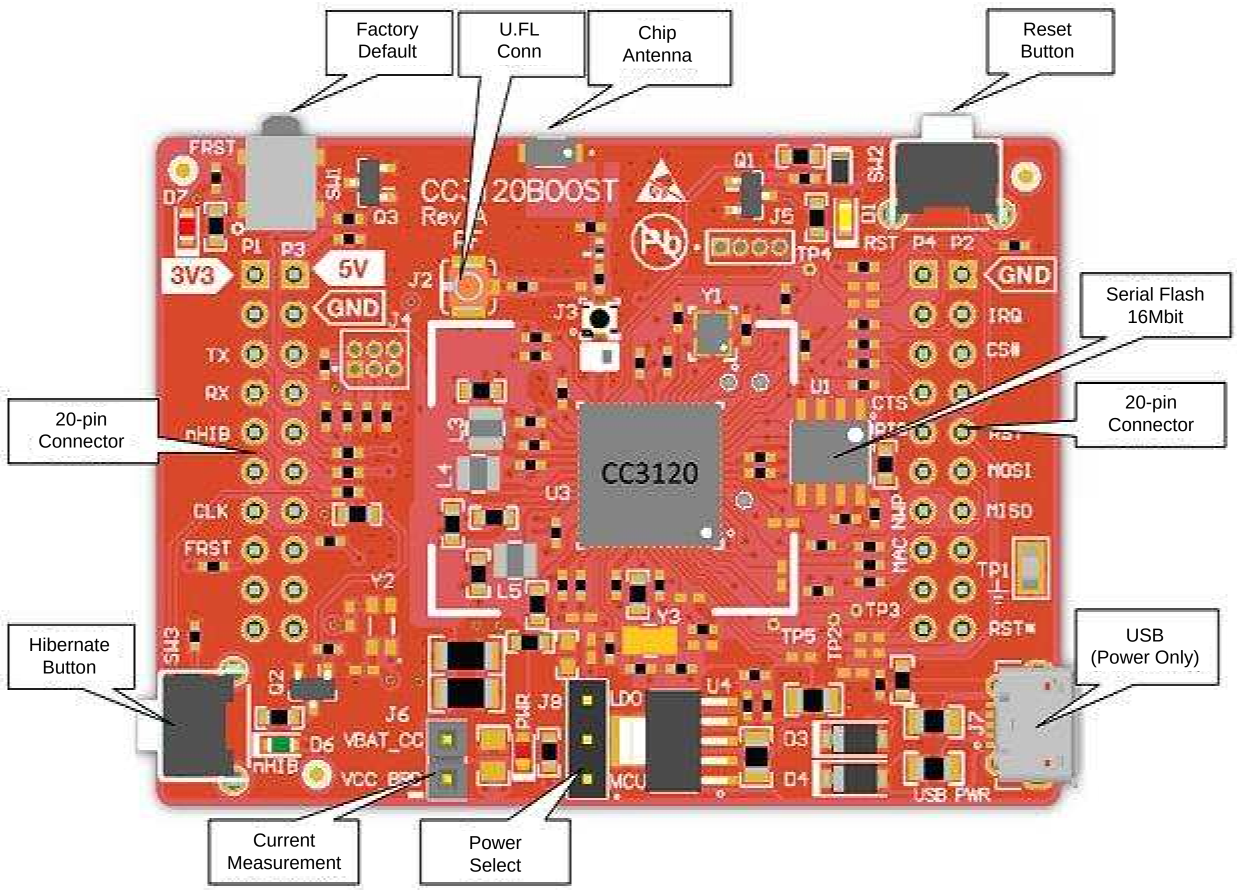

Figure 2. CC3120BOOST Front Side

2.1 Block Diagram

Figure 3 shows the block diagram of the CC3120 device.

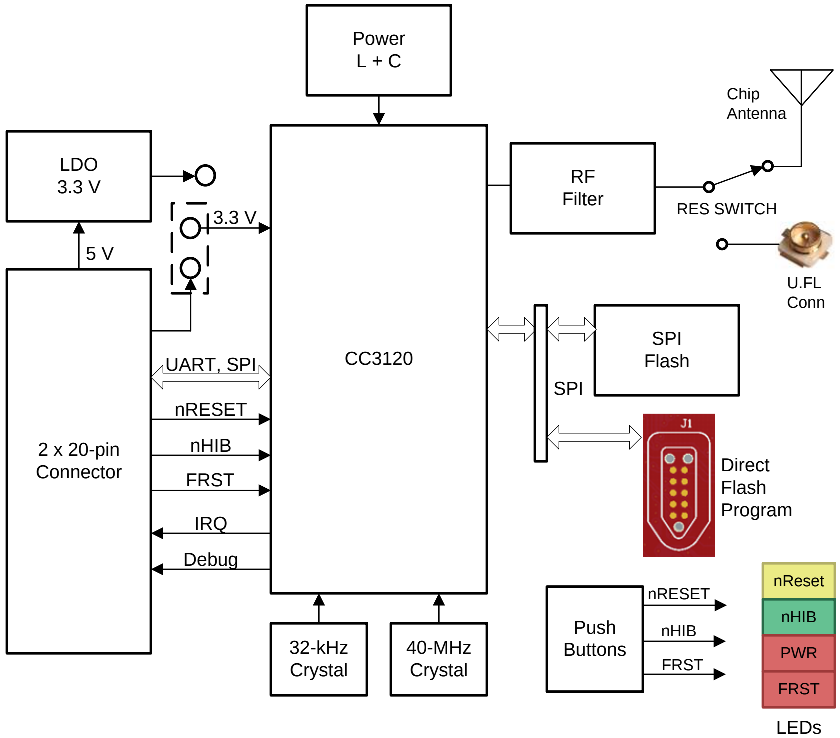

Figure 3. CC3120 Block Diagram

2.2 Hardware Features

- Two 20-pin stackable connectors
- Onboard chip antenna with option for U.FL-based conducted testing
- Power from onboard 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
- A 16-Mbit serial flash (MX25R from Macronix™)
- A 40-MHz crystal, 32-kHz crystal and optional 32-kHz oscillator (not mounted on the PCB)
- A 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 lists the push button descriptions.

Table 1. Push Buttons

Reference	Usage	Comments
SW1	Factory default	This button is used to restore the serial flash to the factory default image. Hold the button and then toggle the RESET push button.
SW2	RESET	This button can be used to Reset the device. Holding the button down sets the device in the SHUTDOWN state.
SW3	nHIB	This button boots the device to the bootloader mode for flashing the firmware over a universal asynchronous receiver/transmitter (UART).

Table 2 lists the LED descriptions.

Table 2. LEDs

Reference	Color	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.
D7	Red	Factory Default	This LED indicates whether the factory default switch is pressed on. The RESET button must be pressed for this LED to function.

2.3.2 Jumper Settings

Table 3 lists the jumper settings.

Table 3. Jumper Settings

Reference	Usage	Comments
J7	USB connector	For powering the BoosterPack when connected with a LaunchPad, which cannot source enough current.
J8	Power selection	Choose the power supply from the LauchPad kit or the onboard USB. J8 (1 to 2) power from the MCU LaunchPad J8 (2 to 3) power from the onboard USB using a 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).
P1…P4	BoosterPack header	2 × 10 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. Using this requires an ECO be made to the board by swapping two resistors.

2.3.3 Assignment of the Two 20-Pin Connectors

Figure 4 shows the signal assignment on the two 20-pin connectors. The convention of J1...J4 is replaced with P1…P4 to avoid confusion with the actual board reference.

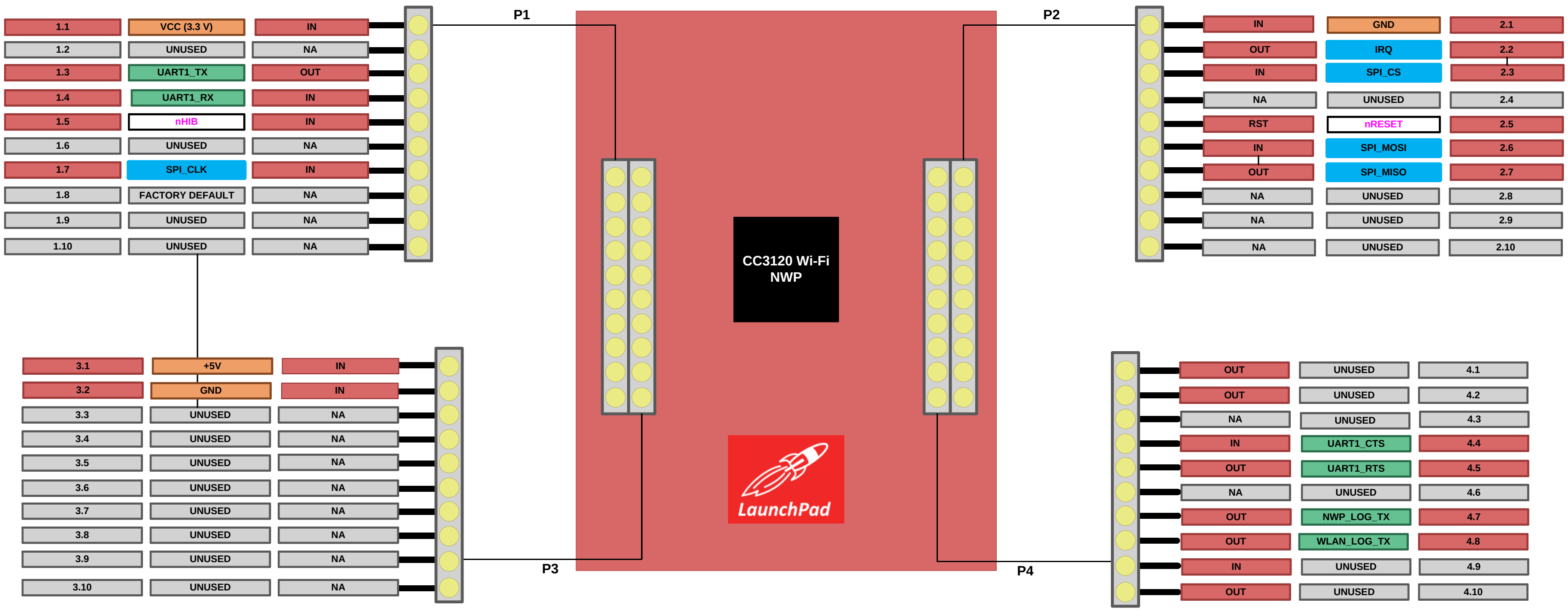

Figure 4. Pin Connector Assignment

Table 4 lists the outer row connectors.

Table 4. Outer Row Connectors

Pin Number	Signal Name	Direction	Pin Number	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

Table 4. Outer Row Connectors (continued)

Pin Number	Signal Name	Direction	Pin Number	Signal Name	Direction
P1.7	SPI_CLK	IN	P2.7	SPI_MISO	OUT
P1.8	FACTORY DEFAULT	NA	P2.8	UNUSED	NA
P1.9	UNUSED	NA	P2.9	UNUSED	NA
P1.10	UNUSED	NA	P2.10	UNUSED	NA

Table 5 lists the inner row connectors.

Table 5. Inner Row Connectors

Pin Number	Signal Name	Direction	Pin Number	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 logic levels, and are referred with respect to CC3120 device. For example, UART1_TX is an output from the CC3120. For the SPI lines, the CC3120 device always acts like a slave.

2.4 Power

The board is designed to accept power from a connected LaunchPad kit, or through the CC31xxEMUBOOST board. Some of the LaunchPad kits are incapable of sourcing the peak current requirements of Wi-Fi, which may be as high as 400 mA. In such cases, the USB connector on the CC3120BOOST can be used to aid the peak current. The use of Schottky diodes ensure that load sharing occurs between the USB connectors on the LaunchPad kit and the BoosterPack module without any board modifications.

Also, the 3.3-V power can be sourced from the LaunchPad kit or from the 3.3-V LDO on the board. This sourcing is done by using jumper J8. If the LaunchPad kit is unable to source the 3.3 V up to 350 mA, then the J8 must be configured to work from the onboard LDO.

2.4.1 Power From the LaunchPad Kit or CC3120EMUBOOST

The most common scenario is powering the CC3120BOOST from the connected LaunchPad kit. In this case, the LaunchPad kit provides 3.3 V to the BoosterPack module for its operation (see Figure 5. In addition to the 3.3 V, some LaunchPad kits provide 5 V from the USB (see Figure 6), which is used to drive a 3.3-V LDO on the BoosterPack module. If the LaunchPad kit is unable to provide the 5 V (for example, the LaunchPad kit with only 20 pins), then the USB connector on the CC3120BOOST must be used to provide the LDO input, as shown in Figure 6.

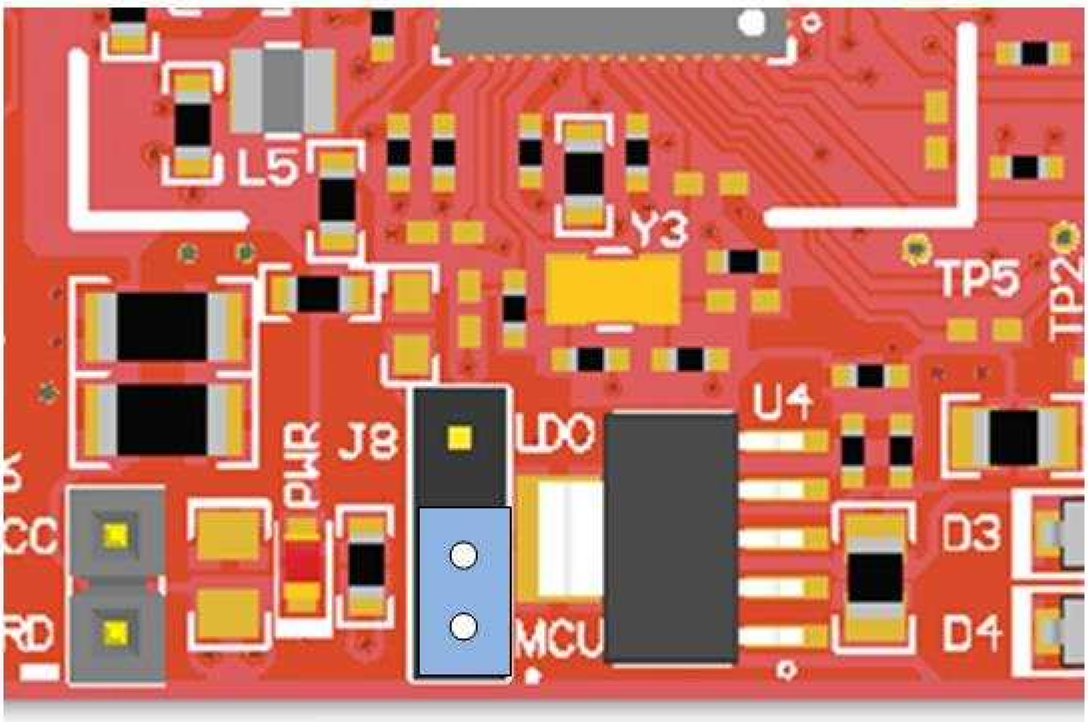

Figure 5. 3.3-V Power From MCU LaunchPad Kit

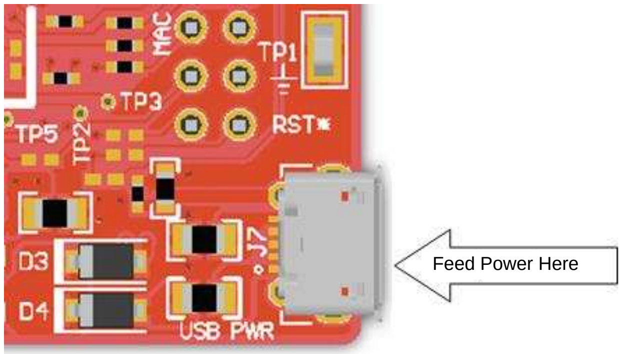

Figure 6. Feed USB on the BoosterPack Module (LaunchPad Kit Cannot Source 5 V on 20-Pin Connector)

2.4.2 Onboard LDO Power Supply

On some LaunchPad kits, the 3.3 V cannot source the 350-mA peak current needed for the CC3120BOOST. In such a case, the onboard 3.3-V LDO can be used (see Figure 7). This LDO would be sourced from the USB connector on the CC3120BOOST and LaunchPad kit in a shared-load manner (see Figure 8).

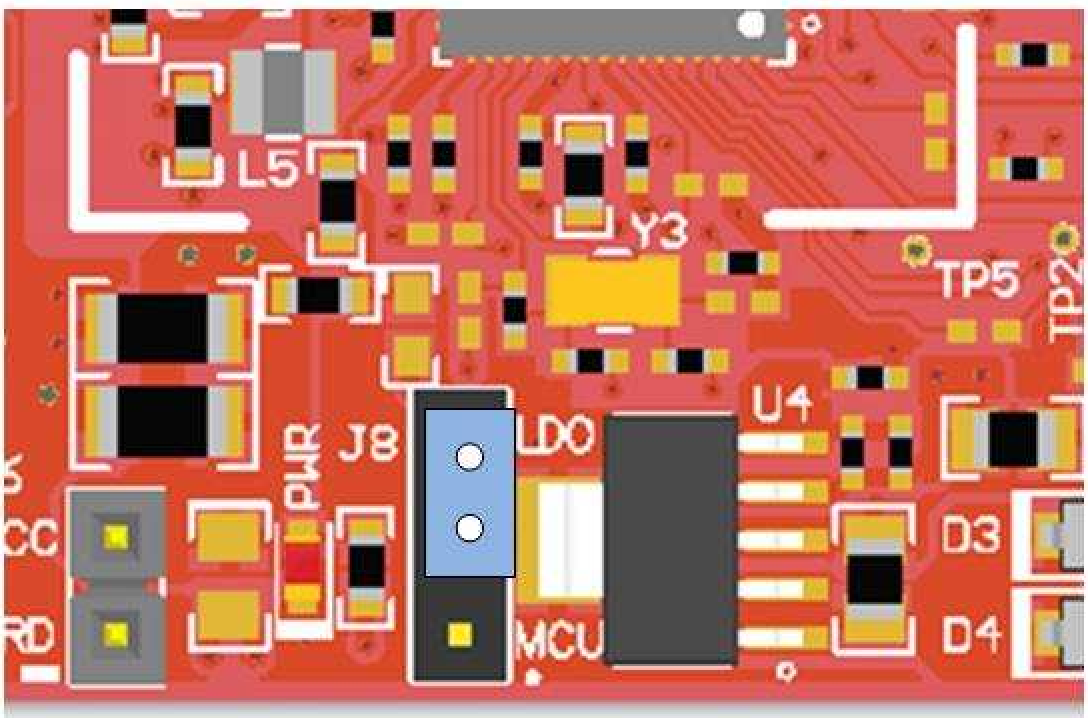

Figure 7. 3.3-V Power from LDO

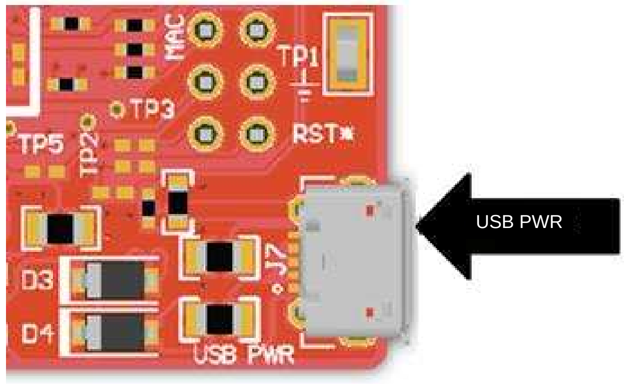

Figure 8. Feed USB on the BoosterPack Module (Always While Using the Onboard LDO)

2.5 Measure the CC3120 Current Draw

2.5.1 Low Current Measurement (Hibernate and LPDS)

To measure the current draw of the CC3120, and the serial flash, a jumper labeled J6 is provided on the board. By removing this jumper, users can place an ammeter into this path to observe the current. TI recommends this method for measuring the LPDS and hibernate currents that are of the order of a few 10s of micro amps.

Jumper J6 is removed, and an ammeter is added in series to measure the hibernate and LPDS currents (see Figure 9).

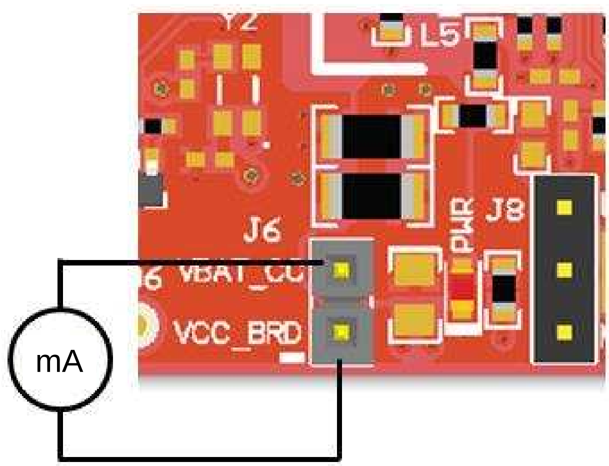

Figure 9. Low Current Measurement

2.5.2 Active Current Measurement

To measure active current in a profile form, TI recommends using a 0.1-Ω 1% resistor on the board, and measuring the differential voltage across the resistor. This measurement can be done using a voltmeter or an oscilloscope for measuring the current profile.

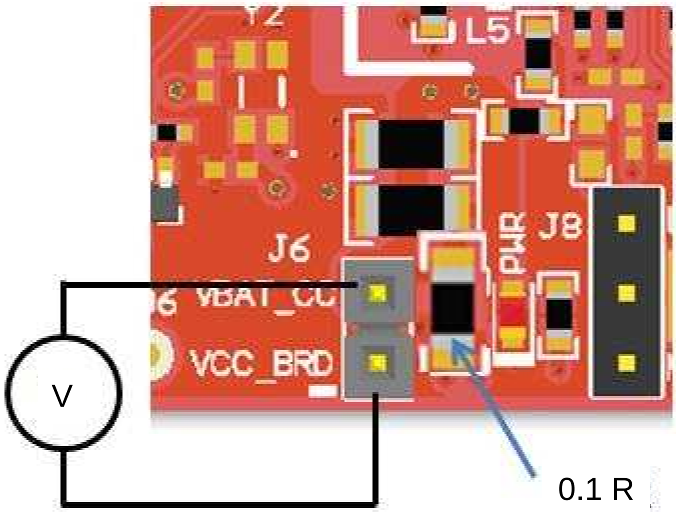

Figure 10. Active Current Measurement

2.6 Clocking

The board provides two crystals for the clocks to the device:

- Y1 is a 40-MHz crystal
- Y3 is a 32-kHz 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 use of the full range of low-power modes.

2.7 Performing Conducted Testing

The BoosterPack board by default ships with the RF signal connected to the onboard chip antenna. Figure 11 shows the miniature UMC connector (Murata MM8030-2610) on the RF path of the board, which can be used for measuring the performance in a conducted mode. In addition to the Murata connector, the board contains a U.FL connector (see Figure 12) that can be used for conducting testing, or connecting an external antenna. An onboard U.FL (Murata) connector provides a way to perform testing in the lab using a compatible cable. Alternately, for testing the conducted measurement an U.FL connector is provided on the board. The use of this connector requires a rework to be performed, which involves swapping the position of a resistor as shown in Figure 11 and Figure 12.

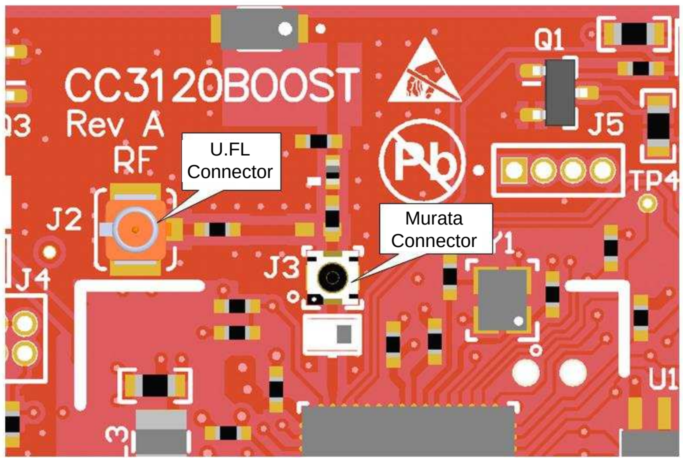

Figure 11. Connectors on the Board

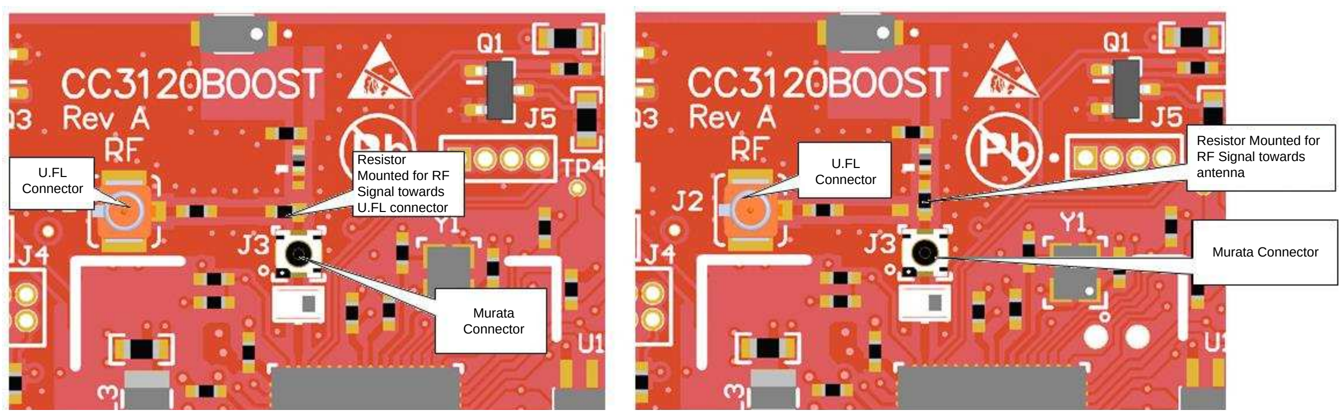

Figure 12. Conducted Mode (Left) Versus Radiated Mode (Right)

3 Connecting to the PC Using CC31XXEMUBOOST

3.1 *CC31XXEMUBOOST Board*

3.1.1 Overview

The CC31XXEMUBOOST board is designed to connect the BoosterPack module to a PC through a USB connection. This connection updates the firmware patches, which are stored in the serial flash on the BoosterPack, and in software development using SimpleLink Studio. The board is also used for measuring the RF performance using a software tool named *RadioTool*. For more information, refer to the CC31xx & CC32xx Radio Tool wiki page.

3.1.2 Hardware Details

Figure 13 shows the CC31XXEMUBOOST board.

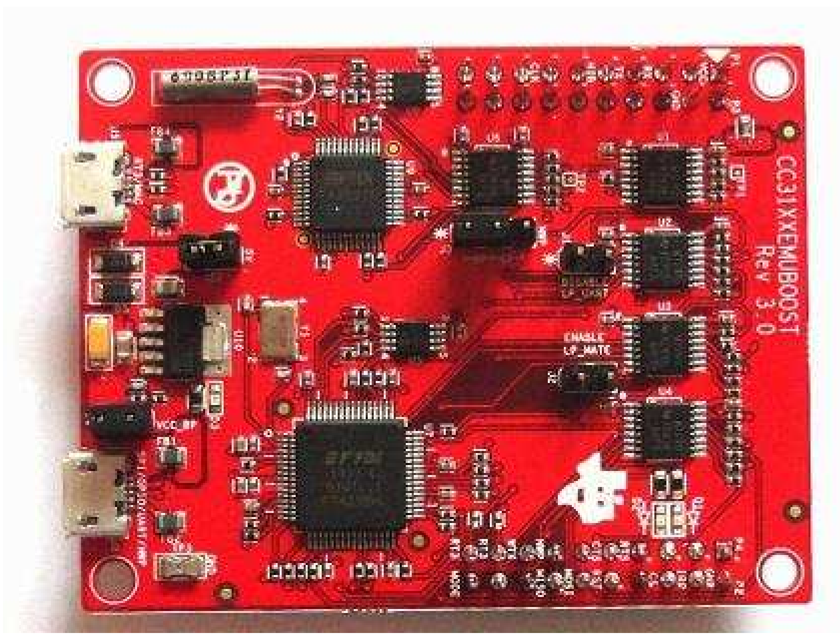

Figure 13. CC31XXEMUBOOST Board

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

Table 6. Ports Available on J6

Port Number	Port Type	Usage	Comments
1	D2XX	SPI port for SimpleLInk Studio	
2	D2XX	GPIO for SimpleLink 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.

The first COM port in the list is used for the flash programming (see Figure 14).

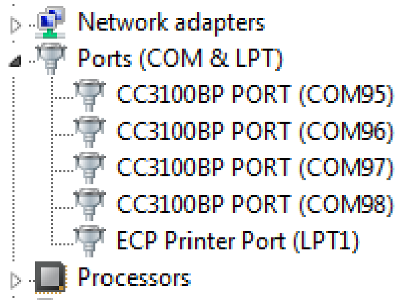

Figure 14. Portable Devices

NOTE: The third com port shown (COM97 for the example in Figure 14) is used for flash programming.

Table 7 lists the ports available on J5.

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 users to install the associated drivers on a PC. This package is available as part of the SDK release in the following folder:

`[Install-Path]\CC3120-sdk\tools\cc31xx_board_drivers\.`

The install path is usually C:\ti\CC3120SDK.

3.2 Connecting the Boards

Figure 15 shows the connection of the CC3120 BoosterPack module to the CC31XXEMUBOOST board. The connectors must be aligned carefully, because the CC31XXEMUBOOST board does not have polarity protection, and the serial flash can be erased as a result. Pin 1 on each of the connectors is marked on the board using a small triangle marking; these pins must be aligned while connecting.

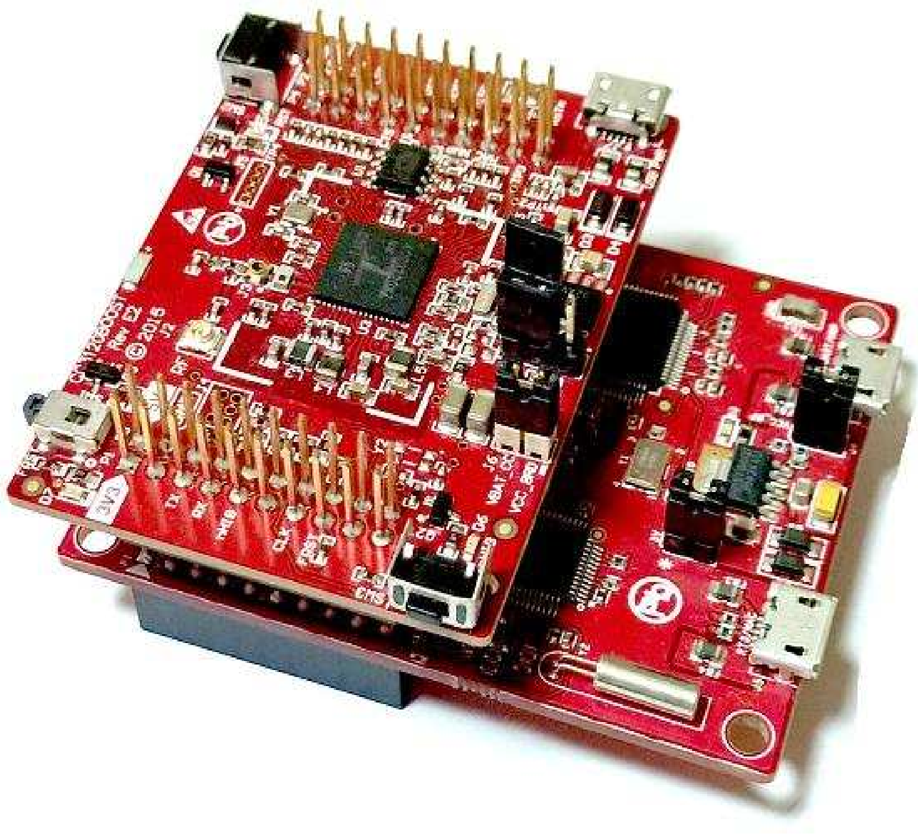

Figure 15. CC3120BOOST Connected to the CC31XXEMUBOOST

CAUTION

Align 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.

3.3 Jumper Settings on the CC3120BOOST

Table 8 specifies the jumpers to be installed on the CC3120BOOOST before pairing with the CC31XXEMUBOOST board.

Table 8. CC3120BOOST Jumper Settings

Number	Jumper Settings	Notes
1	J8 (1-2)	Powers the BoosterPack from the CC31XXEMUBOOST. The jumper shall be placed so that it is near the edge of the PCB.
3	J6 (short)	No current measurement

3.4 Jumper Settings on the CC31XXEMUBOOST

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

Table 9. CC31XXEMUBOOST Jumper Settings

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

The rest of the jumpers can remain open.

4 Connecting to a LaunchPad Kit

The CC3120 BoosterPack module can be directly connected to a compatible LaunchPad development kit using the standard two 20-pin connectors. The jumper settings needed for this connection are the same as those needed for the CC31XXEMUBOOST board, as described in Section 3.4.

Ensure that pin 1 of the two 20-pin connectors are aligned correctly before pairing. Figure 16 shows the connected setup. The USB cable is directly connected to the BoosterPack module to power it only. For debugging, the USB cable on the LaunchPad kit is also required.

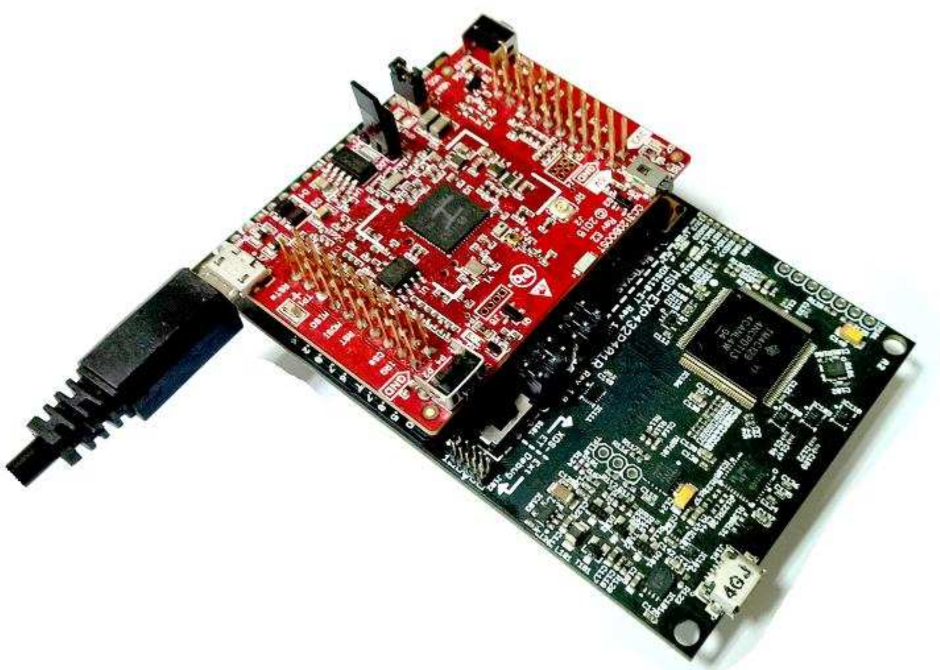

Figure 16. CC3120BP Connected to MSP432™ LaunchPad

4.1 LaunchPad Current Limitation

Some of the LaunchPad kits, including the MSP430FRAM, do not provide enough current to power the CC3120 BoosterPack module. The BoosterPack module can consume up to 400-mA peak current from the 3.3 V, and may need to be powered separately.

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

The power supply jumpers should be configured, as shown in Figure 17, when the power is supplied from the onboard USB connector.

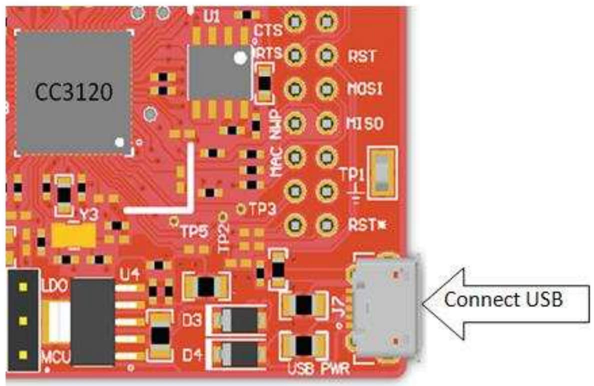

Figure 17. Jumper Settings When Used With LaunchPad Kit

CAUTION

Because two power sources exist in this setup, it is important to follow the power-up sequence. Always power the BoosterPack module before powering the LaunchPad kit.

5 Additional Information

5.1 Design Files

All design files including schematics, layout, bill of materials (BOM), Gerber files, and documentation are available for download from: *CC3120 SimpleLink WI-Fi and Internet of Things - Hardware Design Files*.

5.2 Software

All design files including TI-TXT object-code firmware images, software example projects, and documentation are available from the CC3120 device product page.

The Software Development Kit (SDK) to use with the CC3120 BoosterPack is available from http://www.ti.com/tool/CC3120sdk.

5.3 Hardware Change Log

Table 10 lists the hardware change log.

Table 10. Hardware Change Log

PCB Revision	Description
Rev A	First release

5.4 Known Limitations

5.4.1 Enabling Low-Power Measurement From the LaunchPad Kit

When the CC3120BOOST is powered by a LaunchPad kit, the 3.3-V supply from the LaunchPad is used to power the CC3120 BoosterPack module, as well as other parts on the board including the serial flash, LEDs, and more. The total power drawn into the 3.3-V supply would be several mA in shutdown or hibernate mode. To measure the low-power numbers, users are advised to remove the LEDs (D1, D5, D6 on the board.) Similarly, the shutdown mode would leak about 33 µA into the pullup resistor (R12) on the nRESET pin. This pullup resistor also must be removed to measure the total current below 1 µA in shutdown mode. In hibernate mode, the pullup resistor R296 must be removed to enable the lowest current state.

Revision History

Date	Revision	Notes
February 2017	SWRU457*	Initial release

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