EVM User's Guide: CC3301MOD

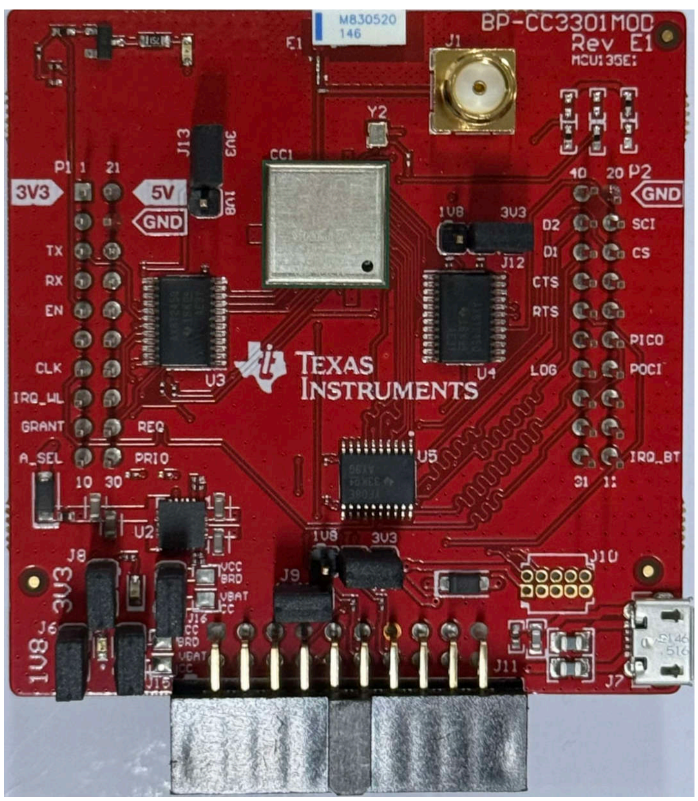
SimpleLink™ CC33X1MOD Wi-Fi 6 and Bluetooth® Low Energy BoosterPack™ Plug-In Module (BP-CC33X1MOD)

Description

The SimpleLink™ CC3301MOD Wi-Fi 6 and Bluetooth® Low Energy devices enable affordable, reliable, and secure connectivity in embedded applications with a processor host running Linux® or an MCU host running RTOS. The CC3301MOD BoosterPack™ plug-in module (BP-CC3301MOD) is a test and development board that can be easily connected to TI LaunchPad™ development kits or processor boards; thus, enabling rapid software development.

Features

- CC3301MOD Wi-Fi 6® and Bluetooth Low Energy combo device
- Two 20-pin stackable connectors (BoosterPack Standard)
- Onboard chip dual-band antenna
- SMA/U.FL connector for conducted RF testing
- Power from onboard dual rail (3.3V and 1.8V) LDO using USB or LaunchPad™
- Three-level shifters for voltage translation (3.3V to 1.8V)
- JTAG header pins for SWD interface with XDS110 or LP-XDS110ET
- Jumper for current measurement on both power supplies (3.3V and 1.8V) with provision to mount 0.1-ohm (0603) resistors for measurement with a voltmeter
- 32kHz oscillator for lower power evaluation



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1 Evaluation Module Overview

1.1 Introduction

The CC33X1MOD BoosterPack™ plug-in module (BP-CC33X1MOD) is a test and development board that can easily be connected to TI LaunchPad™ or processor boards; thus, enabling rapid software development.

This user's guide is intended to explain the various hardware configurations and features of the BP-CC33X1MOD. For more information about the CC3301MOD device, please refer to ti.com CC3301MOD product page.

1.2 Kit Contents

- BP-CC3301MOD Evaluation Board
- EVM disclaimer Read Me

1.3 Specification

The BP-CC33X1MOD is a board designed to enable rapid and easy software and hardware development for the CC33X1MOD device. The block diagram for the BP-CC3301MOD is shown in Figure 1-1.

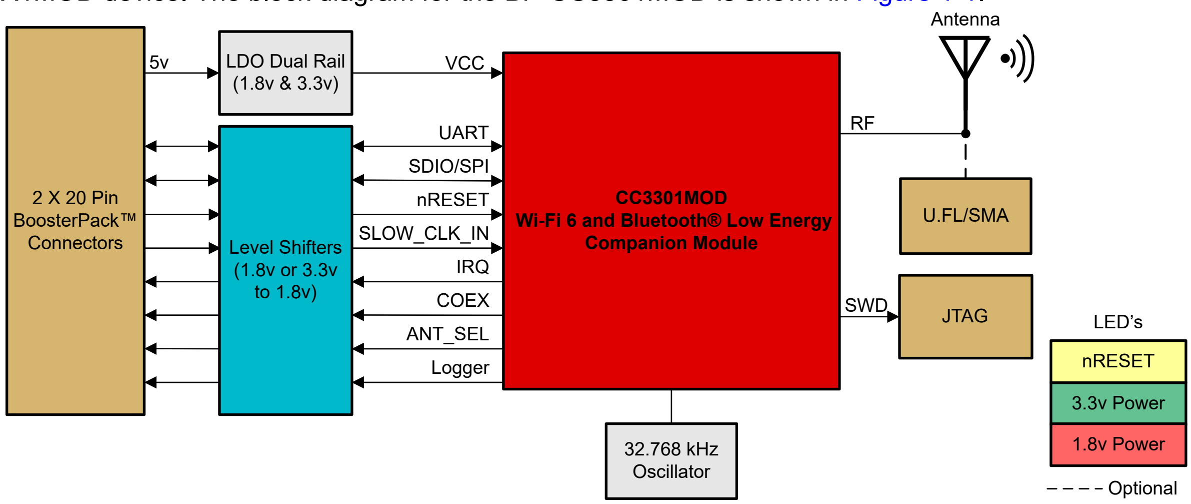

Figure 1-1. BP-CC3301MOD Block Diagram

This kit can be used in three configurations:

1. MCU and RTOS evaluation: BP-CC33X1MOD + LaunchPad with the MCU running TCP/IP like the LP-AM243
2. Processor and Linux evaluation: BP-CC33X1MOD + BP-CC33-BBB-ADAPT + BEAGL-BONE-BLACK
3. RF-testing with PC tools: BP-CC33X1MOD + LP-XDS110ET

In addition, the BP-CC33X1MOD can also be wired to any other Linux or RTOS host board running TCP/IP stack. Refer to Section 3.1 for more information.

1.4 Device Information

The purpose of the BP-CC33X1MOD Evaluation Board is to showcase the hardware and software capabilities of the CC3301MOD device. The other components on the board are populated for testing and support of this main device.

2 Hardware

BP-CC33X1MOD Overview shows the overview of the BP-CC3301MOD.

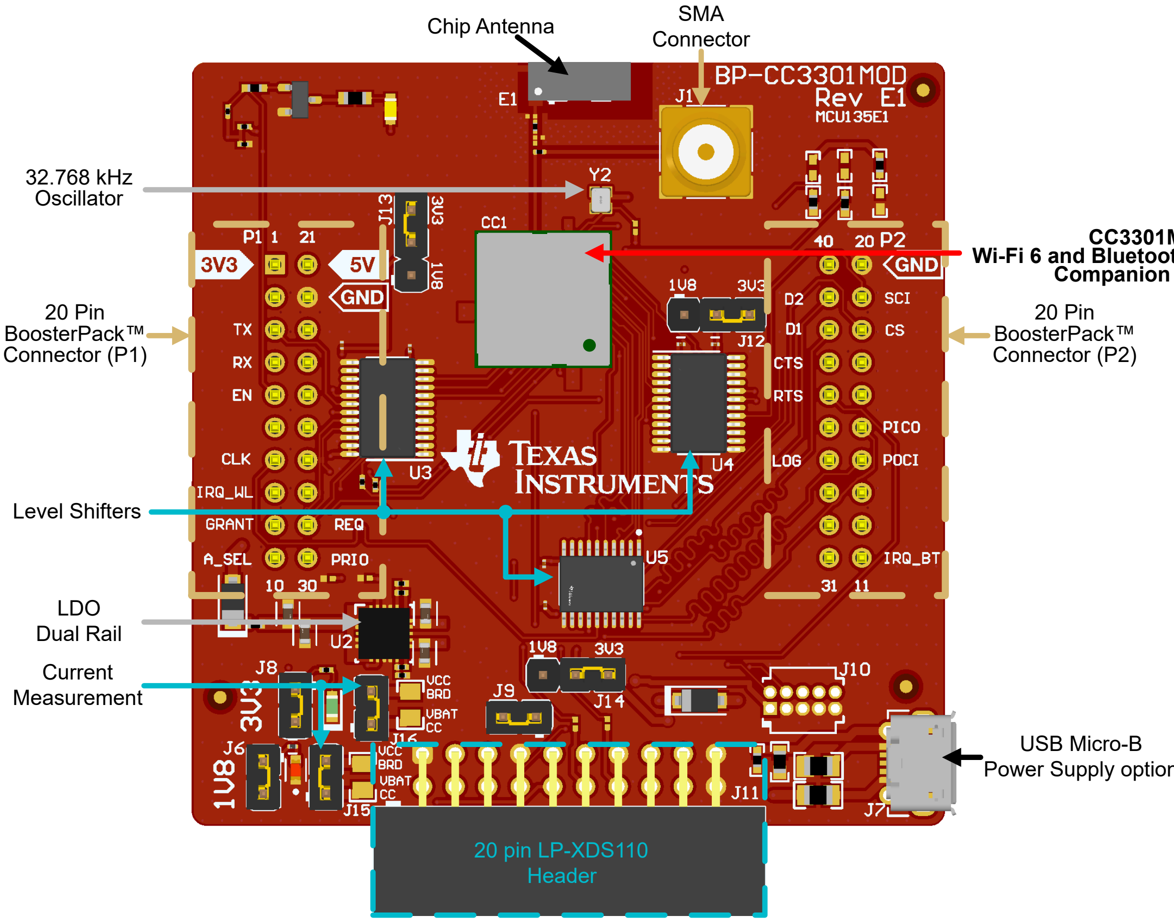

Figure 2-1. BP-CC33X1MOD Overview

2.1 Hardware Features

- CC3301MOD Wi-Fi 6 and Bluetooth® Low Energy combo device which can interface with MPU or MCU systems; adding connectivity
- Two 20-pin stackable connectors (BoosterPack Standard)
- On-board chip dual-band antenna with on-board SMA/U.FL connector for conducted RF testing
- Power from onboard dual rail (3.3V and 1.8V) LDO using USB or LaunchPad
- Three-level shifters for voltage translation (3.3V to 1.8V)
- JTAG header pins for SWD interface with XDS110 or LP-XDS110ET
- Jumper for current measurement on both power supplies (3.3V and 1.8V) with provision to mount 0.1-ohm (0603) resistors for measurement with a voltmeter
- 32kHz oscillator for low power evaluation

2.2 Connector and Jumper Descriptions

2.2.1 LED Indicators

LEDs lists the descriptions of the LEs, and LEDs on BoosterPack™ shows the mentioned LEDs on the board.

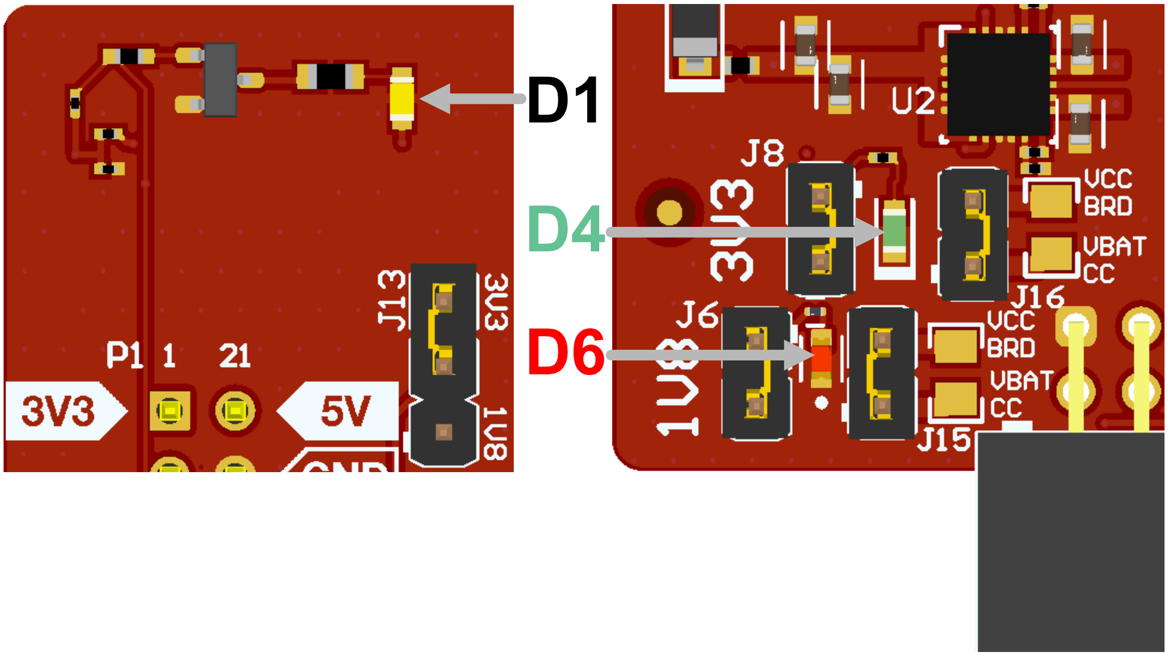

Figure 2-2. LEDs on BoosterPack™

Table 2-1. LEDs

Reference	Color	Usage	Comments
D1	Yellow	nRESET	The LED indicates the state of the nReset pin. If the LED is on, the device is functional, which means nReset is high.
D4	Green	3.3V power indication	On: 3.3V power rail is up. Off: no 3.3V power supplied
D6	Red	1.8V power indication	On: 1.8V power rail is up. Off: no 1.8V power supplied

2.2.2 Jumper Settings

Jumper Settings lists the jumper settings. To reference the default jumper configurations, see BP-CC33X1MOD Overview.

Table 2-2. Jumper Settings

Reference	Usage	Comments
J1, J2	RF Test	SMA connector (J1) or U.FL connector (J2) for conducted testing in the lab. See Section 2.5.
J6, J8	Power to board	Used to enable power to board for both supplies. See Section 2.3.
J15, J16	Current measurement	Used to measure power to device only. See Section 2.3.1.
J7	USB connector	For providing power to the device on the BoosterPack™
J10,J11	JTAG connectors	Headers to interface with XDS110 debug probe. See JTAG Headers.
J9	20-pin header (J11) 5V power	Enables 5V power supply to come from LP-XDS110ET
J12, J13, J14	Level shifter host voltage	Set to 3.3V or 1.8V to enable relevant level shifters to translate to correct host voltage level.
P1, P2	BoosterPack™ header	Two 20 header pins each on the BoosterPack™. See BoosterPack Header Assignment.

2.2.3 BoosterPack Header Assignment

The CC33X1MOD BoosterPack™ has two 20-pin header connectors that provide access to many of the CC33X1MOD pins and features. The signal assignment on these connectors is shown in the figure below and described in Table 2-3 and Table 2-4.

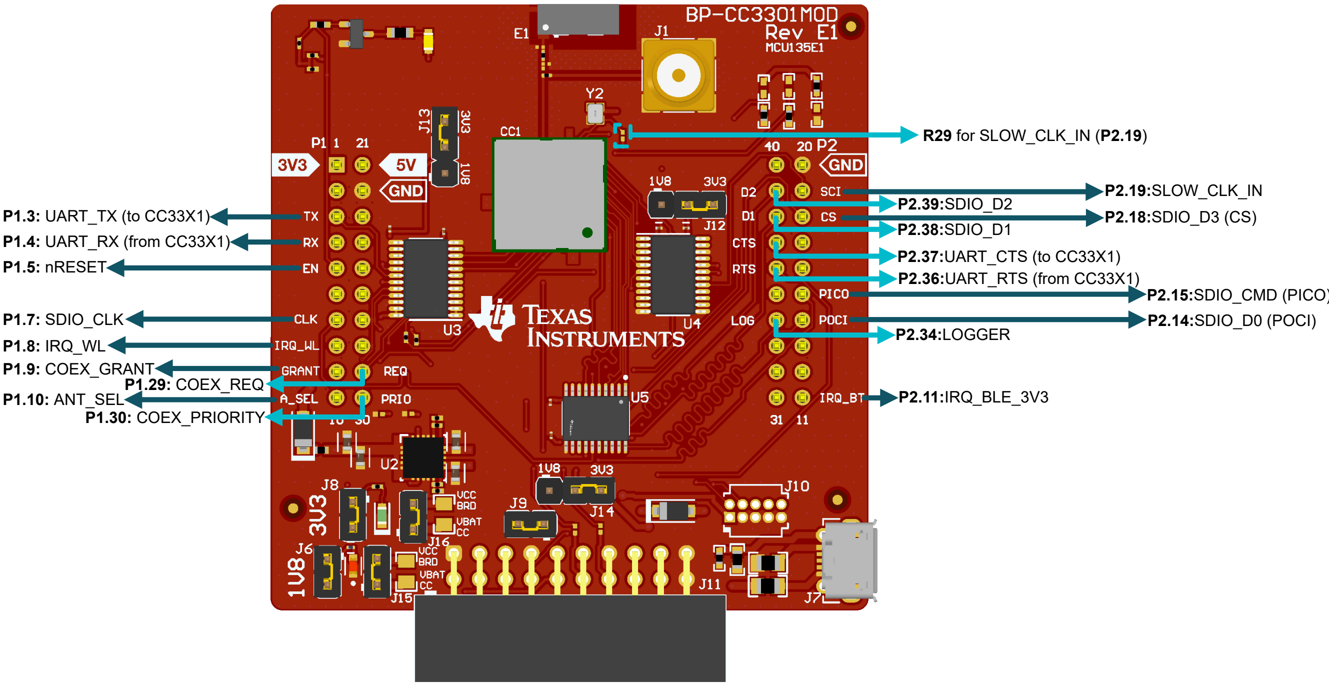

Figure 2-3. CC33X1MOD BoosterPack™ Pinout

Table 2-3. P1 Pin Assignment

Pin	Name (in schematic)	Type/Direction for Device	Description
P1.1	VCC_MCU_3V3	Input	No functional purpose
P1.2	Reserved	N/A	N/A
P1.3	UART_TX_3V3	Output	The CC33X1MOD UART TX to host for BLE host controller interface
P1.4	UART_RX_3V3	Input	The CC33X1MOD UART RX from the host for BLE host controller interface
P1.5	LP_RESET	Input	Reset line for CC33X1MOD used to enable / disable (active low). Driven by host through LaunchPad pins
P1.6	Reserved	N/A	N/A
P1.7	SDIO_CLK_3V3	Input	SDIO clock or SPI clock. Must be driven by host
P1.8	IRQ_WL_3V3	Output	Interrupt request from CC33X1MOD to host for Wi-Fi activity
P1.9	COEX_GRANT_3V3	Output	External coexistence interface - grant (reserved for future use)
P1.10	ANT_SEL_3V3	Output	Antenna select control
P1.21	VCC_MCU_5V	Power	5V supply to board
P1.22	GND	GND	Board ground
P1.23	Reserved	N/A	N/A
P1.24	Reserved	N/A	N/A
P1.25	Reserved	N/A	N/A
P1.26	Reserved	N/A	N/A
P1.27	Reserved	N/A	N/A
P1.28	Reserved	N/A	N/A

Table 2-3. P1 Pin Assignment (continued)

Pin	Name (in schematic)	Type/Direction for Device	Description
P1.29	COEX_REQ_3V3	Input	External coexistence interface - request (reserved for future use)
P1.30	COEX_PRIORITY_3V3	Input	External coexistence interface - priority (reserved for future use)

Table 2-4. P2 Pin Assignment

Pin	Name (in schematic)	Type/Direction for Device	Description
P2.11	IRQ_BLE_3V3	Output	Interrupt request from CC33X1MOD to host for BLE activity
P2.12	Reserved	N/A	N/A
P2.13	Reserved	N/A	N/A
P2.14	SDIO_D0_POCI_3V3	Input/Output	SDIO data D0 or SPI POCI
P2.15	SDIO_CMD_PICO_3V3	Input/Output	SDIO command or SPI PICO
P2.16	Reserved	N/A	N/A
P2.17	Reserved	N/A	N/A
P2.18	SDIO_D3_3V3 (CS)	Input/Output	SDIO data D3 or SPI CS
P2.19	SLOW_CLK_IN_3V3	Input	Input for external RTC clock 32.768kHz
P2.20	GND	GND	Board ground
P2.31	Reserved	N/A	N/A
P2.32	Reserved	N/A	N/A
P2.33	Reserved	N/A	N/A
P2.34	LOGGER_3V3	Output	Tracer from CC33X1MOD (UART TX debug logger)
P2.35	Reserved	N/A	N/A
P2.36	UART_RTS_3V3	Output	UART RTS from CC33X1MOD to host for BLE HCI flow control
P2.37	UART_CTS_3V3	Input	UART CTS to CC33X1MOD from host for BLE HCI flow control
P2.38	SDIO_D1_3V3	Input/Output	SDIO data D1
P2.39	SDIO_D2_3V3	Input/Output	SDIO data D2
P2.40	Reserved	N/A	N/A

2.2.4 JTAG Headers

The BP-CC33X1MOD was designed with two headers (J10, and J11) for the SWD interface with the XDS110 debug probe. The signal assignment for these headers are described in the figures and tables below.

The main JTAG interface for the board is via the LP-XDS110ET that is connected to the 20-pin header (J11). An XDS110 debug probe can also interface with this board via a 10-pin header (J10), however, this header is not populated with the default kit.

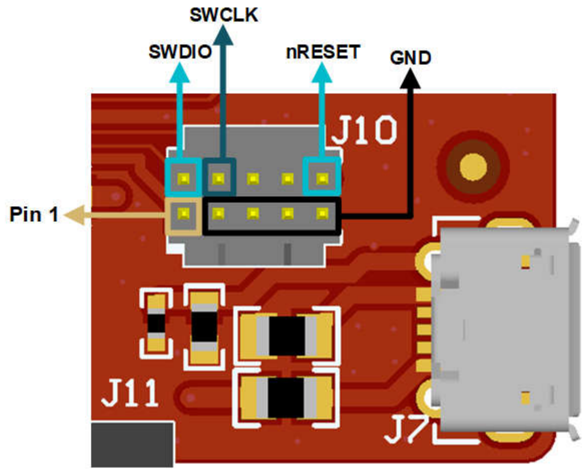

Figure 2-4. ARM 10-Pin JTAG Connector (J10)

Table 2-5. ARM 10-Pin JTAG Connector (J10) Assignment

Pin	Signal Name	Description
J10.1	VCC_BRD_1V8	1.8V supply for a reference voltage to the connector
J10.2	SWDIO	Serial wire data in/out
J10.4	SWCLK	Serial wire clock
J10.10	RESET_1V8	nReset (Enable line for CC33X1MOD)
J10.3, J10.5, J10.7, J10.9	GND	Board ground

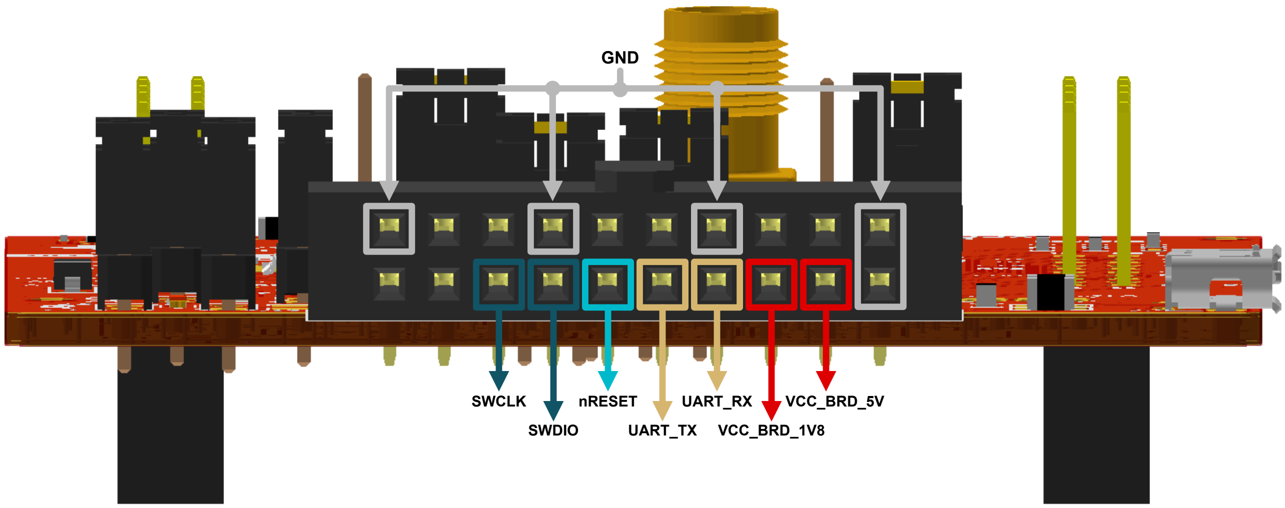

Figure 2-5. 20 pin LP-XDS110 Connector (J11)

Table 2-6. 20 Pin LP-XDS110 Connector (J11) Assignment

Pin	Signal Name	Description
J11.6	SWCLK	Serial wire clock
J11.8	SWDIO	Serial wire data in/out
J11.10	RESET_1V8	nReset (Enable line for the CC33X1MOD)
J11.12	UART_TX_1V8	The CC33X1MOD UART TX to host for BLE host controller interface
J11.14	UART_RX_1V8	The CC33X1MOD UART RX from host for BLE host controller interface
J11.16	VCC_BRD_1V8	1.8V supply for a reference voltage to connector
J11.18	VCC_BRD_5V	5V supply to BP-CC33X1MOD from LP-XDS110ET
J11.1, J11.7, J11.13, J11.19, J11.20	GND	Board ground

2.3 Power

The board is designed to accept power from a connected LaunchPad kit. Some LaunchPad kits cannot source the peak current requirements for Wi-Fi®, which can be as high as 500mA. In such cases, the USB connector (J7) on the BoosterPack™can be used to aid in extra current. Schottky diodes make sure that load sharing occurs between the USB connectors on the LaunchPad kit and the BoosterPack module without any board modifications. The jumpers labeled J6 (1.8V) and J8 (3.3V) can be used to measure the total current consumption of the board from the onboard LDO.

2.3.1 Measure the CC33X1MOD Current Draw

2.3.1.1 Low Current Measurement (LPDS)

To measure the current draw of the CC33X1MOD device for both power supplies (3.3V or 1.8V), a jumper labeled J16 (for 3.3V supply) and a jumper labeled J15 (for 1.8V supply) is provided on the board. By removing J16, users can place an ammeter into this path to observe the current on the 3.3V supply. The same process can be used to observe the current on the 1.8V supply with J15. TI recommends this method for measuring the LPDS.

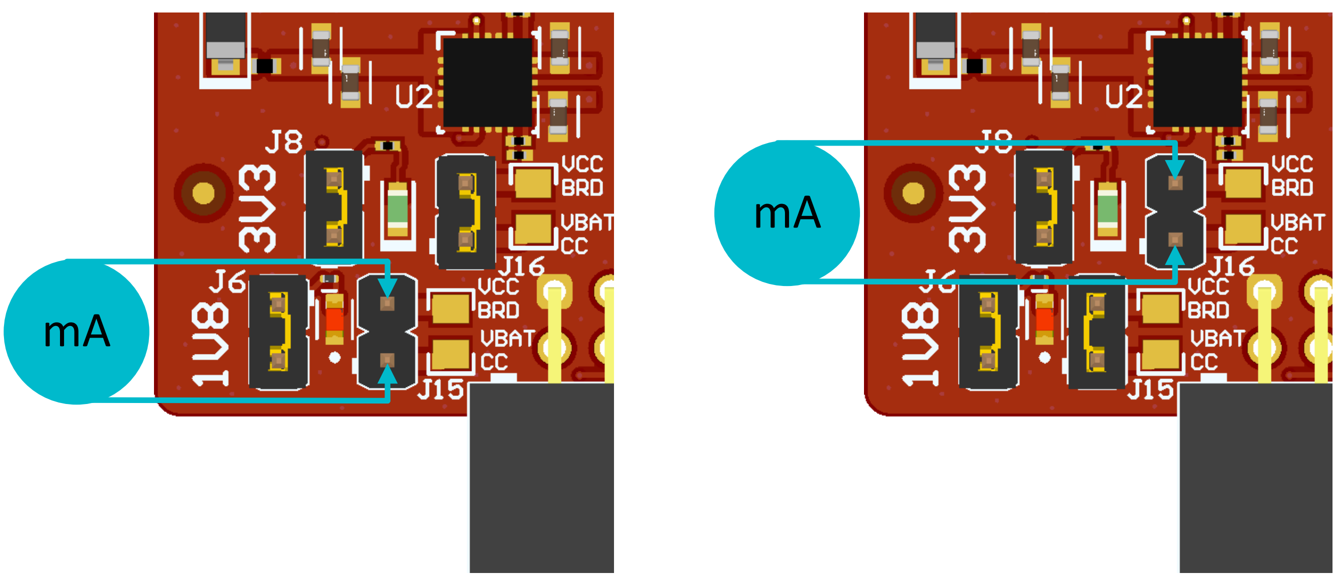

Figure 2-6. Low Current Measurement

2.3.1.2 Active Current Measurement

To measure active current in a profile form, TI recommends utilizing a 0.1Ω 0603 sized resistor, and measuring the differential voltage across the resistor. This can be done using a voltmeter or an oscilloscope for measuring the current profile for both power supplies (3.3V or 1.8V).

The jumper J15 shunt should be removed and the 0.01Ω resistor is populated in parallel to measure the active currents on the 1.8V supply (see Figure 2-8). Similar operation with jumper J16 and 3.3V supply.

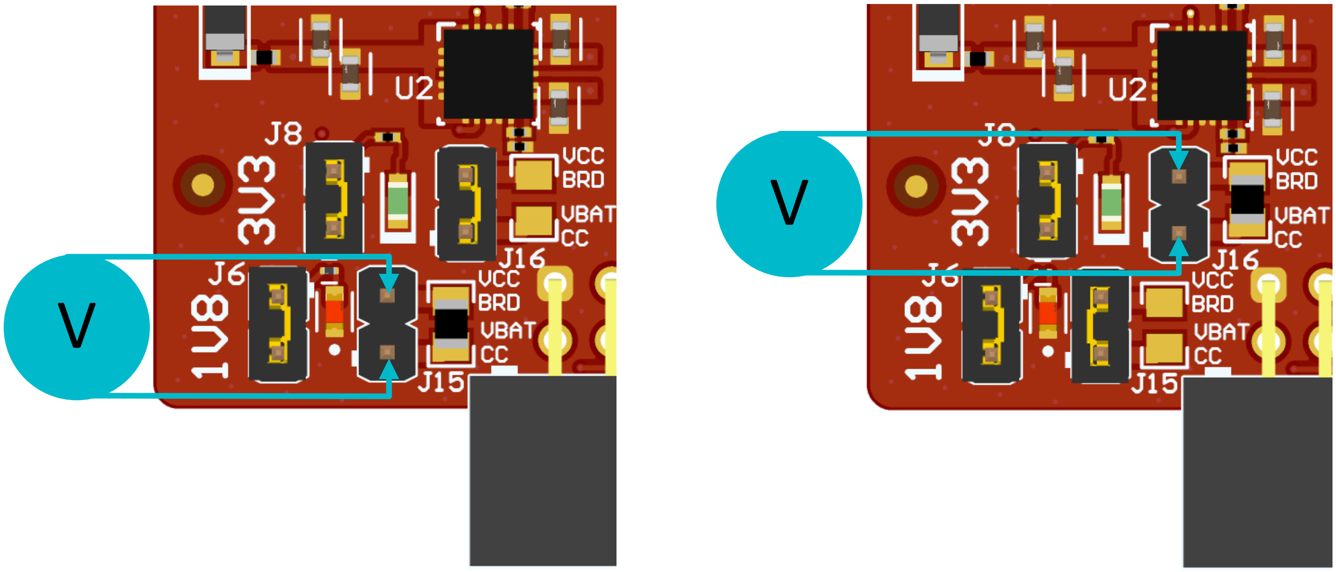

Figure 2-7. Active Current Measurement

2.4 Clocking

The BoosterPack™ plug-in module provides a 32.768kHz oscillator (Y2) component for slow clock input to the CC33X1MOD device.

If the user desires to provide their own external slow clock through the Slow Clock Input pin (P2.19), then some rework must be performed. The Y2 oscillator needs to be removed, and a 0201 sized 0-ohm resistor be populated on R29 pad. See Figure 2-8. The slow clock can also be generated internally to save on BOM.

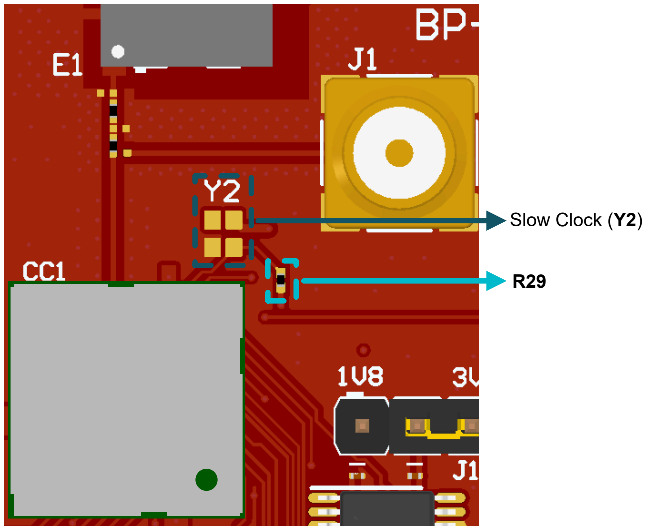

Figure 2-8. BP-CC33X1MOD Extenal Slow Clock

2.5 Performing Conducted Testing

As mentioned in Section 2.1, the BoosterPack™ has an onboard SMA connector and component antenna. The SMA connector (J1) provides a way for testing conducted measurements. Alternately, a footprint for a U.FL connector (J2) is provided on-board to replace the SMA connector and provide a way to test in the lab using a compatible cable.

A rework is needed before using the connector (J1/J2) instead of the Chip Antenna (E1). This involves swapping the position of the existing 10pF capacitor to lead the transmission line on the desired connection (see Figure 2-9).

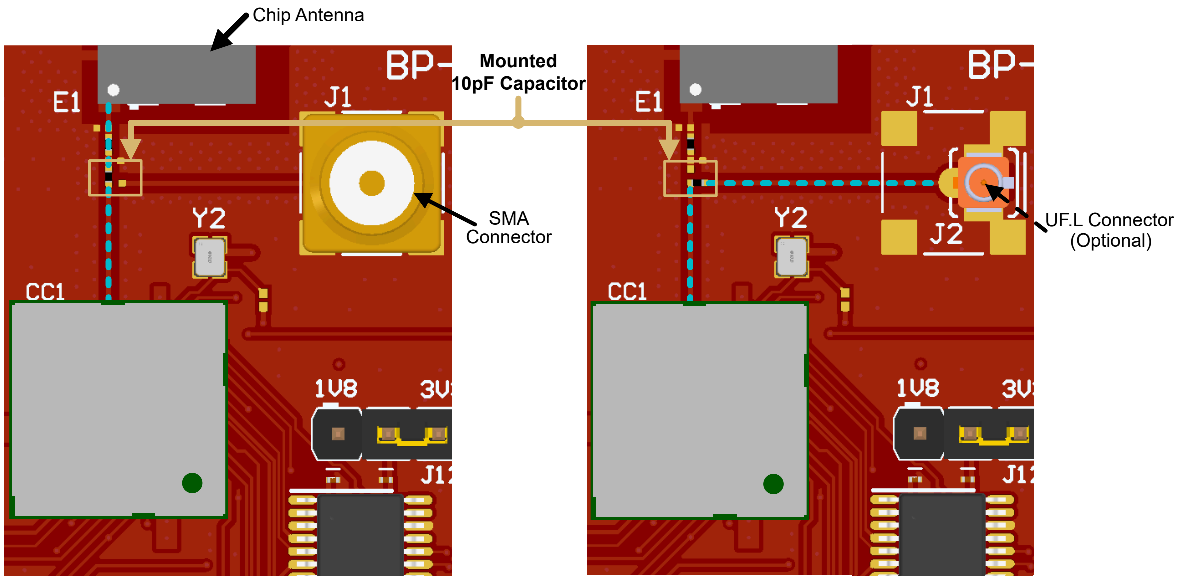

Figure 2-9. RF Paths on BP-CC33X1MOD

3 Implementation Results

3.1 Evaluation Setups

The CC33X1MOD BoosterPack can be used in the following configurations:

- MCU and RTOS evaluation: BP-CC33X1MOD + LaunchPad with the MCU running TCP/IP like the LP-AM243
- Processor and Linux evaluation: BP-CC33X1MOD + BP-CC33-BBB-ADAPT + BEAGL-BONE-BLACK
- RF testing with PC tools: BP-CC33X1MOD + LP-XDS110ET

In addition, the BP-CC33X1MOD can also be wired to any other Linux or RTOS host board running a TCP/IP stack.

3.1.1 MCU and RTOS

The BP-CC33X1MOD can be used with an MCU running TCP/IP, like the LP-AM243, and can easily integrate with the LaunchPad by stacking the 40-pin headers, as shown in Figure 3-1.

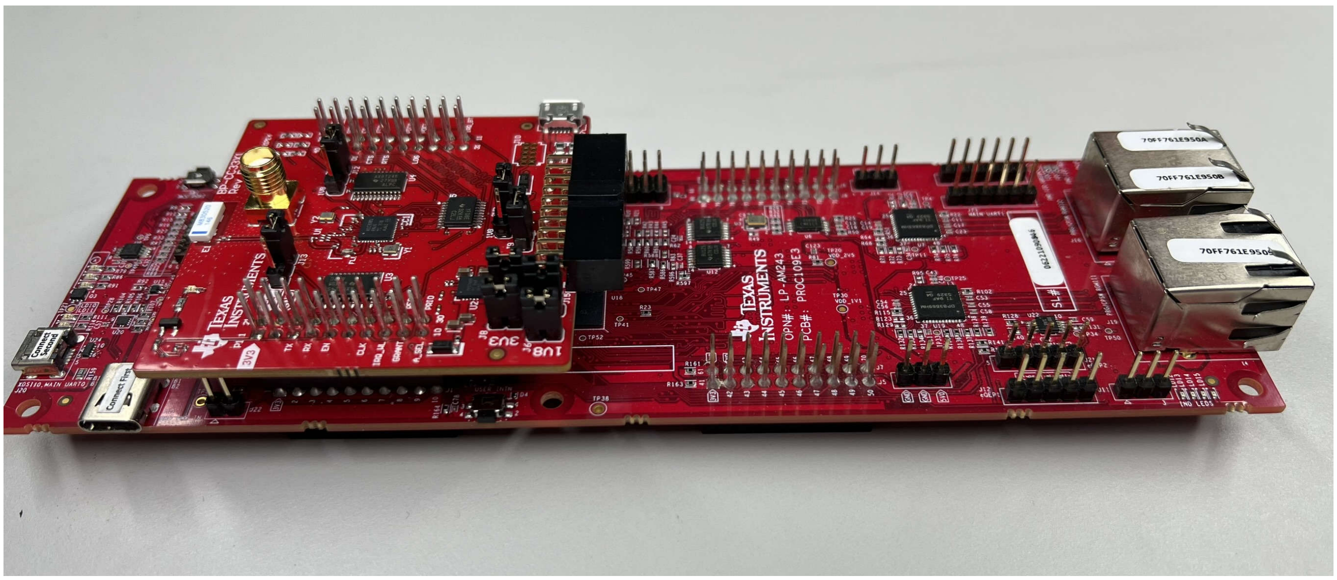

Figure 3-1. BP-CC33X1 with LP-AM243

3.1.2 Processor and Linux

The BP-CC33X1MOD can integrate with a host platform running Linux OS, like the BeagleBone Black (BBB). The BeagleBone Black is a low-cost, community-supported development platform as shown below.

Figure 3-2. BeagleBone Black Board

To interface the BoosterPack™ with a BeagleBone Black, the user also needs the BP-CC33xx to BBB Adapter Board.

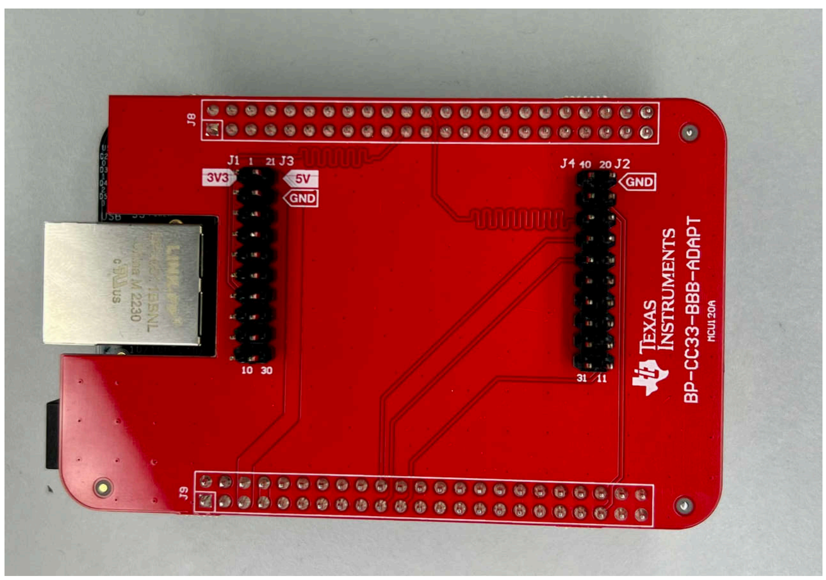

Figure 3-3. Adapter Board for the BeagleBone Black

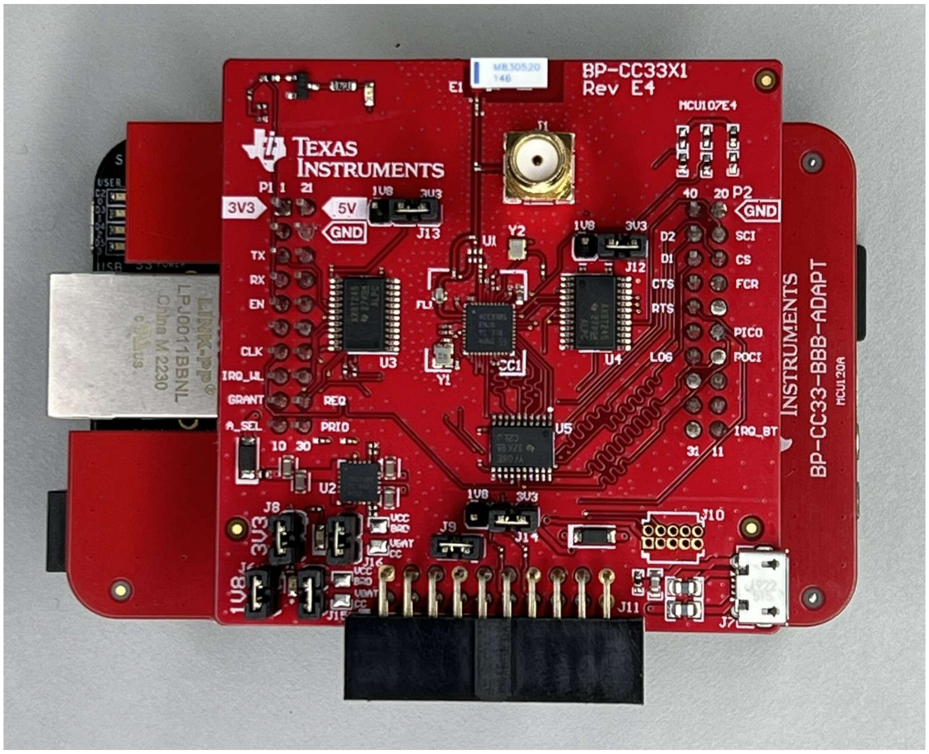

Figure 3-4. BP-CC33X1 + BBB with Adapter Board

To ensure the BeagleBone Black boots up from the SD card, remove the 100k resistor R68 seen on the bottom of the BBB, and add the component to R93 footprint on the top of the BBB. Alternatively, you can press and hold the S2 button on the BeagleBone board during power-up if the hardware modifications were not made (see Figure 3-6 and Figure 3-7).

Lastly, adding a right-angle header on the bottom of the BBB to easily connect the FTDI cable is optional. When the adapter board is attached to the BBB, the FTDI cable can get pinched between the BBB and the adapter board, which can cause communication problems (see Figure 3-7).

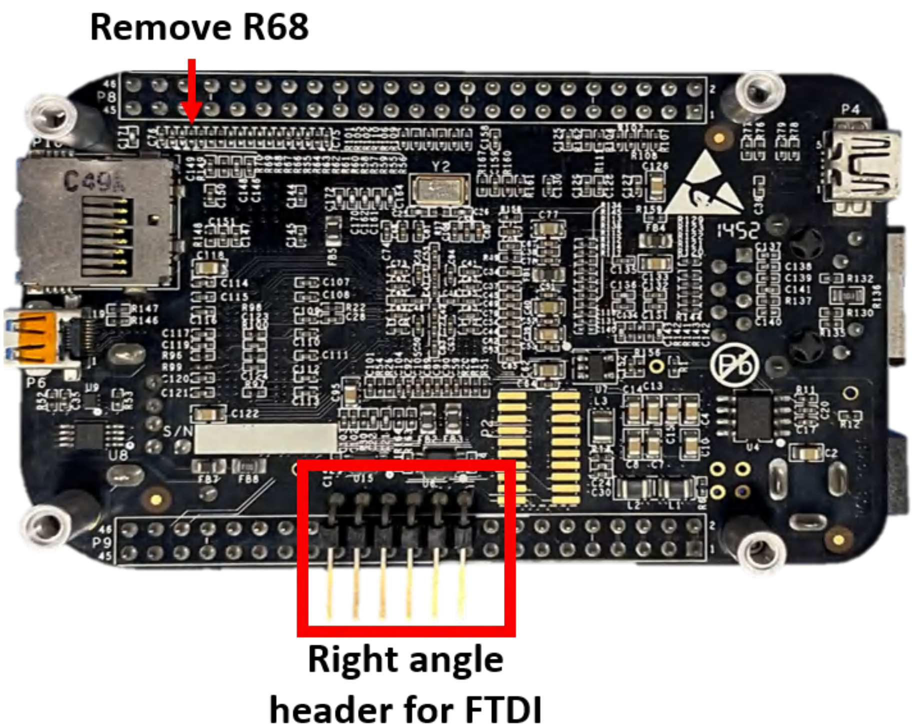

Figure 3-5. Bottom View of Modified BBB

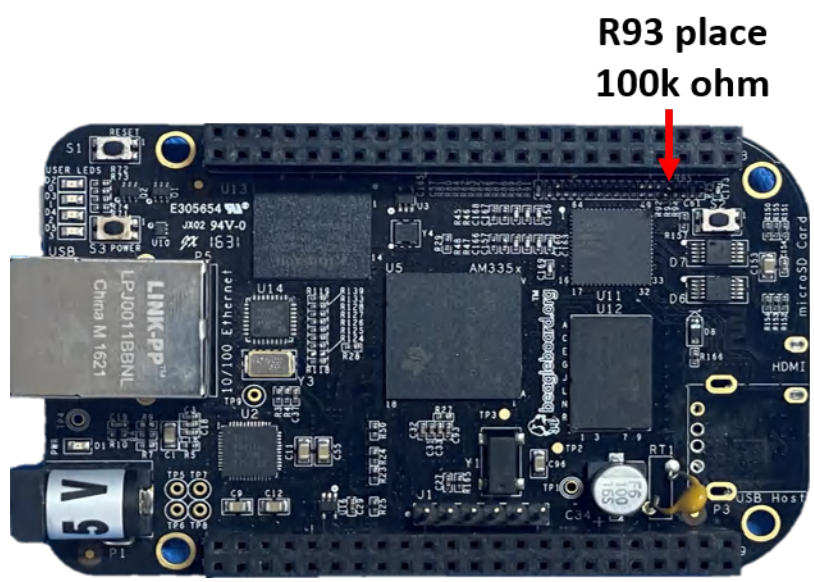

Figure 3-6. Top View of Modified BBB

3.1.3 Standalone RF Testing

The BP-CC33X1MOD can be used standalone (without a host) to test RF capabilities, using Radio Tool. For more information on Radio Tool and where to download it, refer to Wi-Fi Toolbox BP-CC3301MOD Hardware Setup.

The BP-CC33X1MOD has an on-board SMA connector and component antenna, and a U.FL can be populated on the board, for conducted RF testing using compatible cables (a rework can be needed). For more information, see Section 2.5.

3.1.3.1 Radio Tool BP-CC33X1MOD Hardware Setup

Radio Tool is a GUI-based tool for RF evaluation and testing of CC33xx designs during development and certification. The tool enables low-level radio testing capabilities by manually setting the radio into transmit or receive modes. The use of the tool requires familiarity with radio circuit theory and radio test methods. To perform conducted RF testing on the BP-CC33X1MOD, refer to Section 2.5. Note that a rework is necessary for conducted testing.

The user can download this tool in the SIMPLELINK-WIFI-TOOLBOX from CC33XX-SOFTWARE on ti.com.

HW Prerequisites

- Windows 10 64bit/ Ubuntu 18 (or higher) 64-bit operation system
- Latest Chrome web browser
- Installation of Simplelink Wi-Fi Toolbox
- BP-CC3301MOD
- LP-XDS110ET debugger for SWD communication

The LP-XDS110ET enables direct communication to the CC33X1MOD device through the SWD interface. This allows external tools, such as the Radio Tool, to send commands directly to the device without using an embedded host.

Testing with LP-XDS110ET

To use the LP-XDS110ET with the BP-CC33X1MOD, connect the 20-pin connector (J11) on the BoosterPack™ (refer to Figure 2-5) to the corresponding connector on the LP-XDS110ET. Make sure that the jumper on the LaunchPad™ (labeled EXT. XDS) is in the EXT. configuration, as shown in Figure 3-7. This verifies that the target voltage for the JTAG signals are sourced from the BP-CC3301MOD (which is 1.8V) instead of the default LP-XDS110ET target voltage (3.3V).

The power supply for the BP-CC33X1MOD comes from the LP-XDS110ET in this case, but there can be usage scenarios where additional current is needed from the USB connection (J7).

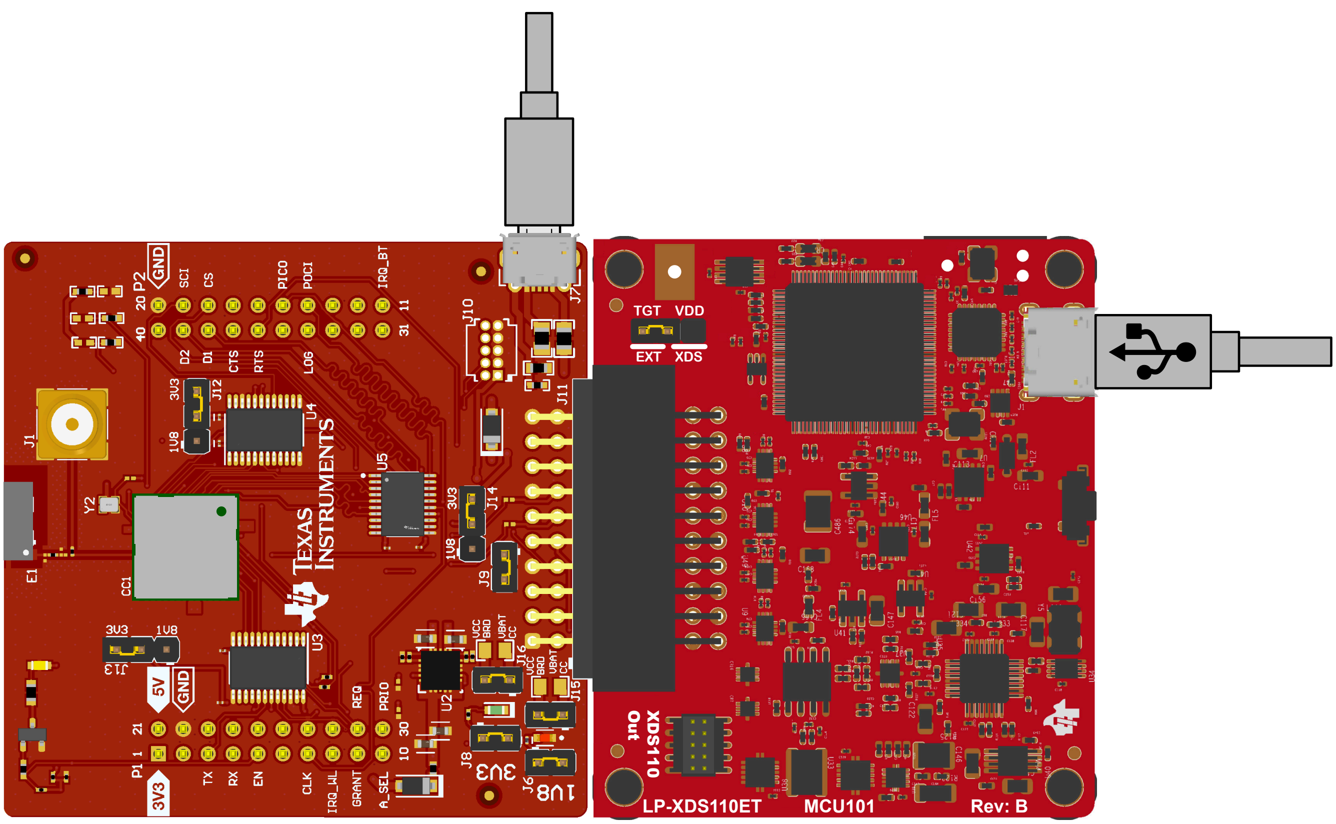

Figure 3-7. BP-CC33X1MOD Connected to LP-XDS110ET

4 Hardware Design Files

4.1 Schematics

To access the schematics for the BP-CC3301MOD, the user can access the Design Files from the CC3301MOD tool folder.

4.2 PCB Layouts

To access the Gerber filesfor the BP-CC3301MOD, the user can access the Design Files from the CC3301MOD tool folder.

4.3 Bill of Materials (BOM)

To access the BOM list for the BP-CC3301MOD, the user can access the Design Files from the CC3301MOD tool folder.

5 Additional Information

5.1 Trademarks

SimpleLink™, BoosterPack™, LaunchPad™ are trademarks of Texas Instruments.
Bluetooth® is a registered trademark of Bluetooth Sig, Inc.
Linux® is a registered trademark of Linux Foundation.
Wi-Fi 6® and Wi-Fi® are registered trademarks of Wi-Fi Alliance.
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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265