User's Guide
SWRU539–January 2019

CC3235x SimpleLink™ Wi-Fi® LaunchPad™ Development Kit (LAUNCHXL-CC3235x)

The CC3235 SimpleLink™ LaunchPad™ Development Kit (LAUNCHXL-CC3235x) is a low-cost evaluation platform for Arm® Cortex®-M4-based MCUs. The LaunchPad (LP) design highlights the CC3235 Dual Band (2.4 GHz and 5 GHz) wireless MCU system on a chip. The CC3235 LaunchPad™ kit also features temperature and accelerometer sensors, programmable user buttons, RGB LED for custom applications, and onboard emulator for debugging. The stackable headers of the LAUNCHXL-CC3235x demonstrate how easy it is to expand the functionality of the LaunchPad™ kit. BoosterPack™ Plug-in Modules allow for interfacing with other peripherals such as graphical displays, audio codecs, antenna selection, environmental sensing, and more.

The CC3235S and CC3235SF devices are part of the SimpleLink™ microcontroller (MCU) ecosystem which consist of Wi-Fi®, Bluetooth® low energy, Sub-1 GHz and host MCUs. All share a common, easy-to-use development environment with a single core software development kit (SDK) and a rich tool set. A one-time integration of the SimpleLink™ platform lets you add any combination of devices from the portfolio into your design. The ultimate goal of the SimpleLink™ platform is to achieve 100% code reuse when your design requirements change. For more information, visit www.ti.com/SimpleLink.

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1 Introduction

1.1 CC3235x LaunchPad™ Development Kit

Created for the Internet of Things (IoT), the SimpleLink™ Wi-Fi® CC3235 device is a single-chip microcontroller (MCU) with built-in Wi-Fi® connectivity for the LaunchPad™ ecosystem, which integrates a high-performance Arm® Cortex®-M4 MCU and lets customers develop an entire application with one device. With on-chip Wi-Fi®, Internet, and robust security protocols, no prior Wi-Fi® experience is required for fast development.

The CC3235 LaunchPad™ kit, referred to by its part number LAUNCHXL-CC3235x, is a low-cost evaluation platform for Arm® Cortex®-M4-based MCUs. The LaunchPad™ design highlights the CC3235 Internet-on-a chip™ solution and Wi-Fi® capabilities. The CC3235 LaunchPad™ also features temperature and accelerometer sensors, programmable user buttons, RGB LED for custom applications, and onboard emulation for debugging. The stackable headers of the CC3235 LaunchPad™ XL interface demonstrate how easy it is to expand the functionality of the LaunchPad™ when interfacing with other peripherals on many existing BoosterPack™ add-on boards, such as graphical displays, audio codecs, antenna selection, environmental sensing, and more. There are two variants of the LaunchPad™: LAUNCHXL-CC3235S and LAUNCHXL-CC3235SF. This user's guide applies to both variants, and any differences are noted in relevant sections.

Multiple development environment tools are also available, including the Eclipse-based Code Composer Studio™ (CCS) integrated development environment (IDE) and IAR Embedded Workbench® from Texas Instruments™. More information about the LaunchPad™, the supported BoosterPack™ modules, and the available resources can be found at the LaunchPad™ portal from TI. Also, visit the CC3235 Wiki page for design resources and example projects.

NOTE: The maximum RF power transmitted in each WLAN 2.4-GHz band is 18.3 dBm. The maximum RF power transmitted in each WLAN 5-GHz band is 17 dBm.

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 operating in conjunction with any other antenna or transmitter.

1.2 Key Features

- CC3235x Dual Band (2.4GHz and 5GHz) SimpleLink™ Wi-Fi®, Internet-on-a chip™ solution with integrated MCU
- 40-pin LaunchPad™ pinout that leverages the BoosterPack™ ecosystem
- on-board XDS110-based JTAG emulation with serial port for flash programming
- Two buttons and RGB LED for user interaction
- Back-channel universal asynchronous receiver/transmitter (UART) through USB to PC
- Onboard chip antenna with U.FL connector for conducted testing
- Onboard accelerometer and temperature sensor
- Micro USB connector for power and debug connections

1.3 Kit Contents

- CC3235 LaunchPad™ development tool (LAUNCHXL-CC3235x)
- Micro USB cable
- Quick Start Guide

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1.4 Regulatory Compliance

The SimpleLink™ CC3235x Wi-Fi® LaunchPads™ are tested for and found to be in compliance with FCC and ISED regulations regarding unlicensed intentional radiators. Hereby, Texas Instruments Inc. declares that the radio equipment type LAUNCHXL-CC3235S and LAUNCHXL-CC3235SF are in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet addresses:

- LAUNCHXL-CC3235x Certification Documents
- LAUNCHXL-CC3235S Declaration of Conformity
- LAUNCHXL-CC3235SF Declaration of Conformity

Indoor Usage Restrictions:

The device is restricted to indoor use only when operating in the 5150 to 5350 MHz frequency range.

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	UK

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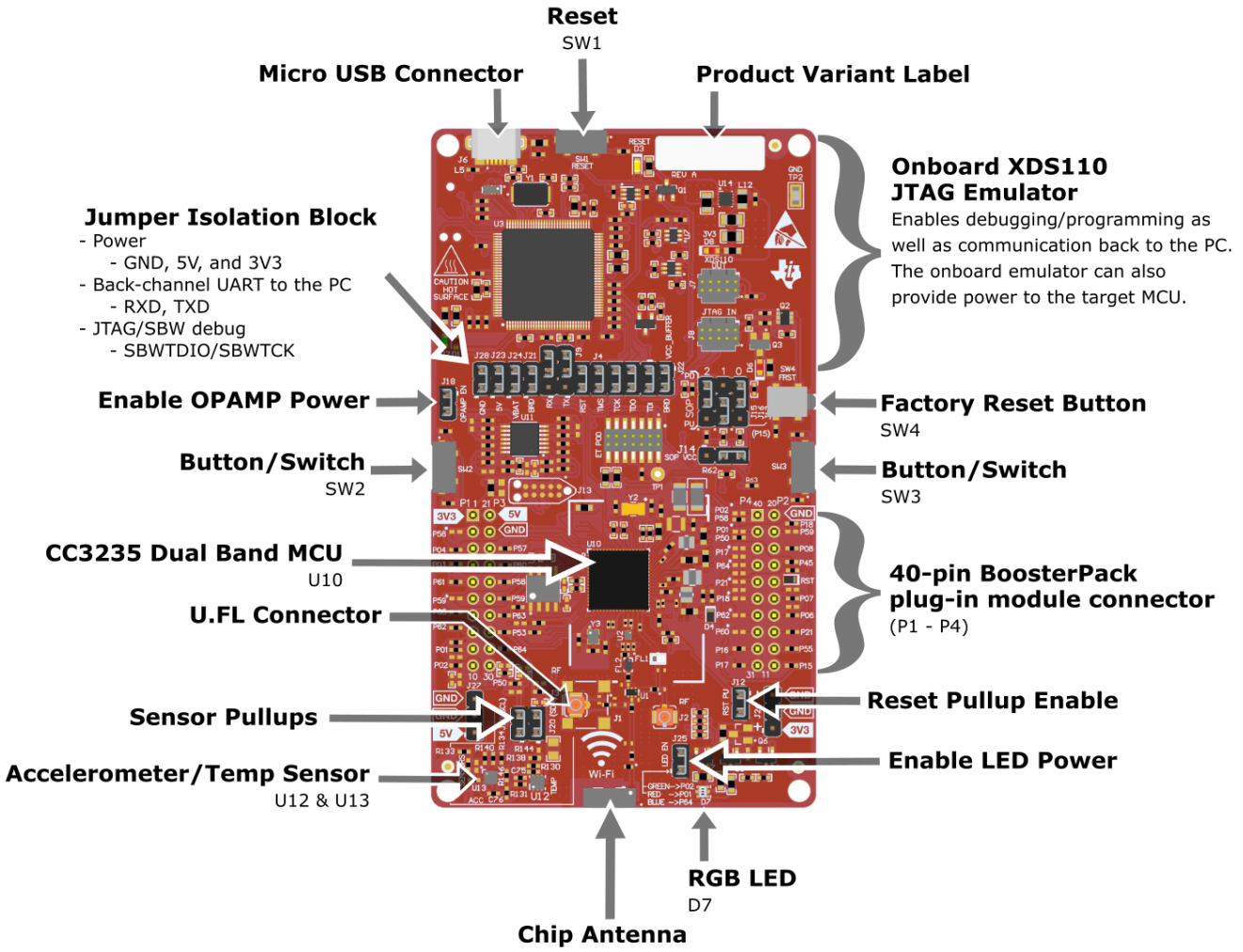
2 Hardware Description

Figure 1 shows the CC3235 LaunchPad™ board.

Figure 1. CC3235 LaunchPad™ Board Overview



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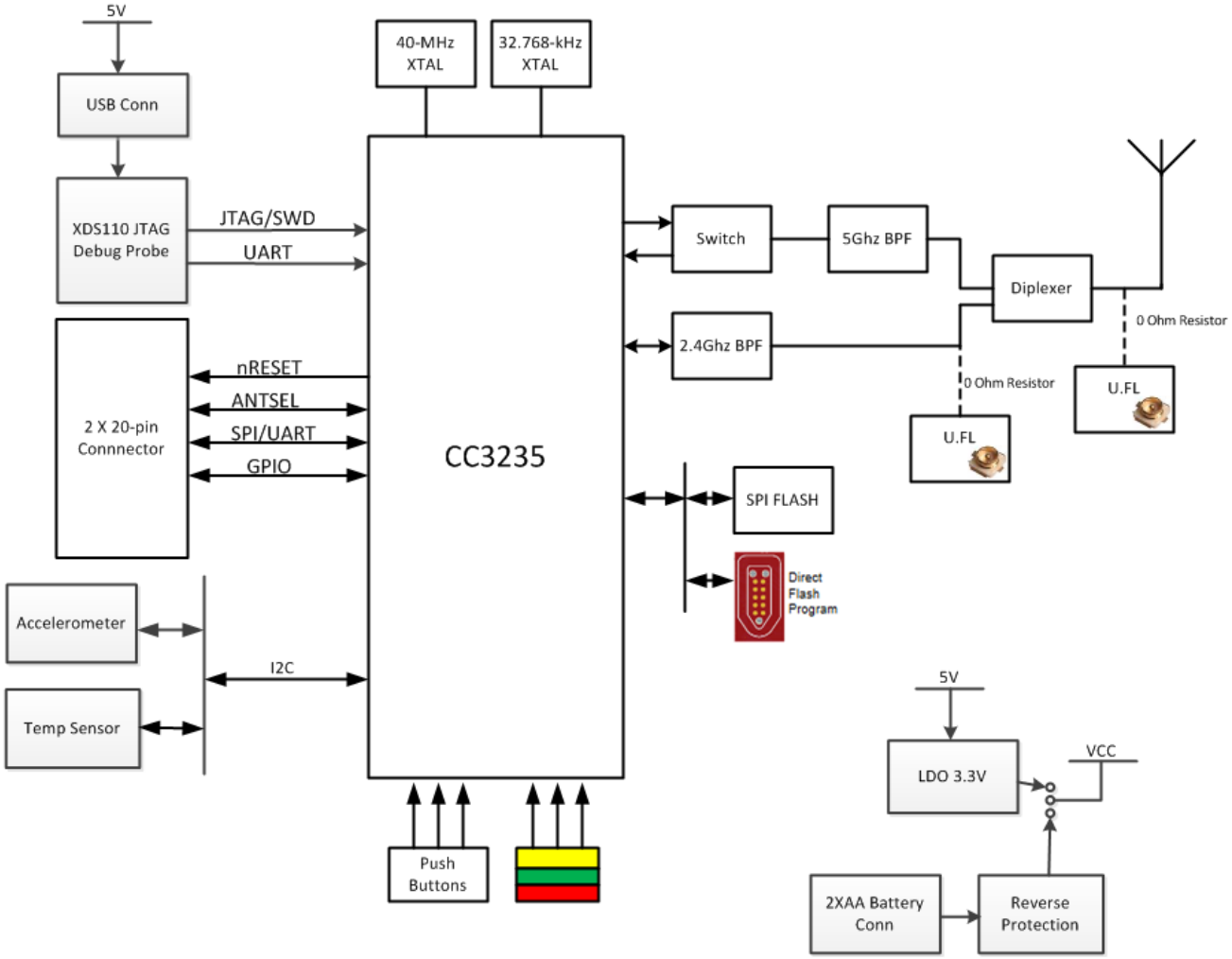
2.1 Block Diagram

Figure 2 shows the CC3235 LaunchPad™ block diagram.

Figure 2. CC3235 LaunchPad™ Block Diagram



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2.2 Hardware Features

- CC3235 SimpleLink™ Wi-Fi®, Internet-on-a chip™ solution with integrated MCU
- 40-pin LaunchPad™ standard that leverages the BoosterPack™ ecosystem
- TI Standard XDS110-based JTAG emulation with serial port for flash programming
- Supports both 4-wire JTAG and 2-wire SWD
- Two buttons and a RGB LED for user interaction
- Virtual COM port UART through USB on PC
- Onboard chip antenna with U.FL or SMA for conducted testing, selectable using 0-Ω resistors
- Onboard accelerometer and temperature sensor for out-of-box demo, with the option to isolate them from the inter-integrated circuit (I^2C) bus
- Micro USB connector for power and debug connections
- Headers for current measurement and external JTAG connection, with an option to use the onboard XDS110 to debug customer platforms
- Bus-powered device, with no external power required for Wi-Fi®
- Long-range transmission with a highly optimized antenna (200-meter typical in open air with a 6-dBi antenna AP)
- Can be powered externally, working down to 2.3 V (typical)

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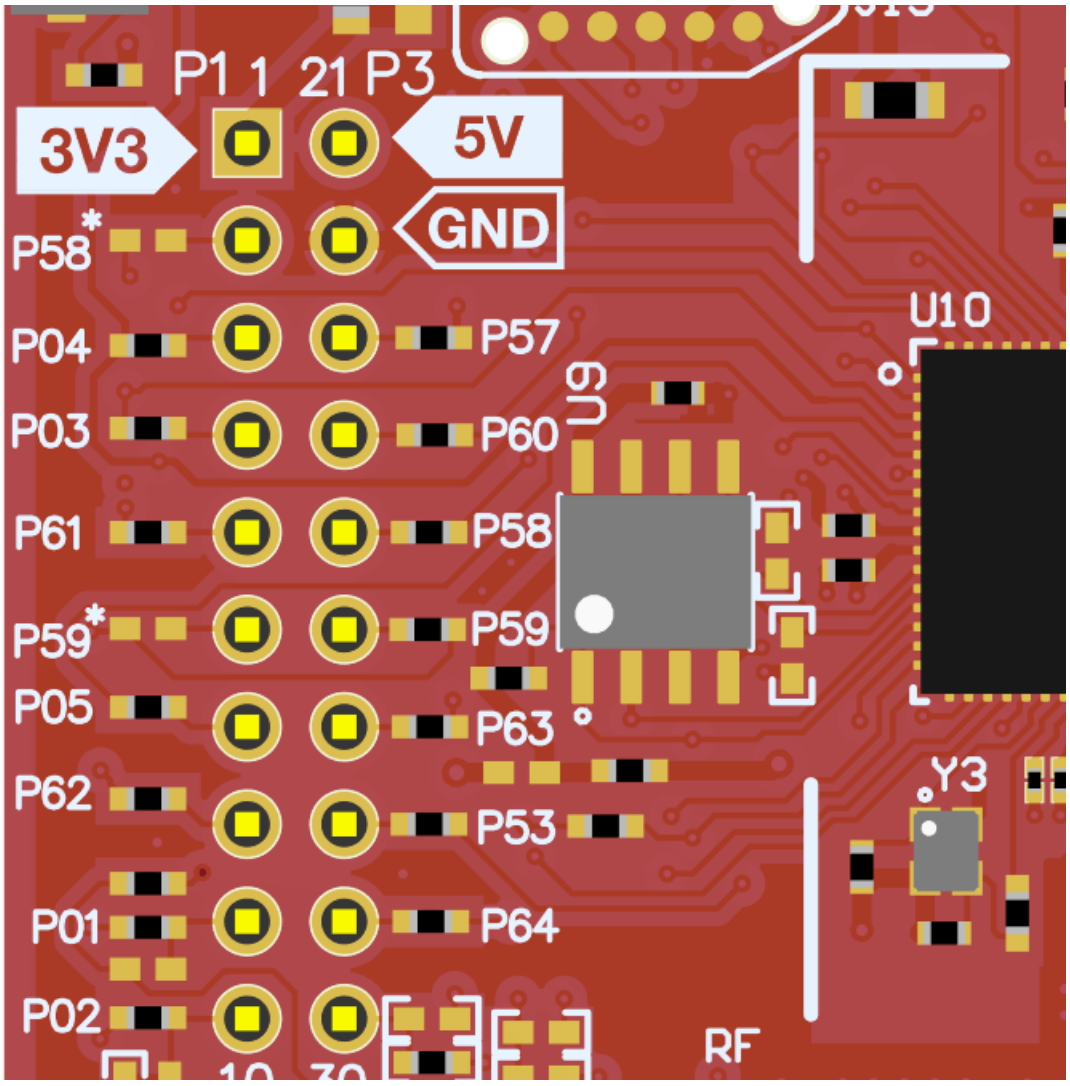
2.3 Connecting a BoosterPack™

A compatible BoosterPack™ can be stacked on top of the LaunchPad™ using the 2-pin × 20-pin connectors. The connectors do not have a key to prevent misalignment of the pins or reverse connection. For ease of use, a BoosterPack™ Checker tool can be used to verify if the LaunchPad™ is compatible with a given BoosterPack™ (see dev.ti.com/bpchecker/#).

Ensure that the 3V3 and 5V pins are aligned with the BoosterPack™ module header pins. On the CC3235 LaunchPad™, a small white 3V3 tag symbol is provided near pin 1 (see Figure 3) to orient all BoosterPack™ modules. This same marking, provided on compatible BoosterPack™ modules, must be aligned before powering up the boards.

Figure 3. Pin 1 Marking on CC3235 LaunchPad™ (3v3 Tag)



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2.4 Wired Connections, Jumper Settings, Buttons, and LEDs

2.4.1 JTAG Headers

Headers are provided onboard to isolate the CC3235 device from the onboard XDS110-based JTAG emulator. These jumpers are shorted by default when the board is shipped from TI. Figure 4 and Table 1 show default configurations. Figure 5 shows the external emulator connection.

Figure 4. Default Jumper Configuration for JTAG Lines

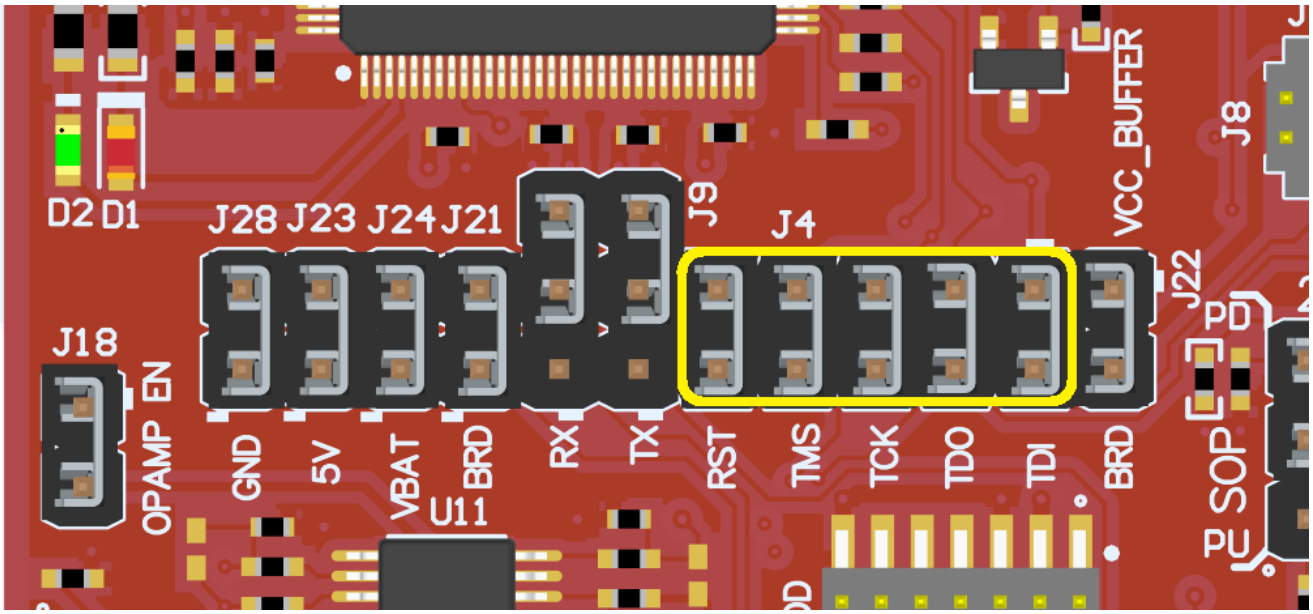

Table 1. JTAG Header Pin Definitions

Reference	Use	Comments
J4 (TCK)[1]	JTAG and SWD	Jumpers populated: onboard emulator connected Jumpers not populated: onboard emulator disconnected
J4 (TMS)[1]	JTAG and SWD	
J4 (TDI)	JTAG	
J4 (TDO)	JTAG	

(1) For SWD mode, only TCK and TMS must be shorted to the CC3235 device.

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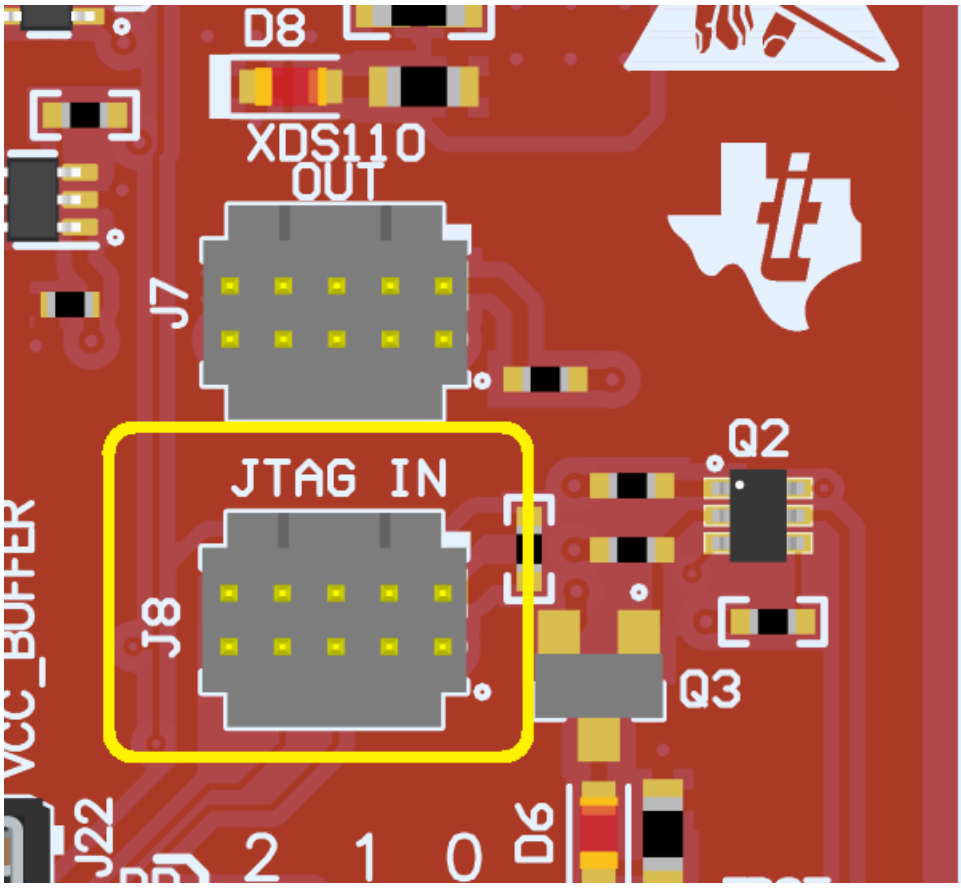
To connect an external emulator, remove these jumpers and place the external emulator on the JTAG IN connector (see Figure 5).

Figure 5. JTAG IN Connector



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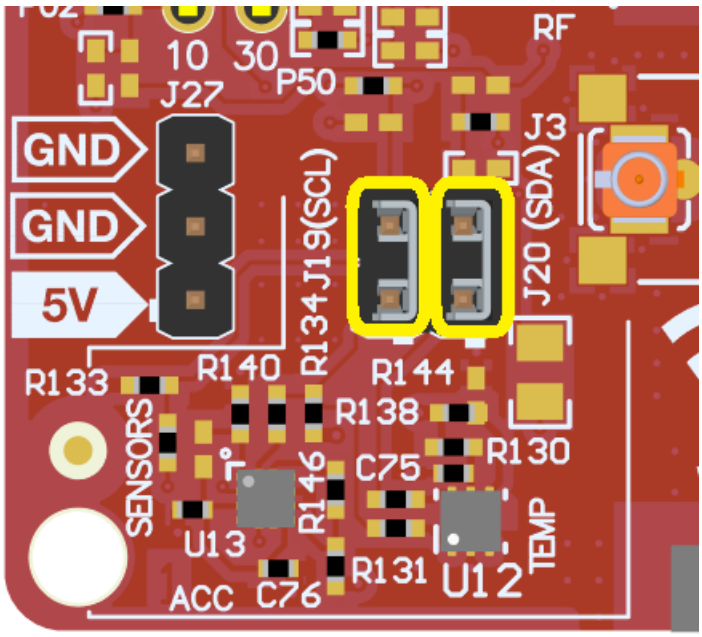
2.4.2 I²C Connections

The board features an accelerometer and a temperature sensor for the out-of-box demo. These features are connected to the I²C bus, and can be isolated using the jumpers provided (J19 and J20).

Figure 6. I²C Connections



By removing J19 and J20, the accelerometer and the temperature sensors are isolated from the I²C bus. This also removes the I²C pull-up resistors from the sensor side of the circuit, and therefore any connection to the circuit requires the user to install external pull-up resistors.

Table 2 lists the I²C jumper definitions.

Table 2. I²C Jumper Definitions

Reference	Use	Comments
J20	I2C SDA	Jumpers populated: onboard sensors connected Jumpers not populated: onboard sensors disconnected
J19	I2C SCL	

2.4.2.1 Default I²C Addresses

Table 3 lists the default I²C addresses of the onboard sensors.

Table 3. Default I²C Addresses (of Onboard Sensors)

Sensor Type	Reference Designator on LaunchPad	Part Number (Manufacturer)	Default Slave Address (Hex)
Temperature (MEMS IR Thermpile)	U12	TMP116 (TI)	0x41
Accelerometer (Triaxial)	U13	BMA280 (Bosch)	0x18

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2.4.3 Power Connections

The board can be powered by using the onboard micro USB connector. An onboard DC-DC converter provides 3.3 V for the CC3235 device and the rest of the board to operate. This supply can be isolated from the DC-DC converter using the jumpers on the board. See the yellow jumpers in Figure 7. VBAT and VBRD are both attached to 3V3, but are routed to different devices to allow for power measurements. VBAT is routed only to critical parts of the LaunchPad™ that are required for operation. This allows for proper measurements of our devices power consumption. VBRD is routed to other devices, like the LEDs, I^2C devices, and BoosterPack™ header by default.

Figure 7. Power Jumpers J28, J23, J24, J18, J21, and J22

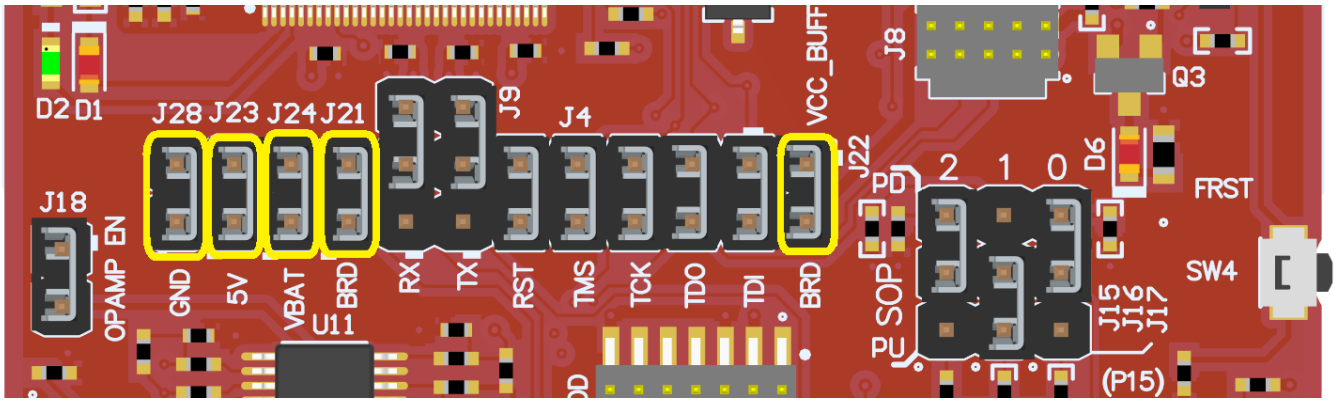

Table 4 lists the jumper settings for the LaunchPad™ power.

Table 4. Jumper Settings for LaunchPad™ Power

Reference	Use	Comments
J18	OPAMP EN	If uninstalled, the power supply to the operational amplifier (OPAMP) is cut off. This can be used to enable low-power measurements.
J28	GND	Ground reference
J23	5V	Connects+5 VDC from emulator section to the rest of the board.
J24	VBAT current measurement	Used to measure the current flowing into the CC3235 device. Also includes the serial flash.
J21	BRD power	Supplies the board power from the onboard DC/DC converter. The board power is used for the sensors, LED, and the OPAMP used to drive the ADC input.
J22	VCC_BUFFER	Used to power the level shifters on the emulator side of the board. The level shifters can be powered by shorting this jumper. Removing this jumper enables low-current measurement.

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The board can be powered by an external supply when USB power is not available, by using J24. J25 is also available to remove any current draw from LEDs being driven by the GPIOs.

Figure 8 shows the external supply connections and LED Enable jumper.

Figure 8. External Supply Connections and LED Enable Jumper

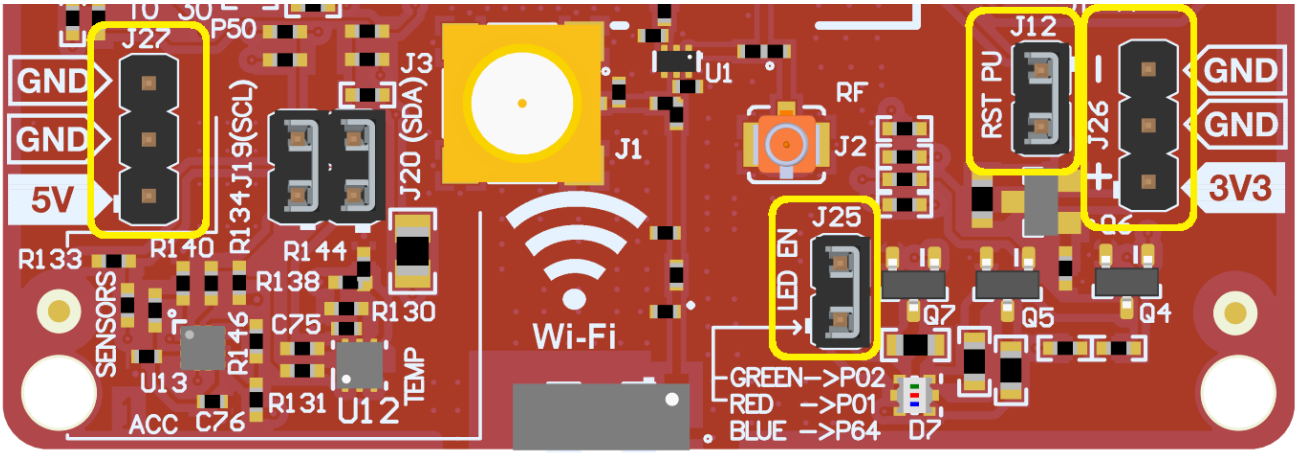

Table 5 lists the jumper settings for the external supply connections.

Table 5. External Supply Connections and LED Enable Jumper

Reference	Use	Comments
J27	+5V power input	Used to power the board from an external 5-V supply.
J26	3.3-V power input	Used to power the board from an external 3.3-V supply. A reverse-voltage protecting diode can be populated on Q6 to prevent the battery from being plugged in the reverse manner. Additionally, resistor R163 must be depopulated and a 0-Ω resistor must be soldered on R169.
J25	LED EN	If uninstalled, the LEDs connected to the GPIO are disabled; this can be used to enable low-power measurements.

2.4.4 Reset Pull-Up Jumper

Table 6 lists the reset pull-up jumper.

Table 6. Reset Pull-Up Jumper

Reference	Use	Comments
J12	RESET pullup	Install this jumper to enable the pull-up resistor on the nRESET pin of the device when the board is powered from an external supply.

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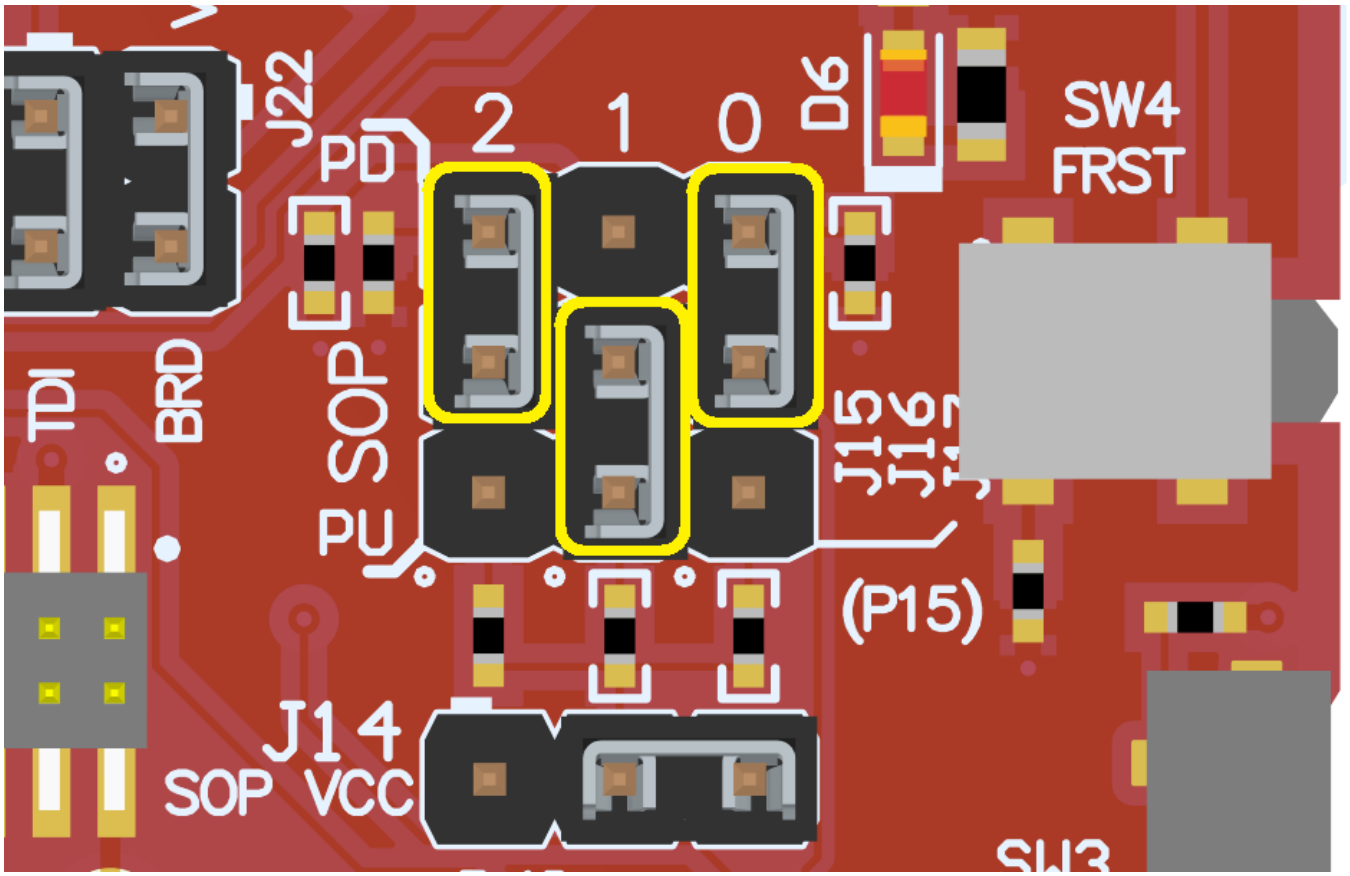
2.4.5 Sense on Power (SOP)

The CC3235 device can be set to operate in four different modes, based on the state of the sense-on-power (SOP) lines. These SOP lines are pins 21, 34, and 35 on the CC3235 device. Table 7 lists the states of the device, and Figure 9 shows the SOP jumpers. Each SOP line has a 3 position header that can be be pulled up or pulled down. The bottom of the SOP configuration is pull ups, and top is pull downs. The current SOP configuration in Figure 9 would then be 010 (Flash/Function).

Table 7. J15, J16, J17 on LaunchPad™

SOP[2:0] (Binary)	Function
000	Functional mode and 4-wire JTAG
001	Functional mode and 2-wire JTAG
010	Functional mode and flash programming
011	Factory default
100	Flash programming

Figure 9. SOP Jumpers (Default Setting Shown)



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NOTE: In the LaunchPad™ schematic design:

- SOP2 corresponds to J15
- SOP1 corresponds to J16
- SOP0 corresponds to J17

Placing a jumper on the top two pins of the header pull downs the SOP line. Placing a jumper on the bottom two pins of the header pulls up the SOP line.

J14 provides an option to pull up the SOP lines using either VBAT_CC or VCC_BRD.

2.4.6 UART Signals

The board supports a USB-based virtual COM port, using the Tiva™ Arm® MCU. The LaunchPad™ is shipped with the UART lines from the CC3235 device connected to the UART of the TM4C129 (Tiva) MCU. The CC3235 UART can also be routed to the 20-pin connector for use as a GPIO or external UART. The selection is performed using onboard jumpers.

Figure 10 shows the UART routed to the USB COM port and Figure 11 shows the UART routed to 20-pin header connector.

Figure 10. UART Routed to USB COM Port

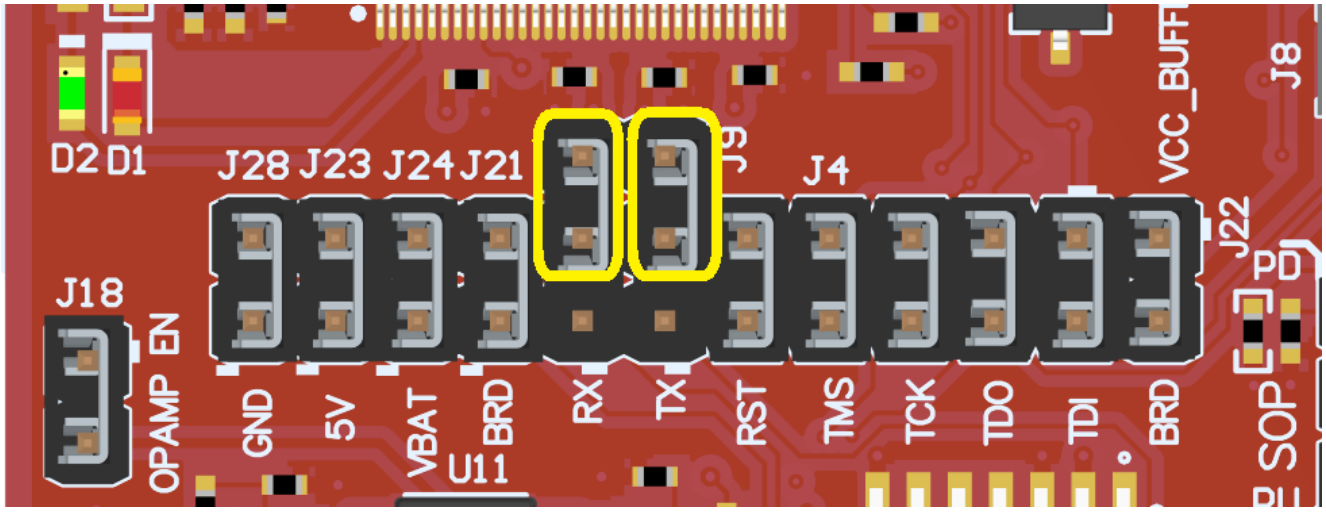
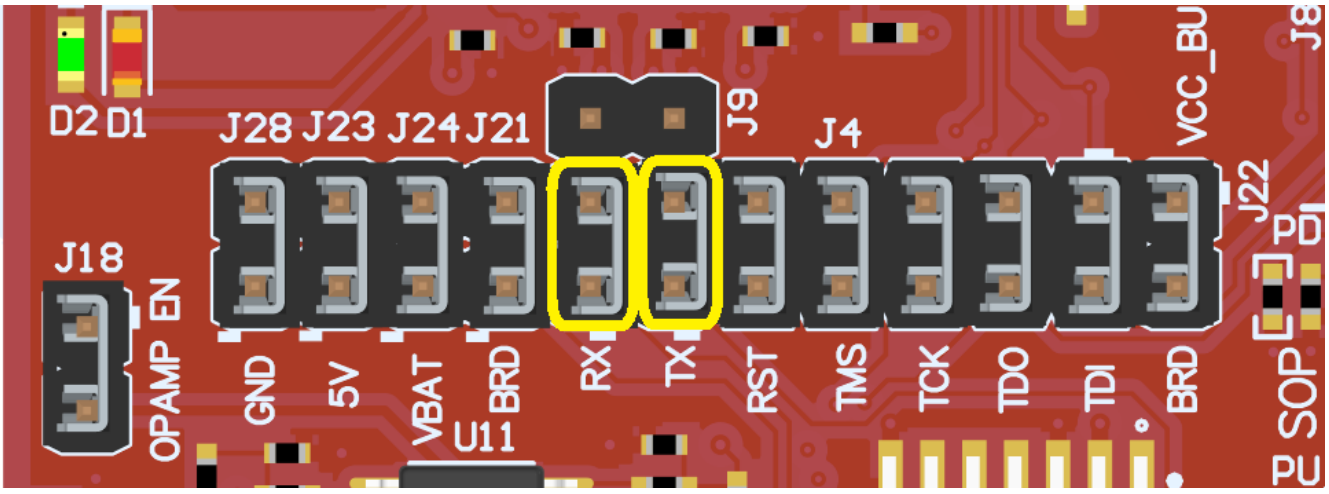


Figure 11. UART Routed to 20-Pin Header Connector



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2.4.7 Push-Buttons and LED Indicators

Table 8 list the push-button definitions. See Figure 1 for location.

Table 8. Push-Button Definitions

Reference	Use	Comments
SW1	RESET	This signal is used to reset the CC3235 device. This signal is also output on the 20-pin connector to reset any external BoosterPack that may be stacked. The reset can be isolated using the jumper block at the center of the board.
SW2	GPIO_13	When pushed, GPIO_13 is pulled to VCC.
SW3	GPIO_22	When pushed, GPIO_22 is pulled to VCC.
SW4	Factory default (FRST)	Pressing this button and toggling RESET (SW1) restores the factory default image on the serial flash. This can be used to recover a corrupted serial flash, provided the s-flash was programmed with a recovery image.

Table 9 lists the LED indicators. See Figure 1 for location.

Table 9. LED Indicators

Reference	Color	Use	Comments
D1, D2	Green and Red	Debug	Indicates the state of the JTAG emulator. For TI use only.
D3	Yellow	nRESET	Indicates the state of the nRESET pin. If this LED is on, the device is functional.
D6	Red	Factory Reset	Indicates that the push-button for the factory reset is pressed.
D7	RGB	GPIO_10(1) GPIO_11(1) GPIO_09	On when the GPIO_xx is logic-1.
D8	Red	Power	Indicates when the 3.3-V power is supplied to the board.

(1) GPIO_10 and GPIO_11 are also used as I^2C. Thus, when the pull-up resistors are enabled, the LEDs are on by default, without configuring the GPIOs.

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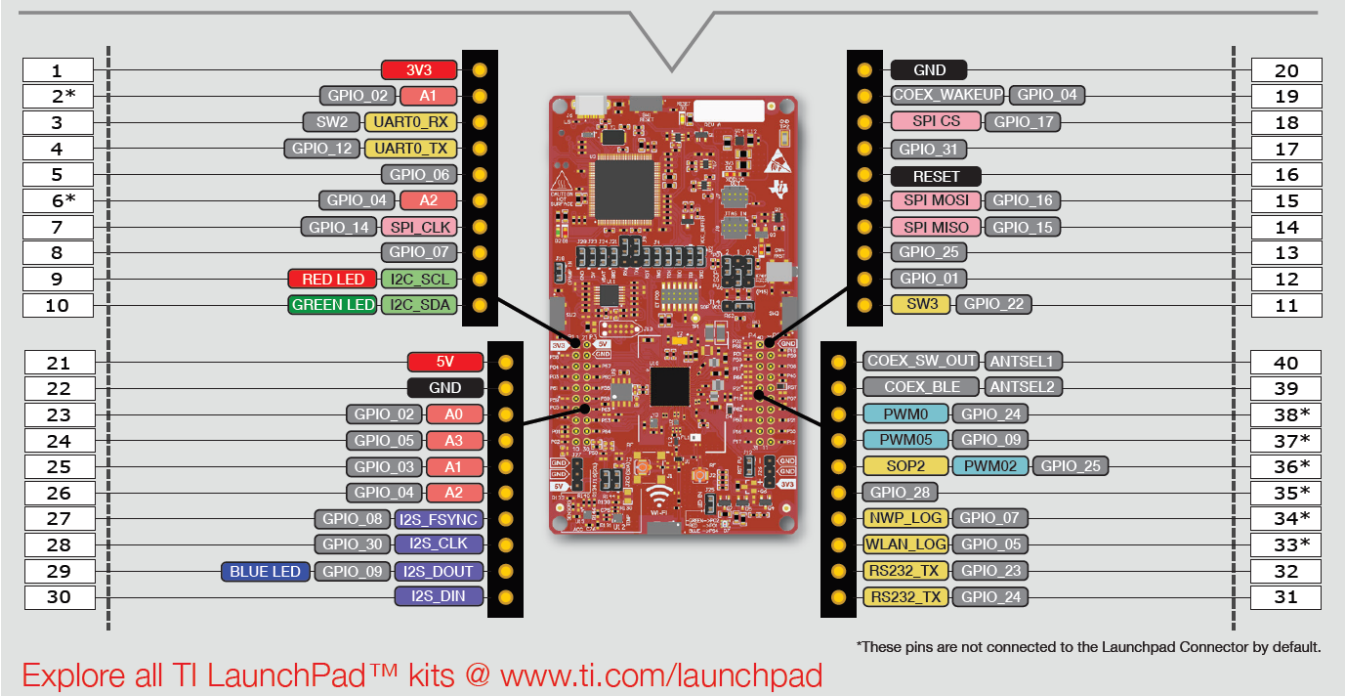
2.4.8 BoosterPack™ Header Pin Assignment

The BoosterPack™ header pinout specification is available at Build Your Own BoosterPack. Also, see the BoosterPack Module Pinout Standard, and the BoosterPack Compatibility Checker.

The CC3235 LaunchPad™ follows this standard, with the exception of naming (P1:P4 is used instead of J1:J4.) See Figure 12 for CC3235 pin-mapping assignments and functions.

Figure 12. CC3235 BoosterPack™ Header Pin Assignments



NOTE: The RESET output is an open-drain-type output and can only drive the pin low. The pullup ensures that the line is pulled back high when the button is released. No external BoosterPack™ can drive this pin low.

All the signals are referred to by the pin number in the SDK; Figure 12 shows the default mappings. Some of the pins are repeated across the connector. For example, pin 62 is available on P1 and P4, but only P1 is connected by default. The signal on P4 is marked with an asterisk (*) to signify that it is not connected by default. The signal can be routed to the pin by using a 0-Ω resistor in the path. For the exact resistor placement, see the CC3235S/CC3235SF SimpleLink™ Wi-Fi® LaunchPad™ Design Files.

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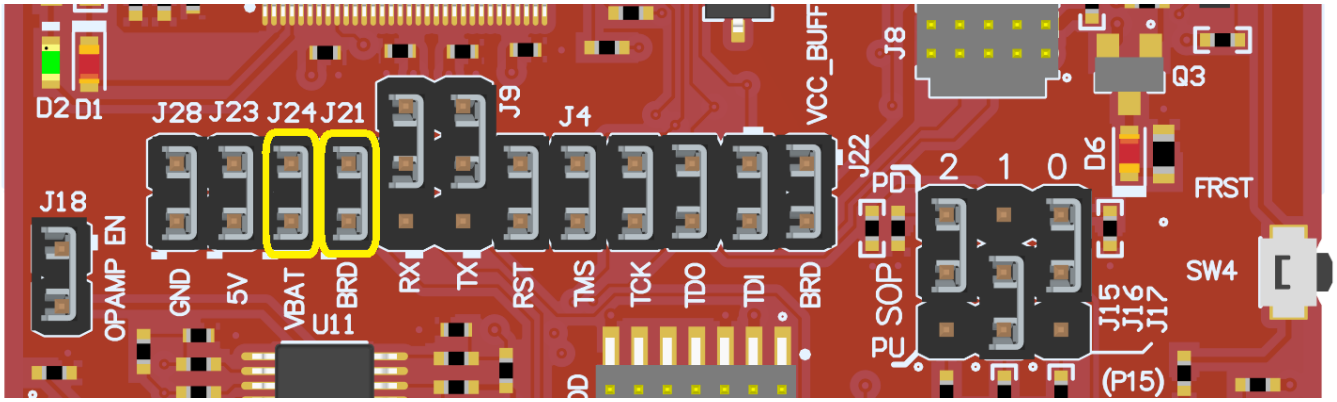
2.5 Power

2.5.1 USB Power

The LaunchPad™ is designed to work from the USB-provided power supply. The LaunchPad™ provides addresses as a bus-powered device on the computer. When the board is powered from the USB connector, the jumpers for VBAT and VBRD must be placed on the following headers, as shown in Figure 13.

Figure 13. Powering From USB Jumper Settings



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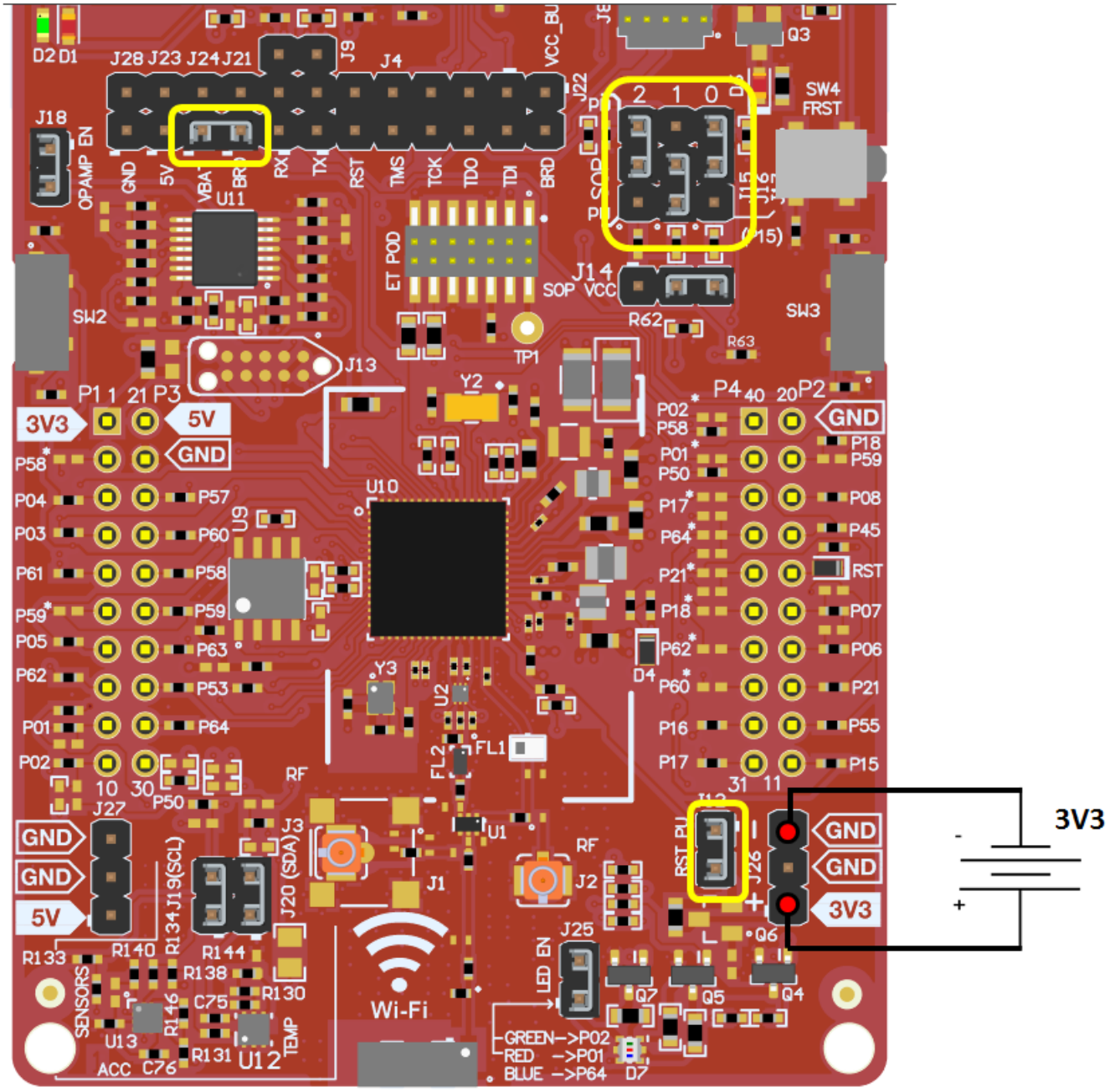
2.5.2 Battery Powering CC3235 LaunchPad™ Kit

The LaunchPad™ kit can also be powered from an external battery pack by applying the voltage on the J26 header. This input features an option to place a reverse-voltage protecting MOSFET, to ensure that the board is not damaged due to an accidental reverse voltage. Perform the following steps before using the board with a battery:

1. Remove the USB cable.
2. Plug in the battery pack on J26 with the correct polarity as shown in Figure 14.
3. Connect the jumper across J121and J24, as shown in Figure 14.
4. Connect Jumper J12 (RST PU) as shown in Figure 14.

Figure 14. CC3235 LaunchPad™ Powered by Battery



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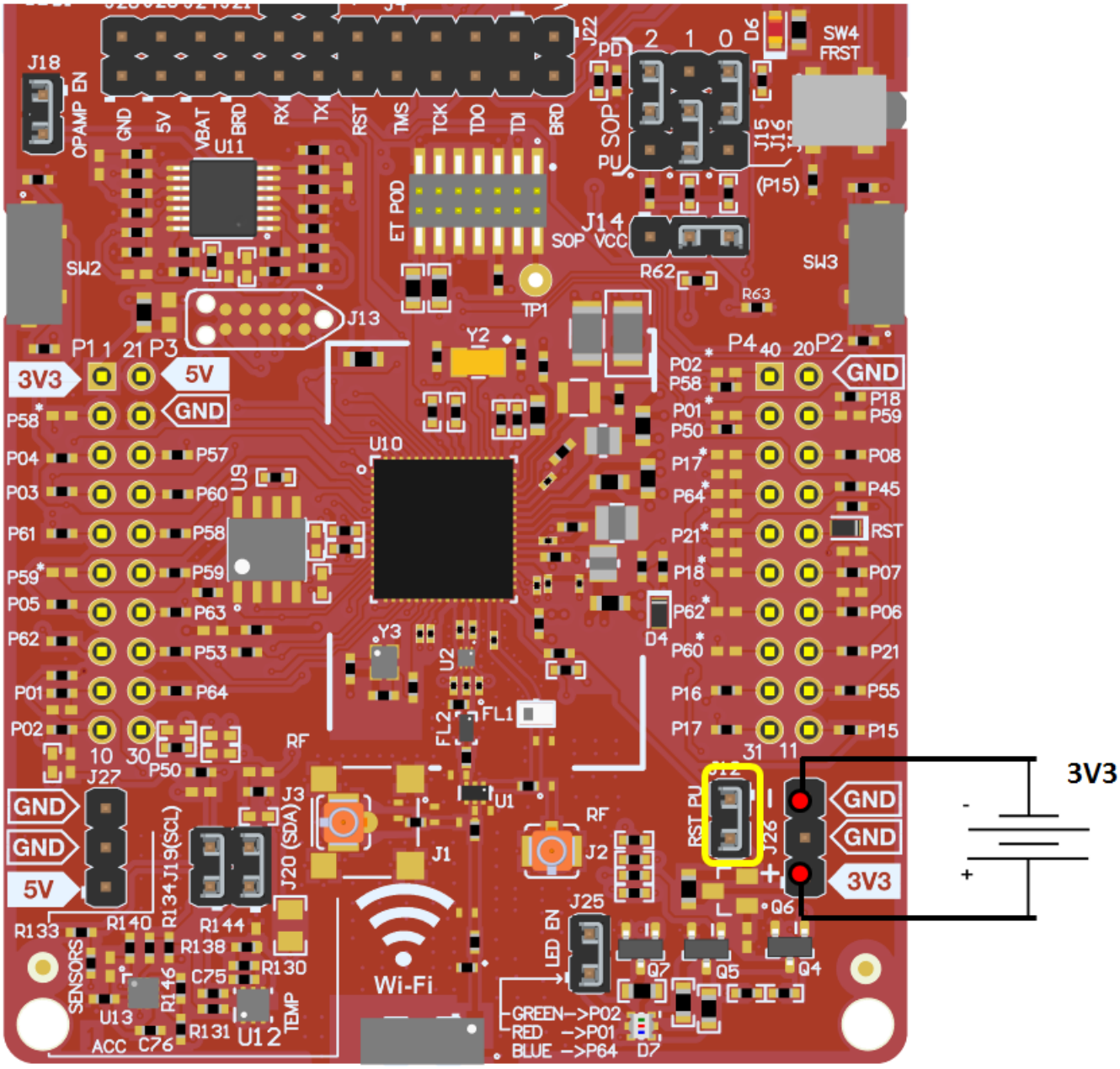
2.5.3 Battery Powering Only CC3235 Device and U10 (Onboard Serial Flash)

In some cases, there may be a requirement to power only the CC3235 device and the serial flash from the battery. The use may not require LEDs, an OP AMP for the ADC, and the sensors. In this case, the other sections can be powered off by removing the appropriate jumpers. Ensure that a jumper is placed on RST_PU (J12) of the LaunchPad™. Lastly, plug in the battery pack on J26 with the correct polarity. The board would appear as shown in Figure 15.

Figure 15. Only CC3235 Device and Serial Flash Powered by Battery



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2.6 Isolated Current Measurement of the CC3235 Device

To measure the current draw of the CC3235 device when powering with a USB cable, use the VBAT jumper on the jumper isolation block (J24). The current measured in this mode includes only the CC3235 device current and the serial flash current, and no external blocks. However, if a GPIO of the CC3235 device is driving a high-current load such as an LED, then that is also included in this measurement.

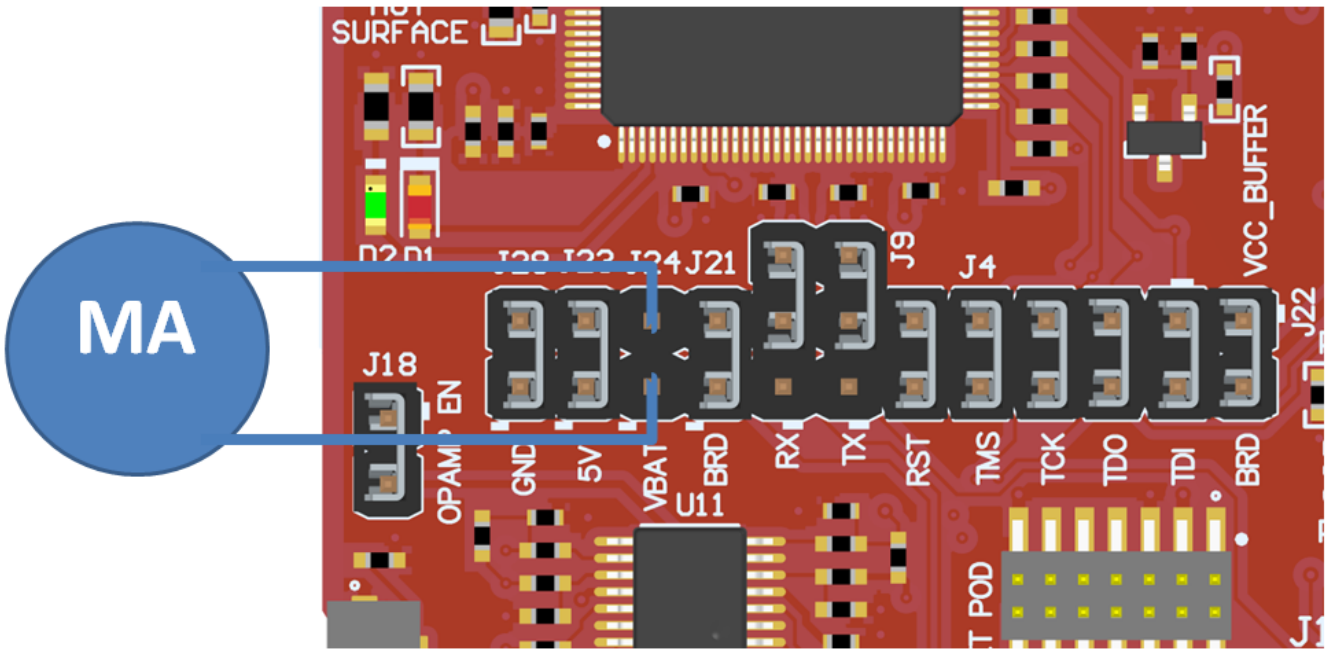
2.6.1 Low-Current Measurement With USB Power (<1 mA)

Follow these steps to measure ultra-low power operation of the CC3235 device:

1. Remove the VBAT jumper (J24) and attach an ammeter as shown in Figure 16. The CC3235 device should not drive any high-current loads directly (such as an LED) because this can draw a large current.
2. Begin target execution and set the device to low-power modes (LPDS or hibernate).
3. Measure the current. If the current levels are fluctuating, it may be difficult to get a stable measurement. It is easier to measure quiescent states.

NOTE: To measure the low-power numbers, remove the LEDs (D8, D9, and D10 onboard) by removing the LED EN jumper (J27). Similarly, the shutdown mode leaks approximately 33 µA into the pull-up resistor (R149) on the nRESET pin. This pull-up resistor must also be removed to measure the total current below 1 µA in shutdown mode.

Figure 16. Low-Current Measurement (<1 mA)



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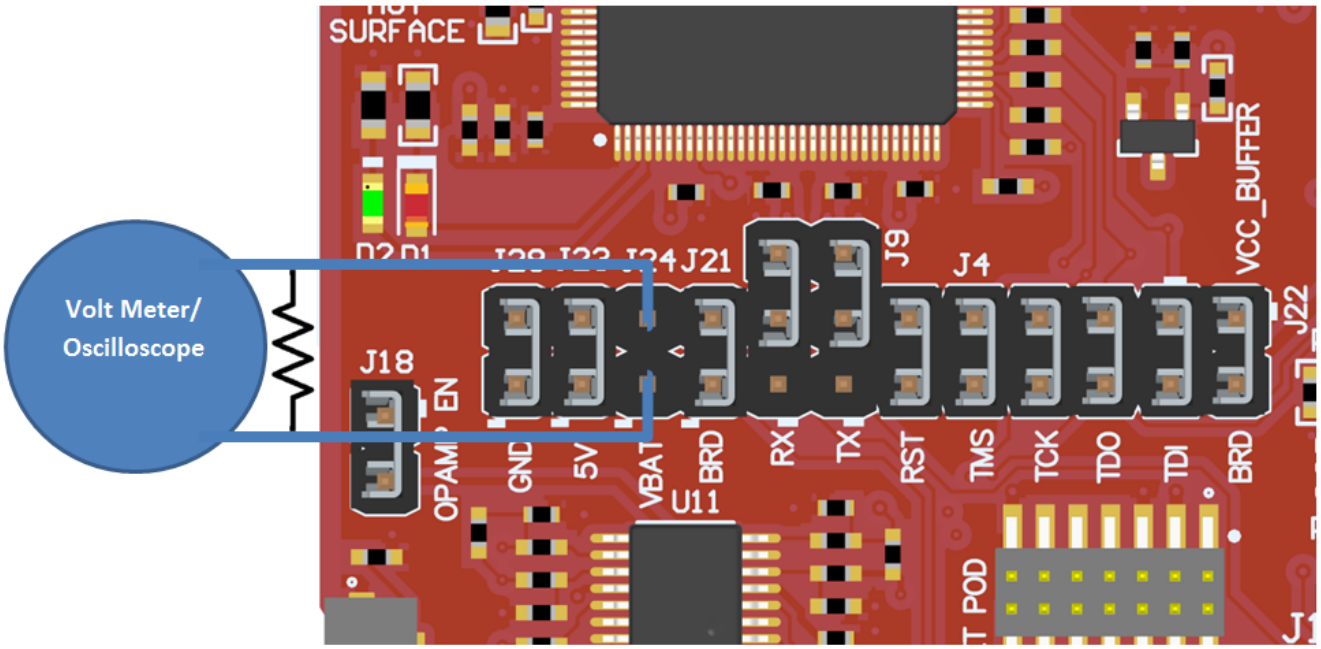
2.6.2 Active Power Measurements (>1 mA)

Follow these steps to measure active operation of the CC3235 device:

1. Remove the VBAT jumper (J24).
2. Solder a 0.1-Ω resistor on a wire, which can be connected to an oscilloscope, as shown in Figure 17. Or, attach a jumper wire between J24 so that it can be used with a current probe.
3. Measure the voltage across the resistor using an oscilloscope with a differential probe (for the current probe, coil the wire around the sensor multiple times for good sensitivity). An ammeter can also be used for this measurement, but the results may be erroneous due to the switching nature of the current.

Figure 17. Active Power Measurements (>1 mA)



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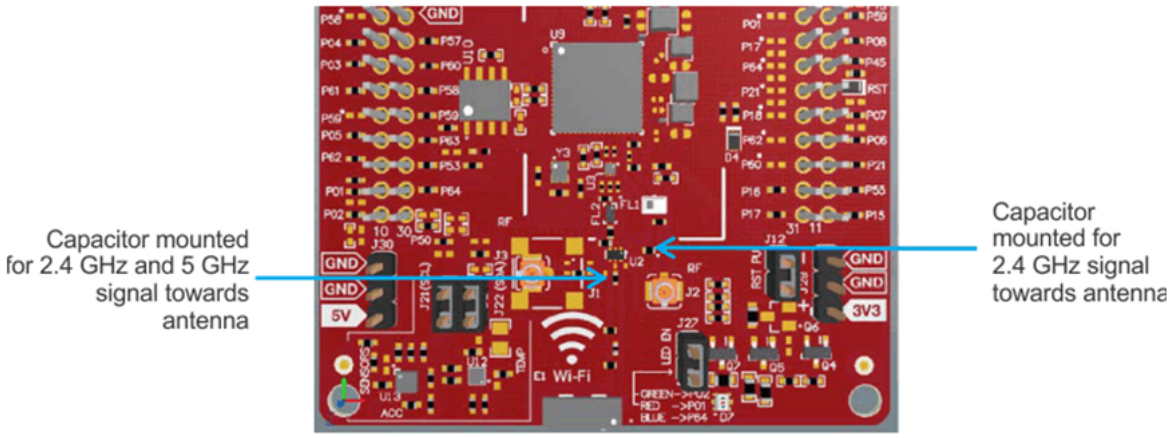
2.7 RF Connections

2.7.1 AP Connection Testing

By default, the board ships with the 2.4-GHz and 5-GHz RF signals routed through a diplexer (U2) and then to the onboard chip antenna, as shown in Figure 18.

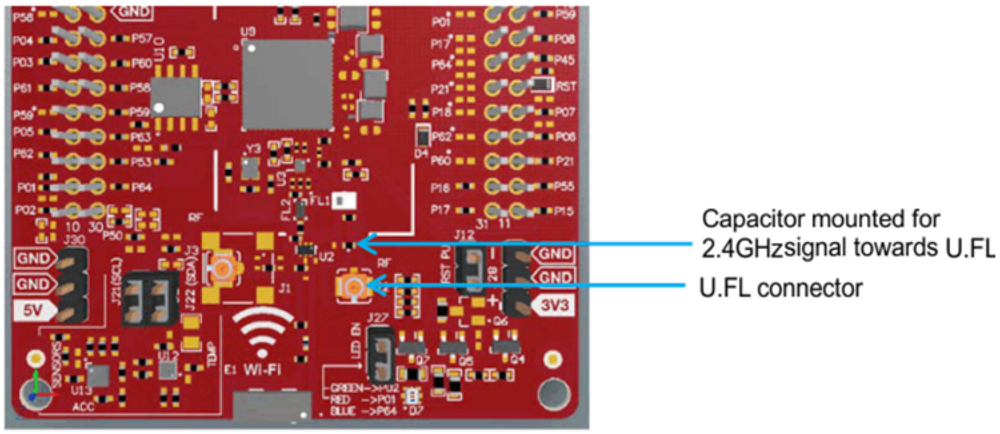
Figure 18. Using Onboard Antenna (Default Condition)



U.FL connectors J2 and J3 provide a way to test in the lab using a compatible cable. Alternately, trackpads for an SMA connector (J1) are provided onboard to replace the J3 U.FL connector for testing conducted measurements. A rework must be performed before these connectors can be used; this involves swapping the position of capacitors.

J2 can be used to measure the 2.4-GHz signal before it is supplied to the diplexer, by removing C6 and populating C2. Figure 19 shows the modified board.

Figure 19. Board Modified for External Antenna Connections (Measure 2.4 GHz)



J1 or J3 can be used to measure either the 2.4-GHz or 5-GHz signal from the diplexer by removing C13 and populating C7. Figure 20 shows the modified board.

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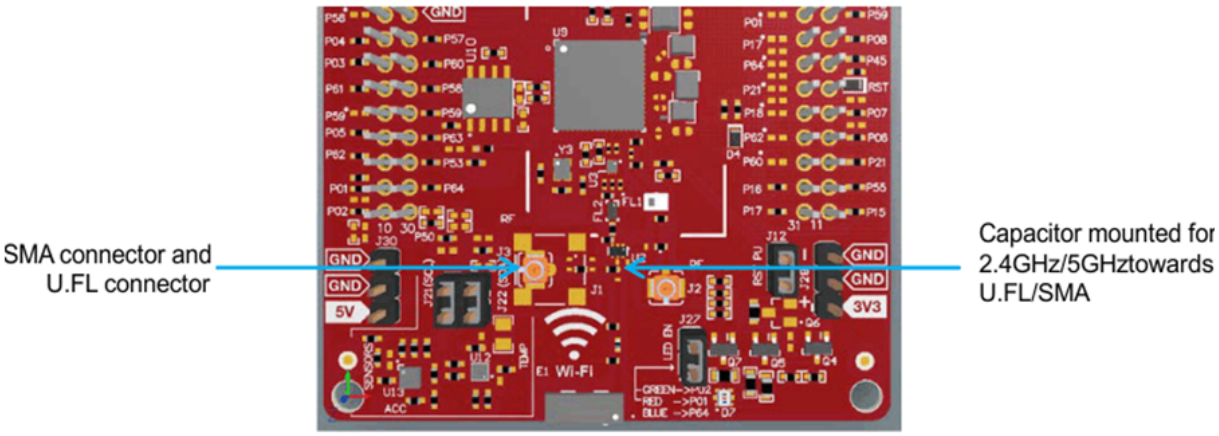
Figure 20. Board Modified for External Antenna Connections (Measure 2.4 GHz or 5 GHz)



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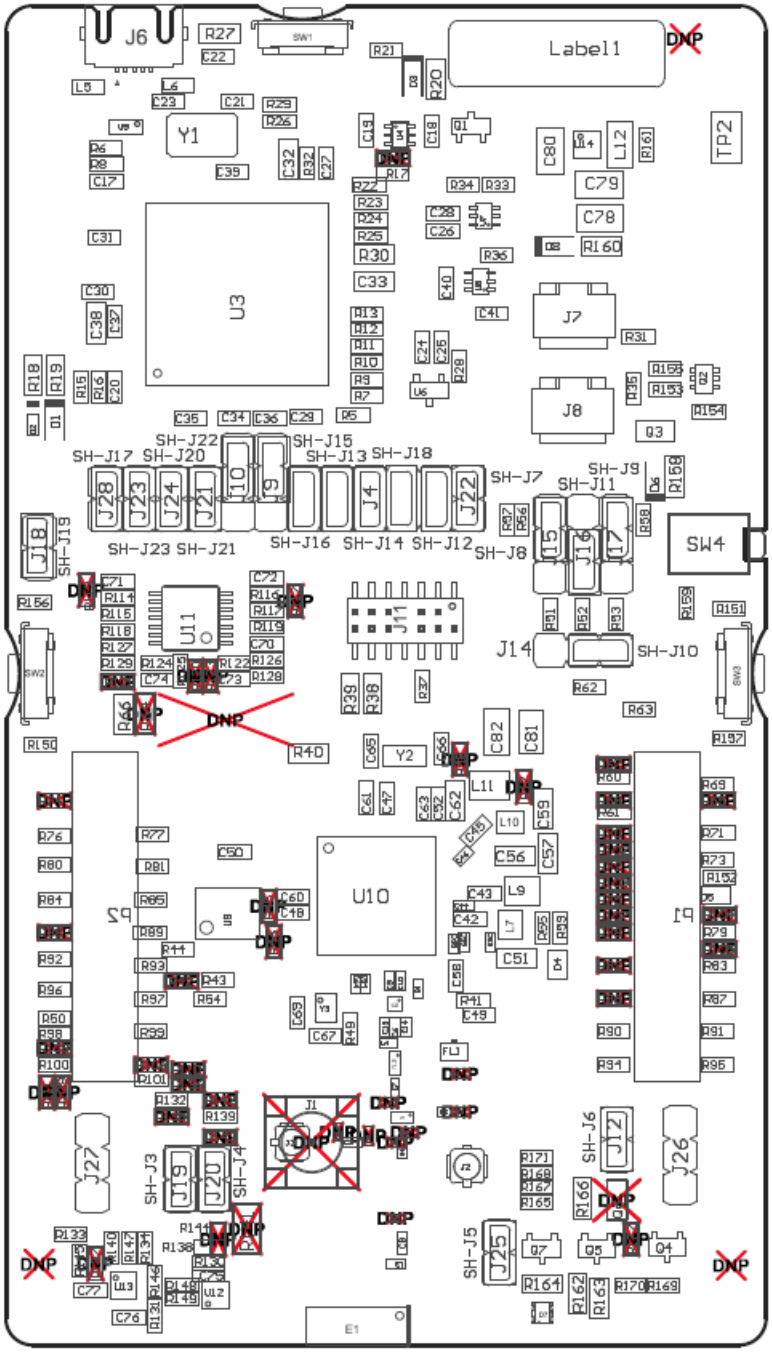
2.8 Assembly Drawing

2.8.1 CC3235SF LaunchPad™ Drawing

Figure 21 shows the top layer assembly drawing of the CC3235SF LaunchPad™.

Figure 21. CC3235SF LaunchPad™ Top-Layer Assembly Drawing



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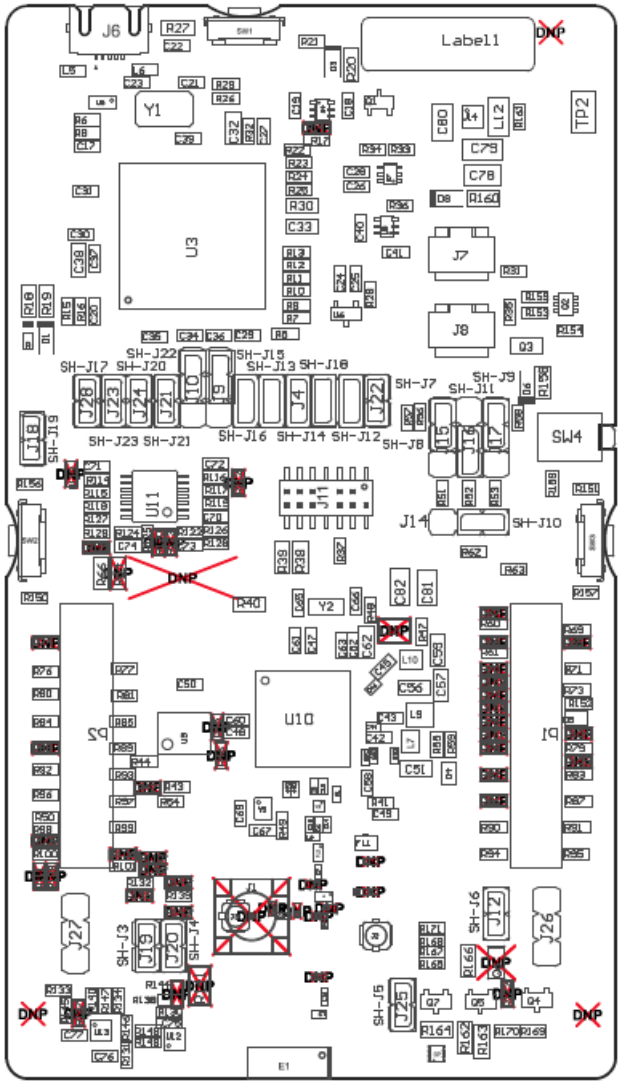
2.8.2 CC3235S LaunchPad™ Drawing

Figure 22 shows the top layer assembly drawing of the CC3235S LaunchPad™.

Figure 22. CC3235S LaunchPad™ Top-Layer Assembly Drawing



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