## User's Guide **SimpleLink™ Wi-Fi**® CC3100, CC3200 Radio Tool

### TEXAS INSTRUMENTS

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#### ABSTRACT

The Radio Tool serves as a control panel for direct access to the radio, and can be used for both the radio frequency (RF) evaluation and for certification purposes. This user's guide describes how to have the tool work seamlessly on Texas Instruments<sup>™</sup> evaluation platforms such as the BoosterPack<sup>™</sup> plus FTDI emulation board for CC31xx devices, and the LaunchPad<sup>™</sup> for CC32xx devices.

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#### 1 Introduction

The SimpleLink<sup>™</sup> MCU portfolio offers a single development environment that delivers flexible hardware, software, and tool options for customers developing wired and wireless applications. With an ultimate goal of 100 percent code reuse across host MCUs, Wi-Fi<sup>®</sup>, *Bluetooth*<sup>®</sup> low energy, Sub-1 GHz devices, and more, choose the MCU or connectivity standard that fits your design. A one-time investment with the SimpleLink software development kit (SDK) lets you reuse often, opening the door to create unlimited applications. For more information, visit www.ti.com/simplelink.

The main use of the Radio Tool is to serve as a control panel for direct access to the radio. The tool can be used for the radio frequency (RF) evaluation, and for certification purposes (such as FCC, ETSI, Telec, and so on). The tool is expected to work seamlessly on TI evaluation platforms: BoosterPack plus FTDI emulation board for CC31xx devices, and LaunchPad for CC32xx devices. If customers want to use the tool on their final platform, see Section 11. The I/O levels of these lines should be kept at VBAT level (the same voltage that powers the CC31xx and CC32xx devices).

For reference RF numbers, see the CC3120 SimpleLink<sup>™</sup> Wi-Fi<sup>®</sup> Wireless Network Processor, Internet-of-Things Solution for MCU Applications Data Sheet and the CC3220 SimpleLink<sup>™</sup> Wi-Fi<sup>®</sup> Wireless and Internetof-Things Solution, a Single-Chip Wireless MCU Data Sheet.

#### 2 Features

- Connection
  - CC3120/CC3135 through the serial peripheral interface (SPI)
  - CC3120/CC3135 through the universal asynchronous receiver/transmitter (UART)
  - CC3220/CC3235x through the UART
- Acquires MAC address
  - Acquires firmware information
- TX Transmission testing
  - Continuous
  - Packetized
  - Carrier Wave (CW)
- RX Receiver testing
  - Statistics
  - Rate histogram
  - RSSI histogram

#### **3 Prerequisites**

#### 3.1 Software Downloads

- SimpleLink™ Wi-Fi<sup>®</sup> Radio Testing Tool
- Microsoft .NET Framework 4.6.1
- Microsoft<sup>®</sup> Visual C++ Redistributable Package for Visual Studio 2015



#### 3.2 Hardware

- One CC31xx BoosterPack plug-in module (CC31xxBOOST)
- One CC31xx Emulation BoosterPack module (CC31xxEMUBOOST)
- One CC32xx LaunchPad with CC3220R, CC32xxS, or CC32xxSF
- One Micro-USB cable
- One WLAN tester and RF equipment (for example, spectrum analyzer)

For the latest complete list of supported SimpleLink hardware, see www.ti.com/simplelink.

#### **4** Radio Tool Installation Directory

The installation process is made straightforward by following the steps. The default installation location is C:\TI\CC3120\_CC3220\_RadioTool\_<version>, but it can be changed any location you want.

Table 4-1 lists the file directory structure after installation.

Table 4-1. File Directory Structure			
Folder Name	Contents		
RadioToolApplication	The Radio Tool GUI application (RadioToolGUI.exe), Radio Tool CLI application (RadioToolCLI.exe), and three precompiled DLL files (CC31xxLibSPI.dll, CC31xxLibUART.dll, CC32xxLib.dll)		
Device Images	CC32xx MCU images. Use these images with Uniflash to flash an MCU image onto the device, see Section 6.		
Source Files	CC32xx MCU image source for development. Place the radiotool folder under the CC32xx SDK example directory, and use Code Composer Studio <sup>™</sup> (CCS) to open the project in the CCS folder inside.		

#### Table 4-1. File Directory Structure

#### 5 Hardware Connections 5.1 CC31xxBOOST Plus CC31XXEMUBOOST

Figure 5-1 shows how to mount the CC31xxBOOST board on top of the CC31XXEMUBOOST board. Ensure P1.1 of both boards is aligned with each other, as indicated by the white arrows on the boards.

Connect the RF connector (J2 or J3) to a WLAN tester/RF equipment for measurements. Ensure the RF connection to the instrument is made before powering on the boards, so that the correct load impedance is provided during power on.

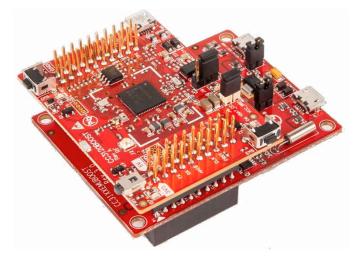


Figure 5-1. CC31xxBOOST Board Mounted on Top of CC31XXEMUBOOST Board

To power the platforms, connect the J6 port of CC31XXEMUBOOST to the Windows PC using a micro USB cable, as shown in Figure 5-2. If the drivers are properly installed as mentioned during the SDK installation, the PC should recognize and list the connected device in the Device Manager, shown in Figure 5-3. For details on the driver and SDK installation, see the *SimpleLink*<sup>TM</sup> *Wi-Fi*<sup>®</sup> and Internet of Things CC3120 Software Getting Started Guide.



Figure 5-2. Powering the Platforms

17	CC3100BP PORT (COM4)
	CC3100BP PORT (COM5)
17	CC3100BP PORT (COM6)
17	CC3100BP PORT (COM7)

Figure 5-3. Device Manager Showing Ports

By default, the RF path is routed to J3 (Murata RF Switch). To use J2 (uFL) for RF measurements, swap the position of the 0- $\Omega$  resistor to disconnect the path to the onboard antenna, and enable the path to the uFL connector.

#### 5.1.1 Using the UART Interface

The emulation board enumerates the UART ports on the PC, as shown in Figure 5-3. Keep a record of the third port number, because it is needed later for connection.

#### 5.1.2 Using the SPI Interface

The SPI does not require users to choose a specific COM port. Simply select the CC31xx SPI option in the tool to start the connection. However, with SPI connection, only one CC31xx can be connected to a PC at a time. This is because Radio Tool cannot determine which CC31xx device to connect to if multiple CC31xx devices are present. For large volume testing, TI recommends using the CC31xx UART.



#### 5.2 CC32xx-LAUNCHXL

Connect the RF connector to a WLAN tester/RF equipment for measurements, and the USB connector on the CC32xx LaunchPad<sup>™</sup> to the PC. Ensure the RF connection to the instrument is made before powering on the board, so that the correct load impedance is provided during power on.

By default, the RF path is routed to J11 (Murata RF Switch). If users want to use J10 (uFL) for RF measurements, swap the position of the  $0-\Omega$  resistor to disconnect the path to the onboard antenna, and enable the path to the uFL connector.

The LaunchPad enumerates COM ports in the Device Manager on the PC, as shown in Figure 5-4. Keep a record of the Application/User UART port number, because it is needed later for the connection.

While using TI's XDS LaunchPad, the RadioTool GUI should automatically detect the correct UART number and set it on the GUI on the "COM Port" combo box.

1.19	Ports (COM & LPT)
1 -	P ECP Printer Port (LPT1)
	TY XDS110 Class Application/User UART (COM13)
L	XDS110 Class Auxiliary Data Port (COM12)

#### Figure 5-4. XDS Connection Ports for CC32xx LaunchPad

#### 6 Flashing the Board

The devices must be flashed with the correct ServicePack to operate this tool correctly. Every Radio Tool release has a corresponding ServicePack and SDK version.

If using the CC32xx device, the Radio Tool application must be flashed in addition to the ServicePack. The precompiled application binary is in the CC32xxBoardApplication Binary folder.

In case Uniflash is installed on the same windows machine as RadioTool, a predefined \*.sli image can be selected and programmed to the device as shown in Figure 6-1.

CC31XX/CC32XX R	adio Tool v1.0.3.2							×
Radio Tool		Set Up TX	RX	Current				
Target Device	CC3220 UART	- Settings			Program			
Connection Status	Connected	Device	CC3220 UAI	RT $\sim$				
Testing Status	Idle	COM Port	COM7	~ 📚	5			
Details		Baud Rate	115200	$\sim$				
Chip ID	0x18 (CC3220RS)		Disconn	ect				
ROM Ver.	0x00							
FW Ver. 3.4.0.0	31.2.0.0.0 . 2.2.0.5							
Host Driver Ver.	2.0.1.21							
MAC Addr. W R	C8:FD:19:07:FC:78							
CC3220 App Ver.	0.9							
Radio Tool Library V	ersion							
CC31XX SPI	1.0.3.2							
CC31XX UART	1.0.3.2							
CC32XX UART	1.0.3.1							
	16							
	RUMENTS	Clear Log	Export Log	g Copy to Clip	board	Online Tool Guide		About
[4/10/2018 11:15 [4/10/2018 11:15 [4/10/2018 11:15 [4/10/2018 11:15 [4/10/2018 11:15	5:23 AM] Program R 5:25 AM] Connectin 5:29 AM] Connectin 5:29 AM] Connected 5:29 AM] Fetching 5:30 AM] Chip ID=0	g g Information			=3.4.0.0.31.2.0.0.0.2.;	2.0.5, MAC=C8:FI	:19:07	:FC:78,

#### Figure 6-1. Radio Tool Setup Page



For instructions on flashing the devices, see the UniFlash CC3x20, CC3x35 SimpleLink<sup>™</sup> Wi-Fi<sup>®</sup> and Interneton-a chip<sup>™</sup> Solution ImageCreator and Programming Tool.

#### 7 Running the RadioTool GUI

The GUI tool provides a user-friendly interface for using the Radio Tool.

#### 7.1 Set Up Tab and General Information

Users have three types of devices for connection:

CC31xx SPI

This is not recommended to use because it is limited to connecting to one CC31xx board with this protocol. If more than one CC31xx is present, CC31xx UART is the recommended connection.

- CC31xx UART
- CC32xx UART

With the UART connection type selected, users can pick from a list of known COM port and baud rates. Click on the blue spinning arrows on the right to refresh the list if the if the appropriate COM port does not appear.

Upon a successful connection, the Details box on the left provides detailed device information on the connected device (see Figure 7-1). Before proceeding, ensure the board is flashed with the desired image version.

FW Ver. (or Firmware version), is arranged as follows: <NWPversion>.<FWversion>.<PHYversion>

The CC32xx App Ver. information is applies only to CC32xx, and indicates the radio tool application version flashed onto the device.

The only supported baud rate now is 115200.

CC31XX/CC32XX Radio Tool v1.0.3.2		-	×
Radio Tool	Set Up TX RX Current		
Target Device CC3220 UART	Settings		
Connection Status Connected	Device CC3220 UART V		
Testing Status Idle	COM Port COM7 V 💈		
Details	Baud Rate 115200 V		
Chip ID 0x18 (CC3220RS)	Disconnect		
ROM Ver. 0x00			
FW Ver. 3.4.0.0 . 31.2.0.0.0 . 2.2.0.5			
Host Driver Ver. 2.0.1.21			
MAC Addr. W R C8:FD:19:07:FC:78			
CC3220 App Ver. 0.9			
Radio Tool Library Version			
CC31XX SPI 1.0.3.2			
CC31XX UART 1.0.3.2			
CC32XX UART 1.0.3.1			
TEXAS			
INSTRUMENTS	Clear Log Export Log Copy to Clipboard Online Tool C	Suide	About
[4/10/2018 11:19:48 AM] Set power [4/10/2018 11:46:28 AM] Disconnec [4/10/2018 11:46:28 AM] Disconnec [4/10/2018 2:00:33 PM] Connecting [4/10/2018 2:00:33 PM] Connected [4/10/2018 2:00:33 PM] Fetching I [4/10/2018 2:00:34 PM] Chip ID=0x MAC=C8:FD:19:07:FC:78, Host_Drive	ting ted  nformation 18 (CC3220RS), ROM_ver=0x00, FW_ver=3.4.0.0.31.2.0.0.0.2.2.0.5,		~

Figure 7-1. Radio Tool Setup Page With Connected Device



#### 7.2 GUI TX Testing

#### Table 7-1 lists the three types of TX testing that are supported.

# Type Description Packetized Each packet is sent one at a time from the application MCU to the network processor. A large delay between packets exists in this mode. This mode is generally used for RF evaluation. Continuous This is a test mode where the network processor sends packets back to back in an internal loop, without the intervention of the host MCU. The delay between packets is typically very small, and hence useful for FCC/ETSI certification purposes where high-duty cycle is required. This mode is used only for emission certification. Carrier Wave (CW) In this mode the device transmits an unmodulated RF tone. The frequencies can be selected in 312.5-kHz steps. The power output with tone 0 is very low. If higher RF power is desired, use tone numbers other than 0.

Table 7-1. TX Testing

Some fields are enabled or disabled depending on the type of test being run. For example, the Amount parameter is disabled only when the Continuous testing type is selected.

Table 7-2 lists parameter explanations.

Parameter	Range (inclusive)	Description
Channel	[1, 13]	802.11 2.4-GHz band Wi-Fi channels. 14 is not supported.
	[36165]	5-Ghz channels are enabled only for devices: CC3235x, CC3135
Power level	[0 to 15]	0 is the maximum power, and 15 is the minimum power. For 5-Ghz channels this parameter has no affect and the actual output power will be set to 0.
Tone	[-25, 25]	CW only. 0 is tone at center frequency. A value N between and within the range [–25, 25] means tone at offset N*312.5 kHz.
Rate		<ul> <li>802.11 PHY data rate. 5Ghz channels has no support for DSSS and CCK rates. Supported:</li> <li>DSSS: 1 Mbps, 2 Mbps</li> <li>CCK: 5.5 Mbps, 11 Mbps</li> <li>OFDM: 6/9/12/18/24/36/48/54 Mbps</li> <li>MCS 0-7</li> </ul>
Preamble	[Long, Short]	802.11b preamble. OFDM preamble is automatically configured by the device when OFDM rates are selected.
Data pattern		<ul> <li>Data pattern in the data field. Supported:</li> <li>All 0: 0x00, 0x00, 0x00</li> <li>All 1: 0xFF, 0xFF, 0xFF</li> <li>Incremental</li> <li>Decremental</li> </ul>
Size	[24, 1400]	Packet size in bytes
Delay	[100 to 1,000,000]	Delay of transmission in milliseconds (ms)
Amount	[0 to 1,000,000]	Number of packets to transmit. A value of 0 indicates infinite number of packets.
Override CCA		Enable this field for CCA (Clear Channel Assessment) override if the Wi-Fi environment is too congested to have a reliable periodic transmission.
CCA threshold		The channel is considered occupied when the signal strength is above this setting. Supported: • -88 dBm (MIN) • -78 dBm (LOW) • -68 dBm (DEFAULT) • -58 dBm (MED) • -48 dBm (HIGH) • -38 dBm (MAX)

Table 7-2. Parameter Explanation



Table 7-2. Parameter Explanation (continued)			
Parameter	Range (inclusive)	Description	
Destination MAC address		Destination MAC address in packets	
Country		Sets device country code. Supported: US, EU, JP. For devices CC3135 and CC3235x there are additional country codes options. There is an option to select "No Limits" to remove all channel limitations or "00" for minimal limits.	

#### Figure 7-2 shows the Radio Tool GUI in the TX Tab.

CC31XX/CC32XX Radio Tool v1.0.3.2	–	×
Radio Tool	Set Up TX RX Current	
Target Device CC3220 UART	Transmission Mode	
Connection Status Connected	Packetized O Continuous O Carrier Wave (CW)     Stop Tx Testi	ng
Testing Status Tx Running	TX Configuration	
Details	Channel 8 (2447MHz) V Destination MAC Address 01:23:45:67:89:AB	
Chip ID 0x18 (CC3220RS)	Rate 54 Mbps (OFDM) V Amount 0 packets (0 for infinite)	
ROM Ver. 0x00	Data Pattern All 0 🗸 Size 1000 🛓 Bytes Tone 0 🛓	
FW Ver. 3.4.0.0 . 31.2.0.0.0 . 2.2.0.5	802.11b Preamble Long V Delay 1 👘 mSec Power (0-15) 0 🔹	
Host Driver Ver. 2.0.1.21	CCA Threshold -68dBm (DEFAULT) V Country US V Override CCA	
MAC Addr. W R C8:FD:19:07:FC:78	Description	
CC3220 App Ver. 0.9	Country: Country Code: US (United States)	
Radio Tool Library Version		
CC31XX SPI 1.0.3.2		
CC31XX UART 1.0.3.2		
CC32XX UART 1.0.3.1		
	Clear Log Export Log Copy to Clipboard Online Tool Guide Ab	oout
[4/10/2018 11:17:24 AM] Connectin		~
[4/10/2018 11:17:24 AM] Connected [4/10/2018 11:17:24 AM] Fetching	nformation	
	18 (CC3220RS), ROM_ver=0x00, FW_ver=3.4.0.0.31.2.0.0.0.2.2.0.5,	
[4/10/2018 11:17:53 AM] TX Starte	, Mode=Packetized, CH=CHANNEL_8, PW=0, Rate=RATE_54M, Preamble=LONG_PREAMBLE_MODE ern=ALL 0 PATTERN, CCA=0, CCA T=SL TX INHIBIT THRESHOLD DEFAULT, ACK=0, Dest=	,
01:23:45:67:89:AB, Country=US	en milo-initian, oar o, oar i bi-in-initii inkesitoid bertoit, kok-o, best-	

Figure 7-2. Radio Tool GUI in TX Tab

#### 7.3 GUI RX Testing

RX testing is used for gathering Wi-Fi statistics in the air within a specified channel in case of external antenna. While using RF connector for accurate RF tests the packets will be accepted by the RF connected path.

**Duration:** Statistics gathering time can be specified with a fixed duration, or 0 to make the testing time indefinite, until you press the STOP button. Statistics are gathered automatically whenever the RX testing is stopped. However, users may choose to gather the statistics any time before RX testing ends by clicking the Get Statistics button. Table 7-3 lists fields explanations.

Field	Description
Valid	Valid packets
Addr Mismatch	Packets with address mismatch
FCS Error	Frame Check Sequence error
Mang frame	Average RSSI in management frames
DataCtrl frame	Average RSSI in Data Control frames

#### Table 7-3. Fields Explanation

Figure 7	-3 lists the Radio Tool GUI in the RX Tab.
i igui c i	

CC31XX/CC32XX F	Radio Tool v1.0.3.2		- 🗆 ×
Radio Tool		Set Up TX RX Current	
Target Device	CC3220 UART	RX Statistics Channel	6 (2437MHz) 🛛 🗸
Connection Status	Connected	Valid Packets Average RSSI : Duration (0 infinit	e) 0 📮 Seconds
Testing Status	Idle	Addr Mismatch O Packets MgMnt frame O dBm Enable ACKs	Start Rx Testing
Details		FCS Error 0 Packets DataCtrl frame 0 dBm Get Statistics	Clear Statistics
Chip ID	0x18 (CC3220RS)	Timestamp (μs)	
ROM Ver.	0x00	Starting Time 0 Statistics Collecting Time 0 Elapse	0
FW Ver. 3.4.0.0	31.2.0.0.0 . 2.2.0.5	RSSI	
Host Driver Ver.	2.0.1.21	> -48dBm 0 % 1Mbps 0 % 18Mbps 0 % MCS	2 0 %
MAC Addr. W R	C8:FD:19:07:FC:78	-48dBm to -55dBm 0 % 2Mbps 0 % 24Mbps 0 % MCS	3 0 %
CC3220 App Ver.	0.9	-56dBm to -63dBm 0 % 5.5Mbps 0 % 36Mbps 0 % MCS	4 0 %
Radio Tool Library V	ersion	-64dBm to -71dBm 0 % 11Mbps 0 % 48Mbps 0 % MCS	5 0 %
CC31XX SPI	1.0.3.2	-72dBm to -79dBm 0 % 6Mbps 0 % 54Mbps 0 % MCS	6 0 %
CC31XX UART	1.0.3.2	< -79dBm 0 % 9Mbps 0 % MCS 0 % MCS	7 0 %
CC32XX UART	1.0.3.1	O Amount  Percentage 12Mbps 0 % MCS 1 0 %	
		Show Graph O Amount   Percentage Sh	ow Graph
		Clear Log Export Log Copy to Clipboard Online Tool G	uide About
	RUMENTS		Ide About
	:36 PM] Rx Testin :28 PM] Rx Testin		<u>^</u>
	:33 PM] Rx Testin :34 PM] Rx Testin		
[4/10/2018 3:38	:36 PM] Rx Testin	Started	
	:43 PM] Rx Testine :48 PM] Rx Testine		
	:15 PM] Rx Testin		
			Ŷ

Figure 7-3. Radio Tool GUI in RX Tab

#### Figure 7-4 lists the Radio Tool GUI in the RX Tab with Running in Progress.

CC31XX/CC32XX Radio	Tool v1.0.3.2						- 🗆 ×
Radio Tool		Set Up TX	RX Current				
Target Device	CC3220 UART	- RX Statistics				Channel	1 (2412MHz) 🗸
Connection Status	Connected	Valid	11642 Packet	Average RSSI :		Duration (0 infin	ite) 66 🚔 Seconds
Testing Status	Rx Running	Addr Mismatch	1 Packet	5 MgMnt frame	-80 dBm	Running (53)	Stop Rx Testing
Details		FCS Error	9934 Packet	5 DataCtrl frame	-77 dBm	Get Statistics	Clear Statistics
Chip ID 01	x18 (CC3220RS)	Timestamp (µs)					
ROM Ver.	0x00	Starting Time	477767394	Statistics Collecting	Time 5437	50617 Elaps	e 65983223
FW Ver. 3.4.0.0 . 31.	2.0.0.0 . 2.2.0.5	RSSI		Rate			
Host Driver Ver.	2.0.1.21	> -480	dBm 0.00 %	1Mbps 22.00	% 18Mbps	0.00 % MC	S 2 1.14 %
MAC Addr. W R C8	:FD:19:07:FC:78	-48dBm to -55d	dBm 0.00 %	2Mbps 0.27	% 24Mbps	3.04 % MC	S 3 0.01 %
CC3220 App Ver.	0.9	-56dBm to -63d	iBm 0.26 %	5.5Mbps 0.03 9	% 36Mbps	0.00 % MC	S 4 0.00 %
Radio Tool Library Version	n	-64dBm to -71d	dBm 11.65 %	11Mbps 10.51	% 48Mbps	0.00 % MC	S 5 0.00 %
CC31XX SPI	1.0.3.2	-72dBm to -79d	dBm 45.48 %	6Mbps 37.12	% 54Mbps [	0.00 % MC	S 6 0.00 %
CC31XX UART	1.0.3.2	< -79d	dBm 42.61 %	9Mbps 0.00	% MCS 0	0.12 % MC	S 7 0.00 %
CC32XX UART	1.0.3.1	◯ Amount	) Percentage	12Mbps 25.51	% MCS 1	0.26 %	
		Show	Graph	🔾 Amount 🖲 Pe	ercentage	S	how Graph
TEXAS							
	UMENTS	Clear Log E	xport Log (	opy to Clipboard		Online Tool 0	Suide About
(4/10/2018 3:35:15 (4/10/2018 3:35:15 (4/10/2018 3:35:15 (4/10/2018 3:35:16 MAC=C8:FD:19:07:FC: (4/10/2018 3:35:22 (4/10/2018 3:37:36	PM] Connected PM] Fetching Im PM] Chip ID=0x1 78, Host_Driver PM] Rx Testing PM] Rx Testing	formation LB (CC3220RS), ==2.0.1.21 Started Finished	ROM_ver=0x00,	FW_ver=3.4.0.0.	31.2.0.0.0.2	.2.0.5,	

Figure 7-4. Radio Tool GUI in RX Tab With Running in Progress

Figure 7-5 shows gathered statistics. Rates and RSSIs are displayed as percentages.

Radio Tool       Set Up       TX       RX       Current         Target Device       CC3220 UART       RX Statistics       Channel       6 (2437MHz)         Connection Status       Connected       Valid       271       Packets       Average RSSI :       Duration (0 infinite)       0 ♀ Seconds         Addr Mismatch       0       Packets       MgMnt frame       -75       dBm       Enable ACKs       Stop Rx Testing         Potalis       FCS Error       74       Packets       DataCtrl frame       -83       dBm       Get Statistics       Clear Statistics         Chip ID       0x18 (CC3220RS)       Starting Time       619695134       Statistics Collecting Time       622098614       Elapse       2403480
Target Device       CC3220 UART         Connection Status       Connected         Testing Status       Rx Running         Details       Cox18 (CC3220R5)         Chip ID       0x18 (CC3220R5)         Fitting Times       C10005134         Chainel       6 (2437MHz)         Chainel       6 (2437MHz)         Details       Chainel         Chip ID       0x18 (CC3220R5)
Connection states     Connection       Testing Status     Rx Running       Details     Addr Mismatch       Chip ID     0x18 (CC3220R5)         Timestamp (µs)
Testing Status     Rx Running       Details     Addr Mismatch     0       Packets     MgMnt frame     -75       Get Statistics     Stop Rx Testing       Chip ID     0x18 (CC3220R5)
Details         FCS Error         74         Packets         DataCtrl frame         -83         dBm         Get Statistics         Clear Statistics           Chip ID         0x18 (CC3220R5)         Timestamp (µs)         Timestamp (µs)         Clear Statistics         Clear Statis<
Chip ID Ox18 (CC3220R5) Timestamp (µs)
POM Ver 0v00 Starting Time 619695134 Statistics Collecting Time 622098614 Elapse 2403480
FW Ver. 3.4.0.0 , 31.2.0.0.0 , 2.2.0.5 RSSI Rate
Host Driver Ver. 2.0.1.21 > -48dBm 0.00 % 1Mbps 73.80 % 18Mbps 0.00 % MCS 2 0.00 %
MAC Addr. W R C8:FD:19:07:FC:78 -48dBm to -55dBm 0.00 % 2Mbps 0.00 % 24Mbps 1.48 % MCS 3 0.00 %
-56dBm to -63dBm 0.00 % 5.5Mbps 0.00 % 36Mbps 0.00 % MCS 4 0.00 %
CC3220 App Ver. 0.9 -64dBm to -71dBm 25.09 % 11Mbps 1.85 % 48Mbps 0.00 % MCS 5 0.00 %
Radio Tool Library Version
CC31XX UART 1.0.3.2 < -79dBm 19.93 % 9Mbps 0.00 % MCS 0 0.00 % MCS 7 0.00 %
CC32XX UART 1.0.3.1 O Amount  Percentage 12Mbps 0.00 % MCS 1 0.00 %
Show Graph O Amount  Percentage Show Graph
INSTRUMENTS Clear Log Export Log Copy to Clipboard Online Tool Guide About
[4/10/2018 3:36:29 EM] Rx Testing Finished (4/10/2018 3:37:36 EM] Rx Testing Started
(4/10/2018 3:38:28 PM) Rx Testing Stated
[4/10/2018 3:38:33 FM] Rx Testing Started [4/10/2018 3:38:34 FM] Rx Testing Finished
(4/10/2018 3:38:36 PM) RX Testing Sinished (4/10/2018 3:38:36 PM) RX Testing Started
4/10/2018 3:38:43 PMI Rx Testing Finished
[4/10/2018 3:38:48 PM] Rx Testing Started



You can also click on the Show Graph buttons to show a bar graph representation of rates or RSSI.

Figure 7-6 shows the RSSI histogram graph in amounts.

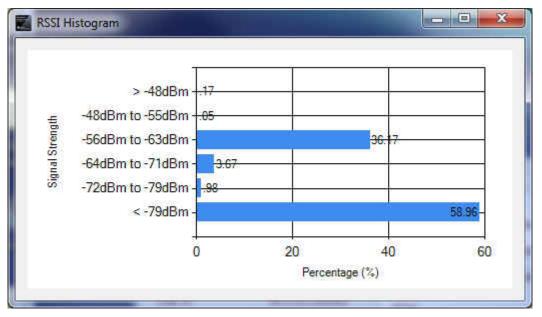
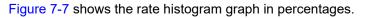


Figure 7-6. RSSI Histogram Graph in Amount



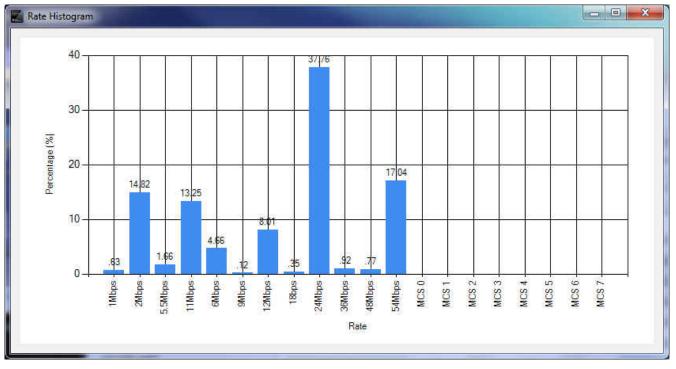


Figure 7-7. Rate Histogram Graph in Percentage

#### 8 Current Measurement

The current measurement tab (Figure 8-1) contains two options for static current measurements for a predefined amount of time. The first mode is Low Power down and the second more is Hibernate. By using this tab, the device's current consumption when in a low-power state can be observed with an external current measuring tool.

CC31XX/CC32XX Radio Tool v1.0.3.2		- 🗆 X
Radio Tool	Set Up TX RX Current	
Target Device CC3220 UART	Current Options	
Connection Status Connected	● Low Power ○ Hibernate Duration in sec 10 🔶 5	Start Current
Testing Status Idle		
Details		
Chip ID 0x18 (CC3220RS)		
ROM Ver. 0x00		
FW Ver. 3.4.0.0 . 31.2.0.0.0 . 2.2.0.5		
Host Driver Ver. 2.0.1.21		
MAC Addr. W R C8:FD:19:07:FC:78		
CC3220 App Ver. 0.9		
Radio Tool Library Version		
CC31XX SPI 1.0.3.2		
CC31XX UART 1.0.3.2		
CC32XX UART 1.0.3.1		
TEXAS		
<b>INSTRUMENTS</b>	Clear Log Export Log Copy to Clipboard Online	e Tool Guide About
	d, Mode=Packetized, CH=CHANNEL_8, PW=0, Rate=RATE_54M, Preamble=L4 tern=ALL_0_PATTERN, CCA=0, CCA_T=SL_TX_INHIBIT_THRESHOLD_DEFAULT,	
01:23:45:67:89:AB, Country=US [4/10/2018 11:18:22 AM] Tx Stoppi		
[4/10/2018 11:18:22 AM] Tx Testin	g Finished	
[4/10/2018 11:18:31 AM] Rx Testin [4/10/2018 11:19:24 AM] Rx Testin		
[4/10/2018 11:19:48 AM] Set power	command.	~

Figure 8-1. Current Tab Modes



#### 9 CLI Version

The CLI tool provides a traditional command line version of the Radio Tool. This version is especially useful when performing large-scale automated testings. The RadioToolCLI.exe application is in the Radio Tool Application directory. Use CMD or batch files to execute the commands.

```
Usage: RadioToolCLI -X [-P=port] [-B=baud] [-M] [-F] [-T|-R|-POW]
       RadioToolCLI [-h|--help] [-i|--info]
Options:
Miscellaneous:
  -h, --help
                             Shows this message
  -i, --info
                             Shows RadioToolCLI and radio tool library version and information.
                             increase debug message verbosity
  -77
Device Connection:
                             The TARGET testing device. 0:CC3120 SPI, CC3135 SPI, 1:CC3120 UART,CC3135 UART 2:CC32X0
  -X, --target=TARGET
                               UART, CC3235 UART. REQUIRED. Range: [0, 2]. Default: 1
  -P, --port=VALUE
                             The port number of the target testing platform.
                               Required for UART connections. Range: [0, 255].
  -B, --baud rate=BAUD RATE The BAUD RATE of the target COM port.
                               Required for UART connections. Range: [0, Int32.MaxValue].
  -M, --mac
                             Returns the MAC address
  -C, --new mac=VALUE
                             Set device MAC address WITHOUT colons. For example, if the MAC address is 01:23:45:67:89:
                               AB, enter 0123456789AB instead. Case insensitive.
                             Returns the firmware version and CC32xx application version (if applicable) in the
  -F, --firmware
                               following order:
                               Chip ID, ROM version, Firmware version, Host Driver version, CC32xx App version, MAC
                               address.
Common for TX and RX:
  -t, --duration=DURATION
                             RX/TX Testing DURATION in seconds for -T and -R options. Range: [1, 65535]. Default: 1
  -c, --channel=CHANNEL
                             RX/TX Testing CHANNEL for -T and -R options. Range: 2.4GHz[1, 13] 5GHz[36-169]. Default:
                             1
  -k, --enable acks
                             TX ACKs enabling (For Rx mode). Default: disabled.
TX (Transmission):
  -T, --tx
                             TX testing for Continuous or Packetized.
  -z, --tx type=TX TYPE
                             TX Testing TX TYPE. 1:Continuous, 2:Packetized, 3:CW. 'tone offset' option can be used if
                               and only if CW is chosen. Range: [1, 3]. Default: 1.
  -w, --power=POWER
                             TX POWER attenuation for Continuous and Packetized testing. 0 being the maximum power and
                               15 being the minimum power.Range: [0, 15]. Default: 0
  -f, --tone offset=TONE OFFSET
                             TX TONE OFFSET for CW testing only. A value of N means tone at offset N*312.5kHz.
                               Range: [-25, 25]. Default: 0
  -m, --rate, --modulation=MODULATION
                             TX Testing rate (with the corresponding MODULATION). Range: [1, 20]. Default: 1 (1Mbps
                               DSSS).
                               1: 1 Mbps (DSSS)
                               2: 2 Mbps (DSSS)
                               3: 5.5 Mbps (CCK)
                               4: 11 Mbps (CCK)
                               5: NOT SUPPORTED
                               6: 6 Mbps (OFDM)
                               7: 9 Mbps (OFDM)
                               8: 12 Mbps (OFDM)
                               9: 18 Mbps (OFDM)
                               10: 24 Mbps (OFDM)
                               11: 36 Mbps (OFDM)
                               12: 48 Mbps (OFDM)
                               13: 54 Mbps (OFDM)
```



	14: MCS 0 15: MCS 1
	16: MCS 2
	17: MCS 3
	18: MCS 4 19: MCS 5
	20: MCS 6
	21: MCS 7
-e,preamble=VALUE	TX preamble for 802.11 rates ONLY. Long:0, Short:1. Default: Long
-r,pattern=VALUE	TX data pattern. See the following for the complete list. Default: 0 (All 0) 0: All 0
	2: Incremental
	3: Decremental
-l,packet_size=SIZE -q,delay=VALUE	TX Testing packet SIZE. Range: [24, 1400]. Default: 1400 TX delay in between packets in milliseconds. Packetized TX only. Range:[100, 1,000,000].
-g,delay-value	Default: 100
-n,amount=VALUE	TX maximum number of packets. Continuous & Packetized only. Range:[0, 1,000,000]. 0 for infinite amount. Default: 0
-o,cca override	TX CCA override enable. Default: non-overriding.
-s,cca_threshold=VALUE	TX CCA threshold value. The channel is considered as occupied when signal strength is
	above this setting. Default: 2 (-68dBm)
	0: MIN (-88dBm)1: LOW (-78dBm)2: DEFAULT (-68dBm)3: MED (-58dBm)4: HIGH (-48dBm)5: MAX ( -38dBm)
-a,dest mac=MAC	TX destination MAC address WITHOUT colons. For example, if the MAC address is 01:23:45:67:
-	89:AB, enter 0123456789AB instead. Case insensitive. Default: 01:23:45:67:89:AB
-y,country_code=VALUE	TX Country Code in two ASCII characters. Letters will be converted to upper case. Options: US, EU, JP. Default: US
RX (Reception):	
-R,rx	RX testing and retrieves statistics. The statistics will be shown as: 1st line: <# valid packets>, <# FCS error packets>, <# address mismatch packets>
	2nd line: <average frame="" in="" management="" rssi="">, <average frame="" in="" other="" rssi="">&gt;</average></average>
	3rd line: RSSI historgram. <greater -48dbm="" than="">, &lt;-48dBm to -55dBm&gt;, &lt;-56dBm to -63dBm&gt;</greater>
	, <-64dBm to -71dBm>, <-72dBm to -79dBm>, <less -79dbm="" than=""></less>
	4th line: Rate historgram, lowest to highest. The list order is identical to the rate/ modulation option.
	5th line: Timestamps in micro-seconds: Starting time, Stats collecting time, Elapse
-d,report period=N	RX statistics reporting period, every N seconds. If set to 0, RX statistics will only
—	report at the end.
	Range: [0, 65535]. Default: 0
-p,report_percent Pow (Power):	Report RX histogram in percentage format. If not set, default is in amount of packets.
POW,pow=VALUE	
POW_CMD_LOW,power	
	Set power command.
POW CMD HIB,power	1-100: Low Power time
	Set hib command.
	1-100: Hib Power time
Please contact TI for any qu	estion with regards to this program.

Example commands follow:

::Show the help page RadioToolCLI.exe -h ::Show the help page RadioToolCLI.exe --help ::Show the help page RadioToolCLI.exe /h ::Show the Firmware version and MAC address of CC31xx via UART RadioToolCLI.exe -X1 -P7 -B115200 -F ::TX Continuous ::CC31xx via SPI ::channel 1 ::1Mbps DSSS ::max power ::packet size 1400bytes ::destination MAC address 01:23:45:67:89:AB ::infinite amount of packets ::long preamble ::all 0 pattern ::1 second testing time RadioToolCLI.exe -X0 -T ::TX Continuous ::CC31xx via UART ::channel 1 ::54Mbps OFDM ::max power ::packet size 1400bytes ::destination MAC address 01:23:45:67:89:AB :: infinite amount of packets ::long preamble ::all 0 pattern ::10 seconds testing time RadioToolCLI.exe -X1 -P7 -B115200 -T -z1 -c1 -m13 -w0 -l1400 -a 0123456789AB -n0 -e0 -r0 -t10 ::TX Packetized ::CC32xx via UART ::channel 1 ::1Mbps DSSS ::max power ::packet size 512bytes ::destination MAC address EE:EE:EE:0E:EE ::100ms delay ::long preamble ::incremental pattern

RadioToolCLI.exe -X2 -P7 -B115200 -T -z2 -c1 -m1 -w0 -1512 -a EEEEEEEE0EEE -n0 -e0 -r1 -t10



::TX CW ::CC31xx via SPI ::channel 6 ::1Mbps DSSS ::-10 OFFSET (-3.125Mhz) RadioToolCLI.exe -X0 -T -z3 -c6 -m1 -f -10 -t10 ::RX ::CC31xx via UART ::channel 6 ::show as number of packets ::20 seconds testing time ::only report statistics at the end RadioToolCLI.exe -X1 -P7 -B115200 -c6 -R -t20 ::sample output 693, 64, 0 -64, -64 128, 128, 211, 10, 2, 158, 184 171504, 20212985, 20041481 RX Finished: SUCCESS ::RX ::CC31xx via UART ::channel 11 ::show as percentage ::5 seconds testing time ::report statistics every 1 second ::verbose RadioToolCLI.exe --target=1 --port 7 /baud rate 115200 -c11 /R -d=1 /t=5 -v ::sample output Connecting... Connected RX Testing Started RX Testing Started. The program will last 5 second(s) and report every 1 second(s). 54, 1, 0 -52, 0 31, 31, 0, 21, 0, 0, 2 174708, 1227552, 1052844 113, 3, 0 -59, -79 48, 48, 1, 36, 0, 3, 25 1227567, 2222249, 994682 63, 1, 0 -54, 0 29, 29, 0, 30, 0, 0, 4 2222264, 3236292, 1014028 77, 2, 0 -57, -54 33, 33, 1, 31, 5, 0, 7 3236306, 4250366, 1014060



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#### **10 Insertion Loss Calibration**

The TX power levels and RX sensitivity numbers quoted in the data sheet are at the device RF pin. Additional losses due to onboard filter, PCB trace, connectors, and cables used to connect to the external RF equipment should be accounted for separately by adding their insertion losses.

On the TI EVMs, the onboard filter insertion loss is typically 1 dB (maximum of 1.35 dB); the PCB trace plus RF connector loss is approximately 0.4 dB. These losses must be accounted for while evaluating the performance. If you have a different filter or a different trace on your PCB, you must measure the insertion loss separately. The insertion loss of the cable used to connect the EVM to the external equipment can be measured using a network analyzer.

#### 11 Hardware Connections on Non-TI EVMs

To use the Radio Tool on platforms other than TI EVMs, the interface signals from the emulation board can be wired to the corresponding pins on the custom platform (see Table 11-1, Table 11-2, and Table 11-3). The signal voltage level from the emulation board LaunchPad is 3.3 V, and the  $V_{CC}$  level is 3.3 V. This  $V_{CC}$  can also be used to power the CC31xx and CC32xx devices on the custom platform. Make sure the I/O voltage levels between the emulation board and the device on the EVM are the same.

#### Table 11-1. Connections for CC31XXEMUBOOST to a Custom CC31xx Platform (UART Connection)

Table 11-1. Connections for COSTAALMODOCOT to a Custom COSTAAT fationin (CART Connection)					
Signal Name	CC31xx Pin	CC31XXEMUBOOST Pin			
VCC		P1.1			
UART1_TX	55	P1.3			
UART1_RX	57	P1.4			
UART1_CTS	61	P4.4			
UART1_RTS	50	P4.5			
GND		P2.1			
nHIB	2	P1.5			

#### Table 11-2. Connections for CC31XXEMUBOOST to a Custom CC31xx Platform (SPI Connection)

Signal Name CC31xx Pin CC31XXEMUBOOST Pin				
Signal Name	CC31XX PIN	CC31XXEMUBOOST Pin		
VCC		P1.1		
SPI_CLK	5	P1.7		
SPI_MOSI	6	P2.6		
SPI_MISO	7	P2.7		
SPI_CSn	8	P2.3		
IRQ	15	P2.2		
GND		P2.1		
nHIB	2	P1.5		

#### Table 11-3. Connections From CC32xx-LAUNCHXL to a Custom CC32xx Platform

Signal Name	CC32xx Pin	CC32xx-LAUNCHXL Pin (Rev B)
VCC		J12 pin 2 (remove J12 jumper)
UART1_TX	55	J7 pin 3 (remove J7 jumper)
UART1_RX	57	J6 pin 3 (remove J6 jumper)
GND		P2.1



#### 12 Source Code for Developers

#### 12.1 RadioTool Application Sources

Source codes of the Radio Tool are in the RadioToolApplication\_Source directory of the installation location. Users need the following:

- Visual Studio 2015 (minimum)
- Full-featured IAR Workbench for Arm (check SDK release notes for the proper IAR version to use)
- Code Composer Studio IDE

#### 12.2 CC32xx Application Source

The CC32xx onboard application source is in the CC32xxBoardApplication\_Source directory. Simply copy this source into the example folder of the CC32xx SDK. Use CCS or IAR to open the project workspace.

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