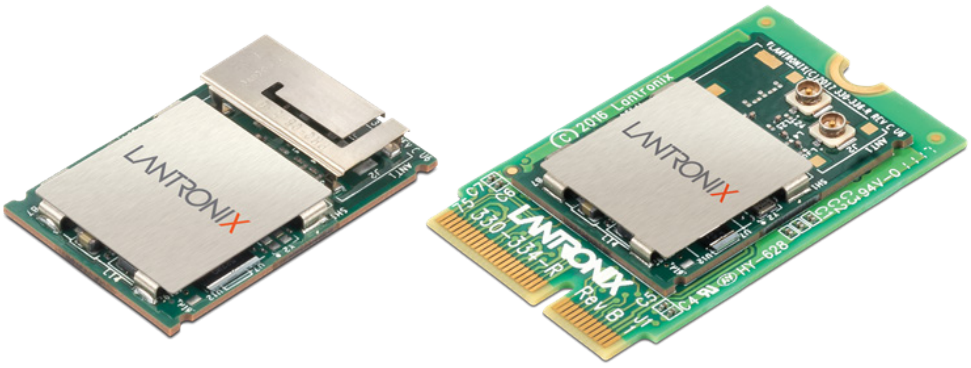
Application Note:

xPico 200® Certification Firmware Instructions



Lantronix, Inc.
7535 Irvine Center Drive
Suite 100
Irvine, CA 92618
Tel: +1 (949) 453-3990

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Contacts

Lantronix, Inc.
7535 Irvine Center Drive, Suite 100
Irvine, CA 92618, USA
Toll Free: 800-526-8766
Phone: 949-453-3990
Fax: 949-453-3995

Technical Support
Online: www.lantronix.com/support

Sales Offices
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This equipment has to be tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device is intended only for OEM Integrators. The OEM integrator should be aware of the following important considerations.

Revision History

Date	Rev.	Comments
April 2018	A	Preliminary Draft.

For the latest revision of this product document, please check our online documentation at www.lantronix.com/support/documentation.

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Overview

This document provides instructions on how to leverage Lantronix® xPico® certificates. In many cases, the Lantronix modular transmitter certification can be leveraged without acquiring full re-certification effort in products which use the Lantronix module.

The xPico 200 series has modular approval for FCC, IC, EU, Japan, China and Australia/New Zealand. All xPico certificates can be found in the xPico 200 module documentation at https://www.lantronix.com/products/xpico-200/#docs-downloads/.

It is recommended that you consult with your certification laboratory to develop your certification plan for your product that includes the xPico 200 series module. The xPico 200 series module certification tests were completed at Bureau Veritas in Hsinchu, Taiwan.

Requirements for Leveraging Lantronix xPico 200 Certificates

To leverage Lantronix modular transmitter certifications, the following are required:

- Following the antenna and layout instructions in the *xPico 200 Series Integration Guide*.
- Using antennas of similar type and equal or less gain than the antennas listed in the *xPico 200 Series Integration Guide*.
- Positioning the xPico 200 module at least 20 cm from a human body and the transmitting antennas at least 20 cm from another transmitter. Lantronix has not completed SAR testing on the xPico 200 module.
- Running EMC tests including the FCC 15-part B and EN 301 489 -1/-17. When leveraging the modular certification, the transmitter and receiver-specific tests normally do not need to be done.
- Placing certifications for the xPico 200 transmitter IDs for various regions on the end-product label according to conditions listed in the *Compliance* section of the *xPico 200 Series Data Sheet.* See https://www.lantronix.com/products/xpico-200/#docs-downloads.
- Running two certification testing modes. See *Certification Test Modes*.

Disqualifications to Leveraging of Lantronix xPico 200 Certificates

The following conditions disqualify the leveraging of Lantronix xPico 200 certifications:

- Using a different type of antenna than shown in the *xPico 200 Series Integration Guide*.
- Using an antenna with higher gain than the antennas called out in the *xPico 200 Series Integration Guide*.
- Installing the xPico 200 module antenna in a location where it is expected to be less than 20 cm from a human body. Under this scenario, SAR testing would need to be completed.
- Installing the xPico 200 module antenna within 20 cm of another transmitter module.
- Installing the xPico 200 module in a country or region not referenced in the *Compliance* section of the *xPico 200 Series Data Sheet.* See https://www.lantronix.com/products/xpico-200/#docs-downloads.

Certification Test Modes

Certification testing requires two different modes. The number of units needed for certification testing depends on the regional certifications planned. Consult with your certification lab prior to testing for their recommended quantity of normal mode and continuous mode test units.

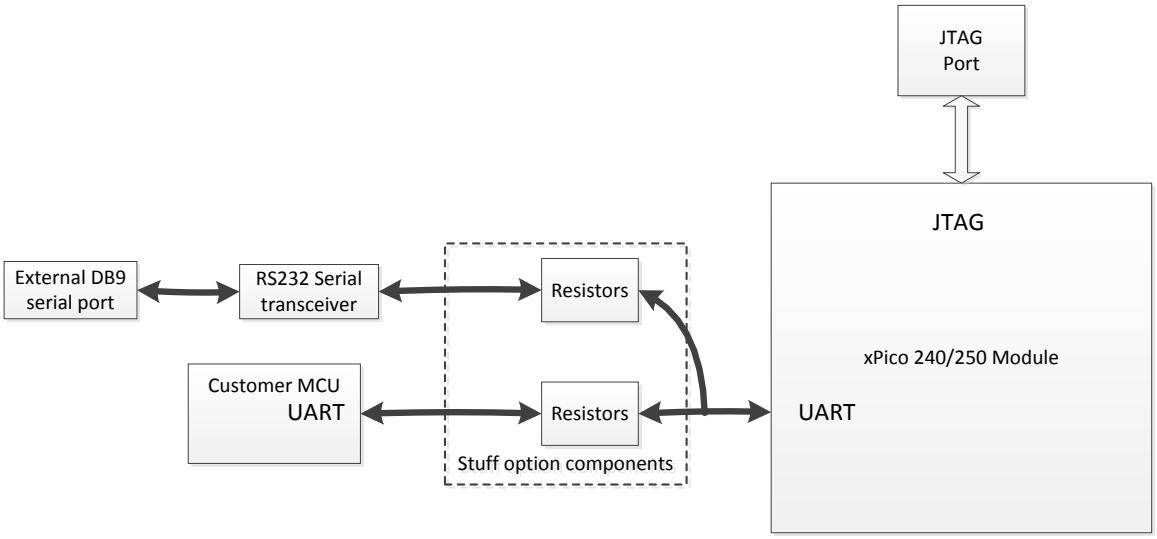
- **Normal mode testing** is conducted with the xPico 200 module running the base application software. In this case the unit should be configured to run tests with the module interfaces both idle and fully exercised. For Ethernet and Wi-Fi interfaces iperf or some other network utilization method can be used, serial and USB ports should utilize a similar program to exercise used ports for certification EMC tests.
- **Continuous mode testing** is conducted in cases where full transmitter certification or re-certification is required. The certification lab will require testing on some units that run continuous mode transmitter and receiver tests. Special firmware needs to be loaded on the xPico 200 module to run the continuous transmit and receive mode tests. Once the continuous mode firmware is loaded, the unit will no longer run or load the standard Lantronix application firmware or SDK generated firmware. As a result and prior to certification, some units should be set aside for continuous mode only testing.

Hardware Requirements for Continuous Mode Testing

These are the hardware requirements needed for continuous mode testing. The continuous mode software can be downloaded at https://www.lantronix.com/products/xpico-200/#docs-downloads/.

- To run the xPico 240/250 transmitter and receiver tests for full certification access to the module, serial port and JTAG port are needed.
- The JTAG port connections are required to load a special firmware image that allows continuous transmit, continuous receive and other tests required for transmitter certification.
- The JTAG pad footprint from the evaluation board should be used to mate to an external JTAG cable. Lantronix uses the Olimex ARM-USB-TINY-H debugger mated to a Tag-connect TC2050-ARM2010 and TC2050-IDC cable for connection to the JTAG port on the xPico 240/250 evaluation board.
- In addition to the JTAG connection, access to the xPico 240/250 UART is required for transmitter and receiver certification tests. Lantronix suggests adding a stuff option to the serial port if the serial port is connected to another device. An example of this connection is shown below. This will allow the certification lab to break into the module UART lines and directly control the module UART during continuous mode testing for certification.

Figure 1: Recommended Stuff Option for Transmitter Certification Tests



See the evaluation board schematic and artwork for recommended transceiver, DB9, and JTAG port connections in the *xPico 200 Series Evaluation Kit User Guide*.

Wi-Fi Continuous Mode Software Installation

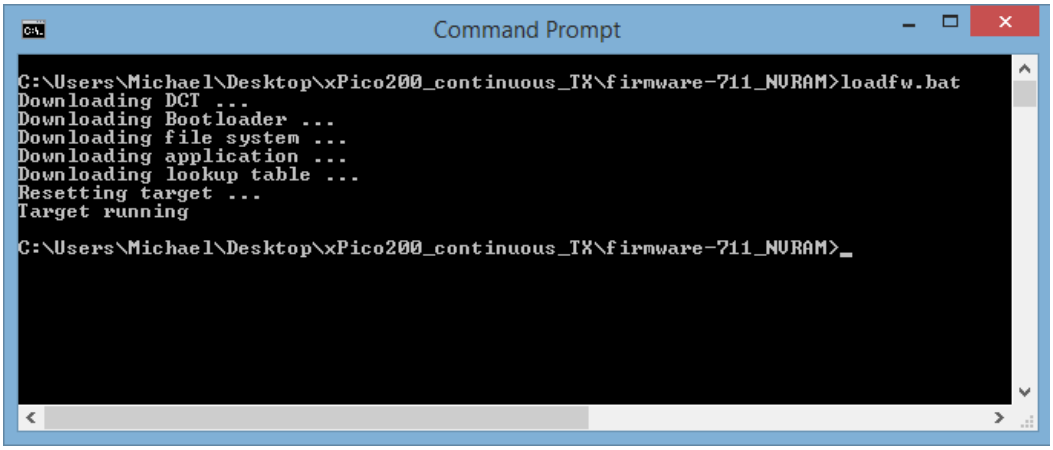
First download the Wi-Fi continuous mode software to use the module for continuous mode testing for certification. Once downloaded and powered up, you will no longer be able to load the standard Lantronix firmware and the module can only be used for continuous mode testing for certification.

1. Download the xPico 200 continuous mode software at https://www.lantronix.com/products/xpico-200/#docs-downloads/.
2. Copy the `xPico200_continuous_tx` directory to the desktop of your PC.
3. Connect the `Olimex ARM_USB_Tiny_H` adapter to your PC and UUT.

   Note: *You will need the Tag-Connect adapter and cable to connect your Olimex to the JTAG port on the evaluation board. Required Tag Connect part numbers TC2050-ARM2010 and TC2050-IDC*
4. Install the appropriate `Zadig` driver for the Olimex on your PC.
5. Open a command prompt and CD to this directory:

   `\Desktop\xPico200_continuous_tx\firmware-711_NVRAM`
6. Power up the unit and run the `loadfw.bat` script to load the continuous mode firmware.

Figure 2: Wi-Fi Continuous Mode Software Installation



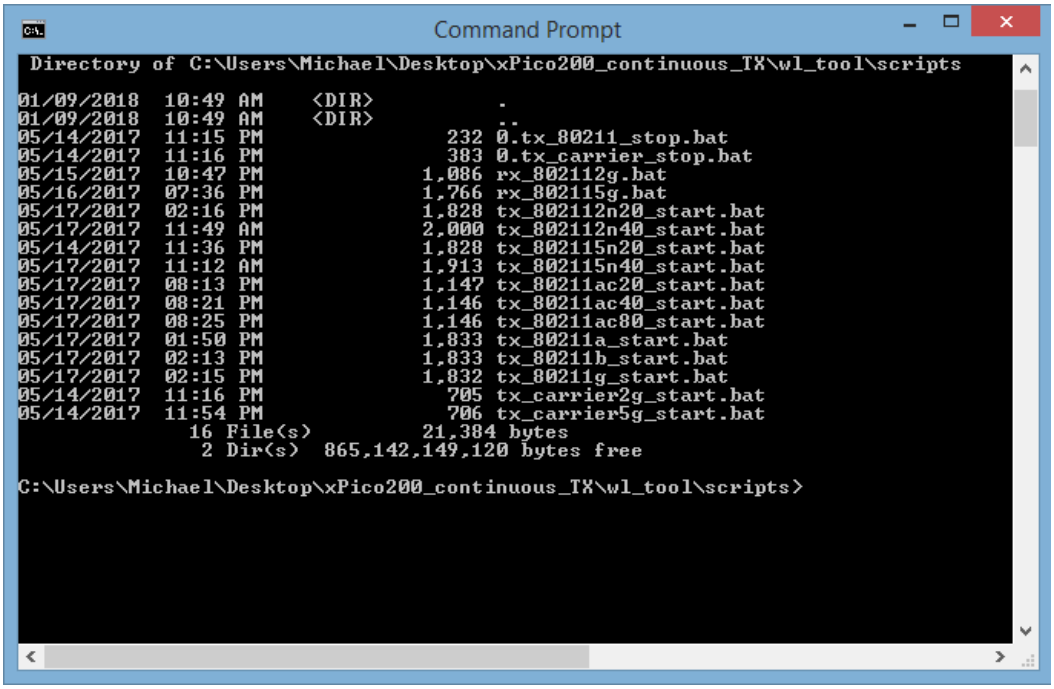
Running the Wi-Fi Continuous Mode Tests

Run the Lantronix xPico 200 continuous mode scripts using the steps below. These scripts are based on the Cypress WL tool commands for the Cypress processor inside of the xPico 200 module. For more information on WL tool commands please see the Cypress reference document at http://www.cypress.com/file/385966/download.

1. Open up a command prompt and CD to the directory below. This directory has the scripts you will need to start and stop the transmit tests.

   ```
   ..\Desktop\xPico200_continuous_tx\wl_tool\scripts
   ```

Figure 3: CD to Scripts Directory



2. Edit the `.bat` files as necessary to change the **bit rate** and **channel number**.
3. On all of the script files you will need to edit the file to call out your serial port. The line below sets the serial port. The example below shows the serial port is set to COM3.

   ```
   set comport=%1 3
   ```

4. The command below sets the channel which is the entry after the -c item. The example below utilizes 36.

   ```
   ..\wl%target% --serial %comport% chanspec -c 36 -b 5 -w 20 -s 0
   ```

   Notes:
   - *For the `-c` item use the desired channel for your test. A full channel listing is provided in the compliance section of the data sheet.*
   - *The `-w` item changes the bandwidth, either 20 or 40.*
   - *The `-b` item sets the band, either 2 or 5 for 2.4 Ghz and 5 Ghz.*
   - *You should not need to change the bandwidth or band in the batch files as separate script files are included for each band and bandwidth.*

5. Edit the line below in the files to change the bit rate.

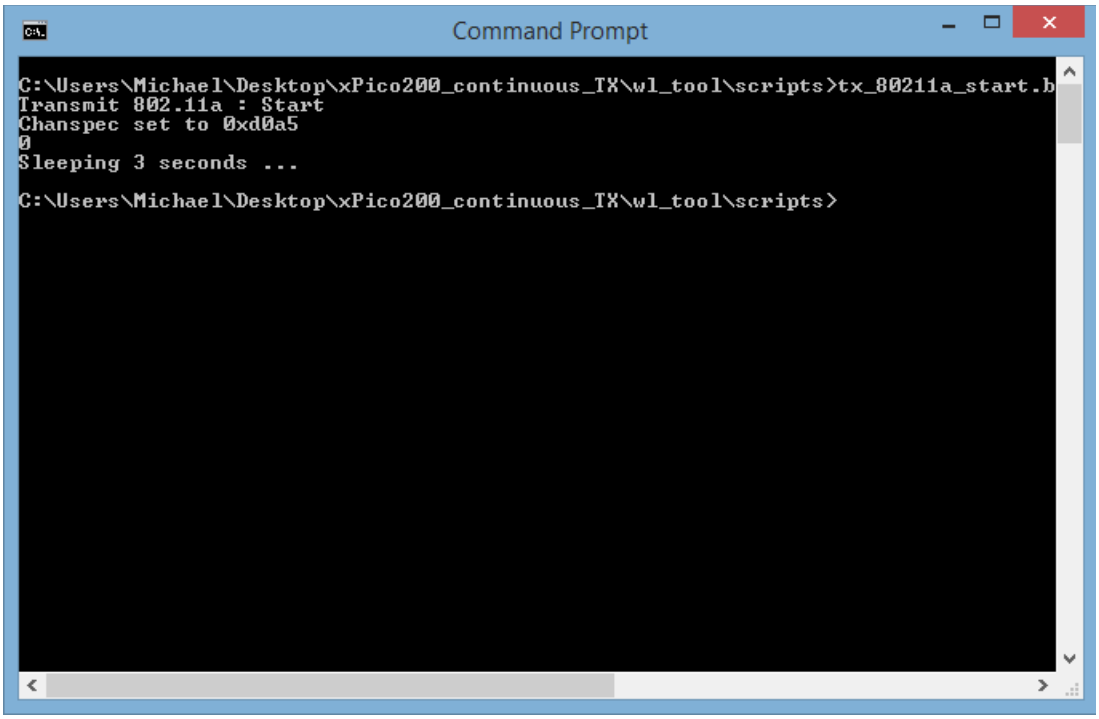
   ```
   ..\wl%target% --serial %comport% nrate -r 54
   ```

   - This line is for 80211a/g rates.
   - Acceptable values 1,2,5.5,11, 6, 9, 12, 18, 24, 36, 48, 54

   ```
   ..\wl%target% --serial %comport% nrate -m 0
   ```

   - This line is for 802.11n rates.
   - Acceptable values 0 to 7.

6. To run a script at the command prompt, type the file name of the script. For example, running the 802.11a transmit script type `tx_80211a_start.bat` at the command prompt.



7. To stop the transmit use the `0.tx_80211_stop.bat` script.
8. RX tests can be done with the `rx_80211.bat` script.
9. Carrier only tests use the `tx_carrier_start.bat` script.

Table 1: Full Wi-Fi Test Script Listing

Script	Purpose
`0.tx_80211_stop.bat`	Stops 802.11 transmitter tests.
`0.tx_carrier_stop.bat`	Stops the transmitter carrier tests.
`rx_802112g.bat`	Starts the 802.11 2.4Ghz receive mode test.
`rx_802115g`	Starts the 802.11 5Ghz receive mode test.
`tx_80211a_start`	Starts the 802.11a transmitter test.
`tx_80211b_start`	Starts the 802.11b transmitter test.
`tx_80211g_start`	Starts the 802.11g transmitter test.
`tx_802112n20_start`	Starts the 802.11n 2.4 Ghz, 20 Mhz bandwidth transmitter test.
`tx_802115n20_start`	Starts the 802.11n 5 Ghz, 20 Mhz Bandwidth transmitter test.
`tx_802115n40_start`	Starts the 802.11n 5 Ghz, 40 Mhz Bandwidth transmitter test.
`tx_carrier2g_start`	Starts the 802.11 2.4 Ghz carrier only test.
`tx_carrier5g_start`	Starts the 802.11 5 Ghz carrier only test.

Bluetooth Continuous Mode Testing

The steps in http://www.cypress.com/file/298091/download describe how to run the Lantronix xPico 200 Bluetooth continuous mode scripts. These scripts are based on the Cypress `mybluetool` commands for the Cypress processor inside of the xPico 200 module.

Loading BT Continuous Firmware

Download the continuous mode BT firmware using the same process as used to load the continuous Wi-Fi firmware. Once downloaded and powered up, you will no longer be able to load the standard Lantronix firmware and the module can only be used for continuous mode testing for certification.

1. Download the xPico 200 continuous mode software at https://www.lantronix.com/products/xpico-200/#docs-downloads/.
2. Copy the `xPico200_bt_test` directory to the desktop on your PC.
3. Connect the `Olimex ARM_USB_Tiny_H` adapter to your PC and UUT.

   Note: *You will need the Tag-Connect adapter and cable to connect your Olimex to the JTAG port on the evaluation board. Required Tag Connect part numbers TC2050-ARM2010 and TC2050-IDC.*
4. Install the appropriate `Zadig` driver for the Olimex on your PC.
5. Open a command prompt and CD to directory: `..\Desktop\xPico200_bt_test\bt`
6. Power up the unit and run the `loadfw.bat` script to load the continuous mode firmware.

Running the BT Test Modes

1. Follow the instructions for each type of test in the Cypress document: http://www.cypress.com/file/298091/download
2. You will need to set the COM port to the COM port on your PC

   `set MBT_COM_PORT=COMxx` (where `COMxx` is the comport on your PC)

   `set MBT_BAUD_RATE=3000000` (this should equal the baud rate for your COM port)
3. Power up the unit.
4. Assert the module reset pin and then wait 10 seconds.
5. Run the `mbt reset` command to reset the unit.
6. Make sure the reset command results with success per the message example for the reset test in the Cypress document.
7. Choose which of the BT tests you need to run and follow the command sequences in the Cypress document.

Table 2: BT Test Commands

BT Test Command	Description
`mbt reset`	This command resets the BT device on the module. Run this prior to running any other certification test. Also, can be used to stop any of the running BT tests.
`mbt le_receiver_test <rx_channel>`	This command runs the le receiver test. rx_channel = receive frequency minus 2402 divided by 2. Acceptable channels are 0 to 39 where 0 is 2402Mhz and 39 is 2480 Mhz.
`mbt le_transmitter_test <tx_channel> <data_length> <data_pattern>`	This command runs the LE transmit test. tx_channel = receive frequency minus 2402 divided by 2. Acceptable channels are 0 to 39 where 0 is 2402 Mhz and 39 is 2480 Mhz. Data_length acceptable values are 0 to 37. Data_pattern acceptable values are 0 to 7. Data Pattern Definitions 0: Pseudo-random bit sequence 9 1: Pattern of alternating bits: 11110000 2: Pattern of alternating bits: 10101010 3: Pseudo-random bit sequence 15 4: Pattern of all 1s 5: Pattern of all 0s 6: Pattern of alternating bits: 00001111 7: Pattern of alternating bits: 0101
`mbt le_test_end`	The LE test end script stops the LE transmitter or LE receiver tests.

BT Test Command	Description
`mbt tx_frequency_arm <carrier On/Off> <tx_frequency> <tx_mode> <tx_modulation_type> <tx_power>`	This test turns on or off the transmitter carrier. carrier on/off: 1: carrier on 0: carrier off tx_frequency: 2402 MHz to 2480 MHz tx_mode: selects unmodulated or modulated with pattern 0: Unmodulated 1: PRBS9 2: PRBS15 3: All Zeros 4: All Ones 5: Incrementing Symbols tx_modulation_type: selects 1 Mbps, 2 Mbps, or 3 Mbps modulation. Ignored if mode is unmodulated. 0: GFSK 1: QPSK 2: 8PSK 3: LE tx_power: –25 dBm to +13 dBm
`mbt receive_only <rx_frequency>`	This test instructs the BT radio to receive on a specific frequency. Rx_frequency: 2402 to 2480

BT Test Command	Description
`mbt radio_tx_test <bd_addr> <frequency> <modulation_type> <logical_channel> <bb_packet_type> <packet_length> <tx_power>`	This command runs the connectionless transmitter test. bd_addr: BD_ADDR of Tx device (6 bytes), for example 00112233445566 frequency: Set to 0 to use a normal Bluetooth hopping sequence, or 2402 MHz to 2480 MHz to transmit on a specified frequency without hopping. modulation_type: Sets the data pattern 0: 0x00 8-bit Pattern 1: 0xFF 8-bit Pattern 2: 0xAA 8-bit Pattern 3: 0xF0 8-bit Pattern 4: PRBS9 Pattern logical_channel: Sets logical channel to Basic Rate (BR) or Enhanced Data Rate (EDR) for ACL packets. 0: EDR 1: BR bb_packet_type: Baseband packet type to use 3: DM1 4: DH1/2-DH1 8: 3-DH1 10: DM3/2-DH3 11: DH3/3-DH3 14: DM5/2-DH5 15: DH5/3-DH5 packet_length: 0 to 65535. The device will limit the maximum packet length based on the baseband packet . type. For example, if DM1 packets are sent, the maximum packet size is 17 bytes. tx_power: –25 dBm to +3 dBm

BT Test Command	Description
`mbt radio_rx_test <bd_addr> <frequency> <modulation_type> <logical_channel> <bb_packet_type> < packet_length>`	This test sets the BT radio to receive on a specific frequency and sends reports about received packets. bd_addr: BD_ADDR for the remote Tx device (6 bytes) frequency: Frequency to listen to from 2402 MHz to 2480 MHz modulation_type: Sets the data pattern to compare received data 0: 0x00 8-bit pattern 1: 0xFF 8-bit pattern 2: 0xAA 8-bit pattern 3: 0xF0 8-bit pattern 4: PRBS9 pattern logical_channel: Sets the logical channel to BR or EDR for ACL packets 0: EDR 1: BR bb_packet_type: Sets the packet type of the expected packets 3: DM1 4: DH1/2-DH1 8: 3-DH1 10: DM3/ 2-DH3 11: DH3/3-DH3 14: DM5/2-DH5 15: DH5/3-DH5 packet_length: 0 to 65535. The device compares the length of the received packets with the specified packet_length.

BT Test Command	Description
`mbt connectionless_dut_loopback_mode COMx`	This command sets up a connectionless loopback test with an external tester for analyzing both RX and TX. Once the connectionless command is entered the unit will prompt for the interactive arguments below. Remote_Device_BD_ADDR: BD_ADDR of the remote transmitting device. [Size: 6 bytes] LT_ADDR: The logical transport address of the BT link. [Size: 1 byte] [Range: 0x01 - 0x07] Number_Of_Tests: The number of tests to be =executed. [Size: 1 byte] [Range: 0x01 - 0x10] The following arguments repeat depending on the number of tests: Retry Offset: When a timeout occurs, subtract the offset to go back to the earlier test. [Size: 6 bits {31:26} in little endian uint32] [Range: 0x01 - 0x3f]. Number_Packets: Number of packets to be received for this test. [Size: 15 bits {25:11} in little endian uint32] [Range: 0x01 - 0x7fff]. TxPowerIndex: Power table index to use. [Size: 3 bits {10:8} in little endian uint32] [Range: 0x00 - 0x07]. RxChannel: Frequency offset in MHz from 2402 MHz. [Size: 7bits {7:1} in little endian uint32] [Range: 0x00 - 0x7f]. Packet Table Type: Defines the type of the packet. [Size: 1bit {0:0} in little endian uint32]. 0x0: Basic Rate Packet Types 0x1: EDR packet types Retry Time Out: The time required to retry. [Size: 1 byte] [Range: 0x01 - 0xff]. Test Scenarios: [Size: 1 byte]. 0x0: RX-TX Loop Back Mode 0x1: RX only with BER stats.