CTACLIUG

Connectivity Test Application Command Line Interface User Guide

Rev. 0 — 9 February 2023 **User guide**

Document information

Information	Content
Keywords	CTACLIU, Connectivity Test Application, Command Line Interface (CLI), User Guide, Packet Error Rate (PER) menu, Range Test menu, Data Transmission
Abstract	This document describes the Command Line Interface (CLI) options provided with the 812.15.4 Connectivity Test application.

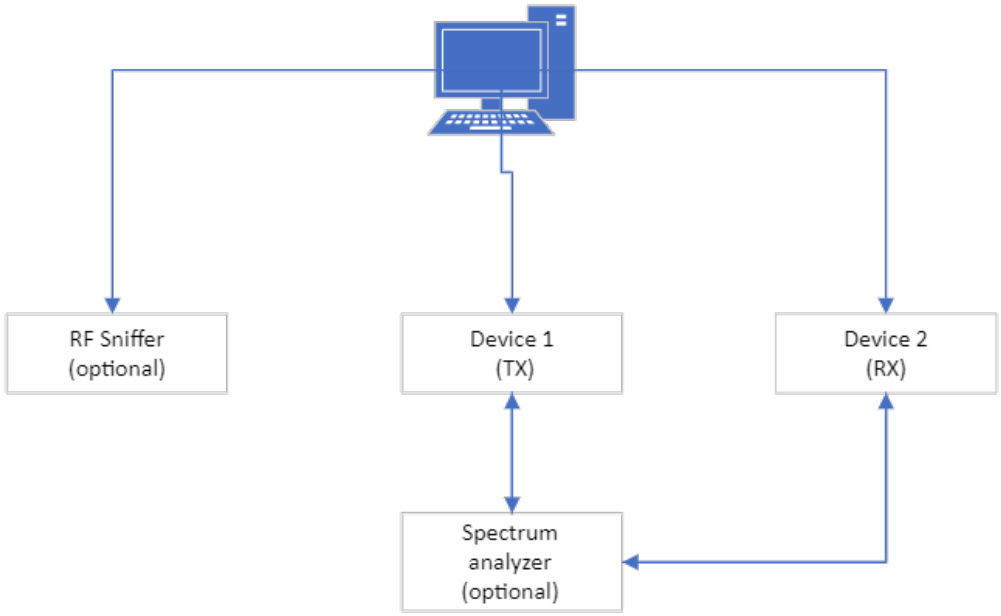
1 Introduction

This document describes the Command Line Interface (CLI) options provided with the **812.15.4 Connectivity Test application**. The application provides tests for measuring transmission between two or more devices. This document also provides the test description, configuration, setup, and steps to perform the test using the application.

2 Connectivity Test application setup

The Figure 1 describes the Connectivity Test Application possible configurations.

Figure 1. Connectivity Test Application Test bed possible configuration



2.1 Test bed description

- Running the Connectivity Test Demo Application requires a PC and two devices.
- Connectivity Test Application CLI is accessed using the serial port of the devices.
- Some features of the Connectivity Test Application like **Packet Error Rate** or **Range Tests** require the usage of two devices.
- For capturing over the air traffic, an RF sniffer can be used.
- For tests where the output power or the modulated output power of the radio should be measured, a spectrum analyzer should be used.

3 Connectivity Test CLI

3.1 CLI initialization and description

The Figure 2 shows how the Command Line Interface (CLI) menu of the **812.15.4 Connectivity Test application** appears at start-up:

Figure 2. Connectivity Test Demo CLI at start-up

Press “**Enter**” on the message prompt. The full CLI menu is displayed as shown in Figure 3.

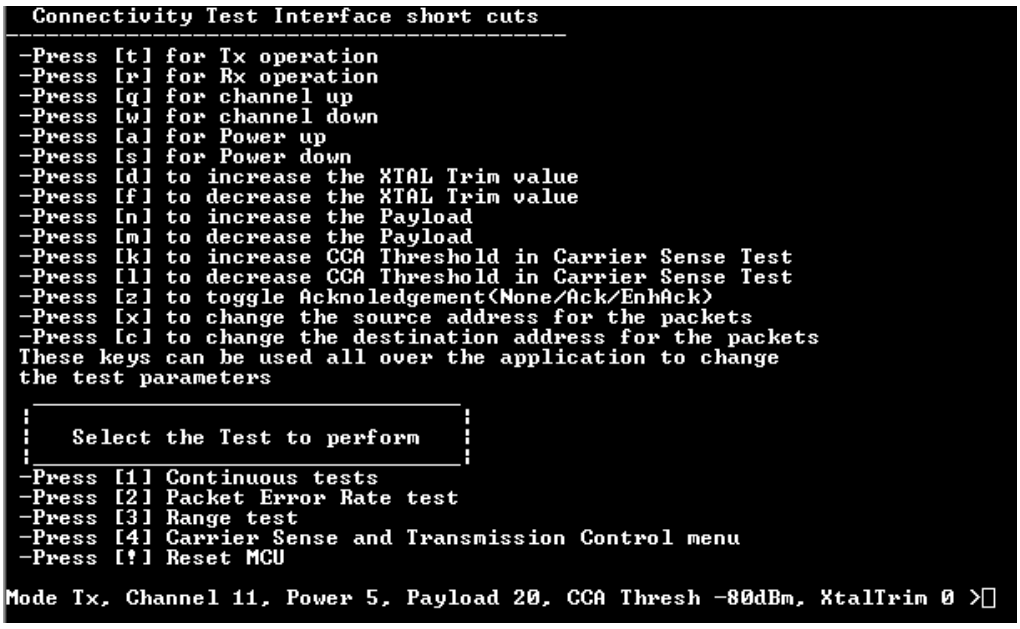


Figure 3. Connectivity Test Demo CLI

The CLI is divided into three main categories:

1. **Shortcuts**: This category provides configuration options that can be used in the tests performed. Shortcuts can be used within any accessed test menu to change the test parameters.
2. **Tests**: This category provides the test that can be performed. Each test category numbered from 1 to 4 contains additional options.
3. **Device state**: This category indicates the current state of the device. The device state can be modified according to user preference by using the shortcut keys available by the CLI. Device state is displayed

within any test menu and is refreshed every time a shortcut command is issued. Device state is not shown when tests are in progress.

3.2 CLI shortcut command description

Commands from this section are used for configuring the device. All the shortcut commands modifications, except **[x]** and **[c]**, are displayed in the device state.

Shortcut commands cover the following configuration settings:

1. **Device operation mode**:
   - **[t]**: configures the device in **transmitter** mode
   - **[r]**: configures the device in **receiver** mode
2. **Channel settings:**
   - Channel number range between [11-26], default value = 11
   - **[q]**: **increments** channel number
   - **[w]**: **decrements** channel number
3. **Output power settings:**
   - Output power range between [0-32], default value = 5
   - **[a]**: **increments** output power
   - **[s]**: **decrements** output power
4. **Crystal trim value settings:**
   - XTAL trim range between [0-127], default value = 0
   - **[d]**: **increases** XTAL trim value
   - **[f]**: **decreases** XTAL trim value
5. **Data payload length settings:**
   - **[n]: increases** the data payload length
   - **[m]**: **decreases** the data payload length
6. **CCA threshold settings:**
   - CCA Threshold range between [0-110], default value=80
   - **[k]**: **increases** CCA Threshold in Carrier Sense Test
   - **[l]**: **decreases** CCA Threshold in Carrier Sense Test
7. **Packet acknowledgment settings:**
   - Default value = NoAck.
   - **[z]**: sets Acknowledgement requirement (NoAck/Ack/EnhancedAck).
8. **Packet source/address settings:**
   - Source address default value = 0xBEAD
   - Destination address default value = 0xFFFF
   - **[x]**: sets **source** address for packets
   - **[c]**: sets **destination** address for packets

3.3 CLI test description

Four major test categories are exposed through Connectivity Test Application:

1. **Continuous tests**
2. **Packet Error Rate Test**
3. **Range Test**
4. **Carrier Sense and Transmission Control**

3.3.1 Continuous Test menu

The Continuous Test menu displays the following modes of operation:

1. **Idle mode**: This mode sets the transceiver into Idle mode.
2. **Burst PRBS transmission using packet mode**: This mode verifies the transceiver operational state by transmitting over the air a Pseudo Random Binary Sequence payload of 65 bytes.
3. **Continuous modulated transmission**: This mode generates and loads a PRBS9 pattern into transceiver's TX buffer and is used to verify the modulated output power of the transceiver.
4. **Continuous unmodulated transmission**: This mode sets the transceiver to continuously transmit an unmodulated carrier (CW) and is used to measure the output power of the transceiver.
5. **Continuous reception**: This mode sets the transceiver into Receive sequence.
6. **Continuous energy detect**: This mode sets the transceiver to perform the Energy Detection operation. It returns the maximal energy on the specified channel.
7. **Continuous scan**: This mode returns values of Energy Detect operation performed on all RF channels.
8. **Continuous CCA**: This mode performs Continuous Clear Channel Assessment (CCA) procedure and returns whether the specified channel is Busy or Idle.

3.3.2 Packet Error Rate (PER) menu

The Packet Error Rate (PER) test mode is used to measure the sensitivity of the radio based on packet reception. The content of this menu is strictly related to the operation mode of the device.

PER test can be performed in three different modes:

1. Transmission *without expected acknowledgement*.
2. Transmission *with expected acknowledgement*.
3. Transmission *with expected enhanced acknowledgement*.

3.3.2.1 Steps to perform a PER test

The steps to perform a PER test procedure are as follows:

1. Set the source and destination address of the transmitter device. For example, `source=0xaaaa`, `destination=0xbbb`. (Any other address can be chosen instead.)
   See Figure 4.

```
Change src address (AAAA) [0-9 a-z symbols] >aaaa
Mode Tx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
Change dst address (BBBB) [0-9 a-z symbols] >bbbb
Mode Tx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
```

Figure 4. PER Test: Set source and destination addresses on TX side

2. Set the source and destination address of the receiver device. For example, `source=0xbbbb`, `destination=0xaaaa` (Any other addresses can be chosen instead). See Figure 5.

```
Change src address (BBBB) [0-9 a-z symbols] >bbbb
Mode Rx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
Change dst address (AAAA) [0-9 a-z symbols] >aaaa
Mode Rx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
```

Figure 5. PER Test: Set destination and destination addresses on RX side

3. Set the receiver device to run.
4. Set the transmitter device to run.

3.3.2.2 Packet error rate when the device is set as transceiver

When the device is set to Transmitter mode, it prompts the user to indicate the following:

- The number of packets that should be transmitted during the test.
- The transmission interval between two consecutive packets.

See Figure 6.

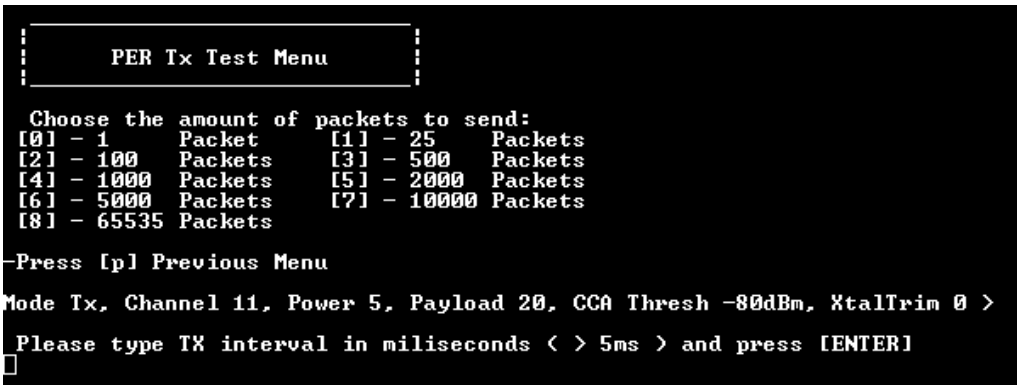


Figure 6. Configuring PER for TX device with no ACK

If the acknowledgment setting has not been previously defined, users can decide whether acknowledgment should be present or not.

The type of acknowledgments that can be used by issuing shortcut commands can also be set.

See Figure 7.

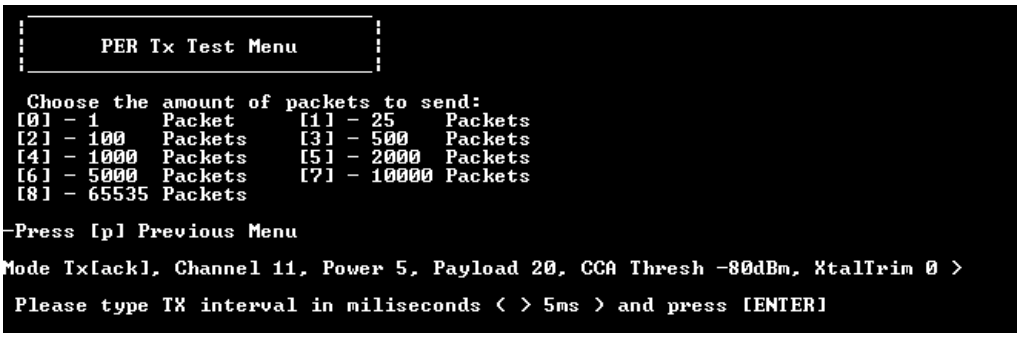


Figure 7. Configuring PER for TX device with ACK

See Figure 8.

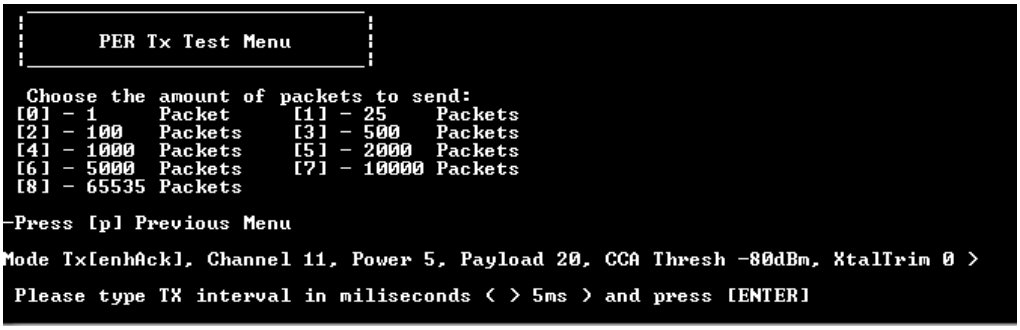


Figure 8. Configuring PER for TX device with Enhanced ACK

With everything being set, the device starts transmitting the packets over the air as shown in Figure 9.

Figure 9. Running PER on TX side

The packet or sequence of packets that have not been acknowledged are indicated on the transmitter CLI. This is applicable for transmissions with acknowledgement or enhanced acknowledgment set, if the receiver device does not send an acknowledgment as required. See Figure 10.

Figure 10. Example of not acknowledged packets

3.3.2.3 Packet error rate menu when the device is set as receiver

When the device is set to receiver mode, the user is only asked to start or stop the receiving sequence as shown in Figure 11.

Figure 11. PER menu interface for RX device

After the receiving sequence begins, incoming packages with destination address set to device's destination address are shown in Figure 12.

```
PER Test Rx Running

Packet 1. Packet index: 1. Rssi during RX: -97
Packet 2. Packet index: 2. Rssi during RX: -97
Packet 3. Packet index: 3. Rssi during RX: -97
Packet 4. Packet index: 4. Rssi during RX: -97
Packet 5. Packet index: 5. Rssi during RX: -97
Packet 6. Packet index: 6. Rssi during RX: -97
Packet 7. Packet index: 7. Rssi during RX: -97
Packet 8. Packet index: 8. Rssi during RX: -97
Packet 9. Packet index: 9. Rssi during RX: -97
Packet 10. Packet index: 10. Rssi during RX: -97
Packet 11. Packet index: 11. Rssi during RX: -97
Packet 12. Packet index: 12. Rssi during RX: -97
Packet 13. Packet index: 13. Rssi during RX: -97
Packet 14. Packet index: 14. Rssi during RX: -97
Packet 15. Packet index: 15. Rssi during RX: -97
Packet 16. Packet index: 16. Rssi during RX: -97
Packet 17. Packet index: 17. Rssi during RX: -97
Packet 18. Packet index: 18. Rssi during RX: -97
Packet 19. Packet index: 19. Rssi during RX: -97
Packet 20. Packet index: 20. Rssi during RX: -97
Packet 21. Packet index: 21. Rssi during RX: -97
Packet 22. Packet index: 22. Rssi during RX: -97
Packet 23. Packet index: 23. Rssi during RX: -97
Packet 24. Packet index: 24. Rssi during RX: -97
Packet 25. Packet index: 25. Rssi during RX: -97

Average Rssi during PER: -97 dBm

PER Test Finished

Received 25 of 25 packets transmitted
```

Figure 12. Running PER on RX side

3.3.3 Range Test menu

This is a simple and quick test in which data packets are exchanged between two devices.

- On the transmitter side, the device initiates the data transfer and expects to receive a packet containing the same data payload. An average RSSI calculation is performed based on the incoming packet's RSSI and the number of sent packets. If the receiving packet does not contain the same data payload, RSSI calculation is not performed, and a 'packet dropped' message is shown in CLI.
- On the receiver side, the device sends back the message to originator.

Range tests can be performed in three different modes:

1. Transmission without expected Acknowledgment.
2. Transmission with expected Acknowledgment.
3. Transmission with expected Enhanced Acknowledgment

3.3.3.1 Steps to perform a Range Test procedure

The steps to perform a Range Test procedure are as follows:

1. Set the source and destination address of the transmitter device: `source=0xaaaa`, `destination=0xbbb`. (Any other addresses can be chosen). See Figure 13.

```
Change src address (AAAA) [0-9 a-z symbols] >aaaa
Mode Tx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
Change dst address (BBBB) [0-9 a-z symbols] >bbbb
Mode Tx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
```

Figure 13. Range Test: Set the source and destination addresses on TX side

2. Set the source and destination address of the receiver device.
   For example, `source=0xbbbb`, `destination=0xaaaa`. (Any other addresses can be chosen).
   See Figure 14.

```
Change src address (BBBB) [0-9 a-z symbols] >bbbb
Mode Rx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
Change dst address (AAAA) [0-9 a-z symbols] >aaaa
Mode Rx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
```

Figure 14. Range Test: Set the source and destination addresses on RX side

3. Set the receiver device to run as shown in Figure 15.

```
 ____________________
|   Range Rx Test Menu   |
|____________________|

-Press [space bar] to start/stop Receiving Packets
-Press [p] Previous Menu

Mode Rx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >

Range Test Rx Running
```

Figure 15. Range Test: Set the RX device to run

4. Set the transmitter device to run.
   TX device CLI messages are shown in Figure 16 and Figure 17.

```
 ____________________
|   Range Tx Test Menu   |
|____________________|

-Press [space bar] to start/stop Transmiting Packets
-Press [p] Previous Menu

Mode Tx, Channel 11, Power 5, Payload 20, CCA Thresh -80dBm, XtalTrim 0 >
```

Figure 16. Range Test: TX device CLI messages

```
Range Test Tx Running

 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm
 RSSI = -97 dBm

Range Test Tx Stopped

Average RSSI      -97 dBm
Packets dropped 0
```

Figure 17. TX device CLI messages

5. Receiver device CLI messages are as shown in Figure 18.

Figure 18. Range Test: RX device CLI messages

3.3.4 Carrier Sense and Transmission Control Select menu

3.3.4.1 Carrier Sense Test with unmodulated input signal

This test performs a “manual” Clear Channel Assessment procedure. First, an energy request procedure is done to obtain the RSSI on the specified channel. Then, the obtained RSSI is compared against CCA threshold value, which can be manually set by issuing shortcut commands **[l]** and **[k].**

If the obtained RSSI value for the specified channel is greater than the CCA threshold value, then the channel is considered busy, no transmission is issued on that channel and another energy detect request is started. This is shown in the Figure 19.

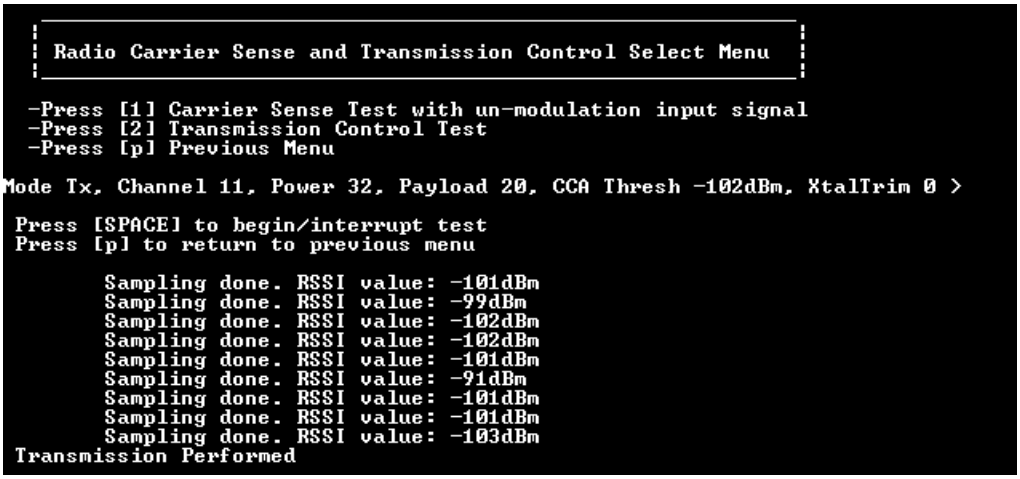


Figure 19. Carrier Sense Test when RSSI is greater than CCA Threshold

However, if the obtained RSSI value for the specified channel is lower than the CCA Threshold value, then the channel is considered as Idle. It indicates that a transmission has occurred and therefore, the test ends. This is shown in the Figure 20.

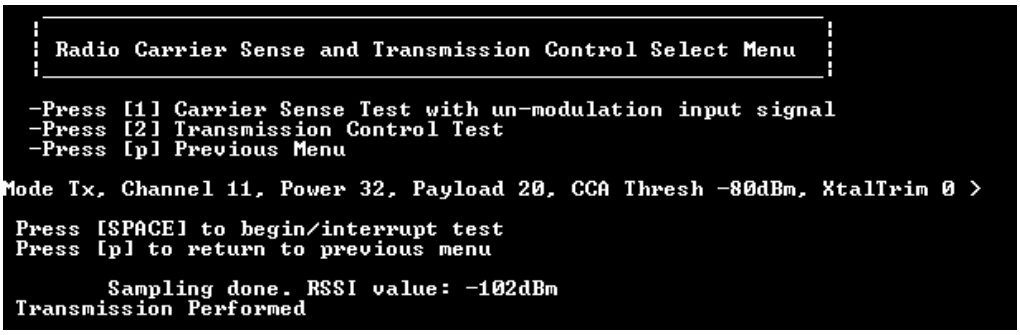


Figure 20. Carrier Sense Test when RSSI is lower than CCA Threshold

3.3.4.2 Transmission Control test

The Transmission Control test performs data transmissions over the air using user-specified options.

The data payload is composed from a predefined data buffer that copies as many bytes as the '`device state payload data length setting`' indicates.

Before any transmission, the test performs an energy detect procedure to obtain the RSSI value of the specified channel. This value is displayed on the side of a message that indicates a message has been sent over the air.

3.3.4.2.1 Steps to perform a Transmission Control Test

Figure 21 illustrates the Transmission Control Test menu.

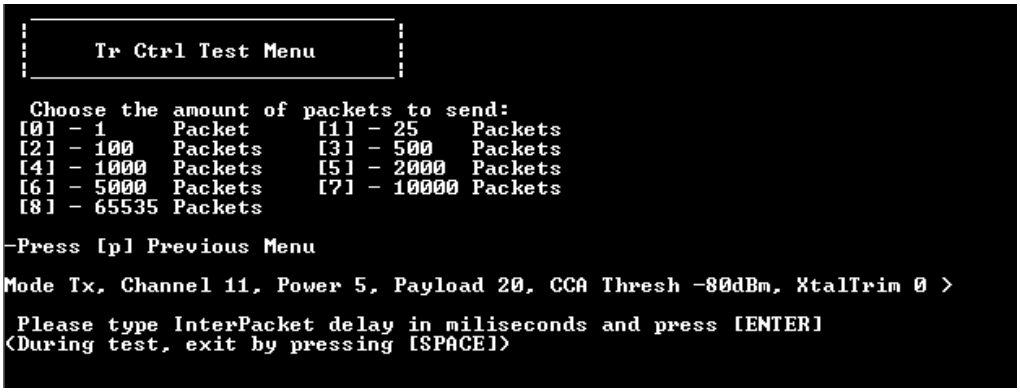


Figure 21. Transmission Control Test menu

The process to conduct the Transmission Control Test is as follows:

1. Select the number of packets to be sent.
2. Specify the inter-packet delay. (Transmission delay between two consecutive packets).

Figure 22 shows this process.

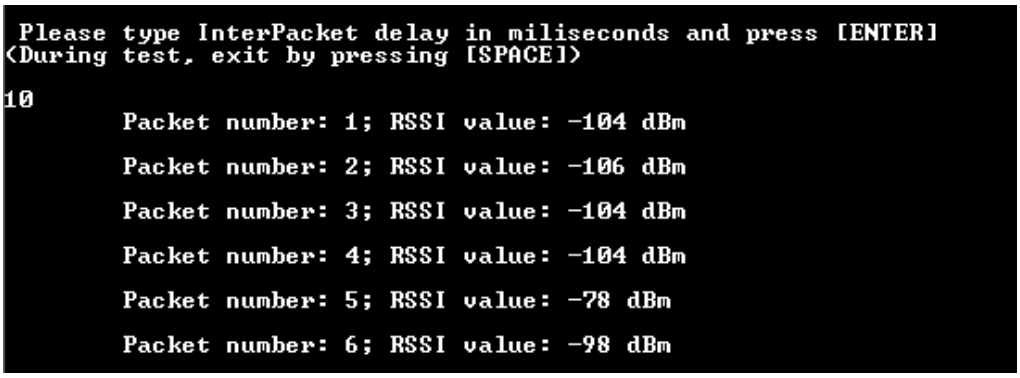


Figure 22. Transmission Control Test execution

This test also calculates an approximation of time needed to perform the Overhead + Transmission + Energy Detect procedure.

If the inter-packet delay has a value lower than the estimation previously calculated, a corresponding message is shown, and the test finishes the execution as shown in Figure 23.

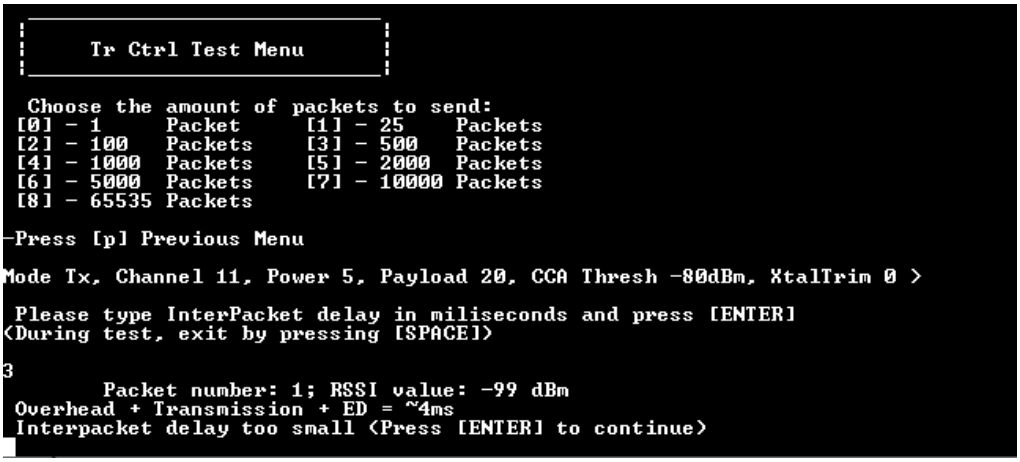


Figure 23. Transmission Control Test – Inter-Packet delay error

4 Revision history

Table 1 summarizes revisions to this document.

Table 1. Revision history

Revision number	Date	Substantive changes
0	9 Feb 2023	Initial release

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