

# Application note: Dialog DA14531



## Setup for RF testing with RTX2254

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## 4 RTX2254 Bluetooth Tester Setup

The RTX2254 Bluetooth RF Tester is a highly optimized, automated instrument for RF test on Bluetooth Low Energy (BLE) devices in the manufacturing environment.

RTX2254 support both the RF test to be performed in DTM or Advertising mode.

The DUT firmware must support DTM using either HCI or 2-wire protocol or support peripheral device sending out periodic advertising packets with 20 to 10240 ms interval.

### 4.1 Hardware setup for measuring in Direct Test Mode

Connect the hardware as shown in Figure 1.

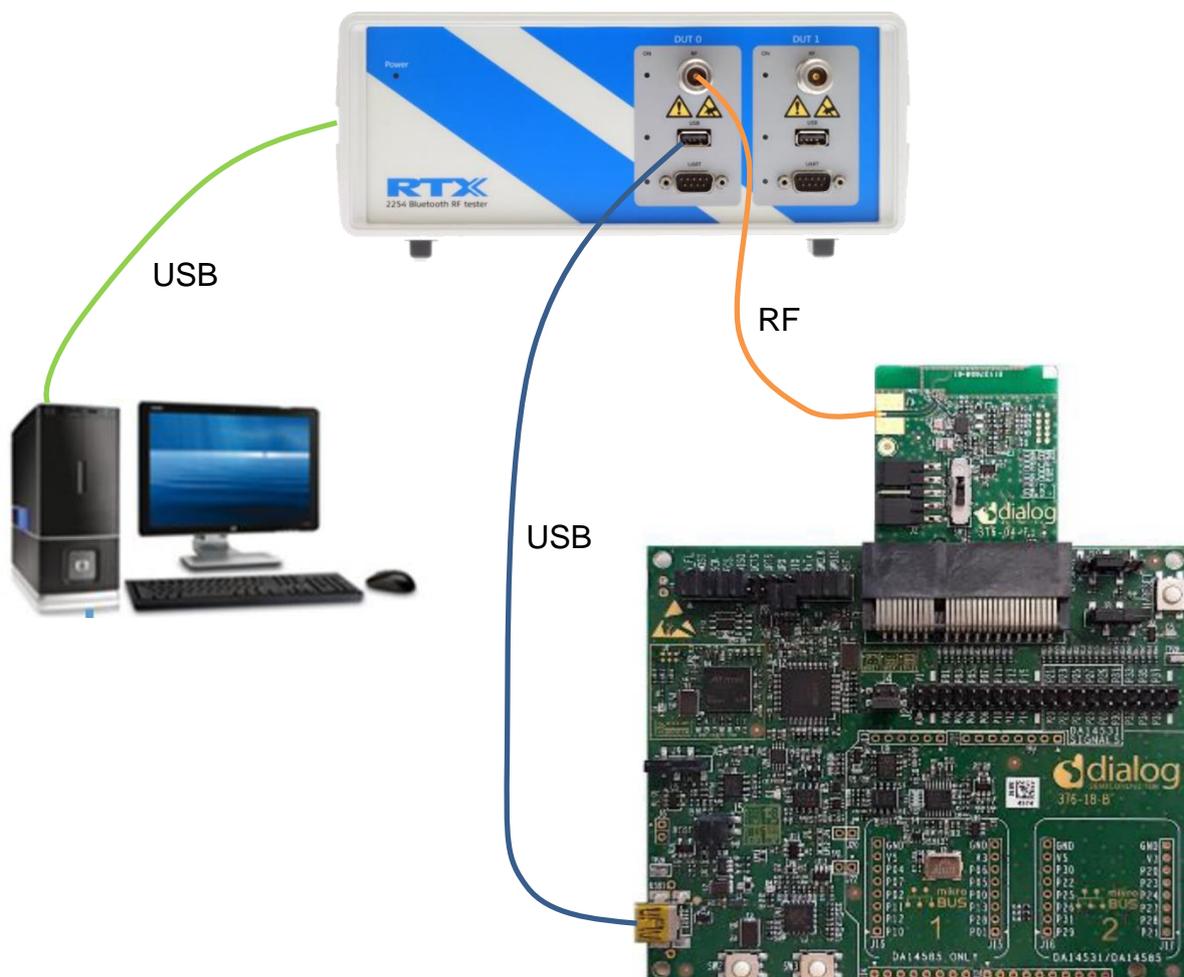
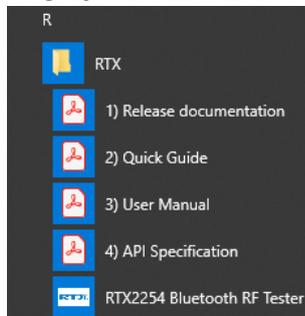


Figure 1: RTX2254 connections to Dialog Pro-DK board installed with DA14531 EVK.

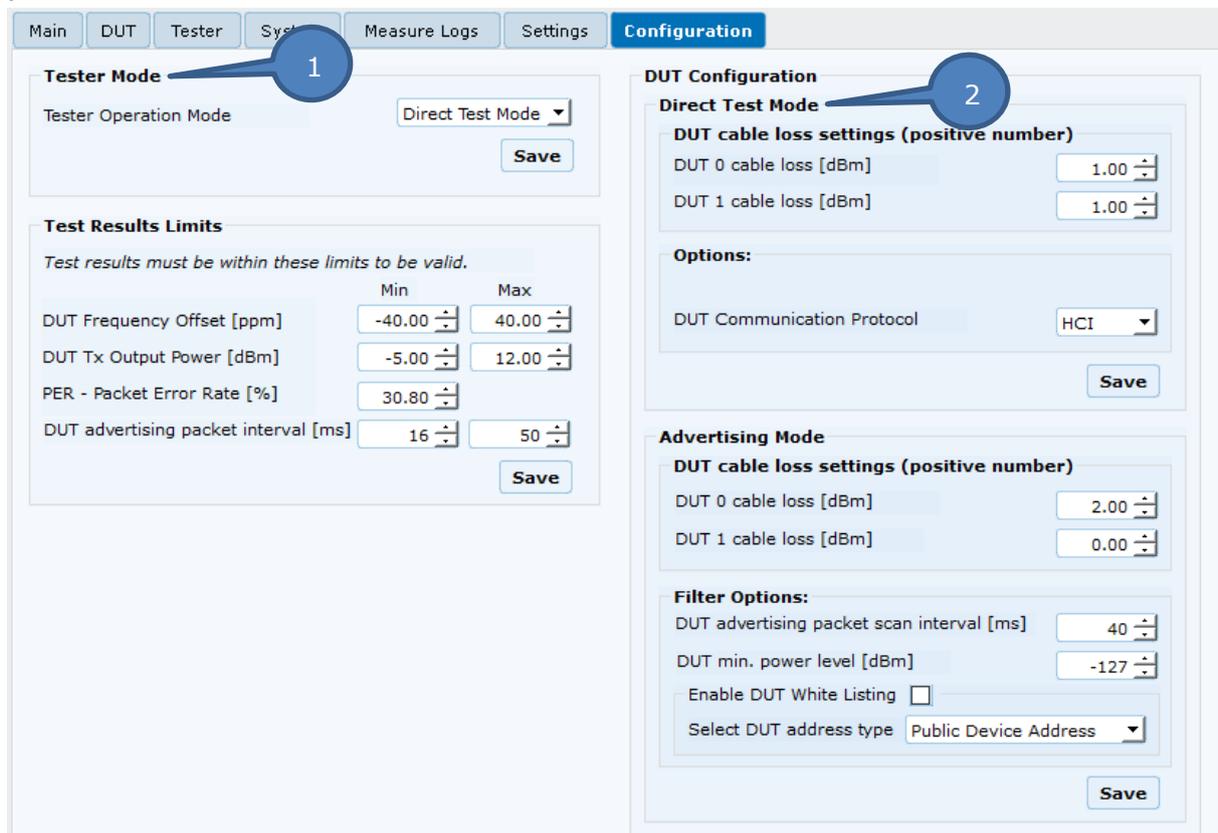
## 4.2 Configuration for RF measurements in Direct Test Mode

Start the application "RTX2254 Bluetooth RF tester" from the Windows menu



RTX2254 application

Setup the tester Mode and DUT communication Protocol in **Configuration** pane:



### 1. **Tester Mode**

Select Direct Test Mode in subsection and press save

### 2. **DUT Configuration**

#### **Direct Test Mode**

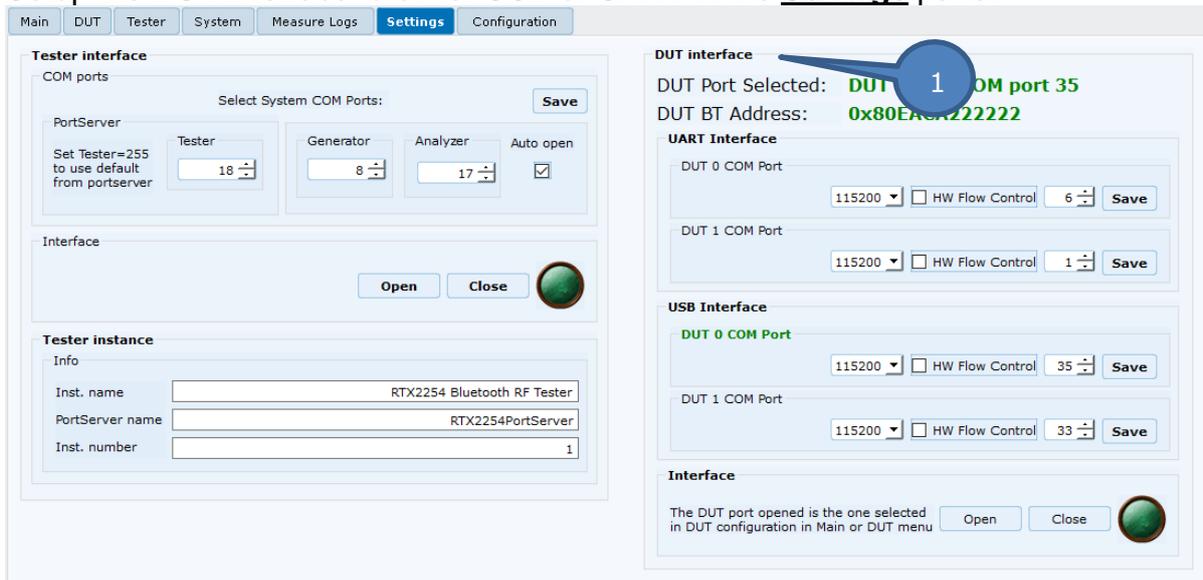
#### **DUT cable loss settings**

DUT 0/1 cable loss: Setup to relevant RF cable loss between DUT and RTX2254

#### **Options:**

Select HCI as DUT Communication protocol in subsection and press save.

Setup the DUT interface to either USB or UART in the **Settings** pane:



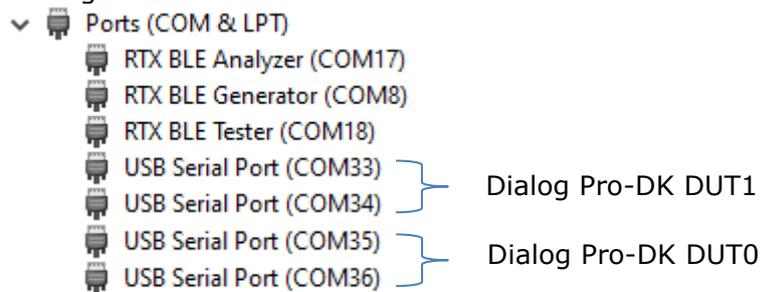
**1. DUT Interface:**  
**USB Interface**

USB: 115200 Baud, no HW flow control, COM port # \*

\*The virtual COM ports used by both RTX2254 and the DUT can be found in the Windows Device manager. Please note that Pro-Dk will have 2 virtual comports (Figure 2) with consecutive numbers, where the lowest number must be used for the required HCI communication.

The example in figure 2 show two Dialog Pro-DK units connected to a dual-ported RTX2254.

Figure 2:



**Interface**

Open the Interface to the DUT

## Setup the criteria for the measurements in **Main** pane.

Key settings to configure:

### 1. Setup

#### PER Test – Packet Parameters:

- No. of Packets: Typical 500
- Payload Type: Set to one of 8 different packet types, e.g. RANDOM9 (PRBS9) or ALTBITS\_10101010
- Gen. Power: Set to required RX measurement level, e.g. -85 dBm

#### DUT Port Selection

- Select RF ports: Either DUT0 RF or DUT1 RF (Only relevant on RTX2254 with 2 ports)
- Select DUT interface: Select the USB port connected to the DUT (DUT0 or DUT1)

#### Open Interface

- DUT:  (Set checkmark)

#### RF Physical Channels

- Select up to 3 channels which can be individually setup for a specific channel, e.g. low, mid and high channel

## 2. Select Tests to Run

Select which parameters to measure by using the individual checkmarks.

Please note that the Rx Sensitivity Test will measure the Rx sensitivity by stepping from the "Gen. Power" level and to the actual Rx sensitivity level in several steps.

This test is typical for Q/A or R&D verification of product performance and NOT manufacturing due to the relative long test time.

### Executing the selected RF tests:

The screenshot displays the software interface for the RTX2254 BT RF tester. It is divided into several sections:

- Setup:** Includes 'Measure Mode' (DTM Burst), 'PER Test - Packet Parameters' (No. of Packets: 500, Payload Length: 37, Payload Type: RANDOM9 (PRBS9), Gen. Power: -50 dBm), 'Open Interface' (DUT checked), 'DUT Port Selection' (DUT0 RF Select), and 'Settings' (Save button).
- Select RF Physical Channels:** Shows three channels selected with frequency offsets of 0 Hz, 12 Hz, and 39 Hz. Channel mapping details are provided: Ch. 0 (37) = 2402 MHz, Ch. 1 (0) = 2404 MHz, Ch. 19 (17) = 2440 MHz, Ch. 39 (39) = 2480 MHz.
- DUT Info:** BT Address: 0x80EACA222222 - [ms]
- Select Tests to Run:**
  - DUT Tx Tests:**
    - DUT Frequency Offset:
 

RF Channel 1	RF Channel 2	RF Channel 3
Frequency Offset [Hz]: 12877 Hz	13517 Hz	13847 Hz
Frequency Offset [ppm]: 5.28 ppm	5.63 ppm	5.74 ppm
    - DUT Tx Output Power:
 

RF Channel 1	RF Channel 2	RF Channel 3
-0.21 dBm	-0.94 dBm	-2.38 dBm
  - DUT Rx Tests:**
    - PER - Packet Error Rate (DTM burst/ADV Mode Only):
 

RF Channel 1	RF Channel 2	RF Channel 3
Error Rate - Measured at Gen. Power [dBm]: 0.80 %	0.80 %	0.00 %
OK Count: 496	496	500
Error Count: 4	4	0
    - Rx Sensitivity Test: Gen. Power Level [dBm] -50, - dBm, - dBm, - dBm
- Test Result:** A large green banner displays 'Test PASSED'. A blue callout bubble with the number '4' points to this banner.
- Test Run:**
  - and  buttons.
  - Loop Test No.: 1, Test Delay [ms]: 0
  - Test Status: Current Channel: 0 Ch., Cable Loss: 1.00, Test Completed: 1
  - Test Limit Errors: Offset: 0, Tx Pwr: 0, PER: 0, Pkt. Int.: 0
  - Ch. Test Time [ms]: Last: 2673.31, Avg.: 2578.22, Total Test Time [s]: 7.735
  - DUT packet interval configuration setting [ms]: 1

## 3. Test Run

The tests will be executed by activating the Start button.

## 4. Test Result

Show the status for all executed measurements.

### 4.3 Hardware setup for measuring in Advertising mode

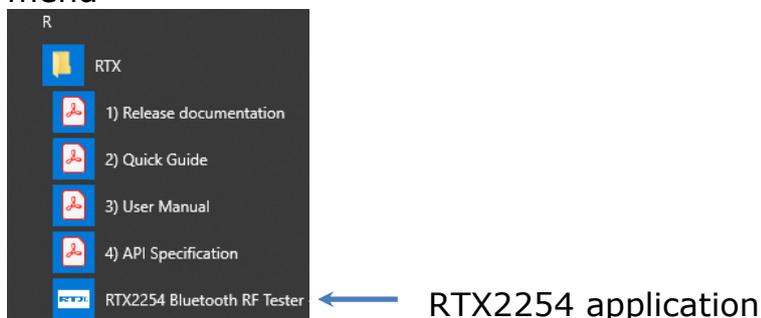
Connect the hardware as shown in Figure 2. It is highly recommended to use a shielded box to minimize any interference from the environment. It is recommended to use a coupling antenna to minimize the transmission loss.



Figure 2: Using RTX2254 for test in Advertising mode

### 4.4 Configuration for RF measurements in Advertising mode

Start the application RTX2254 Bluetooth RF tester from the Windows menu



## Setup the test Mode in the **Configuration** pane

### 1. **Tester Mode**

Select Advertising in subsection and press save (Will only be available if Option D is installed in the RTX2254)

### 2. **DUT Configuration**

#### **Advertising Mode**

#### **DUT cable loss settings**

DUT 0/1 cable loss: Setup to relevant RF cable loss between DUT and RTX2254

#### **Filter Options:**

DUT advertising packet scan interval: Setup to measured value\* + 10ms to provide room for the allowed random delay between advertising packages.

\*See **Main** pane "DUT info"

DUT Info  
BT Address: 0x80EACA222222 105 [ms]

## Setup the criteria for the measurements in **Main** pane.

Key settings to configure:

### 1. Setup

#### PER Test – Packet parameters:

- No. of Packets: Typical 5 (Higher numbers will enhance RX measurement resolution, but increase the test time)
- Pay-load Type: Set to either NO\_SCAN\_RESPONSE (Typical Beacon and TX measurement only) or SCAN\_RESPONSE (Required for RX sensitivity measurement)
- Gen. Power: Set to required RX measurement level, e.g. -86 dBm

#### DUT Port Selection

Select RF ports: Either RF0 or RF1 (Only relevant on RTX2254 with 2 ports)

#### Open Interface

DUT:  (Set checkmark)

#### RF Physical Channels

Select up to 3 predefined Advertising channels (Ch. 37, 38 & 39)

## 2. Select Tests to Run

Select which parameters to measure by using the individual checkmarks.

Please note that the Rx Sensitivity Test will measure the Rx sensitivity by stepping from the "Gen. Power" level and to the actual Rx sensitivity level in several steps. The test is typical for Q/A or R&D verification of product performance and NOT manufacturing due to the relative long test time.

## Executing the selected RF tests

The screenshot displays the software interface for configuring and running RF tests. The interface is divided into several sections:

- Setup:** Includes tabs for Main, Tester, System, Measure Logs, Settings, and Configuration. It features a "Measure Mode" dropdown set to "Adv Burst", "PER Test - Packet Parameters" with "No. of Packets" set to 5 and "Payload Type" set to "SCAN\_RESPONSE", "Gen. Power [dBm]" set to -86, "Open Interface" checked, "DUT Port Selection" set to "DUT0 RF Select", and a "Settings" button with a "Save" option.
- Select RF Physical Channels:** Shows three channels selected: RF Channel 1 (0), RF Channel 2 (12), and RF Channel 3 (39). Channel mapping details are provided: Ch. 0 (37) = 2402 MHz, Ch. 12 (38) = 2426 MHz, and Ch. 39 (39) = 2480 MHz.
- DUT Info:** Displays "BT Address: 0x80EACA222222" and "105 [ms]".
- Select Tests to Run:**
  - DUT Tx Tests:** Includes "DUT Frequency Offset" (138 Hz, 168 Hz, 130 Hz) and "DUT Tx Output Power" (2.3 dBm, 1.0 dBm, 0.8 dBm).
  - DUT Rx Tests:** Includes "PER - Packet Error Rate (DTM burst/ADV Mode Only)" (0.00% for all channels), "Rx Sensitivity Test" (Gen. Power Level [dBm] set to -86), and "Average packet interval" (102 ms, 115 ms, 108 ms).
- Test Result:** A large green banner displays "Test PASSED".
- Test Run:** Includes "Start" and "Stop" buttons, "Loop Test No." (1), "Test Delay [ms]" (0), "Test Status" (Current Channel: 0, Cable Loss: 2.00, Test Completed: 1), "Test Limit Errors" (Offset: 0, Tx Pwr: 0, PER: 0, Pkt. Int.: 0), "Time Out Errors" (0), "Ch. Test Time [ms]" (Last: 4015.96, Avg.: 4218.48), and "Total Test Time [s]" (12.656).

### 1. Test Run

The tests will be executed by activating the Start button.

### 2. Test Result

Show the status for all executed measurements.

## 5 RTX References

1. RTX2254 Quick Guide (Installation guide for RTX2254)
2. RTX2254 User Manual (User guide for RTX2254)
3. RTX2254 Product Information <https://www.rtx.dk/en/design-services/products/rf-test-equipment-and-accessories/>