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BLT2450

nRF Connect application

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Copyright

History

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1 PURPOSE

The BLT2450 tester is designed to simplify and improve development, testing and production of Bluetooth® capable products. This document gives an overview how to use the BLT2450 nRF Connect application for controlling the BLT2450 tester and optimize product development and testing.

The BLT2450 nRF Connect application is a plugin that runs within the nRF Connect for Desktop framework from Nordic Semiconductor. Although the application is a cross-platform framework, it requires a connection to a server that only supports Microsoft Windows PCs.

2 TERMS AND DEFINITIONS

BLT	Bluetooth Tester
DUT	Device Under Test (customer device)
BLE	Bluetooth Low Energy
DTM	Direct Test Mode
PER	Packet Error Rate in %
BER	Bit Error Rate in %
dBm	Power in decibles, relative to 1mW

2.1 References

[1] DTM Specification: See Bluetooth Specification Version 5.2, Vol. 6, Part F

3 HARDWARE

3.1 Basic setup

Image 1 shows the minimal setup required when using the BLT2450 nRF Connect application. Use the provided USB cable to connect a BLT2450 tester to a computer running Microsoft Windows®.

For DTM or sensitivity measurements, a testing device (DUT) must also be connected to the computer. The BLT2450 nRF Connect application supports DTM devices that have a physical or virtual COM port.

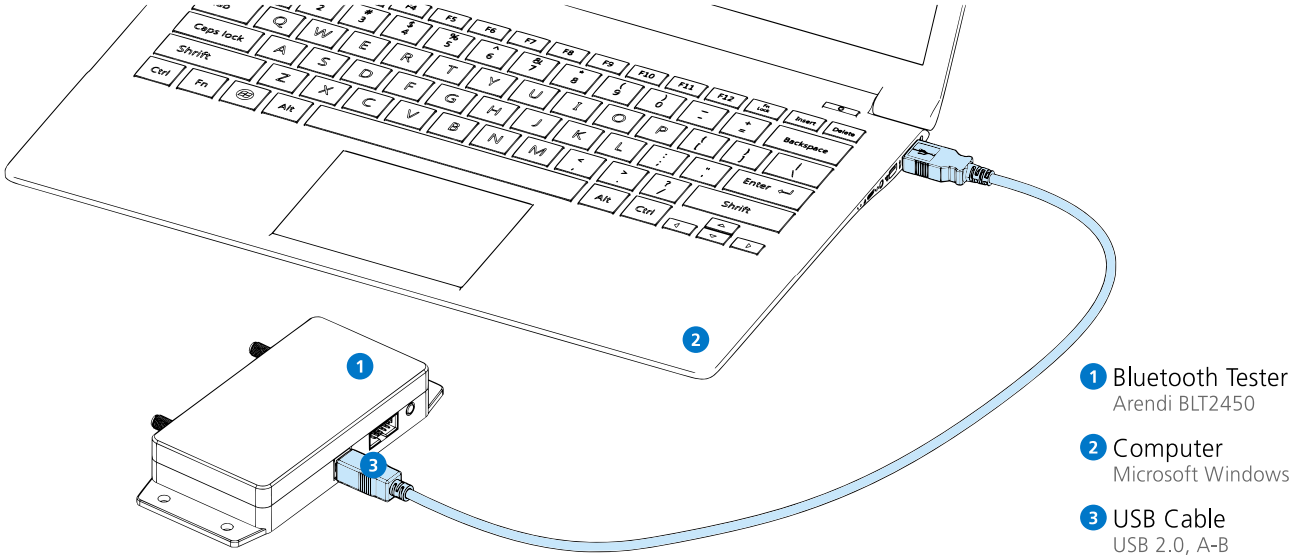


Image 1 Connecting a BLT2450 tester to a computer

3.2 Conducted setup with DUT

Image 2 shows a typical setup for conducted measurements with a DUT. Conducted measurements are preferable for optimum results but require that the DUT provides a suitable coaxial cable connector.

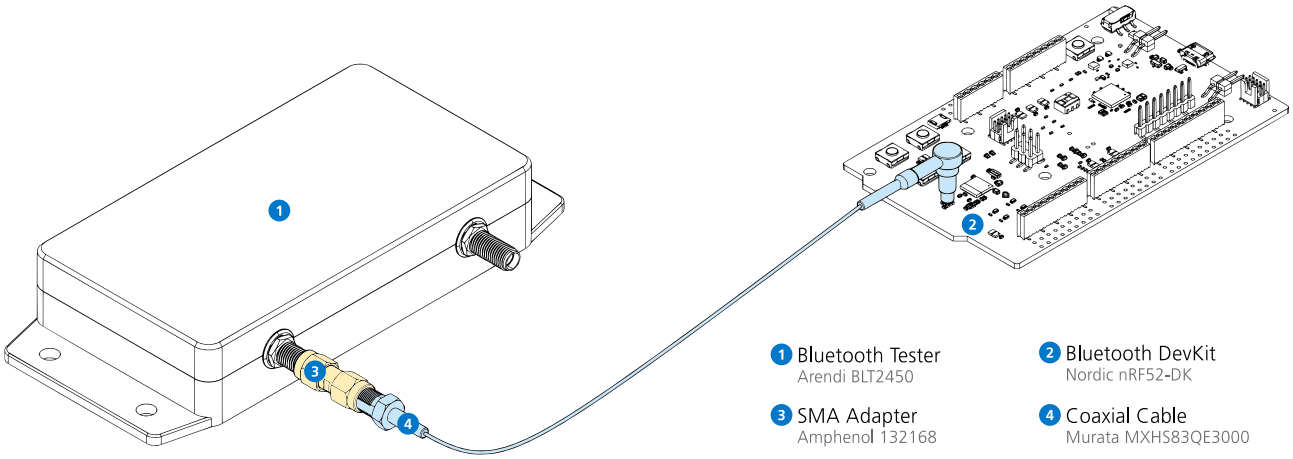


Image 2 Conducted setup with DUT

3.3 Radiated setup with DUT

Image 3 shows a typical setup for radiated measurements with a DUT. Radiated measurements are simple to perform but may suffer from interference. They are a viable option if the DUT has no coaxial cable connector and precautions are taken such as shielding or close proximity to the DUT.

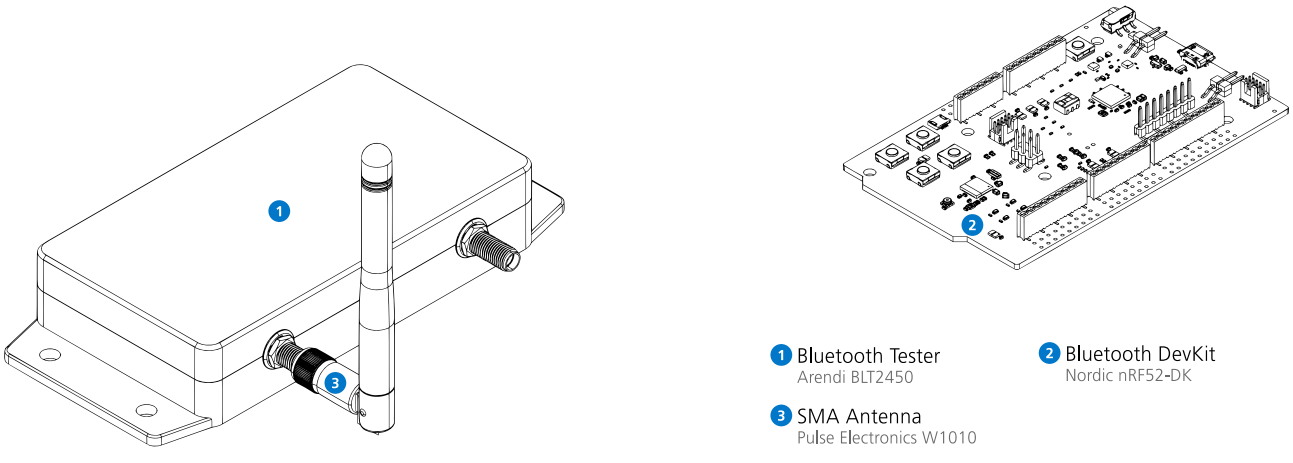
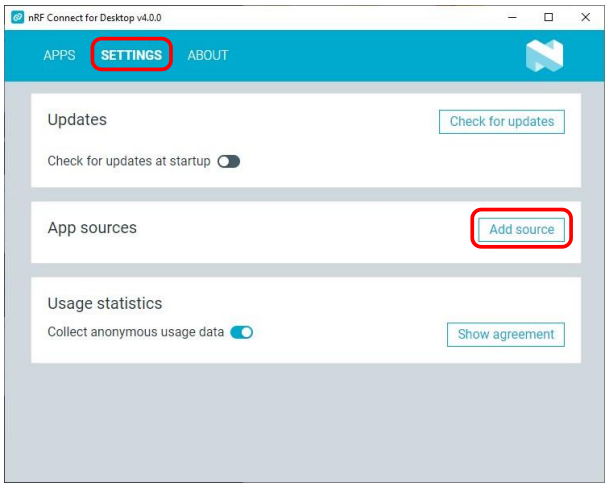


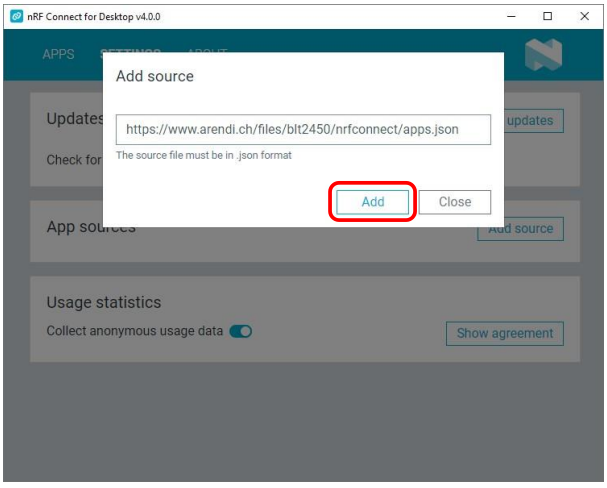
Image 3 Radiated setup with DUT

4 INSTALLATION

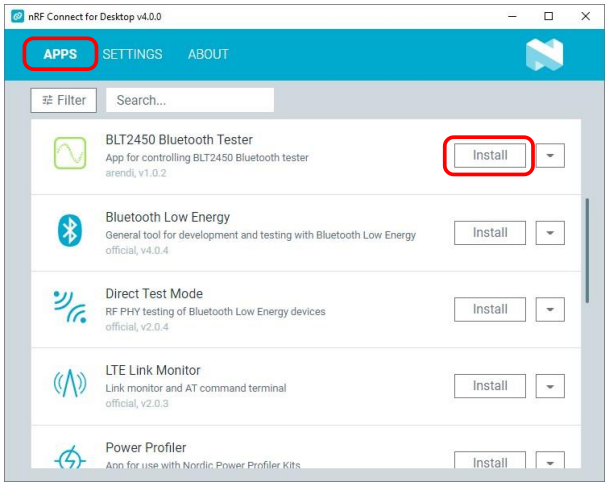
Download and run "nRF Connect for Desktop" from Nordic Semiconductor: https://www.nordicsemi.com/Products/Development-tools/nrf-connect-for-desktop. Execute the installer and follow the steps below:



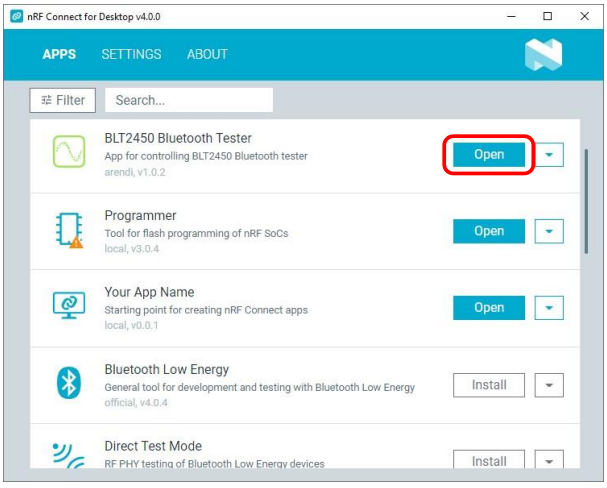
1 Select „Settings“ and click on „Add source“



2 Enter „https://www.arendi.ch/files/blt2450/nrfconnect/apps.json“ and click „Add“



3 Select „Apps“ and click on „Install“ to install the BLT2450 application



4 Click «Open» to start the BLT2450 application

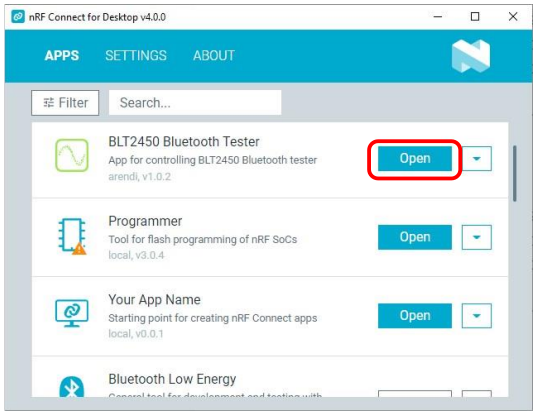
Image 4 Installing Arendi BLT2450 nRF Connect application

4.1 Starting application

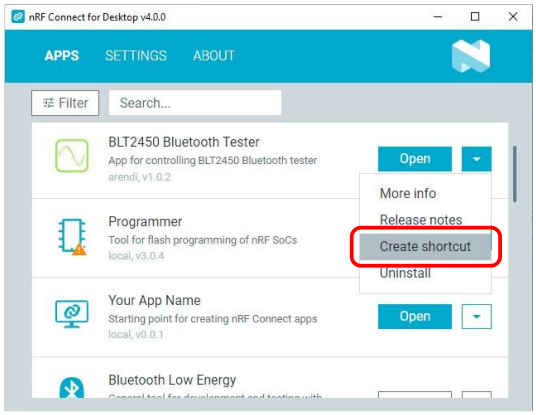
After installation, the BLT2450 nRF Connect application can be started using the steps described below.

1. **Start nRF Connect for Desktop**
   Press the Windows key and type "nrf connect".
   Select the nRF Connect for Desktop application.

2. **Start BLT2450 application**
   Inside nRF Connect for Desktop, click on the "open" button to start the BLT2450 application. Once the application has started, nRF Connect for Desktop can be closed.



3. **Create shortcut**
   We recommend clicking on the "Create shortcut" button from the menu to create a shortcut on the Desktop. Clicking on the shortcut will open the BLT2450 nRF Connect application directly.



5 APPLICATION OVERVIEW

The BLT2450 nRF Connect application contains two main sections. The side panel ❶ is located at the left side of the application and is used for configuration and selecting operation modes. It contains the following controls:

Server control panel ❷ for configuring the server connection.

Tester control panel ❸ for selecting the tester and operation mode.

DUT control panel ❹ for selecting and configuring the DUT.

The main panel ❺ contains all controls required by the current operation mode. All supported modes are described in chapter 6.

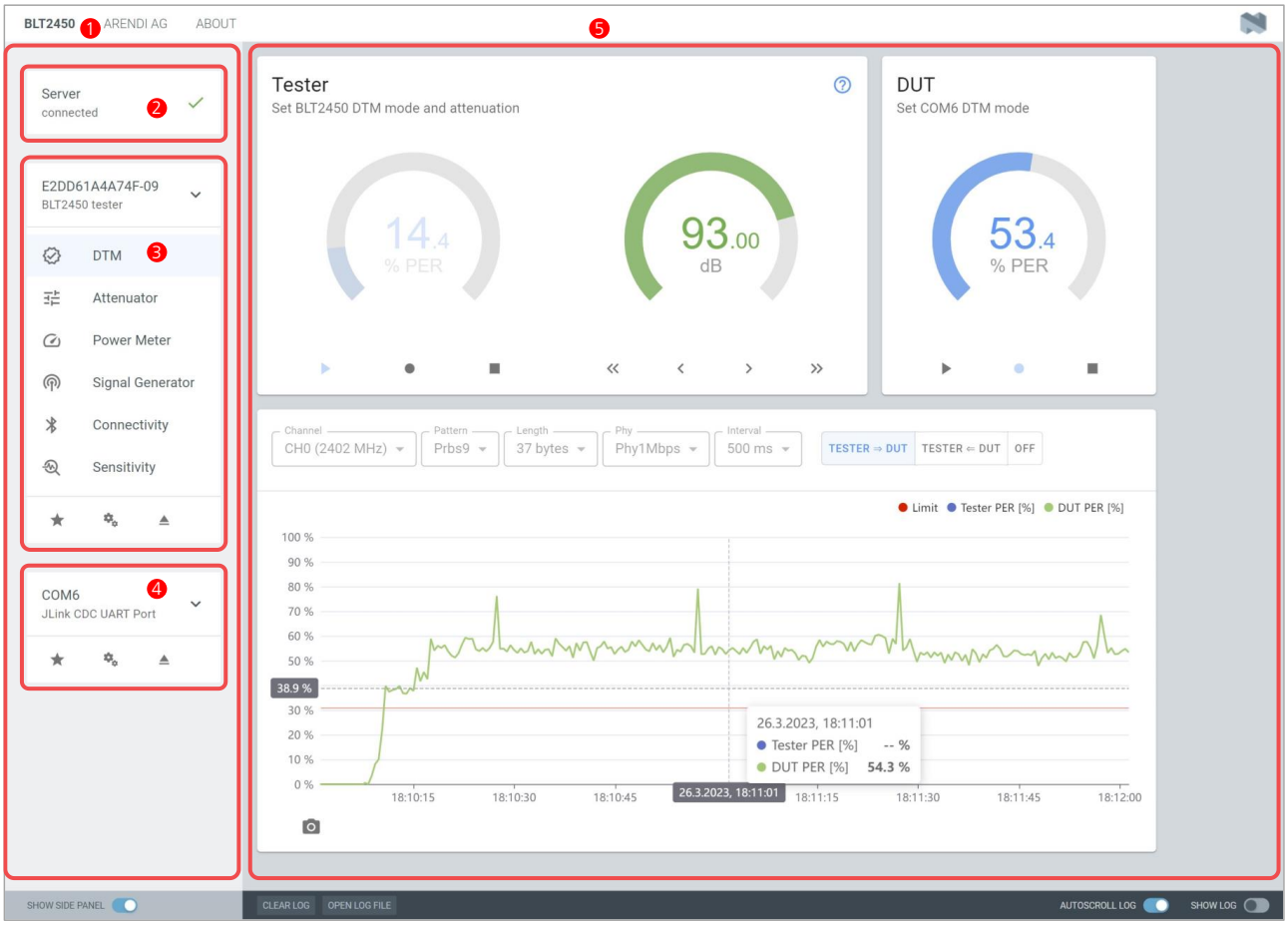


Image 5 Application main controls

5.1 Server configuration

The BLT2450 nRF Connect application requires a WebSocket connection to a server running on the same computer. After starting the BLT2450 nRF Connect application for the first time, it tries to connect to a server using the default settings. If the connection fails, the server settings dialog is opened automatically. The server settings dialog can also be opened by clicking on the server control in the side panel.

In the server settings dialog choose between the two options "remote server" and "local server".

5.1.1 Remote server

Choose this option if the application should connect to an already running WebSocket server. Follow the description in the document "BLT2450 Software Tools" to install and run the server.

Enter the address ❶ and port number ❷ of the remote server. Changing the values triggers a connection test. If the connection is successful, the icon ❸ changes to ✓, otherwise a ✗ is shown.

Click the "save" button ❹ to save and apply the settings.

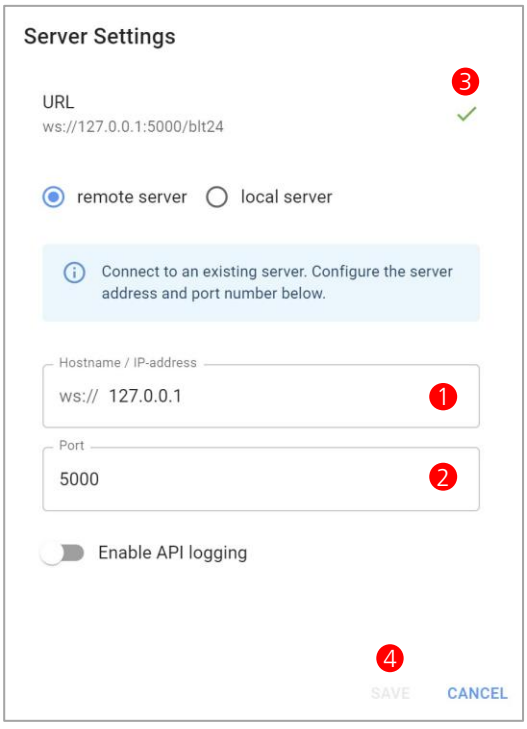


Image 6 Settings for remote server

5.1.2 Local server

Choose this option if the BLT2450 nRF Connect application should run its own server. This is useful if you don't need the other software tools from Arendi and don't want to install them. Note that the local server will continue to run even after the BLT2450 nRF Connect application is terminated.

Enter the desired port number ❶ of the local server. Changing the value triggers a connection test if a local server is already running. If the connection is successful, the icon ❷ changes to ✓, otherwise a ✗ is shown.

Click the "start server" button ❸ to start a local server using the current settings.

Enable "Autostart local server" ❹ to automatically start a local server when required.

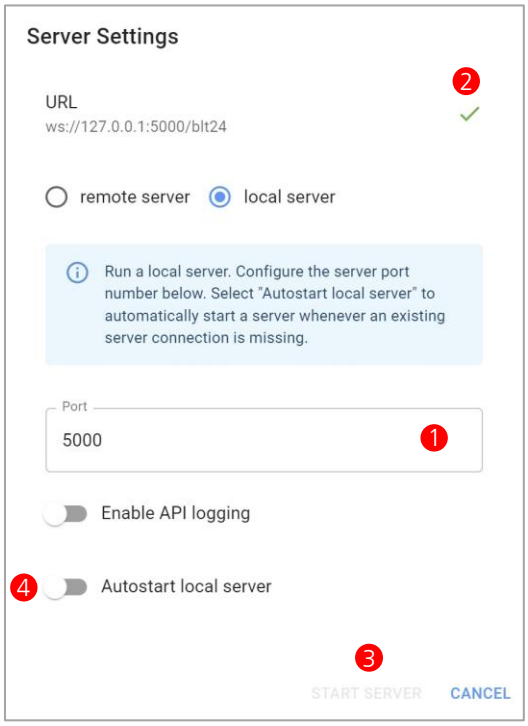
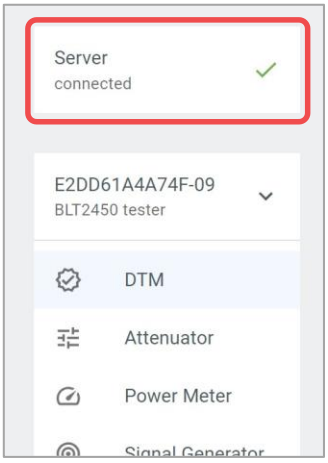


Image 7 Settings for local server



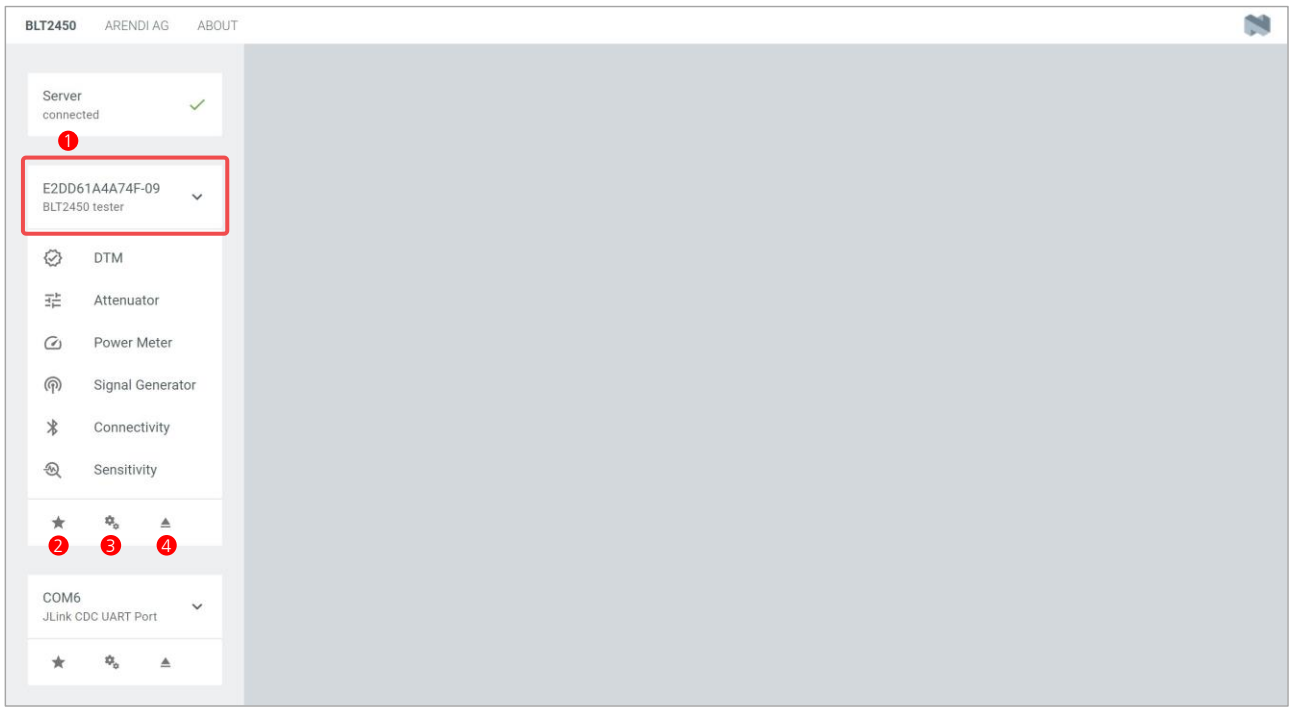
Note

The server settings dialog will open automatically whenever a server connection is missing, but you can always open it by clicking on the server control in the side panel.

The WebSocket server only runs on Microsoft Windows and the "local server" option will not be available on other operating systems.

5.2 Select BLT2450 Bluetooth® tester

To use any of the available modes a BLT2450 tester must be selected first.



✓ **Select tester**
Select a BLT2450 tester from the tester control panel ❶. If only one tester is available, it will be selected automatically and this option is not available.

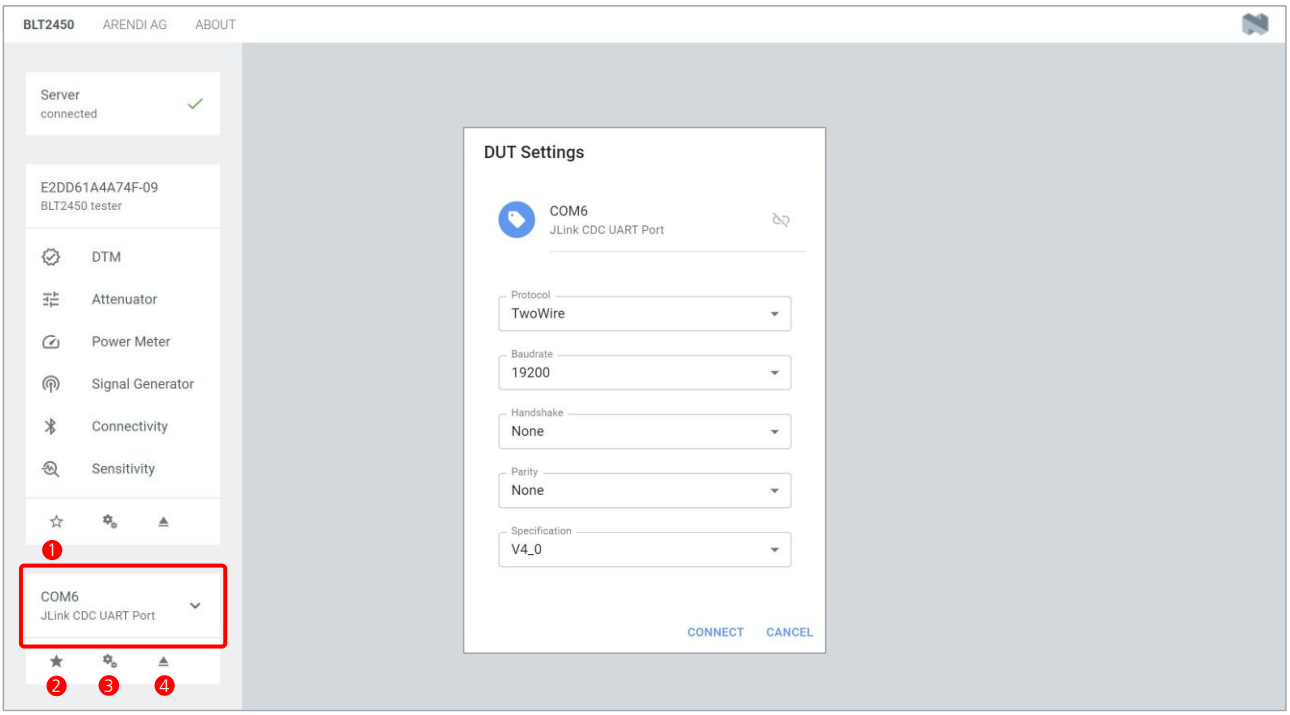
✓ **Set as favorite**
Click on the favorite icon ❷ to mark the active tester as favorite. A favorite tester is easier to find if there are multiple BLT2450 available.

✓ **Open settings**
Click on the settings icon ❸ to open the tester settings dialog.

✓ **Disconnect tester**
Click on the eject icon ❹ to deselect the active tester.

5.3 Select DUT

Some tests can only be executed with a Direct Test Mode (DTM) capable DUT selected. To use DTM, the DUT must be programmed with a suitable firmware and provide a two wire UART interface to execute the DTM commands. Usually, a USB to UART converter is used to connect the DUT to a computer.



✓ **Select DUT**
Select the COM port of a DUT from the DUT control panel ❶.

✓ **Set as favorite**
Click on the favorite icon ❷ to mark the active DUT as favorite. A favorite DUT is easier to find if there are multiple COM ports available.

✓ **Open settings**
Click on the settings icon ❸ to open the DUT settings dialog (see chapter 5.3.1).

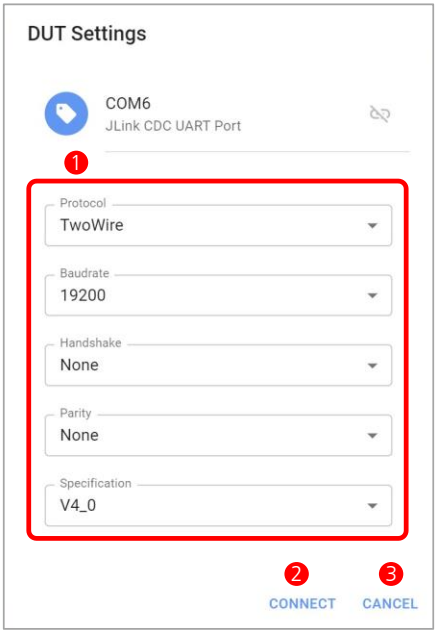
✓ **Disconnect DUT**
Click on the eject icon ❹ to deselect the active DUT.

5.3.1 Configure DUT

Before a DUT can be used, its COM port needs to be configured and connected. The DUT settings dialog opens automatically if a DUT is selected or if the settings icon in the DUT control panel is clicked.

- ✓ **Define COM port settings**
  These settings ❶ need to match the UART settings used by the DTM firmware of the DUT.

- ✓ **Connect and disconnect**
  Click on the "connect" button ❷ to apply the settings and connect to the selected COM port. Once connected, the button changes and is used to disconnect the COM port. Press the "cancel" button ❸ to discard the settings and close the dialog.



Note

If the COM port settings are not correct, communication with the DUT is not possible and the corresponding tests will fail. If you need to change the settings, the COM port has to be closed first by pressing the "disconnect" button.

6 OPERATION MODES

To use any of the available operation modes, a BLT2450 tester must be connected to the computer and a server needs to be running (see chapter 3.1 and 5.1). Select one of the available modes inside the tester control panel ❶.

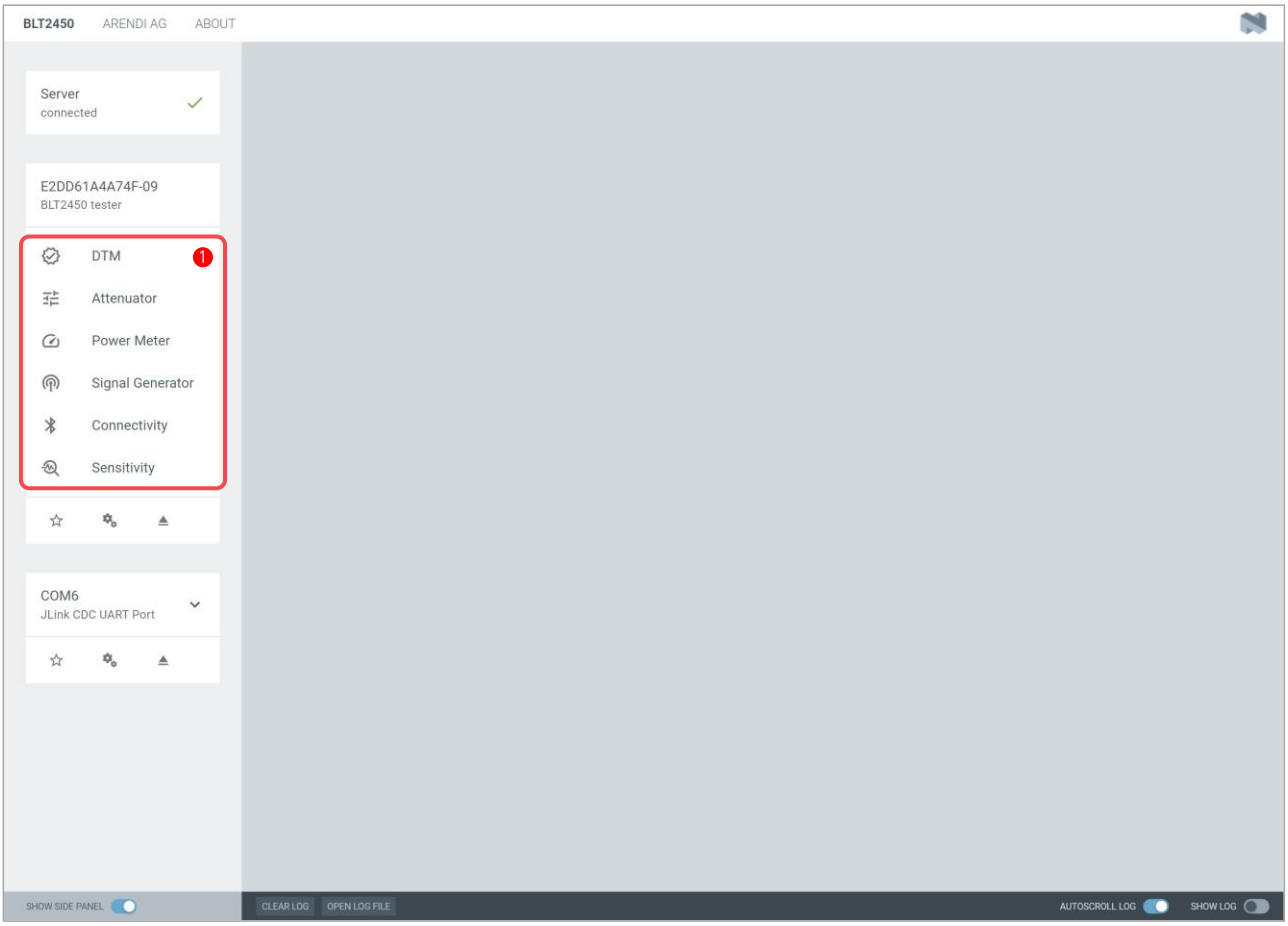


Image 8 Selecting BLT2450 mode

6.1 Direct Test Mode (DTM)

Direct Test Mode (DTM) is a standard protocol [1] for testing the radio of Bluetooth devices at the physical level. Two commands are used for sending and receiving a series of test packets and a third command is used to terminate packet exchange and report the number of received packets. Direct Test Mode allows to modify the packet structure and radio settings and is required for end-product qualification.

6.1.1 Typical setup

A typical DTM setup consists of a DUT that is connected to the BLT2450 tester using a coaxial cable as shown in the image below. The measurement can also be made using antennas, but it will suffer from interference and reduced reproducibility.

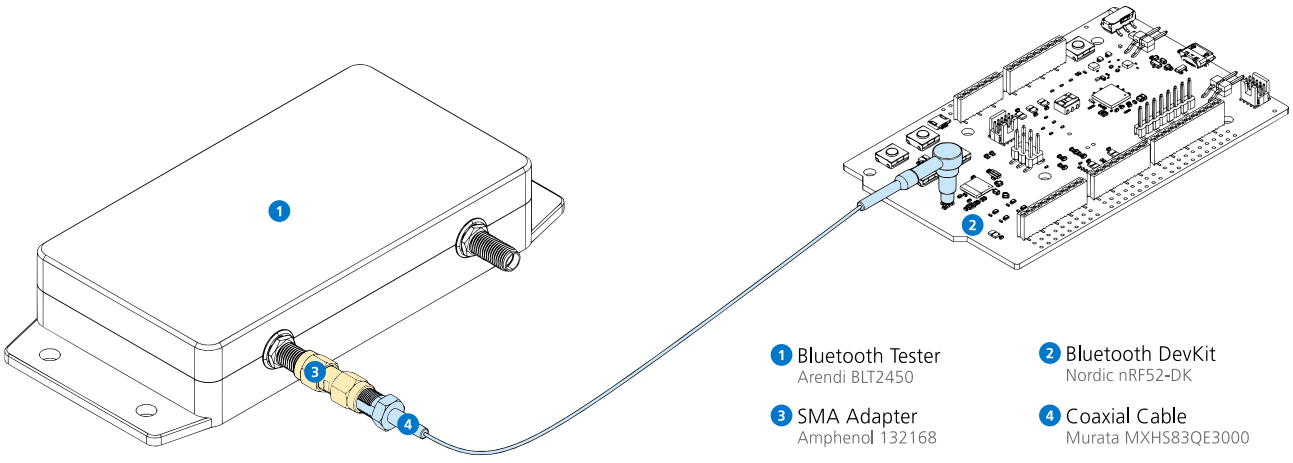
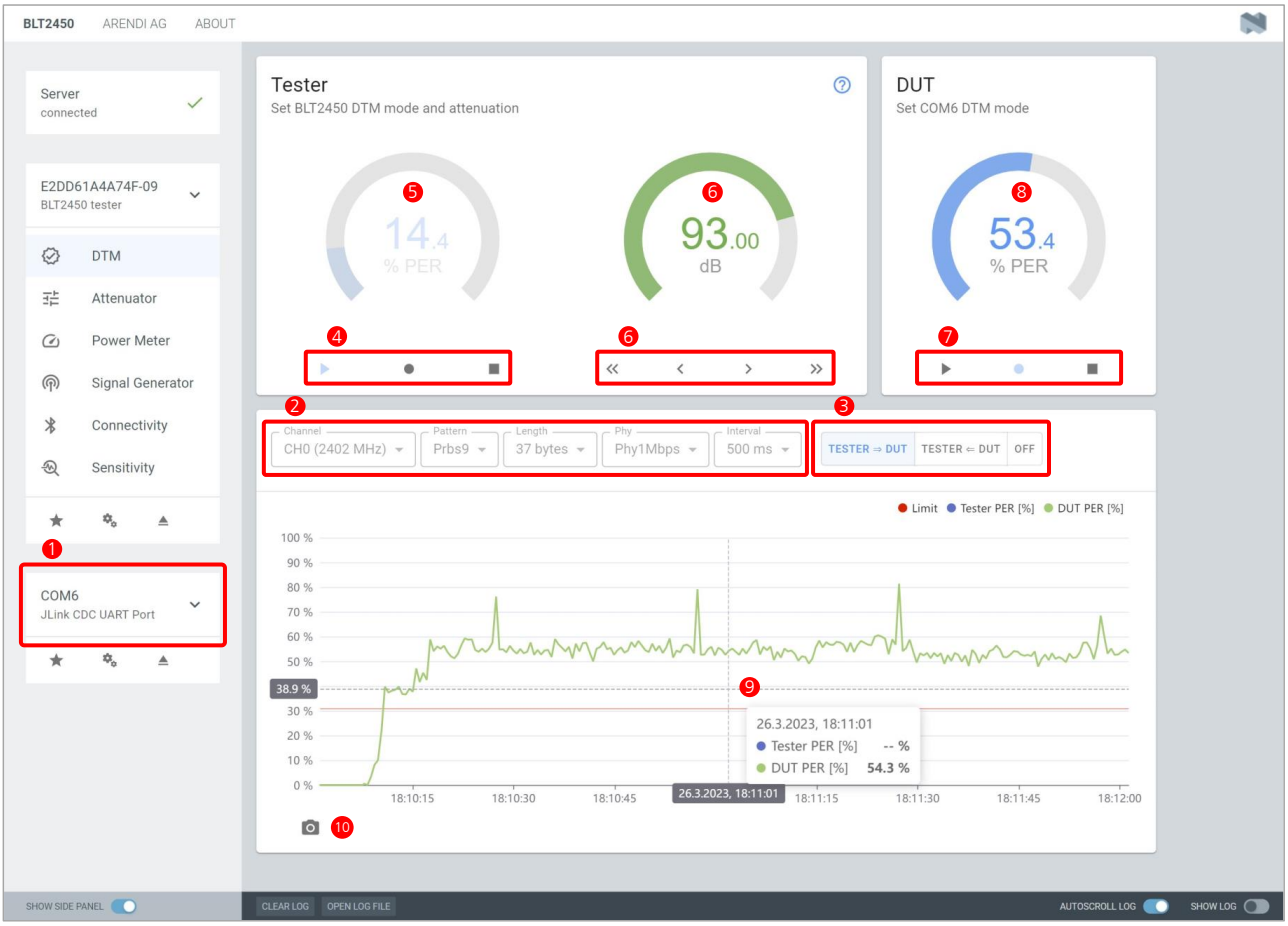


Image 9 Typical setup for DTM measurements

6.1.2 Instructions



✓ **Setup, select DUT**

Activate DTM mode and select the DUT from the DUT control panel ❶.

✓ **Change settings**

Change the DTM settings ❷ that should be used for the measurement. DTM settings can only be changed when tester and DUT are stopped.

✓ **Perform measurements**

Initiate DTM measurements by pressing any of the direction buttons ❸ or one of the Tx, Rx and Stop buttons controlling the tester ❹ or DUT ❼. The current PER of the tester when set to Rx mode is shown in the gauge ❺. The current PER of the DUT when set to Rx mode is shown in the gauge ❽.

During a measurement use the controls ❻ to adjust the attenuation between tester and DUT and see the effect on the PER.
The chart ❾ shows the measured PER over the last two minutes. Place the mouse over a point of interest to reveal details. Click on the snapshot icon ❿ to save an image of the chart.

6.2 Attenuator

The BLT2450 can be used as a programmable attenuator for various RF applications. The bidirectional attenuation between the RF1 and RF2 ports can be adjusted in small steps and is usable over a broad frequency range (see data sheet).

6.2.1 Typical setup

A typical attenuator setup consists of a BLT2450 tester connecting two DUTs with each other using coaxial cables. Another useful application uses the BLT2450 tester to connect an antenna with a DUT.

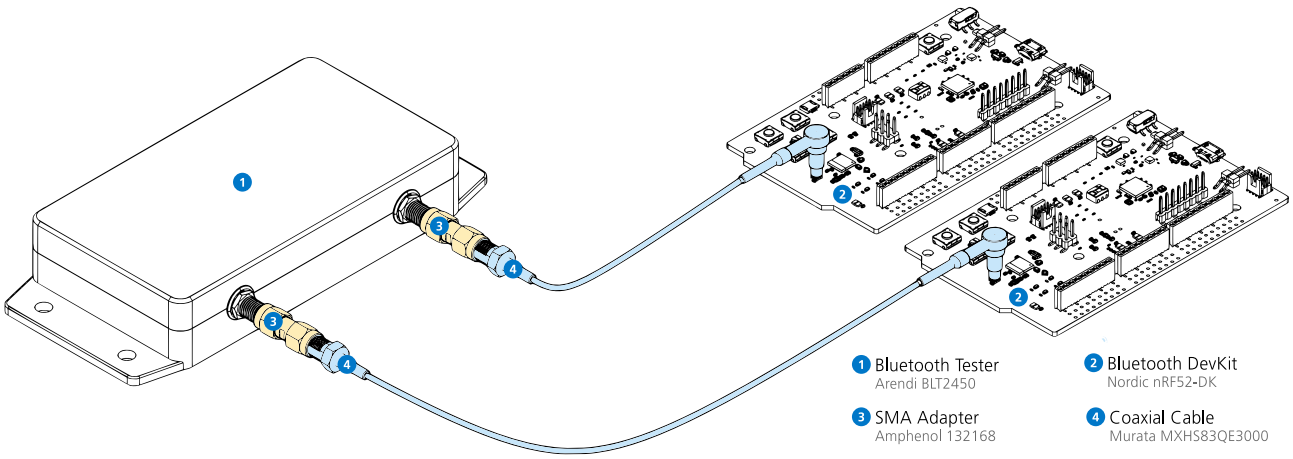
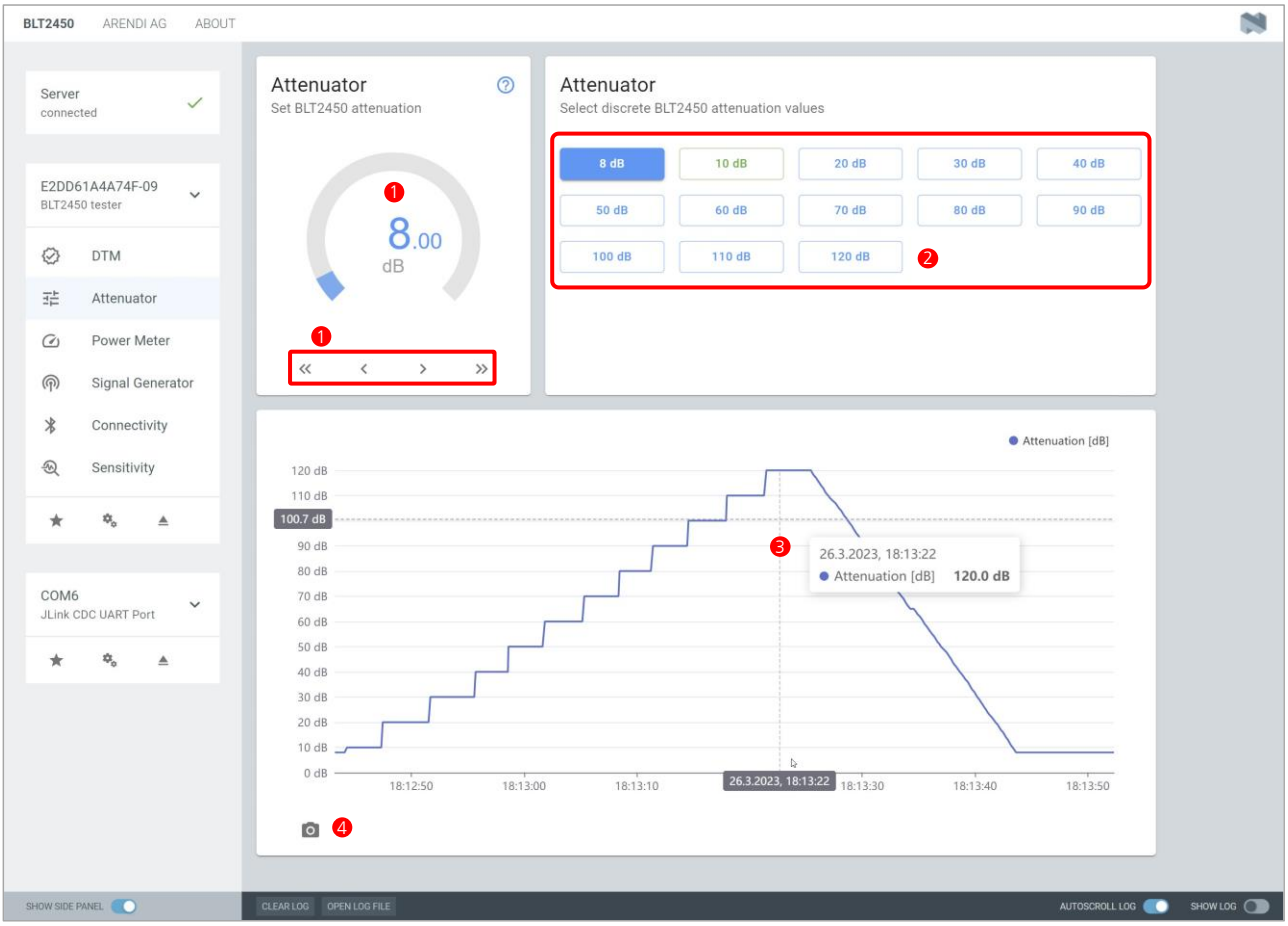


Image 10 Typical setup for variable attenuator mode

6.2.2 Instructions



✓ **Setup**

Activate Attenuator mode.

✓ **Change attenuation**

Use the controls ❶ to adjust the attenuation of the tester in small steps or click on the buttons ❷ to quickly select a predefined value.

✓ **Perform measurements**

The chart ❸ shows the set attenuation over the last two minutes. Place the mouse over a point of interest to reveal details. Click on the snapshot icon ❹ to save an image of the chart.

6.3 Power Meter

The BLT2450 can be used as a power meter for various RF applications. The peak power of any RF signal applied to the RF1 port is measured over a broad frequency range (see data sheet).

6.3.1 Typical setup

A typical power meter setup consists of an RF signal generating device connected to the BLT2450 RF1 port using a coaxial cable as shown in the image below. The measurement can also be made using antennas, but it will suffer from interference and reduced reproducibility.

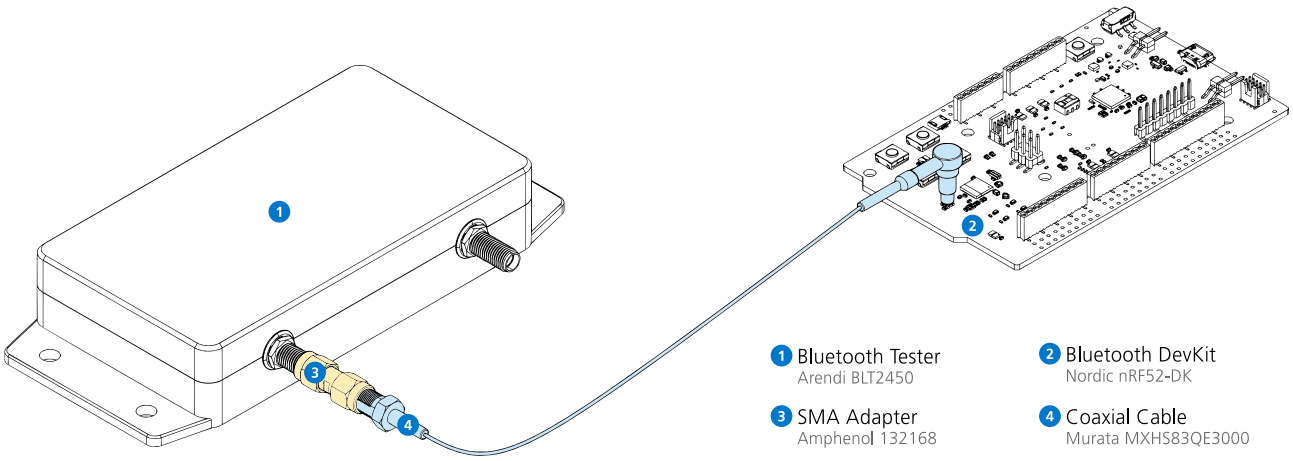
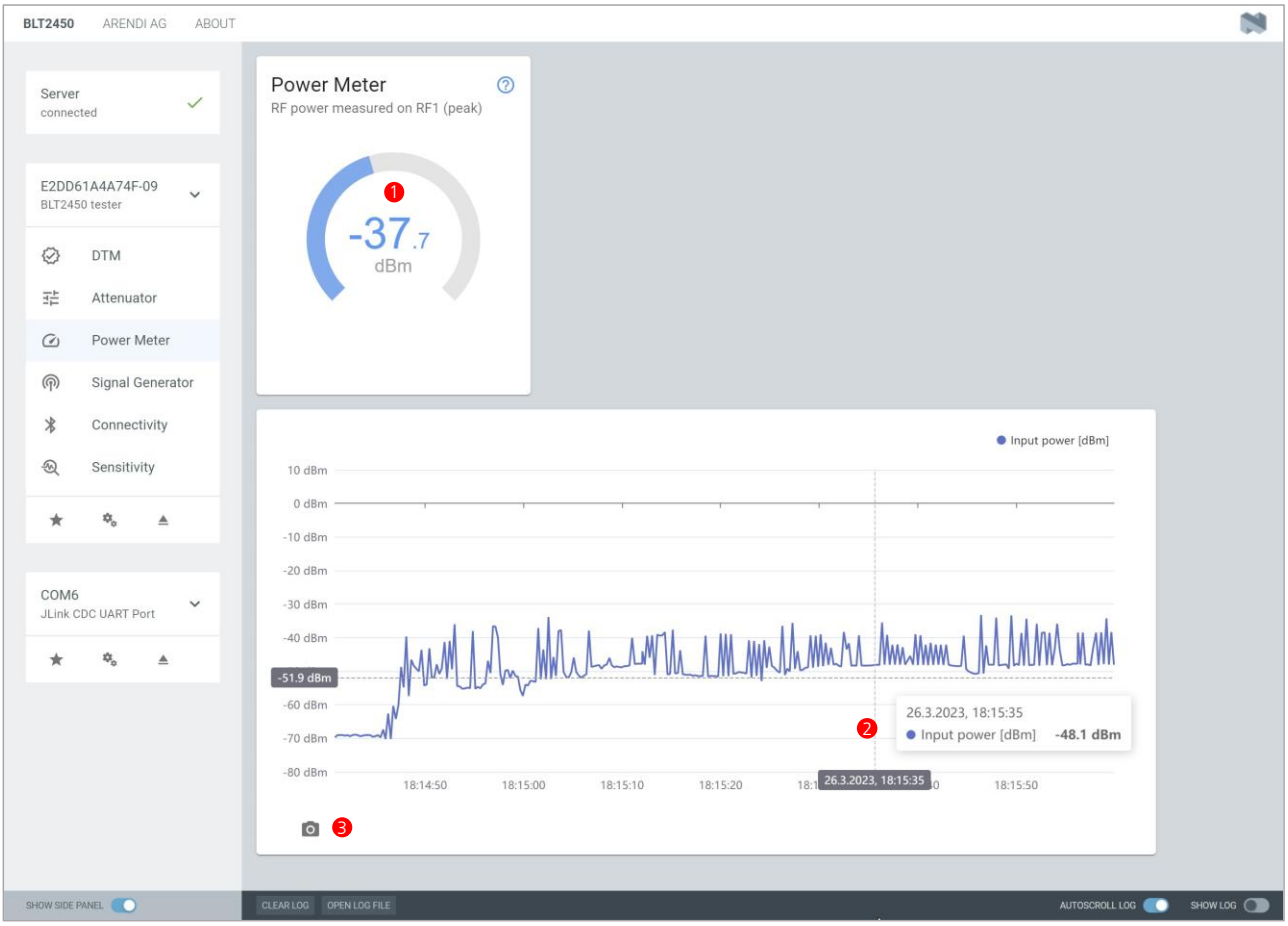


Image 11 Typical setup for using the power meter mode

6.3.2 Instructions



✓ **Setup**

Activate Power Meter mode

✓ **Perform measurements**

The current peak power is shown in the gauge ❶. The chart ❷ shows the measurements over the last two minutes. Place the mouse over a point of interest to reveal details. Click on the snapshot icon ❸ to save an image of the chart.

6.4 Signal Generator

The BLT2450 can be used as a simple signal generator for various RF applications. The output power and frequency of an unmodulated carrier can be adjusted and used as a test signal.

6.4.1 Typical setup

A typical setup consists of an RF signal consuming device connected to the BLT2450 RF1 port using a coaxial cable as shown in the image below. The setup can also use antennas, but it will suffer from interference and reduced reproducibility.

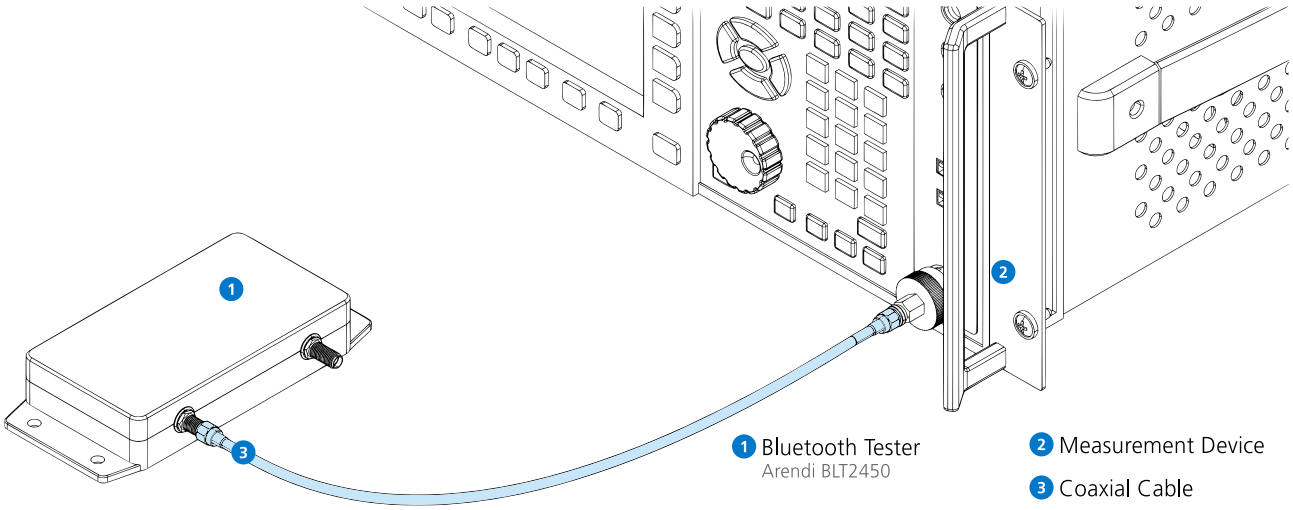
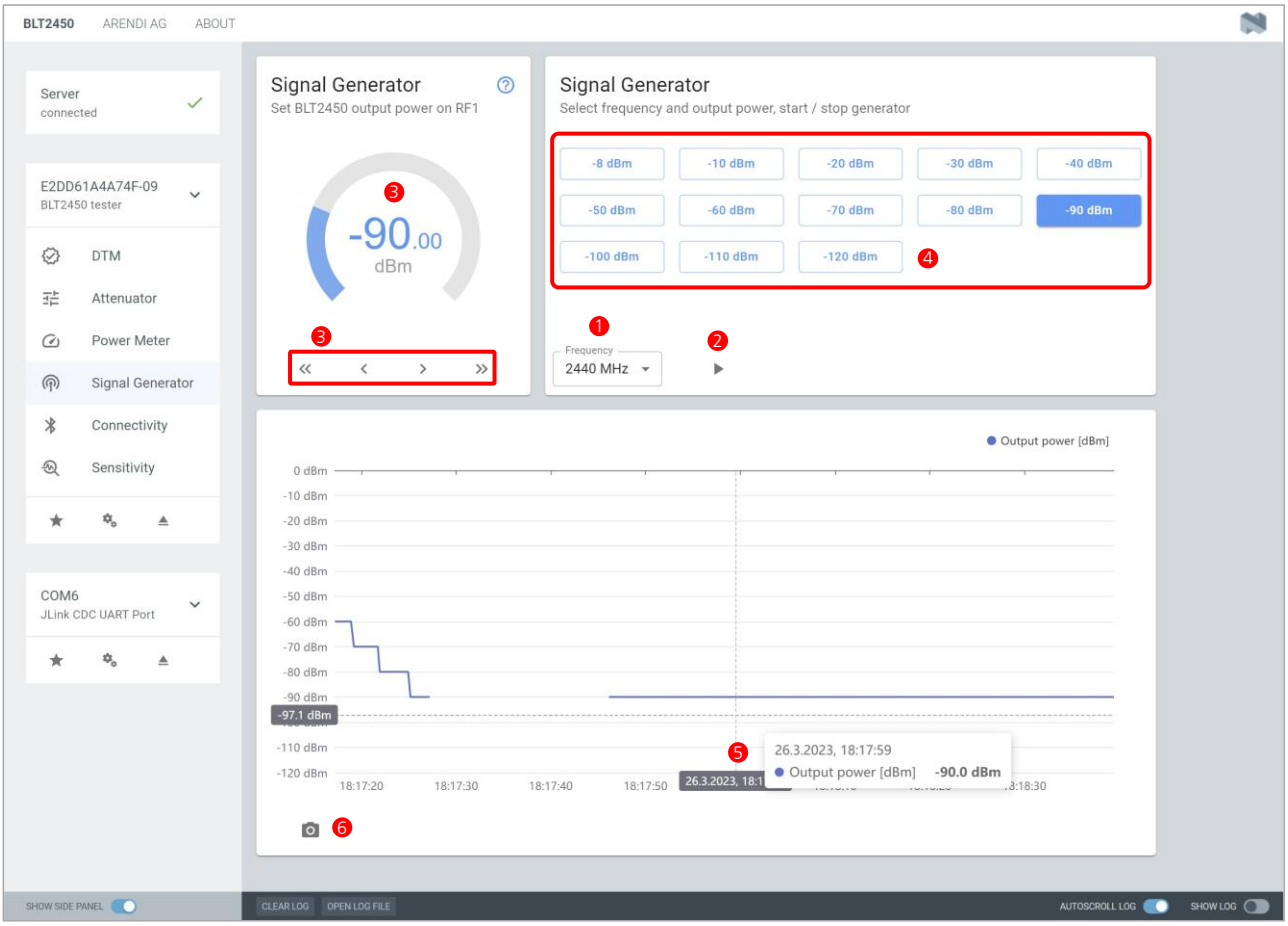


Image 12 Typical setup for using the signal generator mode

6.4.2 Instructions



✓ **Setup**

Activate Signal Generator mode.

✓ **Generate RF signal**

Select the wanted frequency ❶ and press the start button ❷ to enable signal generation. When activated, the button changes into a stop button for disabling signal generation.

✓ **Adjust output power**

Use the controls ❸ to adjust the output power of the tester in small steps or click on the buttons ❹ to quickly select a predefined value. The chart ❺ shows the set output power over the last two minutes. Place the mouse

over a point of interest to reveal details. Click on the snapshot icon ❻ to save an image of the chart.

6.5 Connectivity

The BLT2450 can be used as a Bluetooth central device for scanning and connecting Bluetooth peripherals. This is very useful during development and testing to verify that a Bluetooth device works as expected. Another important use case is to monitor the proper operation of a Bluetooth device during EMC testing.

6.5.1 Typical setup

A typical setup consists of one or multiple BLE peripheral devices placed close to the BLT2450 tester. An antenna is attached to the BLT2450 RF1 port to allow for wireless connections. Make sure the BLE peripheral devices are advertising and connectable (if required).

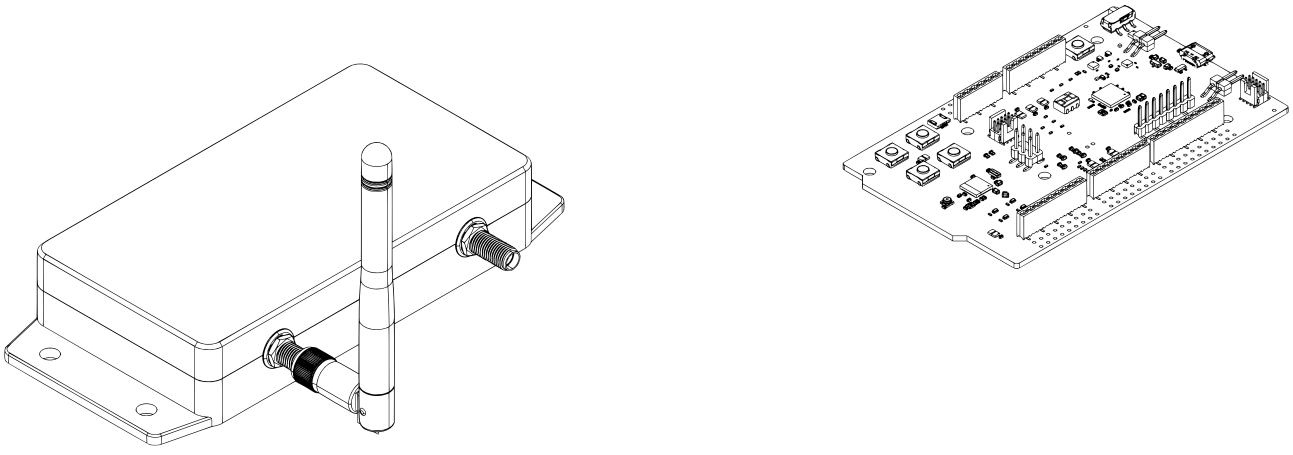
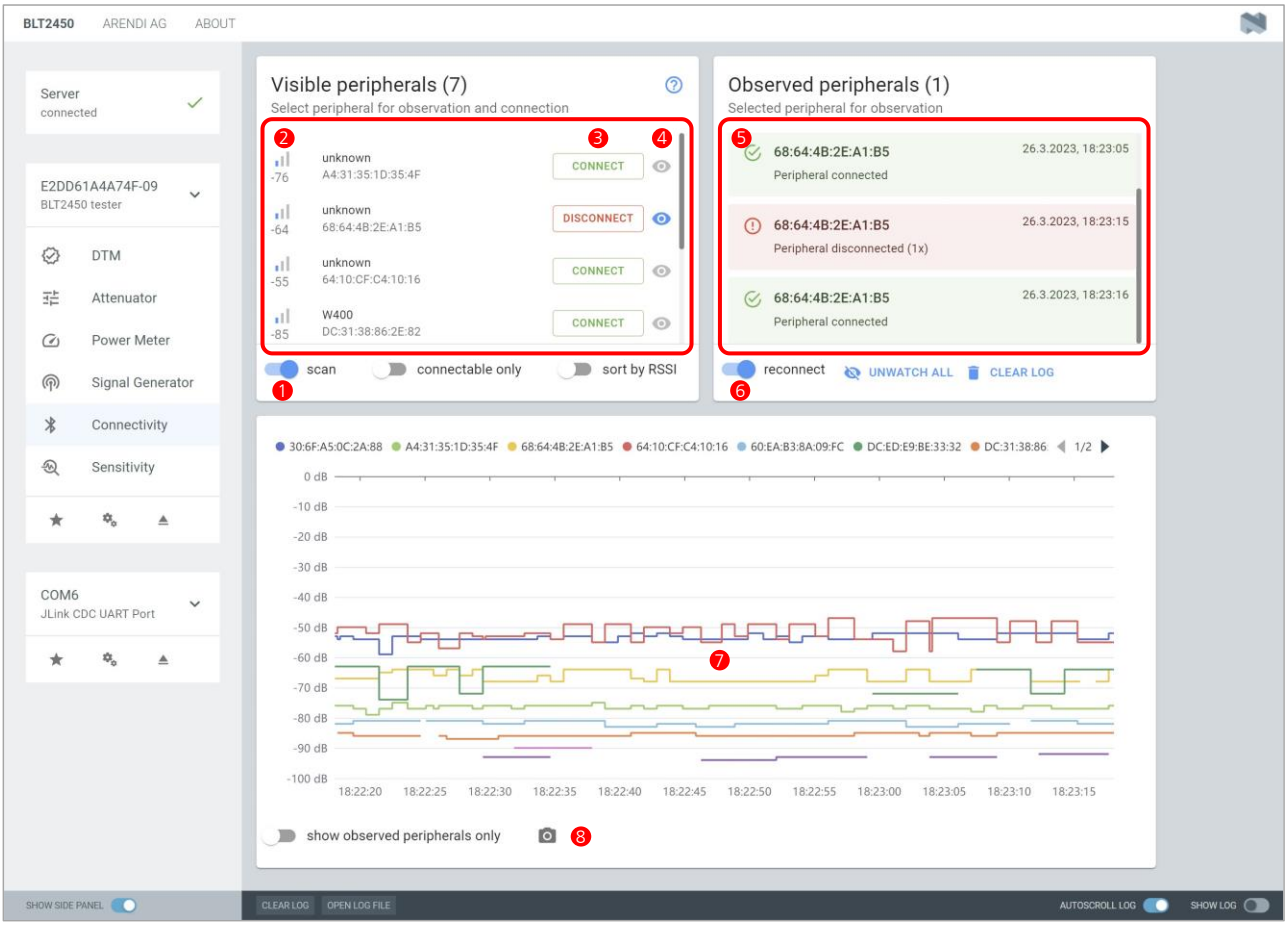


Image 13 Typical setup for connectivity mode

6.5.2 Instructions



✓ **Setup**
Activate Connectivity mode.

✓ **Scan BLE peripherals**
Enabling BLE scanning ❶ to show all visible BLE peripherals in the peripheral list ❷. Click on a peripheral in the list to open the peripheral info dialog.

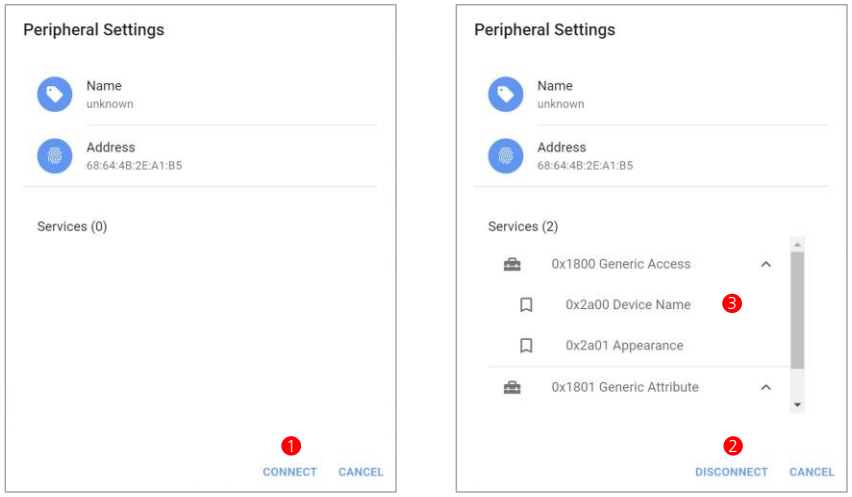
✓ **Watch and connect peripherals**
Click the watch icon ❹ to add the peripheral of interest to the list of observed peripherals ❺. Click the connect button ❸ to connect to a specific peripheral and add it to the observed list. Peripherals in the observed list are continuously tracked and any connection / disconnection events will be

reported. If "reconnecting" ❻ is enabled, the application will automatically attempt to reconnect observed peripherals after their connection was lost.

The chart ❼ shows the RSSI values of all visible BLE peripherals over the last two minutes. Place the mouse over a point of interest to reveal details. Click on the snapshot icon ❽ to save an image of the chart.

6.5.3 Peripheral info dialog

The info dialog is opened when clicking on a BLE peripheral in the peripheral list. It allows to connect and disconnect the BLE peripheral and shows the available services and attributes when connected.



✓ **Connection**
Click the buttons ❶ and ❷ to connect and disconnect the peripheral.

✓ **Discover services and attributes**
When the peripheral is connected, the available services and attributes are shown in the list ❸.

6.6 Sensitivity

Sensitivity mode is very useful for measuring the receiver sensitivity of a DUT. Sensitivity mode uses the Direct Test Mode to measure the Packet Error Rate (PER) of the DUT while continuously reducing the signal strength. The sensitivity limit of the DUT is reached, when the PER exceeds 30.8% which corresponds to a Bit Error Rate (BER) of 1%.

6.6.1 Typical setup

A typical sensitivity measurement setup consists of a DUT that is connected to the BLT2450 tester using a coaxial cable as shown in the image below. The measurement can also be made using antennas, but it will suffer from interference and reduced reproducibility.

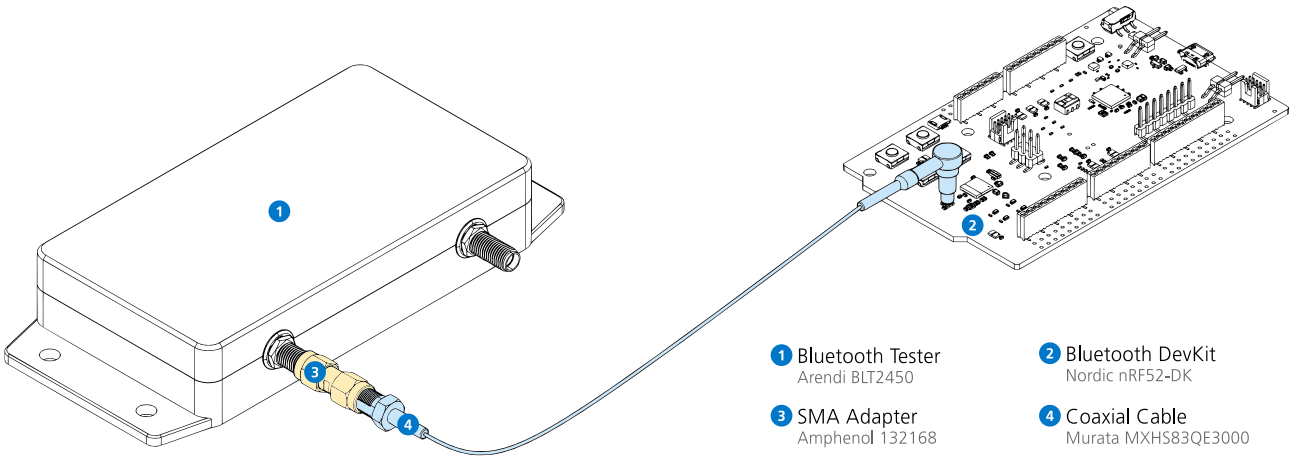
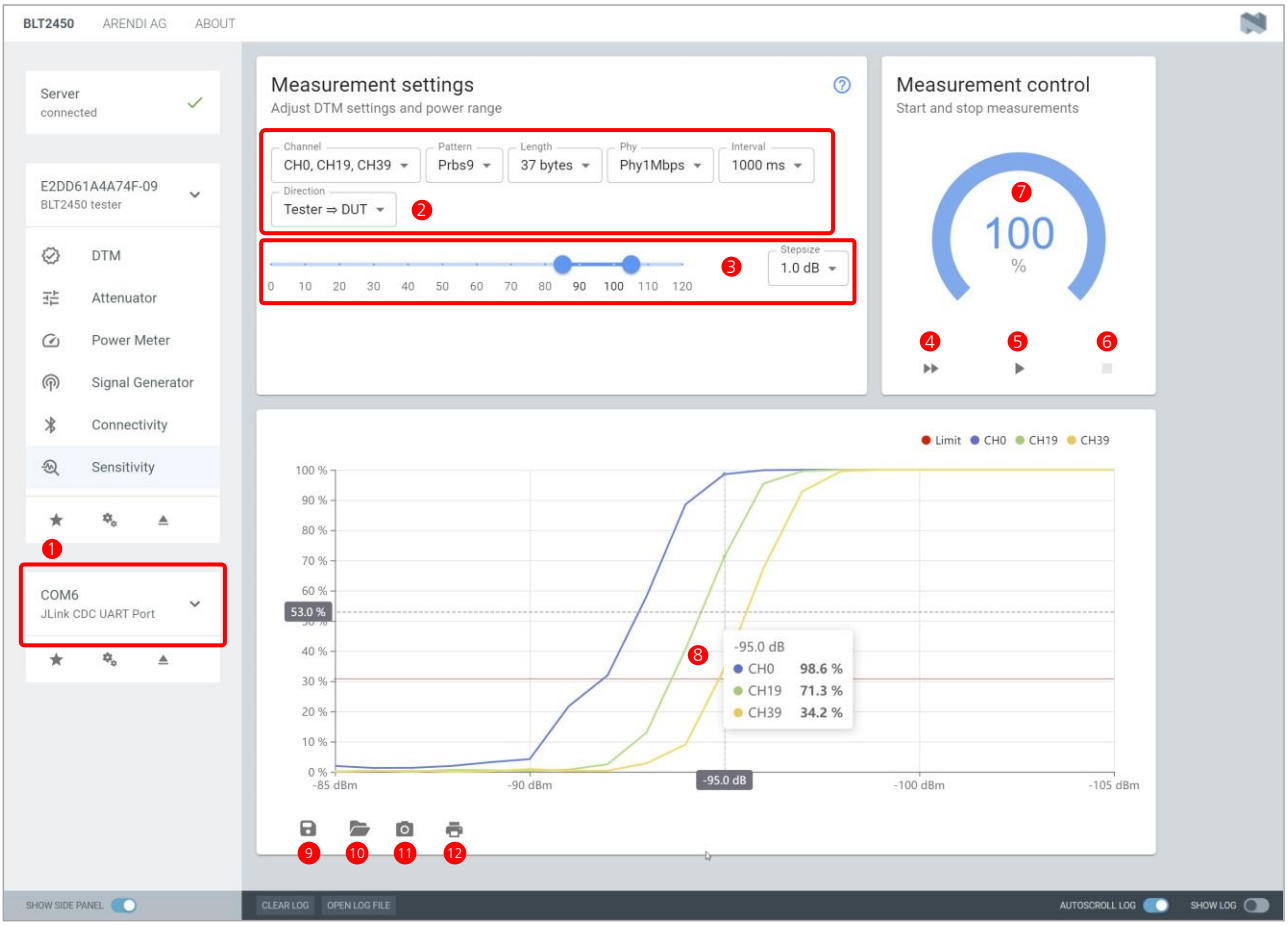


Image 14 Typical setup for sensitivity measurements

6.6.2 Instructions



✓ **Setup, select DUT**

Set Sensitivity mode and select the DUT from the DUT control panel ❶.

✓ **Change settings**

Change the DTM settings ❷, the measurement range ❸ and the stepsize (resolution) that should be used for the measurement. The settings can only be changed when no measurement is active.

✓ **Perform measurements**

Press the Scan button ❹ to quickly find the sensitivity limit. After the scan has completed, press the Start button ❺ to perform the complete

measurement using the configured resolution. Press the Stop button ❻ to terminate an ongoing measurement.

The progress of the measurement is shown in the gauge ❼ and the sensitivity curve is updated in the chart ❽. Place the mouse over a point of interest to reveal details.

Click the save icon ❾ to save the current measurement to a file using CSV format. Click the open icon ❿ to load the measurement of a previously saved CSV file. Click on the snapshot icon ⓫to save an image of the chart.

✓ **Create report**

Save a PDF report containing the sensitivity chart and the most important measurement results by pressing on the print icon ⓬.