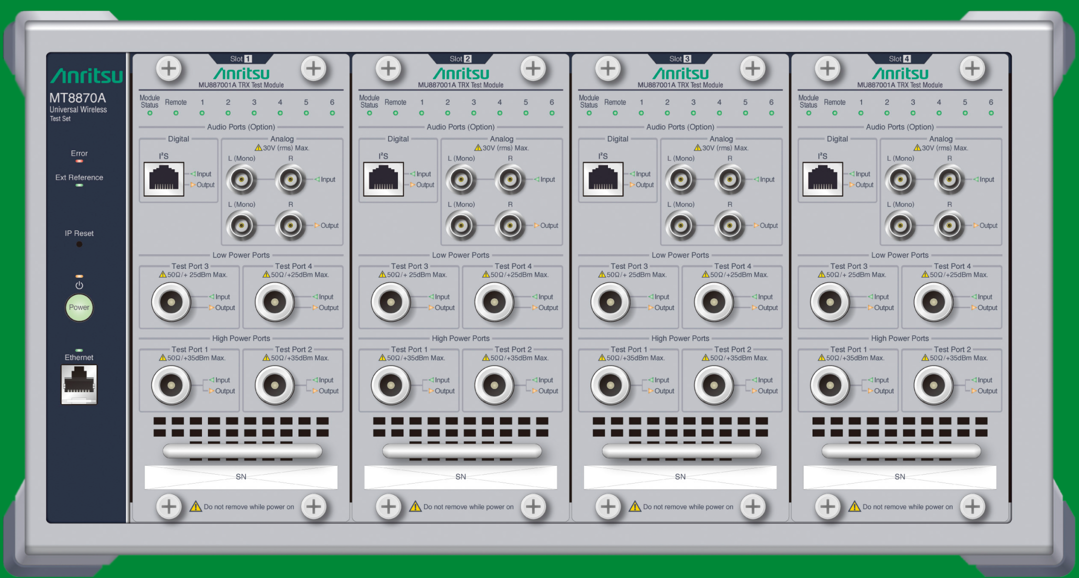
Operation Manual

CombiView

MX880052A
Short Range Wireless Applet



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MX880052A
Short Range Wireless Applet
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Anritsu Limited
200 Capability Green
LUTON, LU1 3LU
UK

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Safety Symbols

To prevent risk of personal injury or loss related to equipment malfunction, Anritsu Corporation uses the following safety symbols to indicate safety-related information. Ensure that you clearly understand the meanings of the symbols BEFORE using the equipment. Some or all of the following symbols may be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

Symbols Used in Manuals

DANGER

This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.

WARNING

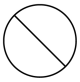
This indicates a hazardous procedure that could result in serious injury or death if not performed properly.

CAUTION

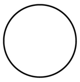
This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manuals

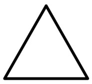
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE using the equipment.



This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



This indicates an obligatory safety precaution. The obligatory operation is indicated symbolically in or near the circle.



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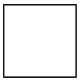
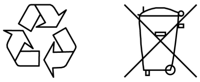


This indicates a note. The contents are described in the box.



These indicate that the marked part should be recycled.

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- This warranty does not cover damage to this software caused by Acts of God, natural disasters, and misuse or mishandling by the customer.

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- **iii.** Recovery of lost or damaged data.
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If matters of dispute or items not covered by this EULA arise, they shall be resolved by negotiations in good faith between you and Anritsu.

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This EULA shall be interpreted in accordance with Japanese law and any disputes that cannot be resolved by negotiation described in Article 8 shall be settled by the Japanese courts.

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Chapter 1 — Introduction

1-1 About this Manual

This manual explains how to use the CombiView SRW Applet (MX880052A) to make CW, *Bluetooth,* and WLAN transmitter and receiver measurements.

Note	Details of the CombiView cellular applet can be found in the MX880051A Cellular Application Applet Operation Manual.

1-2 What is CombiView?

CombiView is a PC application that you can use to control the MT8870A Universal Wireless Test Set. It allows you to configure measurements and to view measurement results.

1-3 CombiView Applets

CombiView uses applets to enable testing of short range wireless and cellular communication standards.

The Short Range Wireless (SRW) applet is provided free of charge, but to make measurements you must purchase and register at least one of the MX8870xxA measurement options:

- WLAN 802.11b/g/a/n (Option MX887030A)
- WLAN 802.11ac (Option MX887031A)
- WLAN 802.11p (Option MX887032A)
- WLAN 802.11ax (Option MX887033A)
- *Bluetooth* basic rate, enhanced data rate, and low energy (Option MX887040A)
- CW power and frequency (Option MX887050A)

1-4 CombiView Features

- Supports transmitter and receiver testing using the Anritsu MT8870A Universal Wireless Test Set
- Performs testing without the need for input of remote commands
- Automatically detects the connected MT8870As and the registered applications
- Performs detailed packet analysis
- Provides a complete testing solution for current and future wireless standards
- Supports Ethernet or GPIB (optional) remote interface
- Supports WLAN auto configuration
- Supports *Bluetooth* auto configuration
- Runs on Windows 7 or Windows XP

1-5 Available Measurements

You can use the CombiView Short Range Wireless applet to make the following measurements:

CW Measurements

- Power
- Frequency
- Spectral Profile

WLAN Measurements

Output Power Measurements

- Transmit Power
- Crest Factor
- Power Profile
- CCDF
- Power Ramp (802.11b only)

Frequency / Modulation Measurements

DSSS

- EVM
- Center Frequency Tolerance
- IQ Offset
- Phase & Magnitude Error
- IQ Imbalance
- Chip Clock Frequency Tolerance
- IQ Constellation
- Carrier Suppression from IQ Offset

OFDM

- EVM
- Center Frequency Leakage
- Center Frequency Tolerance
- Symbol Clock Frequency Tolerance
- IQ Imbalance
- IQ Constellation
- Spectral Flatness
- EVM v Symbol
- EVM v Subcarrier
- Frequency Error v Time

- Phase Error v Symbol

Spectral Measurements

- Occupied Bandwidth
- Power Spectral Density
- Spectral Mask
- Spectral Profile
- Carrier Suppression IEEE (802.11b only)

Bluetooth Measurements

Output Power Measurements

- Transmit Power
- Power Burst Profile
- EDR Relative Transmit Power (not Bluetooth LE)

Frequency / Modulation Measurements

- Modulation Characteristics
- Initial Carrier Frequency Tolerance (not Bluetooth LE)
- Carrier Drift
- Frequency Deviation
- Eye Diagram
- EDR Modulation Characteristics (not Bluetooth LE)
- EDR Differential Phase Encoding (not Bluetooth LE)
- EDR IQ Constellation (not Bluetooth LE)
- EDR DEVM v Symbol (not Bluetooth LE)
- EDR Vector Diagram (not Bluetooth LE)

Spectral Measurements

- Adjacent Channel Power (not Bluetooth LE)
- In-Band Spurious Emissions (not Bluetooth LE)
- 20 dB Bandwidth (not Bluetooth LE)
- Frequency Range (not Bluetooth LE)
- Spectral Profile

Bluetooth BLE Measurements

Output Power Measurements

- Transmit Power

- Power Burst Profile

Frequency / Modulation Measurements

- Modulation Characteristics
- Carrier Offset & Drift
- Frequency Deviation
- Eye Diagram

Spectral Measurements

- BLE In Band Emissions
- Spectral Profile

Chapter 2 — Getting Ready to Test

2-1 Checking the Operating Environment

You need the following environment in order to install and run CombiView.

- Microsoft Windows 7 with Service Pack 1 or Windows XP with Service Pack 3, Windows 8 or Windows 10.
- NI VISA 5.0.3 or later
- Windows Installer 4.5 or later
- English, Chinese, or Japanese language environment
- PC display settings of 1024 x 768 or greater
- Ethernet (or optional GPIB) remote connection from the CombiView PC to the MT8870A
- .NET Framework 4.0 (full set version)

2-2 Configuring the Equipment

You can install each MT8870A instrument with up to four MU887000A modules. Configurations for testing differ depending on the number of modules, the number of device under test (DUT), and the number of measurement standards to be tested. An MT8870A installed with four modules could, for example, be used to:

- run tests on a DUT that supports a single wireless standard
- run sequential tests on a DUT that supports multiple wireless standards
- run concurrent tests on multiple DUTs that support a single wireless standard

The figure below shows the required configuration for testing a single DUT.

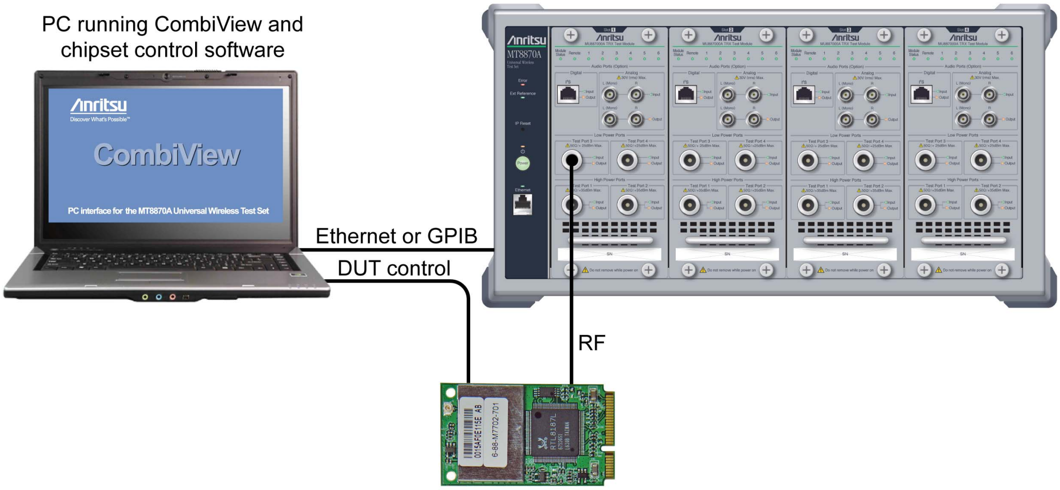


Figure 2-1. Configuration for Testing Single DUT

The figure below shows the required configuration for testing multiple DUTs.

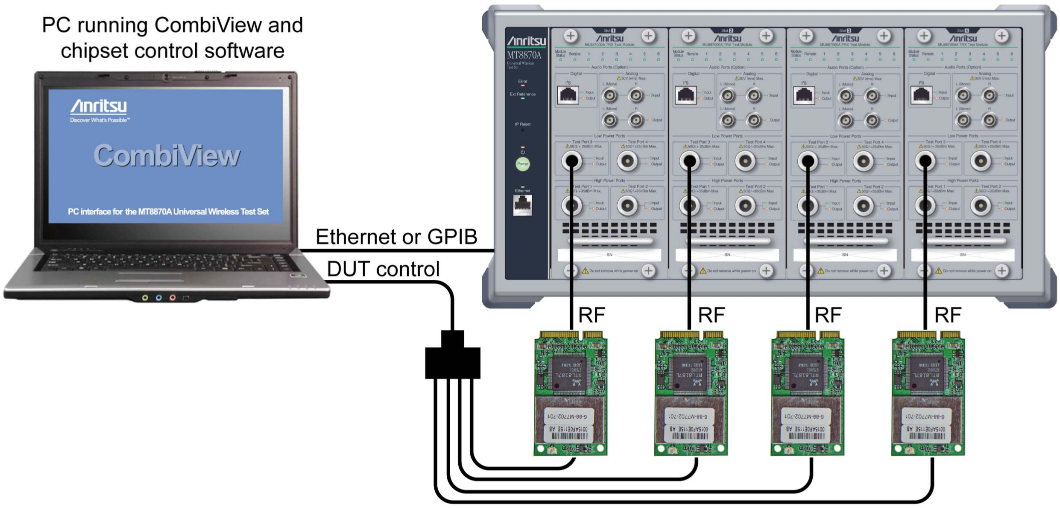


Figure 2-2. Configuration for Testing Multiple DUTs

Note	You can use this mode of operation only if the silicon vendor's test mode software supports multiple DUTs from a single PC.

1. Connect the Ethernet cable from the PC running CombiView to the connector on the front or rear panels of the MT8870A.

Note	A GPIB interface is also available as option MT8870A-001. The GPIB cable connector is located on the rear panel.

2. Connect an RF cable from the test port on the front of the MT8870A to the DUT.
3. Install the DUT client software on the PC and configure the channel and operating mode settings in line with the testing requirements.
4. Connect the DUT to the PC using the appropriate host control interface.
5. Turn on the MT8870A.

2-3 Installing CombiView

Install the CombiView software from the product CD.

1. Double-click the installer file (CombiViewSetup.msi).
2. Click **Next** at the Welcome dialog.
3. Read the license agreement. If you agree to the terms select “I accept the terms in the License Agreement” and click **Next**.
4. Accept or change the install location (C:\Program Files\Anritsu\CombiView). Select “Create a shortcut on the desktop” and click **Next**.
5. Click **Install** to start the installation.
6. Click **Finish** when the installation is complete.

2-4 Installing the Short Range Wireless Applet

Note	You should install the CombiView platform before installing the SRW applet.

Install the Short Range Wireless Applet from the product CD.

1. Double-click the applet installer file, CombiViewSetup.msi.
2. Read the license agreement. If you agree to the terms select "I accept the terms in the License Agreement" and click **Install**.
3. Click **Finish** when installation is complete.

Note	The Short Range Wireless applet installation includes a check for the presence of MATLAB. If MATLAB is not detected, the MATLAB Compiler Runtime (MCR) installation dialog displays automatically. Follow the on-screen instructions to install MCR.

2-5 Opening the CombiView Manager

Double-click the **CombiView** icon generated on the desktop during installation, or select **CombiView** from the **Anritsu** directory in the programs section of the Windows **Start** menu.

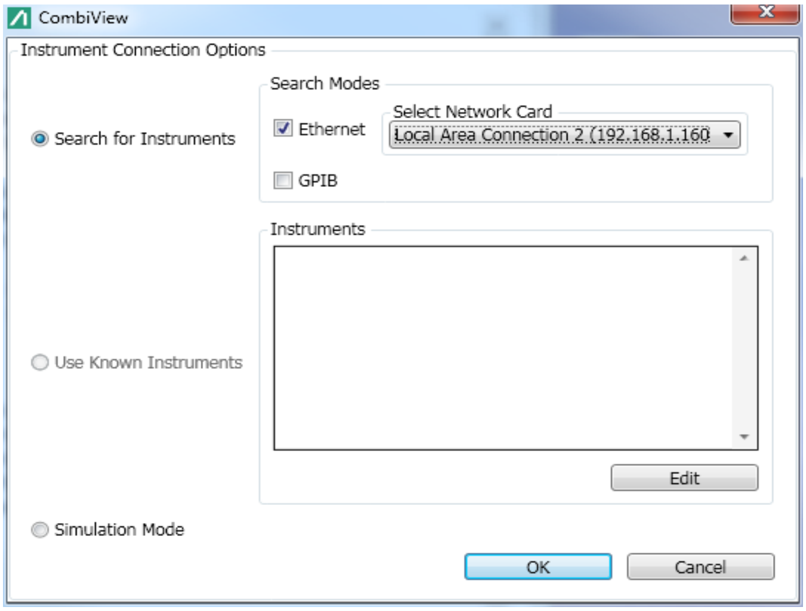


Figure 2-3. Instrument Connection Options

The Instrument Connection Options Dialog is displayed. You use this dialog to specify how CombiView will communicate with the instrument. You can select Ethernet or GPIB control. You can request CombiView to search for available instruments or use instrument that you have chosen previously. Finally you can choose Simulation Mode to run CombiView without an Instrument.

1. Select one of the three options on the left of the form. Simulation mode does not require an instrument. See Chapter 14, “Demonstrating CombiView”. The other two options allow you to choose whether CombiView will search the selected interface for all MT8870 instruments, or limit the search to known instruments that you have used previously. You may find that the search time is shorter if you specify known instruments.
2. At Search Modes choose the interface - Ethernet or GPIB. If you choose Ethernet, select the PC network card to use from the drop-down list.
3. If you wish CombiView to limit its search to known instruments, check the list of instruments and if necessary click Edit to add or remove items from the list. When you add an instrument you will need to enter its IP address.

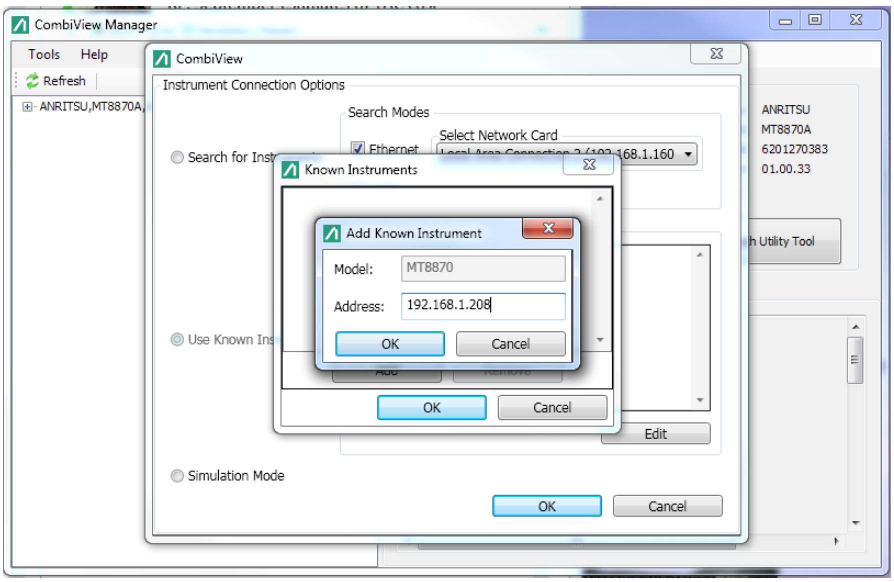


Figure 2-4. Adding a Known Instrument’s IP Address

4. When you have finished making any changes to the Instrument Connection Options dialog, click OK to start the search process.

CombiView Manager automatically detects the MT8870s on your network and the options that you have installed. Options (applets) that are not available for use display in italics.

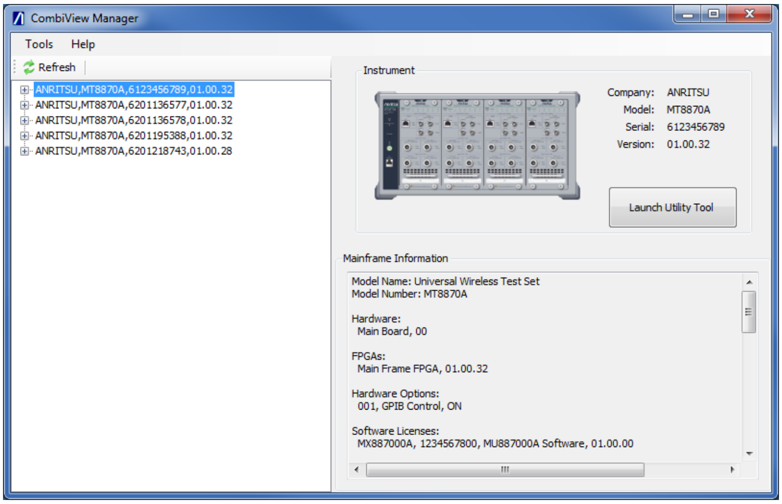


Figure 2-5. CombiView Manager

2-6 Opening the SRW Applet

1. Open the CombiView Manager as described above.
2. In the **CombiView Manager** device tree, double-click the **Anritsu MT8870A** that you are using to make measurements.

   Double-click the **Anritsu, MU887000A** module that you are using to make measurements. In the figure below the CombiView manager has detected five MT8870As on the network. The selected instrument contains two modules. The selected module (serial number 6201221315) is module number 1, as indicated by the yellow rectangle that displays on the image of the MT8870A.

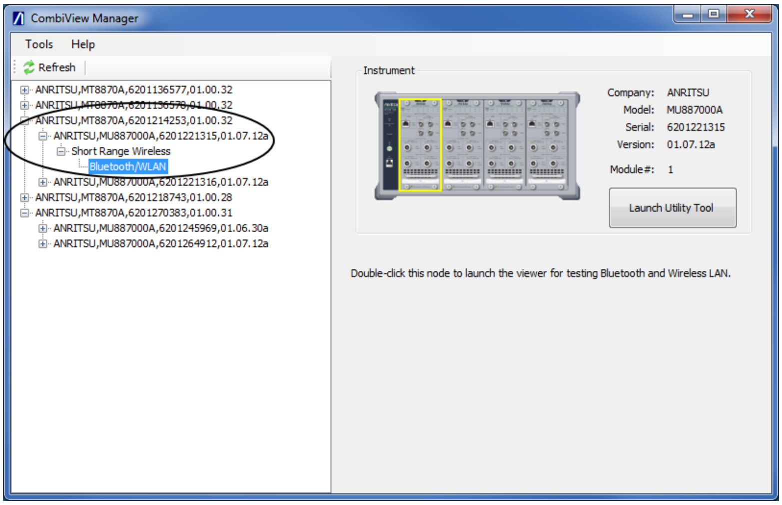


Figure 2-6. CombiView Manager

3. Double-click **Short Range Wireless**.

4. Double-click **Bluetooth/WLAN** to open the CombiView SRW Applet as shown below.

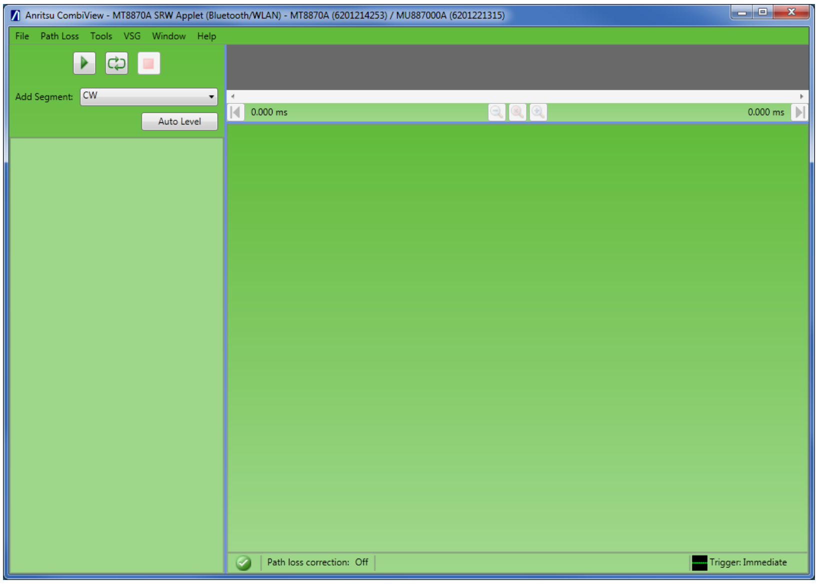


Figure 2-7. CombiView SRW Applet

5. When first opened, the SRW Applet does not yet contain any segment configurations. Click the **Add Segment** drop-down to view the segment types that can be added. The procedure for adding and configuring segments is explained over the following chapters for each type of testing.

Chapter 3 — Single Waveform Transmitter Testing

3-1 Configuring the Analysis Settings

1. Open a SRW Applet as described in section 2-6 “Opening the SRW Applet”.
2. At “Add Segment”, select the standard to match the data that you are transmitting from the DUT.

   You can select the standard by name or you can select one of the Auto-ID options based on the modulation type. If you select an Auto-ID options, the data rate (or MCS index) and PPDU settings are acquired automatically.

   When you select a standard from the list, a segment for that standard displays at the left of the window as shown in the example below.

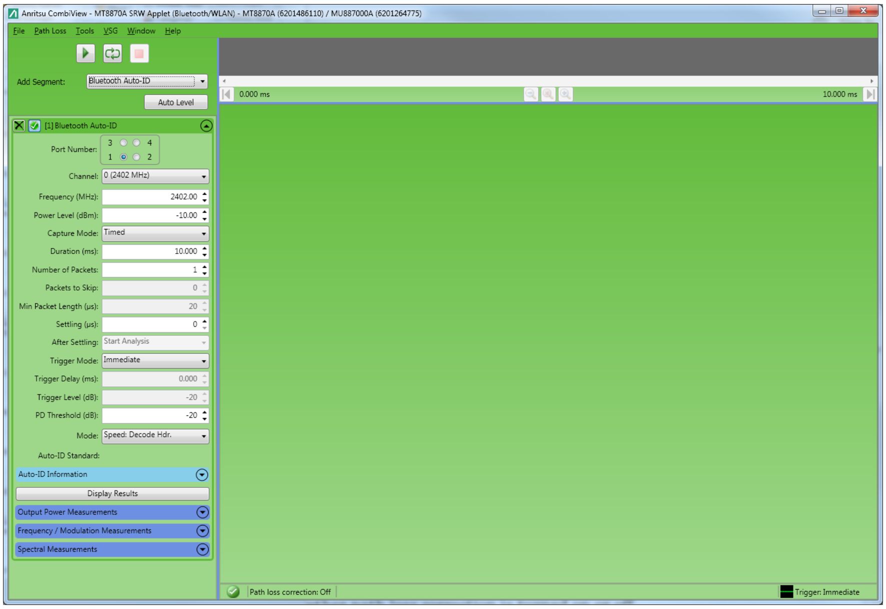


Figure 3-1. CombiView Window with Bluetooth Auto-ID Segment

3. At “Port Number”, select the test port on the MT8870A that you are using to connect to the DUT. Test ports 3 and 4 are the most suitable for SRW testing because they have the best dynamic range.

4. Configure the analysis settings in line with the data that you are transmitting from the DUT. Set the power level manually or click **Auto Level** to set the power to automatically match that of the data being transmitted.

Note	Refer to **Appendixes A, B, and C** for definitions of the analysis settings for each type of wireless standard.

5. Click **Display Results** to display a tab that will be populated with results when you run the measurements.

3-2 Selecting and Configuring Measurements

1. The transmitter measurements are arranged in groups in the area immediately below the analysis settings. Each group of measurements is accessed from a blue title bar. Click the down arrow on the first measurement group to display the associated tests.

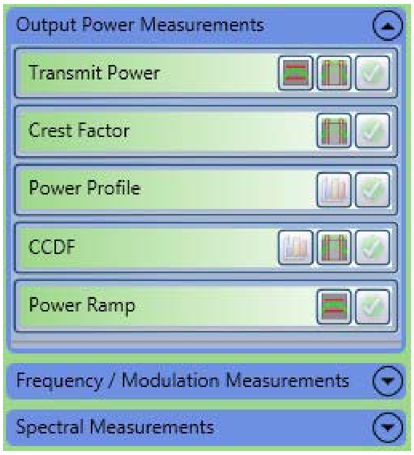


Figure 3-2. Measurement Groups for 802.11b

2. Select the tests to be run by clicking the check mark on the test bar.

   - Tests that are selected display this button: .
   - Tests that are not selected display this button: .

Note	Details of each test are provided in the MX8870xxA SRW Application Operation Manual.

3. Some tests support the display of graphical results. When available, graphical results can be selected by clicking the graphics button on the test bar.

   - Tests for which graphical results are available display this button: .

- Tests that have graphical results selected display this button: .

Note	Graphical results, such as power profile, do not have pass/fail conditions. They are displayed to show the detailed performance of the DUT. Selecting multiple graphical results may reduce the speed of system update.

4. Certain tests support the setting of limits.

Tests that support the setting of limits display this button: .

Click the limits button to display a **Configure Limits** dialog such as the one below. Set the limits as required and click **OK**.

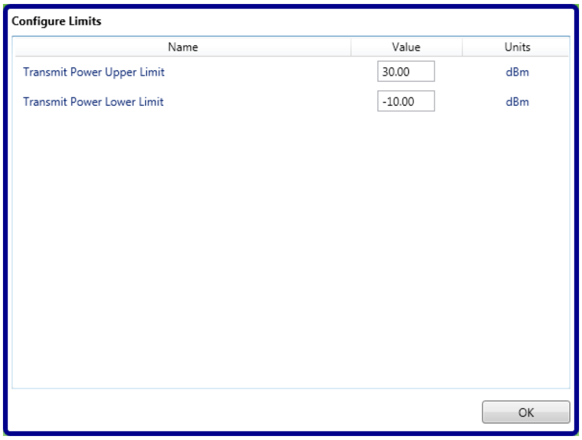


Figure 3-3. Configure Limits

5. Certain tests support the setting of gates.

Tests that support gates display this button: .

Click the gates button to display a **Configure Gates** dialog such as the one below.

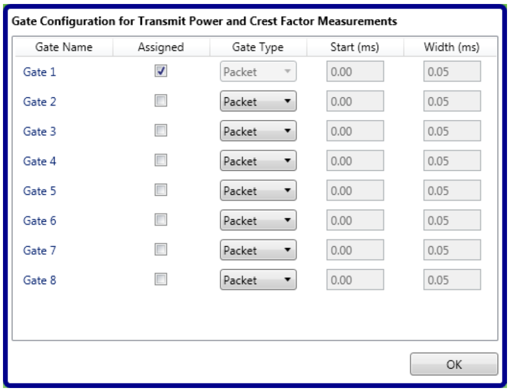


Figure 3-4. Gate Configuration

6. Open the remaining measurement groups and repeat the procedure above.

Note	Refer to Section 8-6 for a full description of gates.

3-3 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File** > **Save Settings As**.

You can load settings you have saved by selecting **File** > **Load Settings**.

3-4 Transmitting Data from the DUT

From the DUT, transmit data to the MT8870A in line with the analysis settings you have made within CombiView.

3-5 Running the Tests

Click  to run the selected tests once. Click  to run the selected tests in a continuous loop. Tests running in a loop can be stopped at any time by clicking .

Note	Refer to Chapter 8 for information on viewing and interpreting the test results.

Chapter 4 — Multiple Waveform Transmitter Testing

Certain DUTs support a mode of operation that is used specifically for testing purposes. This is frequently referred to as “list mode”. List mode allows a DUT to transmit a continuous stream of data that may include any type of 802.11 or Bluetooth packets.

CombiView provides support for list mode by dividing a capture into multiple segments. You add and configure capture segments for each SRW standard used within a list mode transmission of the DUT.

A second common use for multiple segment captures is when measuring IEEE 802.11ac 80+80 signals. See “IEEE 802.11ac 80+80 Measurements” on page 4-7

4-1 Configuring the Analysis Settings for the First Segment

1. Open a SRW Applet as described in section 2.7.
2. Remove any existing segments currently listed in the left hand pane. To do this click the  button on the title bar of each segment and confirm deletion when prompted.
3. At “Add Segment” expand the drop-down list and select the standard to match the data that the DUT will transmit in the first segment of the list transmission.

   You can select the standard by name or you can select one of the Auto-ID options based on the modulation type.

When you select a standard from the list, a segment for that standard displays at the left of the window as shown in the example below.

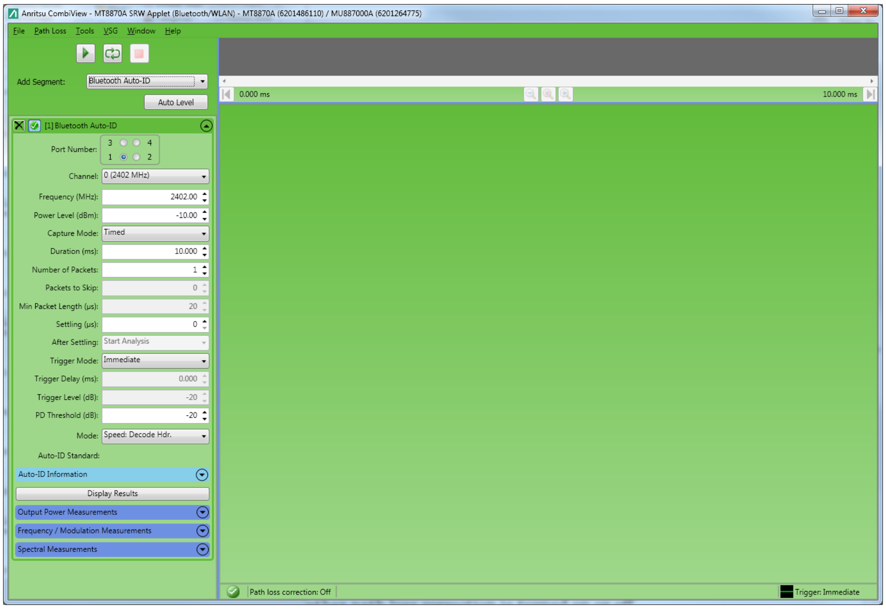


Figure 4-1. CombiView Window with Bluetooth Auto-ID Segment

4. If necessary expand the configuration settings of the new segment by clicking its title bar - Figure 4-1.
5. At “Port Number”, select the test port on the MT8870A that you are using to connect to the DUT. Test ports 3 and 4 are the most suitable for SRW testing because they have the best dynamic range.
6. At “Trigger Mode” select “Level”.

Note	The test instrument and DUT must be synchronized to ensure that the stream of packets generated by the DUT matches the segment definitions set up in the test instrument. Level trigger mode ensures that the capture starts when the instrument receives the first packet from the DUT.

7. At “Capture Mode” consider using “Packet Count” rather than “Timed” captures.

Note	To configure a “Timed” capture, you will need to know the timing of the DUT’s list output exactly so that you can set the capture duration for each segment. This information may not be easy to find except by experiment. The timing may not be consistent from run to run, and may be dependent on the version of the DUT manufacturer’s control software. In general it is much easier to use packet counting mode. In this mode you set the number of packets expected from the DUT in each segment of the capture. The instrument counts the packets generated by the DUT and uses this value to determine when to switch to the next capture segment.

8. Configure the analysis settings in line with the data that you are transmitting in the first segment of the multi-segment transmission.

Note	Refer to **Appendixes A, B, and C** for definitions of the analysis settings for each type of wireless standard.

9. Click **Display Results** to display a tab that will be populated with results when you run the measurements.

4-2 Adding and Configuring Additional Segments

1. Repeat the process above to add segments for the remaining portions of the list mode transmission.
2. You can add as many segments as required up to a maximum of 64. Each segment displays as a title bar as shown in the figure below.

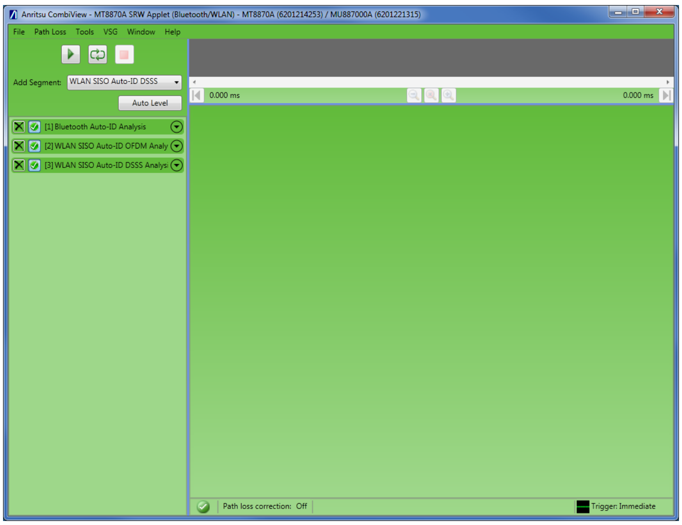


Figure 4-2. CombiView Window with Bluetooth Auto-ID Segment

3. Click the title bar to display the configuration settings and measurements as explained in chapter 3.

4. You can delete a segment by clicking the close buttons.

4-3 Selecting and Configuring Measurements

Expand each segment in turn by clicking the arrow in its title bar, then select and configure the required measurements as explained in section 3-2, Selecting and Configuring Measurements.

4-4 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File** > **Save Settings As**.

You can load settings you have saved by selecting **File** > **Load Settings**.

4-5 Setting the Input Power Level

Before running the tests you must ensure that Power Level setting is set up correctly for each segment. Proceed as follows:

1. Set up the DUT to transmit continuously.
2. Click **Auto Level.**

This will determine a suitable power level for capturing the input signal, and will apply it to all segments. If you know that the DUT will produce signals of widely differing levels during the capture, you can optimize the power level settings for each segment manually. However if you do this you will need to take account of an additional hardware settling time of 500 µs at the start of each segment. See 4-8, Advanced Features.

4-6 Single Shot Measurement

To make a single multi-segment capture proceed as follows:

1. Ensure that the DUT is not transmitting.

2. Click At this point, because the DUT is not transmitting, you should see the "waiting for trigger" status message - Figure 4-3.

Figure 4-3. Waiting for Trigger

3. Use the control software for your DUT to transmit the list sequence once. The instrument should trigger on the rising edge of the first RF pulse, and capture the number of packets you specified when configuring the segments.

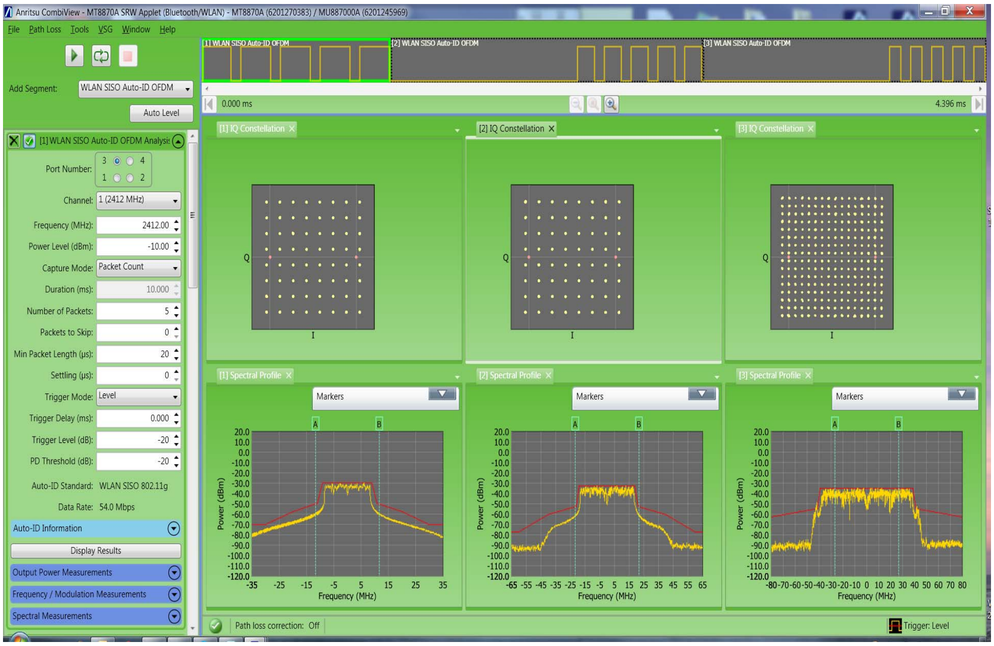


Figure 4-4. Multi-Segment Capture

In the example shown above, the DUT has been configured to generate a sequence of:

- 802.11g 54 Mbps - 5 packets
- 802.11n 40 MHz MCS7 - 5 packets
- 802.11ac 80 MHz MCS9 - 5 packets

4-7 Continuous Measurement

Note	To make continuous measurements, the DUT must be able to output the same sequence of packets in a continuous loop.

1. Ensure that the DUT is not transmitting.
2. Click  to run the selected tests in a continuous loop. At this point, because the DUT is not transmitting, you should see the "waiting for trigger" status message - Figure 4-3.
3. Use the control software for your DUT to transmit the list sequence in a repeated loop. The instrument should trigger on the rising edge of the first RF pulse, and capture the number of packets you specified when configuring the segments.
4. You can stop the tests at any time by clicking .

4-8 Advanced Features

If the frequency, power level or port number changes between segments, the captured data is unstable and not suitable for analysis for up to 500 µs at the start of each segment. You must take this into account when configuring the segment settings.

You can:

- use the “Packets to Skip” setting to disregard one or more complete packets at the start of the segment; or
- set a minimum of 500 µs settling delay for each segment.

Of these two methods, “Packets to Skip” is the easier to use:

1. At “Capture Mode” for each segment, select “Packet Count”.
2. At “Number of Packets” for each segment, enter the number of packets to measure.
3. At “Packets to Skip” for each segment, enter the number of packets needed to exceed the required settling time of 500 µs. This will depend on the packet length and the spacing between the packets.
4. When configuring the packet sequence on the DUT, set the number of packets required for each segment to the value you entered for “Number of Packets” **plus** the number you entered for “Packets to Skip.

Note	Some DUTs run an internal calibration sequence when their frequency or power setting is changed. During this time the DUT may produce packets that do not meet the required performance specification. You can use the “Packets to Skip” feature to prevent these packets from being included in the measurement results.

Figure 4-5 shows an example set-up. The DUT will generate five packets in this segment. One will be skipped and the remaining four measured.

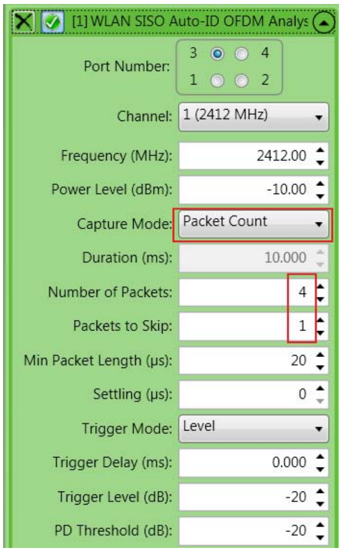


Figure 4-5. Packet Count Mode with Packet Skip

Figure 4-6 shows the resulting measurement. Note that the packet selector at the top of the screen now shows that four packets, rather than five, are being measured in each segment.

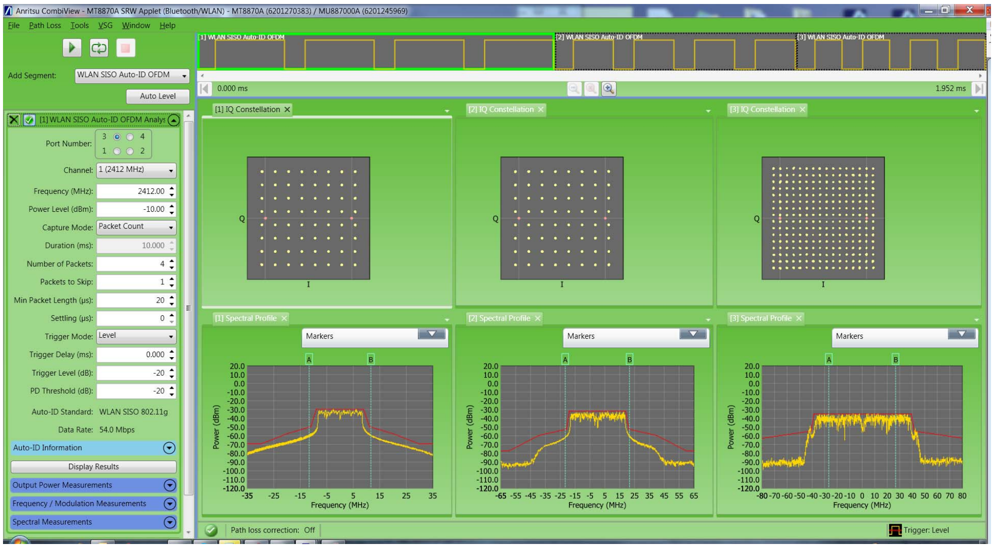


Figure 4-6. Multi-Segment Measurement with Packet Skip

4-9 IEEE 802.11ac 80+80 Measurements

In addition to 160 MHz (VHT160) transmissions, the 802.11ac standard specifies a method for transmitting a pair of 80 MHz frequency segments that can be positioned separately within the 5 GHz WLAN band to minimize the effect of interference from other services. This type of transmission is known as “80+80”.

Within the IEEE standard, the 80+80 frequency segments are referred to as “primary” and “secondary”. The use of “primary” and “secondary” does not describe which frequency segment is located at the higher frequency.The secondary frequency segment can be at a lower or higher frequency than the primary.

For clarity, this manual uses the terms “lower” and “upper” to distinguish between the two carrier frequencies.

4-10 80+80 SISO Measurements

80+80 transmissions can be measured using the multiple waveform transmitter testing features of the MT8870A, and the CombiView SRW Applet automates the instrument set-up.

This section describes 80+80 SISO (single input single output) measurements using sequential or concurrent techniques. Concurrent measurements require two MU887000A modules, but guarantee to capture the 80+80 upper and lower frequency segments from the same packet. Sequential measurements require a single MU887000A. The upper and lower frequency segments of the 80+80 signal are captured sequentially.

The measurement results available include the combined EVM of the two 80+80 frequency segments and spectral emission measurements against a combined mask calculated according to the IEEE standard.

Note	CombiView supports concurrent and sequential True MIMO measurements of 80+80 2x2 MIMO transmissions. See “80+80 MIMO Measurements” on page 5-6

4-11 80+80 Sequential SISO Measurements

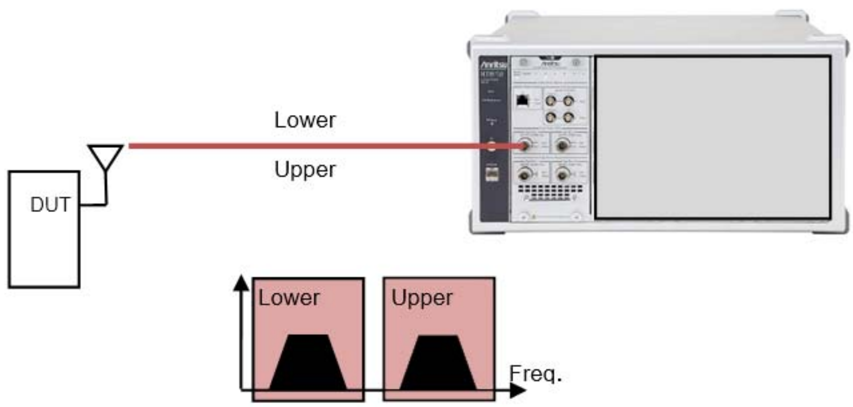


Figure 4-7. Connections for Sequential 80+80 SISO - Combined Signals

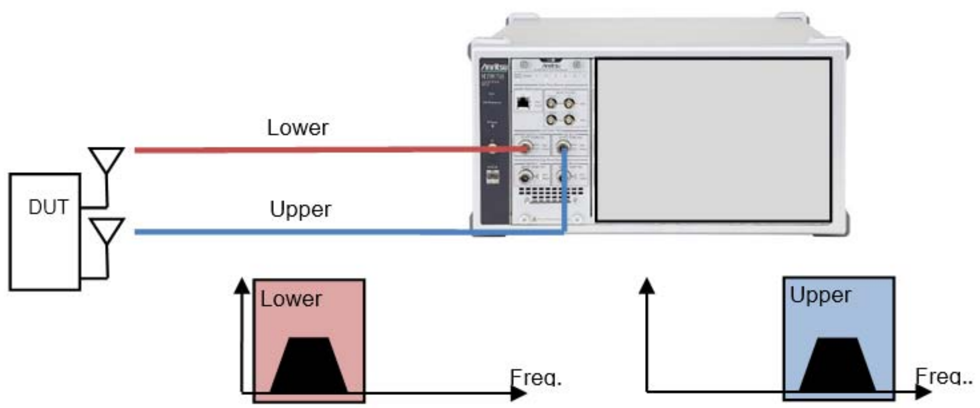


Figure 4-8. Connections for Sequential 80+80 SISO - Separate Signals

1. Open a SRW Applet as described in section 2-6 “Opening the SRW Applet”.

2. At “Add Segment” expand the drop-down list and select “WLAN Seq 80+80 SISO”. (If one or more segments are already defined, CombiView will display a prompt to confirm that they may be deleted. Click **Yes**.)

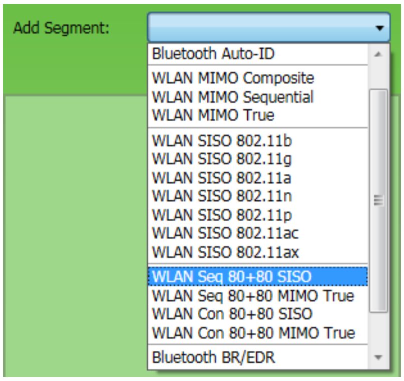


Figure 4-9. Set up an 80+80 Sequential SISO Measurement

CombiView automatically creates two segments, one for each carrier of the 80+80 transmission.

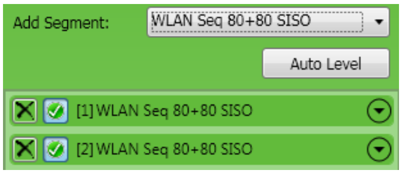


Figure 4-10. Segments for Sequential 80+80 SISO Measurements

3. Expand the configuration of the first segment by clicking its title bar.
4. At “Port Number”, select the test port that you will use to measure the lower carrier of the 80+80 transmission. Test ports 3 and 4 are the most suitable for SRW testing because they have the best dynamic range.
5. At “Frequency (MHz)” or “Channel”, enter the frequency or select a channel for the lower carrier of the 80+80 transmission.
6. Configure the other settings (Capture mode, number of packets, etc.,) as required. These settings are shared automatically with the other segment.

7. Expand Spectral Measurements and then Spectral Profile Settings. Change the 80+80 Signal State settings to Separate if required.

Note	This setting is necessary so that the SRW analysis software can use the correct method to calculate the combined spectrum. If the 80+80 Carriers are combined within the DUT and are output through a single port, or if they are output through separate antenna ports and combined before the input to the instrument, leave the setting unchanged as “Combined”. This is the most common set-up. If the DUT has two separate outputs for the two carriers and these are taken to two separate inputs of the instrument, change this setting to “Separate”.

8. Expand the configuration of the second segment by clicking its title bar.
9. At “Port Number” select the test port that you are using to measure the upper carrier of the 80+80 transmission.
10. At “Frequency (MHz)” or “Channel”, enter the frequency or select a channel for the upper carrier of the 80+80 transmission.

4-12 Selecting and Configuring Measurements

Expand the first segment by clicking the arrow in the title bar, then select and configure the required measurements as explained in section 3-2, “Selecting and Configuring Measurements”

Note	CombiView offers two additional measurements for 80+80 signals: Combined EVM displays the combined EVM of the upper and lower frequency segments. When selected, this result appears in the numeric results table. Combined Spectral Profile displays the spectral profiles of the upper and lower frequency segments within the same graph area. If the carriers are less than or equal to 280 MHz apart, a combined spectral mask is displayed. This is calculated according to the IEEE Standard.

4-13 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File > Save Settings As**.

You can load settings you have saved by selecting **File > Load Settings**.

4-14 Setting the Input Power Level

Before running the tests you must ensure that the Power Level setting is set up correctly for each segment. Proceed as follows:

1. Set up the DUT to transmit continuously.
2. Click **Auto Level**

4-15 Making Measurements

Click  to make a single shot measurement, or Click  to run the selected tests in a continuous loop.

4-16 80+80 Concurrent SISO Measurements

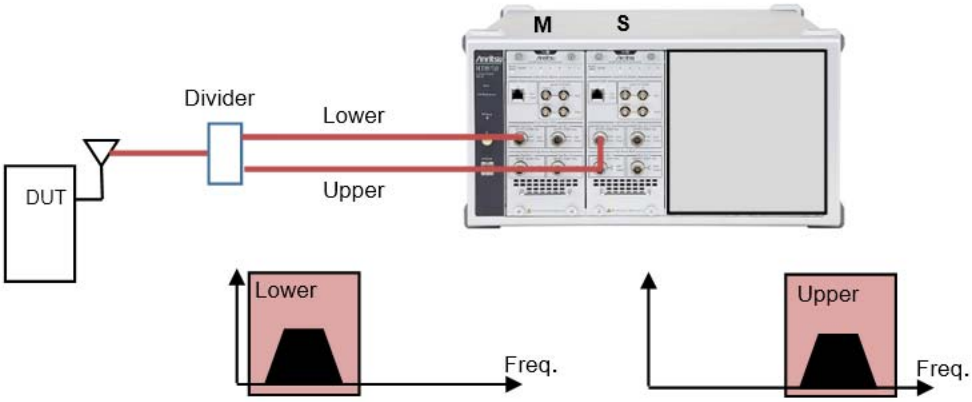


Figure 4-11. Connections for Concurrent 80+80 SISO - Combined Signals

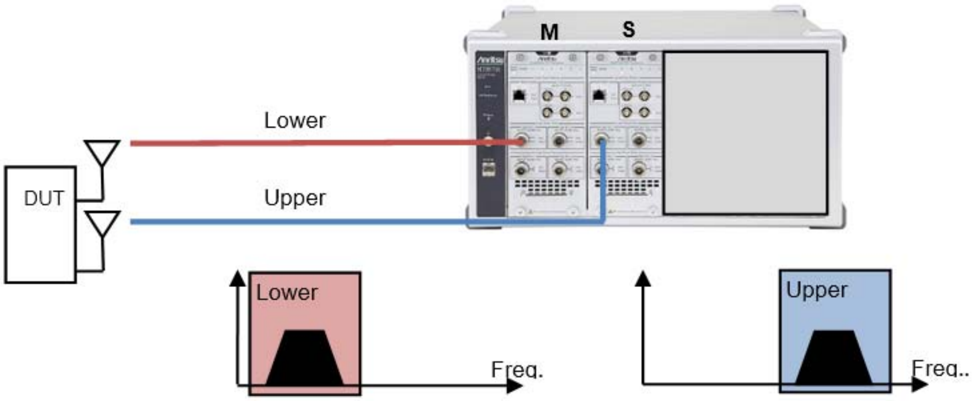


Figure 4-12. Connections for Concurrent 80+80 SISO - Separate Signals

1. Open a SRW Applet as described in section 2-6 “Opening the SRW Applet”.

Note	The SRW Applet must be opened to control a MU887000A module located in either slot 1 or slot 3 of an MT8870A mainframe. This is the “Master Module” for the measurement. A second (“Slave”) module is required to measure the second 80+80 carrier concurrently. If the Master is in slot 1 the Slave module can be in any of the other slot positions, but you should use slot 2 if possible because CombiView can automate the set-up. If the Master is in slot 3 the slave module must be in slot 4. Be sure to check that the Slave module is not being controlled by another program such as another instance of CombiView. If it is, the Master module will not be able to take control of it.

2. At “Add Segment” expand the drop-down list and select “WLAN Con 80+80 SISO”. (If one or more segments are already defined, CombiView will display a prompt to confirm that they may be deleted. Click **Yes**.)

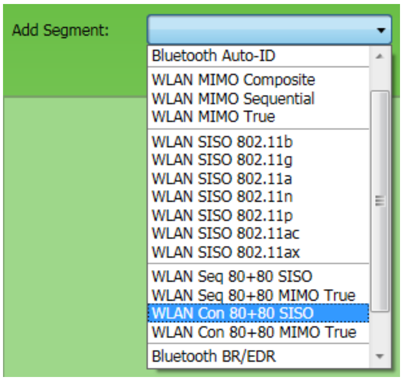


Figure 4-13. Set up an 80+80 Concurrent SISO Measurement

CombiView automatically creates two segments, one for each carrier of the 80+80 transmission.

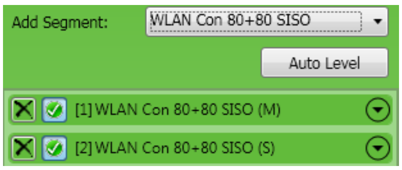


Figure 4-14. Segments for Concurrent 80+80 SISO Measurements

3. Expand the configuration of the first segment by clicking its title bar.
4. At “Port Number”, select the test port that you will use to measure the lower carrier of the 80+80 transmission. Test ports 3 and 4 are the most suitable for SRW testing because they have the best dynamic range.

5. At “Frequency (MHz)” or “Channel”, enter the frequency or select a channel for the lower carrier of the 80+80 transmission.
6. Configure the other settings (Capture mode, number of packets, etc.,) as required. These settings are shared automatically with the other segment.
7. Expand Spectral Measurements and then Spectral Profile Settings. Change the 80+80 Signal State settings to Separate if required.

Note	This setting is necessary so that the SRW analysis software can use the correct method to calculate the combined spectrum. If the 80+80 Carriers are combined within the DUT and are output through a single port, or if they are output through separate antenna ports and combined before the input to the instrument, leave the setting unchanged as “Combined”. This is the most common set-up. if the DUT has two separate outputs for the two carriers and these are taken to two separate inputs of the instrument, change this setting to “Separate”.

8. Expand the configuration of the second segment by clicking its title bar.
9. At “Port Number” select the test port that you are using to measure the upper carrier of the 80+80 transmission.
10. At “Frequency (MHz)” or “Channel”, enter the frequency or select a channel for the upper carrier of the 80+80 transmission.
11. At “IP Address”, check and if necessary enter the IP address of the “S” (“Slave”) module.

Note	Normally you do not need to change the IP address. CombiView sets it for you automatically. If the Master module is in slot 1 and the slave module is in a position other than slot 2, you must set the IP address manually.

4-17 Selecting and Configuring Measurements

Expand the first segment by clicking the arrow in the title bar, then select and configure the required measurements as explained in section 3-2, “Selecting and Configuring Measurements”

Note	CombiView offers two additional measurements for 80+80 signals: Combined EVM displays the combined EVM of the upper and lower frequency segments. When selected, this result appears in the numeric results table. Combined Spectral Profile displays the spectral profiles of the upper and lower frequency segments within the same graph areas. If the carriers are less than or equal to 280 MHz apart, a combined spectral mask is displayed. This is calculated according to the IEEE Standard.

4-18 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File > Save Settings As**.

You can load settings you have saved by selecting **File > Load Settings**.

4-19 Setting the Input Power Level

Before running the tests you must ensure that the Power Level setting is set up correctly for each segment. Proceed as follows:

1. Set up the DUT to transmit continuously.
2. Click **Auto Level**

4-20 Making Measurements

Click  to make a single shot measurement, or Click  to run the selected tests in a continuous loop.

Chapter 5 — True MIMO Transmitter Testing

5-1 What is MIMO?

In a MIMO (multiple-input and multiple-output) system, multiple antennas are used to increase data throughput without adding bandwidth or increasing power. The data being transmitted is split into a number of spatial streams that are then reconstructed by the receiver.

There are three types of MIMO measurement system: true (or real) MIMO, sequential MIMO, and composite MIMO.

True MIMO transmitter testing is explained in this chapter. Sequential and composite MIMO transmitter testing is explained in chapters 6 and 7.

5-2 True MIMO

In a true MIMO measurement system all data streams are measured simultaneously.

Testing true MIMO data requires a dedicated vector signal analyzer (VSA) for each of the spatial streams (SS). On the MT8870A true MIMO testing therefore requires a dedicated MU887000A module for each of the streams being transmitted. This is shown in figure 5-1 below.

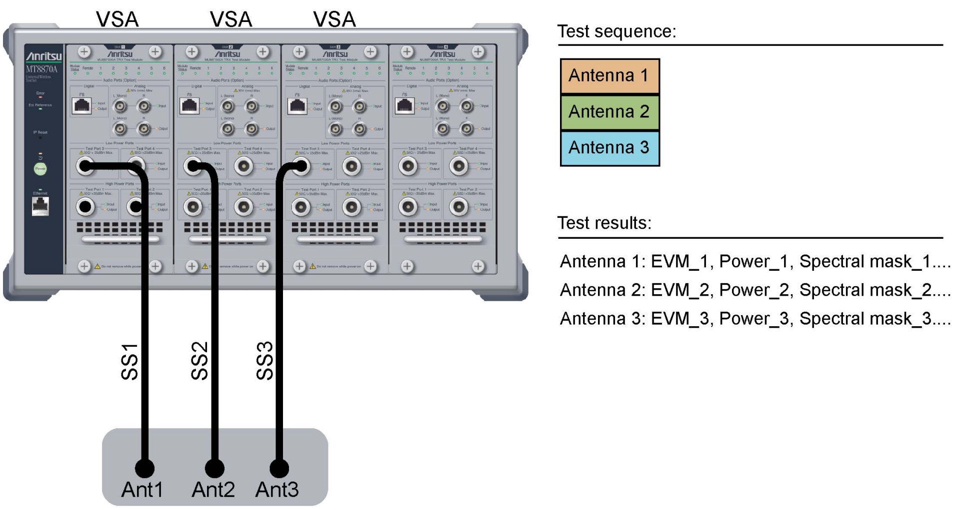


Figure 5-1. True MIMO Transmitter Testing

True MIMO analysis includes cross-stream power leakage and its effect on error vector magnitude (EVM). This analysis depends on the ability to process measurement data from all the streams in one place. To achieve this, one of the MU887000A modules acts as a “master” module that controls the other modules and assembles the measurement data for analysis. Up to four spatial streams can be analyzed using up to 4 MU887000A modules.

- The “M” module can be located in the slot 1 or slot 3 position of the MT8870A mainframe.
- If it is located in slot 1 it can control up to 3 “S” modules located in the same mainframe.
- If it is located in slot 3 it can only control 1 “S” module, and this must be located in slot 4 of the same mainframe. (This feature allows two sets of 2 x 2 T-MIMO measurements to be performed simultaneously using four MU887000A modules in a single mainframe.)

5-3 Configuring the Analysis Settings

For simplicity we will assume that the DUT is a 2 x 2 MIMO device and that the MT8870A contains two MU887000A modules, located in slots 1 and 2.

1. Ensure that there are no connections established to any of the MU887000A modules that you wish to use for the true MIMO measurement. If another application is using a module, the master module will not be able to control it.
2. From the CombiView Manager, open a SRW Applet for the module located in slot 1.
3. At “Add Segment”, select “WLAN MIMO True (M)”.When the **MIMO Streams** dialog appears, select the **2 Streams** option - Figure 5-2.

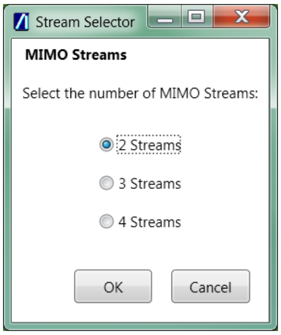


Figure 5-2. Select Number of MIMO Streams

CombiView automatically creates two segments, one designated “M” and one designated “S” - Figure 5-3.

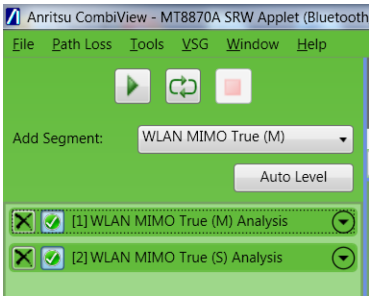


Figure 5-3. True MIMO Segments

4. Expand the “M” segment settings by clicking the arrow in its title bar - Figure 5-4.
5. At “Port Number”, select the port that you will use to connect to the DUT.
6. At “Number of Packets”, enter the number of packets to measure.
7. At “Trigger Mode”, select “Level”.
8. Set up other settings as required. These are described in Appendix A, “WLAN Setting Definitions”.
9. Click **Display Results** to display a table that will be populated with results when you run the measurement.

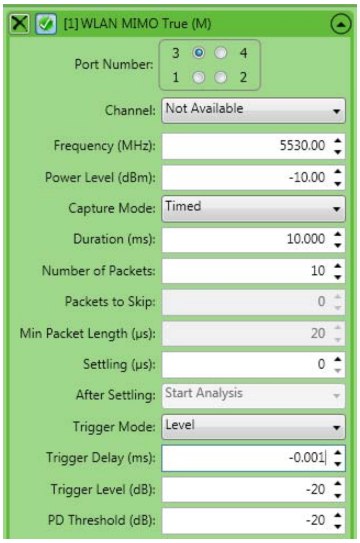


Figure 5-4. “M” Segment Settings

10. Expand the “S” segment by clicking the arrow in its title bar.
11. At “Port Number”, select the port that you will use to connect to the DUT.

12. The IP Address is that of the module in slot 2. It will be used by the “M” module in slot 1 to control the “S” module in slot 2. This field is populated automatically by CombiView and you should not need to change it.
13. Click **Display Results** to display a results table for this stream. The table appears as a separate tab. If you wish you can display the results for the two streams side by side or one above the other. Refer to Chapter 8 for details of how to view the test results.

5-4 Selecting and Configuring Measurements

Expand the “M” segment settings by clicking the arrow in its title bar, select and configure the required measurements as explained in section 3-2, Selecting and Configuring Measurements.

5-5 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File** > **Save Settings As**.

You can load settings you have saved by selecting **File** > **Load Settings**.

5-6 Transmitting Data from the DUT

From the DUT, transmit packets to the MT8870A.

5-7 Setting the Input Level for All Modules

Click Auto Level. The “Power Level (dBm)” fields in both the “M” and “S” segment settings should update automatically with the optimum power level for measurement.

Note	If you wish to set the power level manually, you must do so separately for each true MIMO segment.

5-8 Running the Tests

Click  to run the selected tests once. Click  to run the selected tests in a continuous loop. Tests running in a loop can be stopped at any time by clicking .

Note	Refer to chapter 8 for information on viewing and interpreting the test results.

Figure 5-5 is an example of a true MIMO measurement of a 2 x 2 MIMO DUT, showing:

- Spectrum and constellation displays for each stream
- Cross power measurements for each stream
- EVM measurements for each stream (with correction for cross power leakage applied)

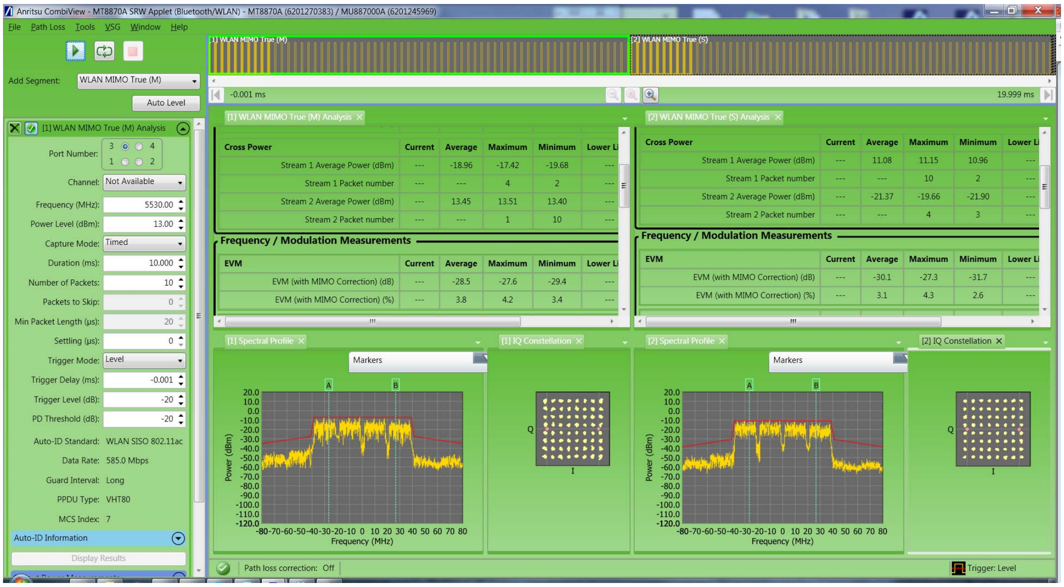


Figure 5-5. True MIMO 2 x 2 Measurement

5-9 Troubleshooting Guide

If you have difficulties while setting up a true MIMO measurement, check the following.

1. You can only add true MIMO segments on module 1 or 3. An error is reported if you try to add a true MIMO segment on one of the other modules - Figure 5-6

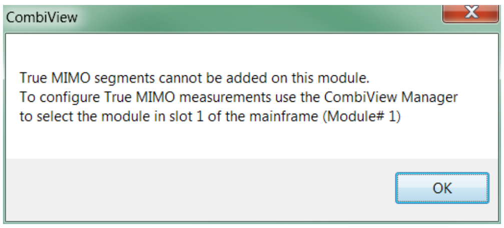


Figure 5-6. True MIMO segments can only be set up on module 1 or 3

2. Check for error reports. If the green check mark symbol is not displayed, click the symbol to open the error report. See Figure 5-7. Possible errors include “Cannot

apply settings” or “Failed to read measurement results”, which mean that the “M” module was unable to communicate with one or more of the “S” modules.

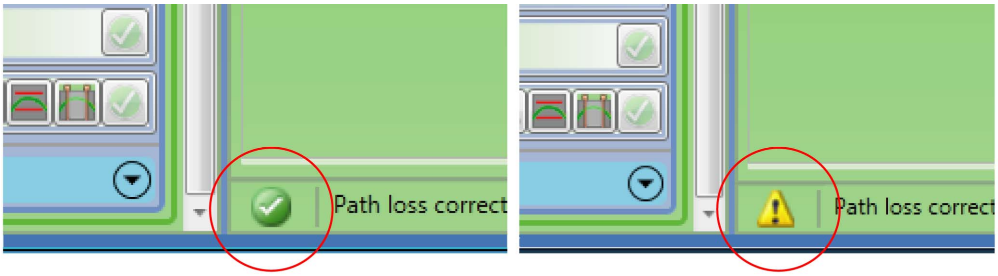


Figure 5-7. Error Status Indicators

3. Check that there are no other applications using any of the “S” modules. You might have previously opened a CombiView Applet for one of these modules and omitted to close it before setting up the T-MIMO measurement.
4. Open the segment settings for each “S” segment and confirm that the “IP Address” field contains a valid address corresponding to its module. If the address is 0.0.0.0, it is possible that you have selected more streams than there are MU887000A modules installed in the MT8870A mainframe.
5. Check that the port number is set correctly for each segment.
6. Remember that if you do not use auto level, you must enter the “Power Level**”** setting separately for each segment.

5-10 IEEE 802.11ac 80+80 Measurements

In addition to 160 MHz (VHT160) transmissions, the 802.11ac standard specifies a method for transmitting a pair of 80 MHz frequency segments that can be positioned separately within the 5 GHz WLAN band to minimize the effect of interference from other services. This type of transmission is known as “80+80”.

Within the IEEE standard, the 80+80 frequency segments are referred to as “primary” and “secondary”. The use of “primary” and “secondary” does not describe which frequency segment is located at the higher frequency.The secondary frequency segment can be at a lower or higher frequency than the primary.

For clarity, this manual uses the terms “lower” and “upper” to distinguish between the two carrier frequencies.

5-11 80+80 MIMO Measurements

80+80 transmissions can be measured using the multiple waveform transmitter testing features of the MT8870A, and the CombiView SRW Applet automates the instrument set-up.

This section describes 80+80 2x2 MIMO (multiple input multiple output) measurements using concurrent or sequential techniques.

Concurrent 80+80 True MIMO measurements require as many MU887000A modules as there are carriers (two for 80+80) multiplied by the number of space-time streams (two for 2x2 MIMO). So for an 80+80 2x2 True MIMO measurement you need four MU887000A modules. This measurement set-up ensures that the system captures both MIMO streams transmitted on each of the 80+80 upper and lower frequency segments from the same packet.

Sequential 80+80 True MIMO measurements require as many MU887000A modules as there are space time streams (two for 2x2 MIMO). Both space-time streams are captured at the same time from one of the two 80+80 carriers, then the process is repeated for the other carrier.

The measurement results available include the combined EVM of the two 80+80 frequency segments and spectral emission measurements against a combined mask calculated according to the IEEE standard.

Note	CombiView supports concurrent and sequential measurements of 80+80 SISO transmissions. See “80+80 SISO Measurements” on page 4-7

5-12 80+80 Concurrent 2x2 T-MIMO Measurements

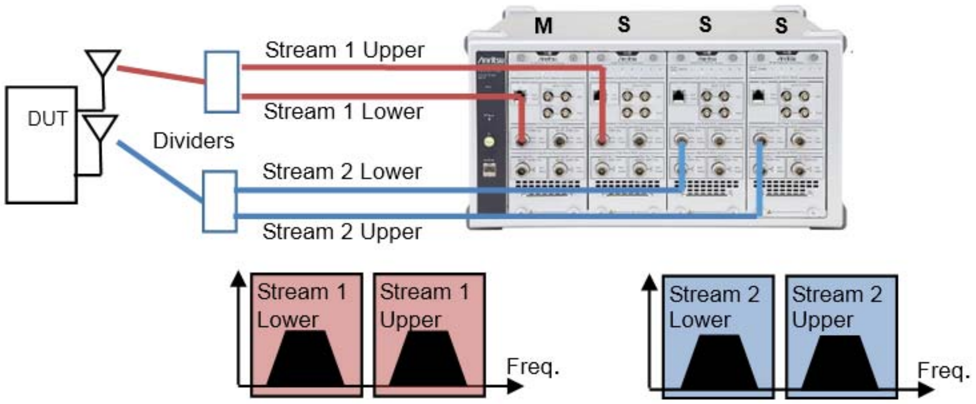


Figure 5-8. Connections for Concurrent 80+80 2x2 T-MIMO - Combined Signals

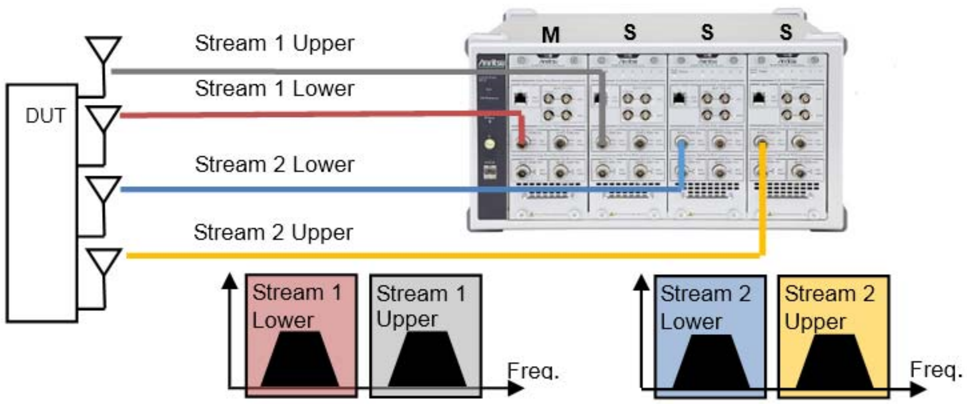


Figure 5-9. Connections for Concurrent 80+80 2x2 T-MIMO - Separate Signals

1. Open a SRW Applet as described in section 2-6 "Opening the SRW Applet".

Note	The SRW Applet must be opened to control a MU887000A module located in slot 1 of an MT8870A mainframe. This is the "Master Module" for the measurement. By convention, this will measure stream 1 on the lower carrier. (See the connection diagrams above.) Three further ("Slave") modules are required to measure stream 2 on the lower carrier and streams 1 and 2 on the upper carrier - all concurrently. Be sure to check that none of the Slave modules are being controlled by other programs such as other instances of CombiView. If they are, the Master module will not be able to take control of them.

2. At "Add Segment" expand the drop-down list and select "WLAN Con 80+80 MIMO True". (If one or more segments are already defined, CombiView will display a prompt to confirm that they may be deleted. Click **Yes**.)

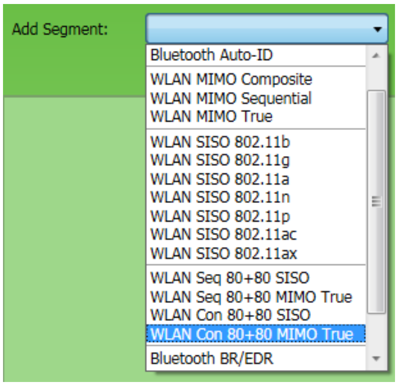


Figure 5-10. Set up an 80+80 Concurrent 2x2 T-MIMO Measurements

CombiView automatically creates four segments, one for each space-time stream on each of the 80+80 carriers.

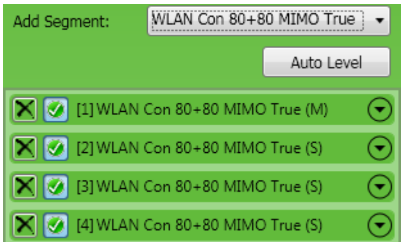


Figure 5-11. Segments for Concurrent 80+80 2x2 T-MIMO Measurements

3. Expand the configuration of the first segment by clicking its title bar.

4. At “Port Number”, select the test port that you will use to measure stream 1 on the lower carrier of the 80+80 transmission. Test ports 3 and 4 are the most suitable for SRW testing because they have the best dynamic range.
5. At “Frequency (MHz)” or “Channel”, enter the frequency or select a channel for the lower carrier of the 80+80 transmission.
6. Configure the other settings (Capture mode, number of packets, etc.,) as required. These settings are shared automatically with the other segments.
7. Expand Spectral Measurements and then Spectral Profile Settings. Change the 80+80 Signal State settings to Separate if required.

Note	This setting is necessary so that the SRW analysis software can use the correct method to calculate the combined spectrum. If the 80+80 Carriers are combined within the DUT and are output through a single port, or if they are output through separate antenna ports and combined before the input to the instrument, leave the setting unchanged as “Combined”. This is the most common set-up. However if the DUT has two separate outputs for the two carriers and these are taken to two separate inputs of the instrument, change this setting to “Separate”.

8. Expand the configuration of the second segment by clicking its title bar.
9. At “Port Number” select the test port that you are using to measure stream 1 on the upper carrier of the 80+80 transmission.
10. At “Frequency (MHz)” or “Channel”, enter the frequency or select a channel for the upper carrier of the 80+80 transmission.
11. Check the “IP Address”. CombiView should have automatically set up this segment with the IP address of the second module in the mainframe.
12. Expand the configuration of the third segment by clicking its title bar.
13. At “Port Number” select the test port that you are using to measure stream 2 at the lower carrier frequency.
14. Check the “IP Address”. CombiView should have automatically set up this segment with the IP address of the third module in the mainframe.
15. Expand the configuration of the fourth segment by clicking its title bar.
16. At “Port Number” select the test port that you are using to measure stream 2 at the upper carrier frequency.
17. Check the “IP Address”. CombiView should have automatically set up this segment with the IP address of the fourth module in the mainframe.

5-13 Selecting and Configuring Measurements

Expand the first segment by clicking the arrow in the title bar, then select and configure the required measurements as explained in section 3-2, "Selecting and Configuring Measurements"

Note	CombiView offers two additional measurements for 80+80 signals: Combined EVM displays the combined EVM of the upper and lower frequency segments. When selected, this results appears in the numeric results table. Combined Spectral Profile displays the spectral profiles of the upper and lower frequency segments within the same graph areas. If the carriers are less than or equal to 280 MHz apart, a combined spectral mask is displayed. This is calculated according to the IEEE Standard.

5-14 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File > Save Settings As**.

You can load settings you have saved by selecting **File > Load Settings**.

5-15 Setting the Input Power Level

Before running the tests you must ensure that the Power Level setting is set up correctly for each segment. Proceed as follows:

1. Set up the DUT to transmit continuously.
2. Click **Auto Level**

5-16 Making Measurements

Click  to make a single shot measurement, or Click  to run the selected tests in a continuous loop.

5-17 80+80 Sequential 2x2 T-MIMO Measurements

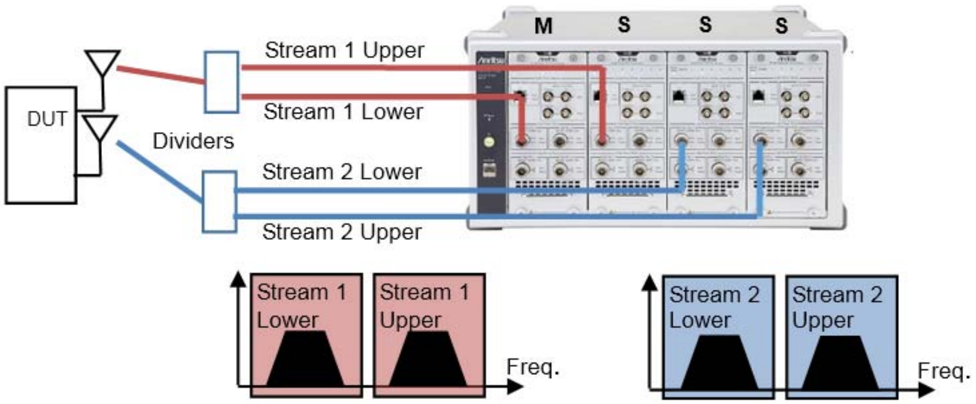


Figure 5-12. Connections for Sequential 80+80 2x2 T-MIMO - Combined Signals

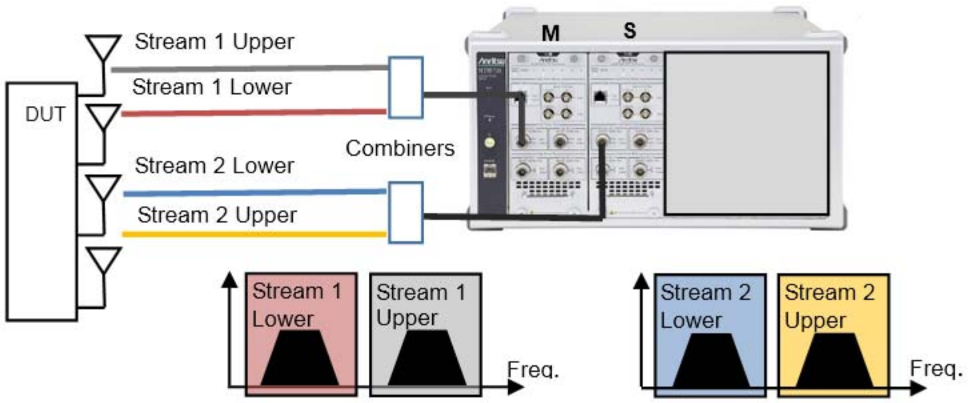


Figure 5-13. Connections for Sequential 80+80 2x2 T-MMO - Separate Signals

1. Open a SRW Applet as described in section 2-6 "Opening the SRW Applet".

Note

The SRW Applet must be opened to control a MU887000A module located in either slot 1 or slot 3 of an MT8870A mainframe. This is the "Master Module" for the measurement.

A second ("Slave") module is required to measure the second MIMO stream concurrently. If the Master is in slot 1 the Slave module can be in any of the other slot positions, but use slot 2 if possible because CombiView can automate the set-up. If the Master is in slot 3 the slave module must be in slot 4.

Be sure to check that the Slave module is not being controlled by another program such as another instance of CombiView. If it is, the Master module will not be able to take control of it.

2. At "Add Segment" expand the drop-down list and select "WLAN Seq 80+80 MIMO True". (If one or more segments are already defined, CombiView will display a prompt to confirm that they may be deleted. Click **Yes**.)

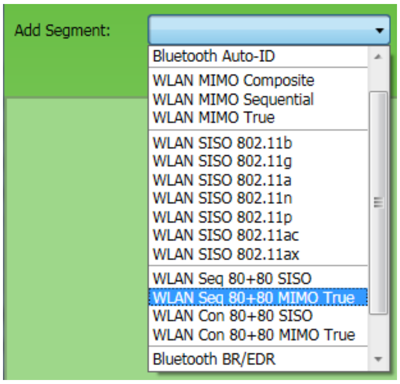


Figure 5-14. Set up a Sequential 80+80 2x2 T-MIMO Measurement

CombiView automatically creates four segments - two "Master" and two "Slave", one for each space-time stream on each of the 80+80 carriers.

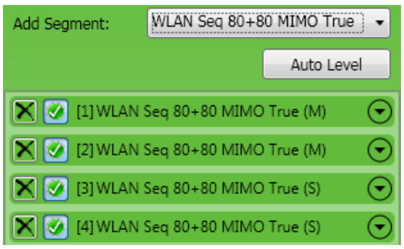


Figure 5-15. Segments for Sequential 80+80 2x2 T-MIMO Measurements

3. Expand the configuration of the first segment by clicking its title bar.

4. At "Port Number", select the test port that you will use to measure stream 1 on the lower carrier of the 80+80 transmission. Test ports 3 and 4 are the most suitable for SRW testing because they have the best dynamic range.
5. At "Frequency (MHz)" or "Channel", enter the frequency or select a channel for the lower carrier of the 80+80 transmission.
6. Configure the other settings (Capture mode, number of packets, etc.,) as required. These settings are shared automatically with the other segments.
7. Expand Spectral Measurements and then Spectral Profile Settings. Change the 80+80 Signal State settings to Separate if required.

Note	This setting is necessary so that the SRW analysis software can use the correct method to calculate the combined spectrum. If the 80+80 Carriers are combined within the DUT and are output through a single port, or if they are output through separate antenna ports and combined before the input to the instrument, leave the setting unchanged as "Combined". This is the most common set-up. However if the DUT has two separate outputs for the two carriers and these are taken to two separate inputs of the instrument, change this setting to "Separate".

8. Expand the configuration of the second segment by clicking its title bar.
9. At "Port Number" select the test port that you are using to measure stream 1 on the upper carrier of the 80+80 transmission.
10. At "Frequency (MHz)" or "Channel", enter the frequency or select a channel for the upper carrier of the 80+80 transmission.
11. Expand the configuration of the third segment by clicking its title bar.
12. At "Port Number" select the test port that you are using to measure stream 2 on the lower carrier of the 80+80 transmission.
13. At "IP Address", check and if necessary enter the IP address of the "S" ("Slave") module.

Note	Normally you do not need to change the IP address. CombiView sets it for you automatically. If the Master module is in slot 1 and the slave module is in a position other than slot 2, you must set the IP address manually.

14. Expand the configuration of the fourth segment by clicking its title bar.
15. At "Port Number" select the test port that you are using to measure stream 2 on the upper carrier of the 80+80 transmission.

5-18 Selecting and Configuring Measurements

Expand the first segment by clicking the arrow in the title bar, then select and configure the required measurements as explained in section 3-2, "Selecting and Configuring Measurements"

Note	CombiView offers two additional measurements for 80+80 signals: Combined EVM displays the combined EVM of the upper and lower frequency segments. When selected, this results appears in the numeric results table. Combined Spectral Profile displays the spectral profiles of the upper and lower frequency segments within the same graph areas. If the carriers are less than or equal to 280 MHz apart, a combined spectral mask is displayed. This is calculated according to the IEEE Standard.

5-19 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File > Save Settings As**.

You can load settings you have saved by selecting **File > Load Settings**.

5-20 Setting the Input Power Level

Before running the tests you must ensure that the Power Level setting is set up correctly for each segment. Proceed as follows:

1. Set up the DUT to transmit continuously.
2. Click **Auto Level**

5-21 Making Measurements

Click  to make a single shot measurement, or Click  to run the selected tests in a continuous loop.

Chapter 6 — Sequential MIMO Transmitter Testing

6-1 What is MIMO?

In a MIMO (multiple-input and multiple-output) system, multiple antennas are used to increase data throughput without adding bandwidth or increasing power. The data being transmitted is split into a number of spatial streams that are then reconstructed by the receiver.

There are three types of MIMO measurement system: true (or real) MIMO, sequential MIMO, and composite MIMO.

Sequential MIMO transmitter testing is explained in this chapter. True MIMO transmitter testing is explained in Chapter 5; composite MIMO transmitter testing is explained in Chapter 7.

6-2 Sequential MIMO

In a sequential MIMO system, all data streams are transmitted in parallel but, unlike testing in a true MIMO system, the data from each stream is captured in turn and measurements are made sequentially.

On the MT8870A, sequential MIMO transmitter testing can be performed using a single MU887000A module with each of the data streams connecting to a different test port on that module. This is shown in Figure 6-1 below.

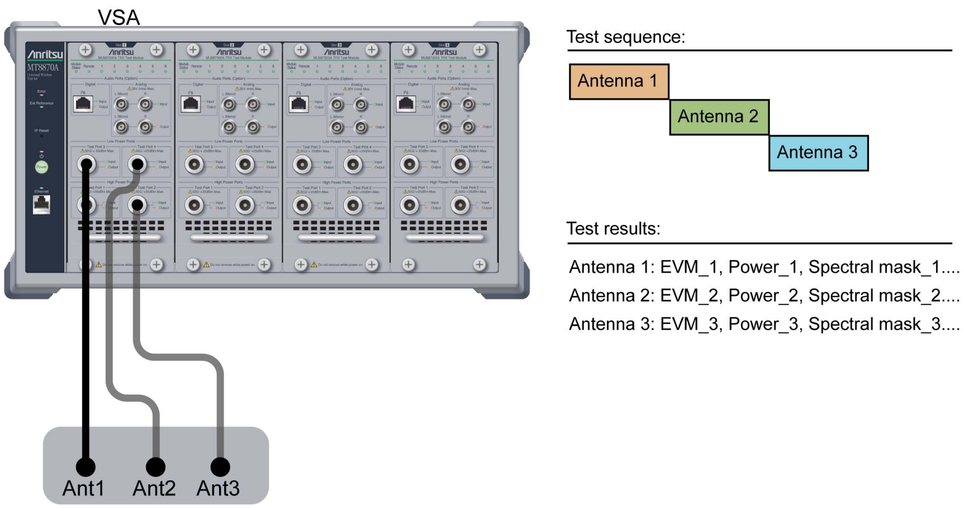


Figure 6-1. Sequential MIMO Transmitter Testing

Sequential MIMO analysis includes cross-stream power leakage and its effect on error vector magnitude (EVM). However, because the streams are captured sequentially rather than in parallel, MIMO EVM correction of cross-stream leakage requires that the payload data for each packet in the stream must remain constant. This means that the DUT must be set up to use a fixed scramble seed. If this is not possible, you should ensure that MIMO EVM correction is switched off. This is explained later in the chapter.

6-3 Configuring the Analysis Settings

For simplicity we will assume that the DUT is a 2 x 2 MIMO device with the two RF output connected to ports 3 and 4 of an MU887000A module.

1. From the CombiView Manager, open a SRW Applet.
2. At "Add Segment", select "WLAN MIMO Sequential".
3. When the **MIMO Streams** dialog appears, select the **2 Streams** option - Figure 6-2.

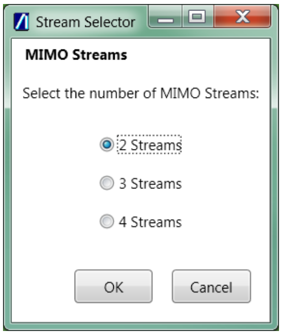


Figure 6-2. Stream Selection

Combiview automatically creates two capture segments, one for each spatial stream - Figure 6-3.

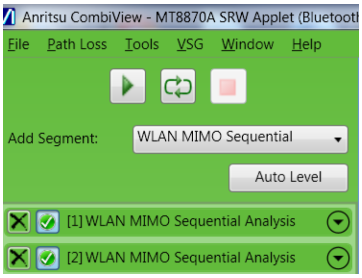


Figure 6-3. Sequential MIMO Segments

4. Expand the first segment settings by clicking the arrow in its title bar -Figure 6-4.

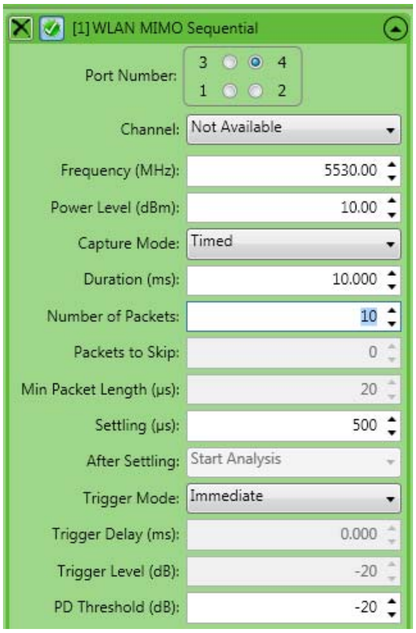


Figure 6-4. Sequential MIMO - First Segment

5. At “Port Number”, select the port that you will use to measure one of the spatial streams.
6. Either select the channel on which the DUT will transmit, or enter the frequency directly at “Frequency (MHz)”.
7. At “Number of Packets”, enter the number of packets to measure.
8. Set up other settings as required. These are described in Appendix A, “WLAN Setting Definitions”.

Note	“Settling (µs)” is set by default to 500 µs. This is the minimum settling time required at the start of each segment when ports are switched during a multi-segment capture. Measurement accuracy may be affected if you set a value less than 500 µs.

9. Click **Display Results** to display a tab that will be populated with results when you run the measurements.

10. Expand the second segment by clicking the arrow in its title bar -Figure 6-5.

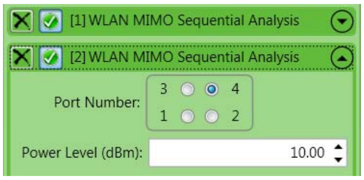


Figure 6-5. Sequential MIMO - Second Segment

11. At "Port Number", select the port that you will use to measure the other spatial stream.
12. Click Display Results to display a results table for this stream. The table appears as a separate tab. If you wish you can display the results for the two streams side by side or one above the other. Refer to Chapter 8 for details of how to view the test results.

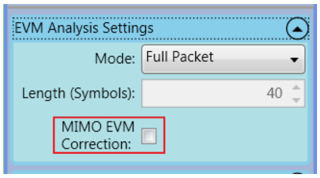
6-4 Selecting and Configuring Measurements

Expand the settings for the first segment and select and configure the required measurements, as explained in section 3-2, Selecting and Configuring Measurements.

Note

MIMO EVM Correction is selectable under "EVM Analysis Settings". When enabled, the EVM analysis software attempts to compensate for cross-stream power leakage. It is enabled by default. For this function to work correctly, the payload data in successive packets must be the same, which means that the packets must be generated using a fixed scramble seed.

You should disable this setting if you are unable to fix the scramble seed in the DUT, otherwise the EVM result is likely to be worse than expected.



6-5 Saving the Settings

You can save your CombiView configuration settings to an xml file by selecting **File** > **Save Settings as**.

You can load settings you have saved by selecting **File** > **Load Settings**.

6-6 Transmitting Data from the DUT

From the DUT, transmit data to the MT8870A in line with the analysis settings you have made within CombiView.

6-7 Setting the Input Level for All Segments

Click **Auto Level**. The “Power Level (dBm)” fields in both the segments should update automatically with the optimum power level for measurement.

Note	If you wish to set the power level manually, you must do so separately for each segment.

6-8 Running Tests

Click to run the selected tests once. Click to run the selected tests in a continuous loop. Tests running in a loop can be stopped at any time by clicking .

Note	Refer to chapter 8 for information on viewing and interpreting the test results.

Figure 6-6 shows an example of a sequential MIMO measurement of a 2 x 2 MIMO DUT:

- Spectrum and constellation displays for each stream.
- Cross power measurements for each stream.
- EVM measurements for each stream. (EVM correction for cross power leakage has been disabled because it is not possible to fix the scramble seed for this particular DUT.)

Figure 6-6. Sequential MIMO 2 x 2 Measurement

Chapter 7 — Composite MIMO Transmitter Testing

7-1 What is MIMO?

In a MIMO (multiple-input and multiple-output) system, multiple antennas are used to increase data throughput without adding bandwidth or increasing power. The data being transmitted is split into a number of spatial streams that are then reconstructed by the receiver.

There are three methods for measuring MIMO signals: true (or real) MIMO, sequential MIMO, and composite MIMO.

Composite MIMO transmitter testing is explained in this chapter. True MIMO transmitter testing is explained in Chapter 5; sequential MIMO transmitter testing is explained in Chapter 6.

7-2 Composite MIMO

In a composite MIMO measurement system, all data streams are channeled through a passive combiner, and then measured as a composite signal. This differs from true and sequential MIMO measurement techniques in which unique results are generated for each of the spatial streams.

On the MT8870A, composite MIMO transmitter testing is performed using a single test port on a single MU887000A module. This is shown in Figure 7-1 below.

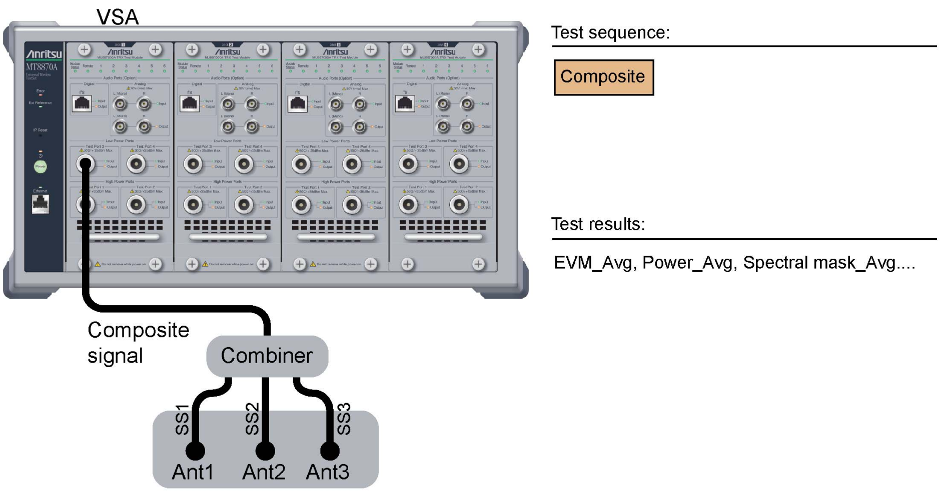


Figure 7-1. Composite MIMO Transmitter Testing

7-3 Generating a Reference Data File

Before you can make composite MIMO measurements, you must generate a reference data file. The reference data file enables the measurement algorithms to successfully decode the spatial streams from the composite signal.

You generate the reference data file by transmitting a SISO data stream and capturing constellation data. The payload data from the SISO stream is extracted and used to create the reference data file.

Note	You do not need to generate a reference data file again unless you change the data rate, wireless standard or number of streams.

1. Transmit a single data stream to the MT8870A at the MCS rate that you will use when making MIMO measurements. We recommend that you capture at least 20 packets. This will maximize the chances of capturing the payload accurately without a cyclic redundancy check (CRC) error.
2. From the **CombiView Manager**, double-click **Bluetooth/WLAN** to display a SRW Applet.
3. In the SRW Applet, add a segment for "WLAN SISO Auto-ID OFDM".
4. At "Port Number", select the test port on the MT8870A that you are using to connect to the DUT.
5. Click **Auto Level**.
6. Click **Display Measurements** to display a table that will be populated with measurement results
7. Open the **Frequency / Modulation Measurement** group and enable the **IQ Constellation** measurement.
8. Open the **Channel Estimation Settings** shown in the figure below and set **Mode** to **Long Training Sequence**.

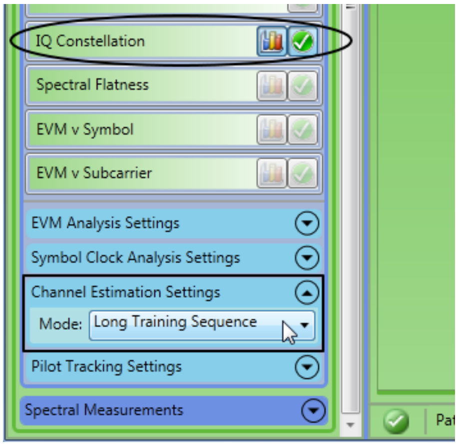


Figure 7-2. Channel Estimation Settings

9. Click Run and check that the auto identified properties match the data stream that you are transmitting from the DUT.
10. Check that the EVM measurement indicates a pass in CombiView and that the constellation points are tightly clustered around the ideal symbol positions. If the EVM measurement is not within specification it is unlikely that the payload data can be extracted from the packets without error. The figures below provide examples of varying EVM results.

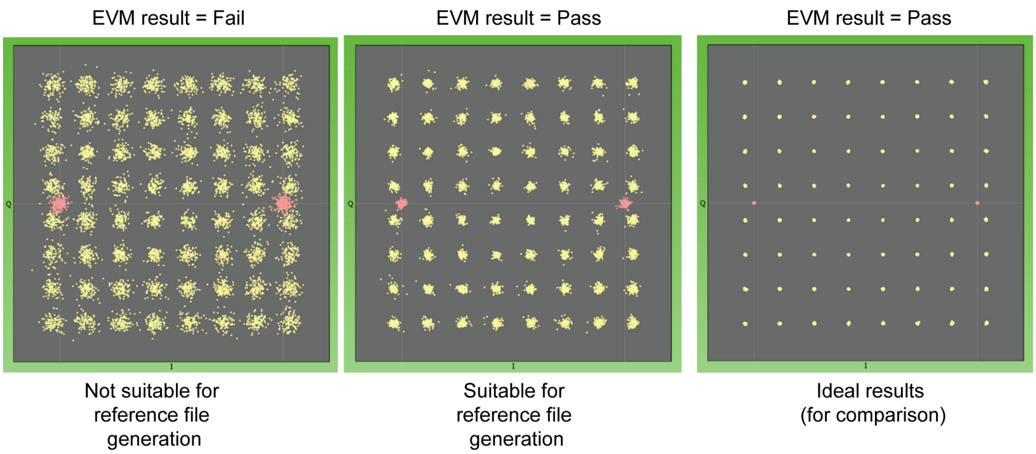


Figure 7-3. IQ Constellation Results - Good and Bad

Note	What to do if your DUT produces a signal with a poor EVM, or if the Reference File Generator reports CRC errors for the payload data. • Try changing the transmission frequency. The performance of some DUTs can vary across the frequency band. • Try reducing the transmit power. • Try a different DUT of the same type.

11. If the EVM measurement results indicate a pass, select **Tools** > **Composite MIMO Reference File Generator**.

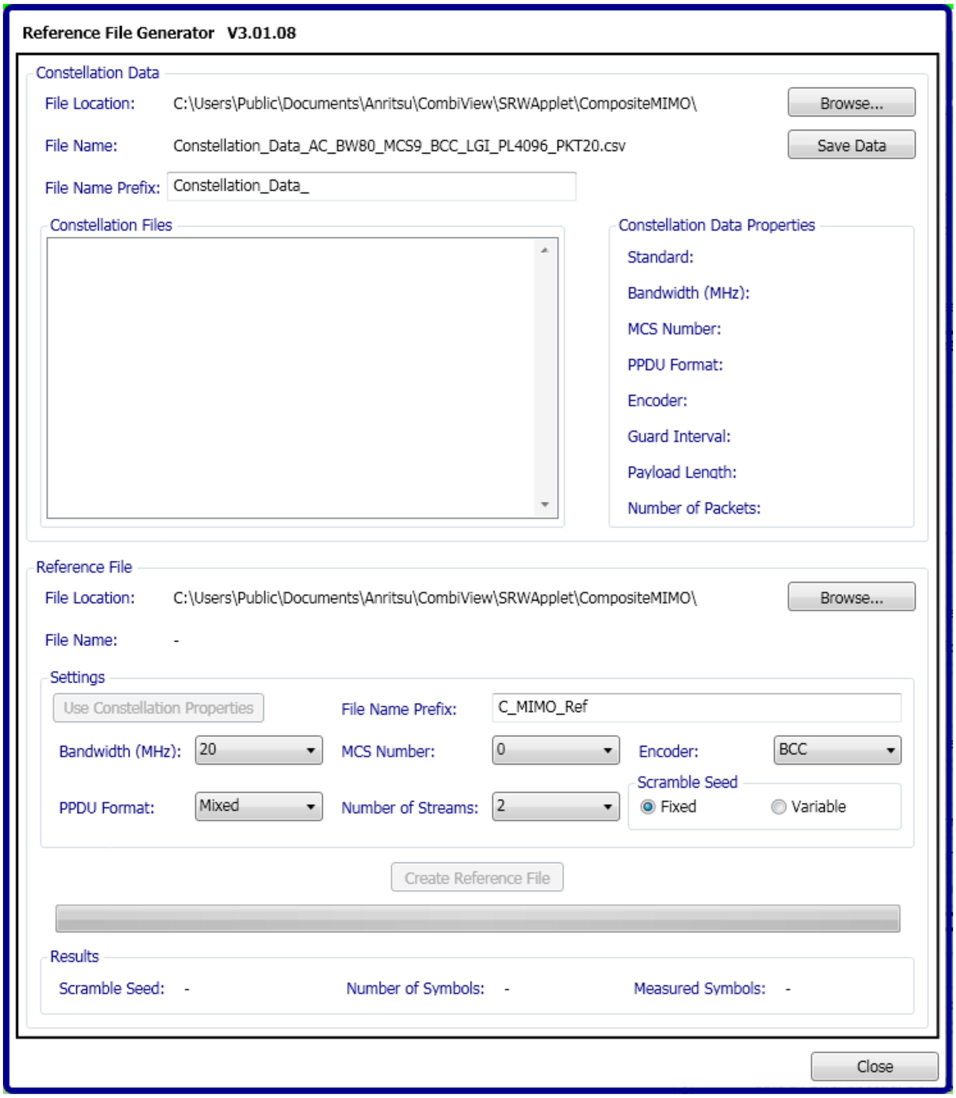


Figure 7-4. Reference File Generator

12. The upper part of the form is used to manage constellation data. The **File Location** shows the path to the folder where constellation data will be saved. Click **Browse** to change the location.

13. Click **Save Data** to save the constellation data captured from the DUT. The filename is generated automatically using the auto identified properties. (You should always save the constellation data because you can use it in the future to recreate a reference file without having to repeat the capture of SISO data from a DUT.)

14. The constellation data file will appear in the **Constellation Files** list. When you select a file name from the list, its properties are displayed under **Constellation Data**

Properties. Select the constellation data file you wish to use to generate the reference file.

15. The lower part of the form is used to create reference files. The **File Location** shows the path to the folder where reference files will be saved. Click **Browse** to change the location.
16. The **Settings** section allows you to define the properties of the reference data file. Start by clicking Use Constellation Properties. This will populate the settings form using properties from the constellation data highlighted in **Constellation Files**. This is a good starting point for generating a reference file.
17. Define the properties of the MIMO signal you wish to measure. These properties are the bandwidth, MCS, encoder, PPDU Format (802.11n only) and number of streams. Set up these values on the Settings form.
18. At **Scramble Seed**, select "Fixed" if the scramble seed can be fixed in the DUT. Otherwise select "Variable**"** (The resulting reference data file will be much larger if "Variable" is selected.)
19. Check the **File Name Prefix** and edit it if required. (We suggest that you change the prefix according to the DUT type. This will make it easier to choose the correct file for measurement. For example if the DUT is based on a "1234" device from wireless chip manufacturer "XY", you could change the prefix to "C_MIMO_Ref_XY1234".)
The rest of the reference file filename is generated automatically based on the settings you have selected.
20. Click **Create Reference File** to generate the reference data file. The file has a .mimo extension.

7-4 Transmitting MIMO Data from the DUT

Transmit all data streams to the MT8870A. The streams should be transmitted with the MCS index that you used when generating the reference data file.

7-5 Running the Tests

1. Return to the CombiView interface and add a segment for **WLAN MIMO Composite**.
2. Set the frequency as appropriate.
3. Set up other settings (port, number of packets, etc.) as required. These are described in Appendix A, "WLAN Setting Definitions".
4. Click **Auto Level**.
5. Click "Reference File" and browse to the reference file that you generated earlier.
6. Run the tests and view the results.

Note	Refer to chapter 8 for information on viewing and interpreting the test results.

Chapter 8 — Viewing and Analyzing Transmitter Results

8-1 Viewing Errors and Warnings

You can check whether errors occurred during capture or measurement by looking at the icon that displays at the bottom of the SRW Applet.

If no errors are detected, a green circle displays with a white check mark inside.

If errors occurred, or if warnings were output, a warning symbol displays such as the one shown on the right in the figure below.

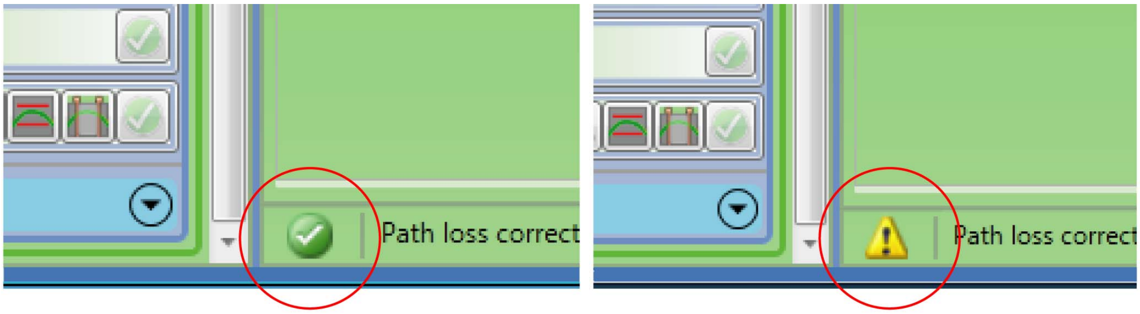


Figure 8-1. Error Status Indicators

You can click the warning symbol to display details of the errors.

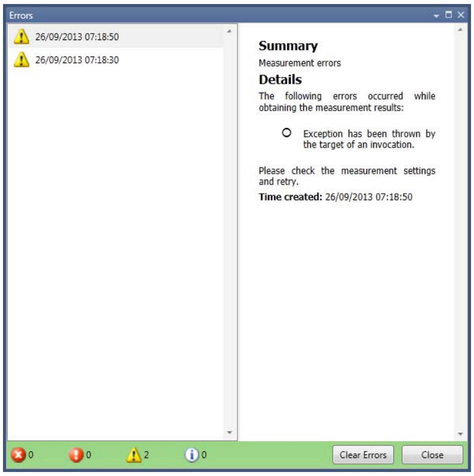


Figure 8-2. Error Details

There are four levels of information:

- information messages
- warnings
- serious warnings
- critical errors

All of the errors and warnings are listed in the pane on the left of the Error Details window. You can click each error or warning to display its details in the pane on the right. You should resolve each error and then, when the information is no longer required, click **Clear Errors** to remove the record.

8-2 Viewing Numerical Results

Click **Display Results** to display the numerical results on a tab within the main area of the SRW Applet. The results for each test (that supports numerical results) display in a separate area of the table.

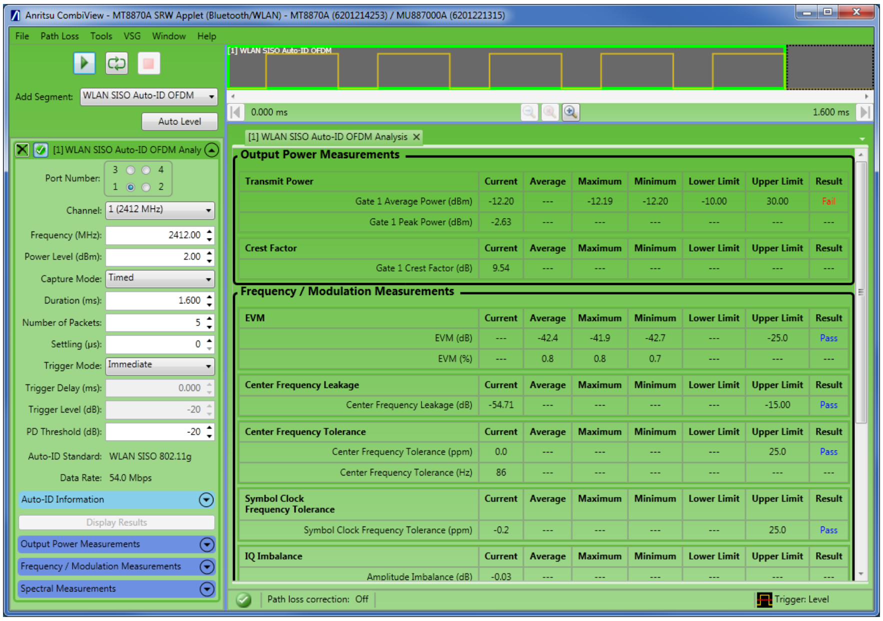


Figure 8-3. Results Display

Note	Not all fields are populated for each measurement made.

8-3 Viewing Graphical Results

Certain measurements support the display of graphical results. Graphical results display on a separate tab for each selected measurement.

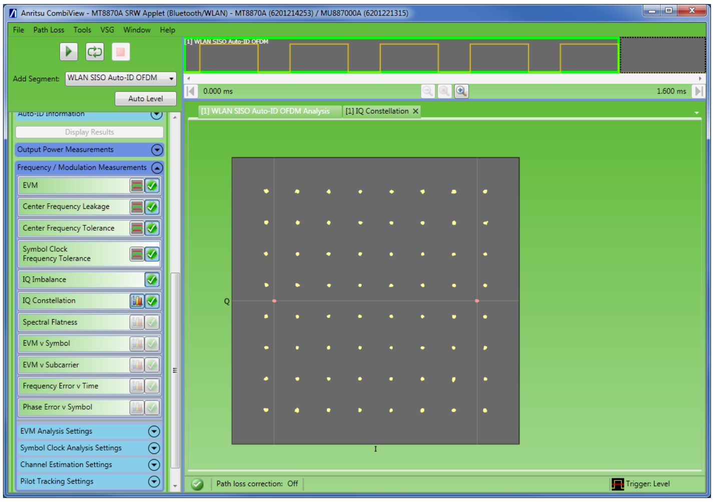


Figure 8-4. Graphical Results Tabs

8-4 Displaying Packet-Specific Results

By default the graphical and numerical tabs display summary results for the entire capture. You can also display results for any of the captured packets. Follow the procedure below to display packet-specific results.

1. Wait for all measurements to complete or press the stop button when sufficient data has been captured.
2. Click any of the packets in the packet display area at the top of the SRW Applet.

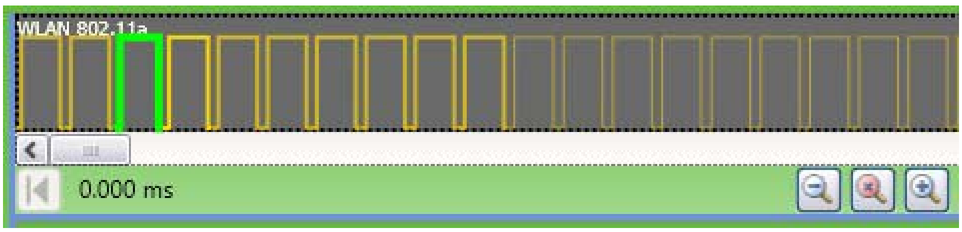


Figure 8-5. Packet Display

3. The selected packet turns green when clicked and the results (graphical and numerical) are updated to provide data for the selected packet only.

4. To revert to the summary display for the entire capture, click in the area immediately above or between the packets. The packet is deselected and the results are updated to show the average for the entire capture period.

8-5 Arranging Results Windows

Each of the results windows (graphical and numeric) displays as a tabbed page within the SRW Applet. You can float (undock) any of the results windows or you can arrange them so that you can see all of the results at once.

Floating and Docking a Results Window

To float a window and position it freely anywhere inside or outside of the SRW Applet, right-click a results tab and select **Float** from the menu.

You can redock a floating window by clicking **Dock** from the menu on the toolbar of the floating window.

Displaying Multiple Results Windows Together

1. Click a results tab and drag it towards the center of the SRW Applet. A docking target displays as shown in the figure below.
2. Drop the results tab directly onto any of the four arms of the docking target (top, bottom, right, or left) to snap it to that position within the SRW Applet.
3. You can use the window tiling commands on the menu (**Window > Tile Horizontal** and **Window > Tile Vertical**) as a starting point before re-sizing or rearranging them manually. **Window > Reset Window Layout** restores a tabbed layout.

In the figure below a results tab has been dragged to the top area of the docking target. The darker green color identifies the position that the tab will occupy if dropped at that position.

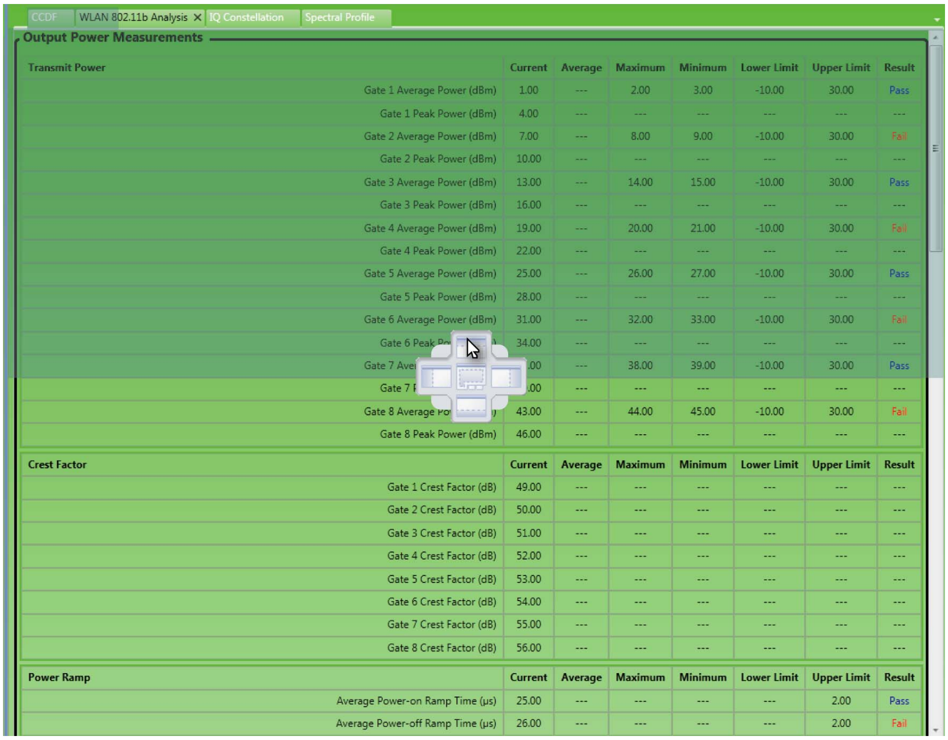


Figure 8-6. Arranging Results Windows

4. Repeat this process to position the other results windows as required. You can return a window to its original position by dragging it to the center of the docking target.

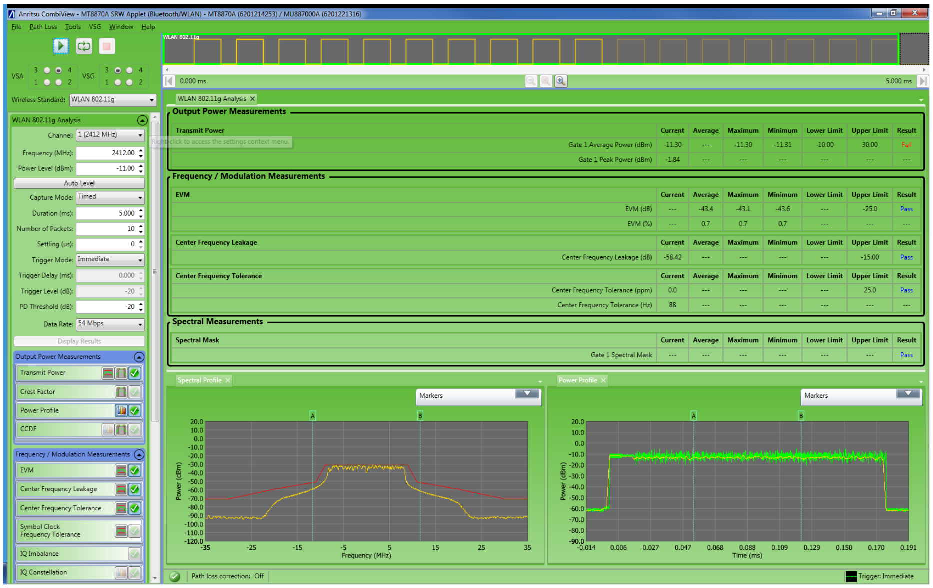


Figure 8-7. Multiple Results Windows

8-6 Scaling Features

Most graphical displays have Y-Scaling features that allow you to control the appearance of the measurement.

1. Right click anywhere within a graphical results window to display a pop-up menu.

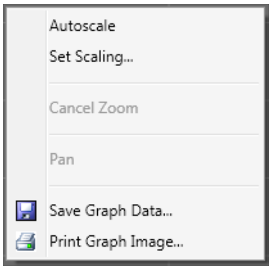


Figure 8-8. Pop-up Menu in Graphical Results Window

2. Select “Autoscale” to optimize the display scaling automatically, or “Set Scaling...” to display the Y-Scaling dialog.

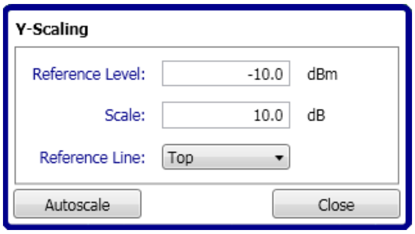


Figure 8-9. Y-Scaling Dialog

3. Using the Y-Scaling dialog, you can control the appearance of the display. Choose the “Reference Line” from the drop-down list. The reference line is indicated by a small black arrow to the left of the graph area. Enter a value for the reference line and then the “Scale” value in units per division. The “Autoscale” button on this dialog has the same effect as the function in the pop-up menu.
4. Click Close to dismiss the Y-Scaling dialog.

You can also “zoom in” to any part of a graphical display:

1. Position the mouse cursor at the upper left position of the area you wish to enlarge.
2. Hold down the left mouse button and drag to define a rectangular area of interest.

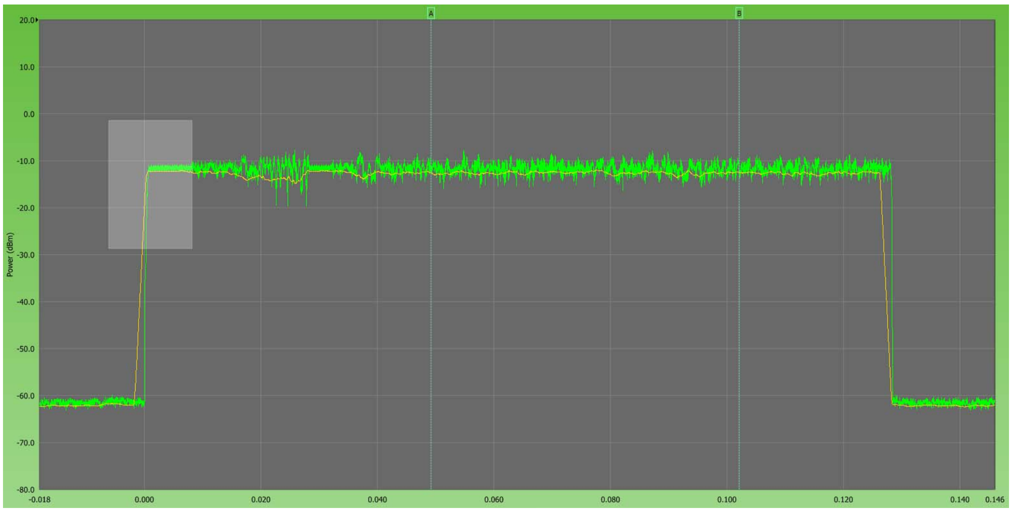


Figure 8-10. Left Click and Drag to Select Area to be Zoomed

3. Release the mouse button and the display will zoom to the area you have selected.

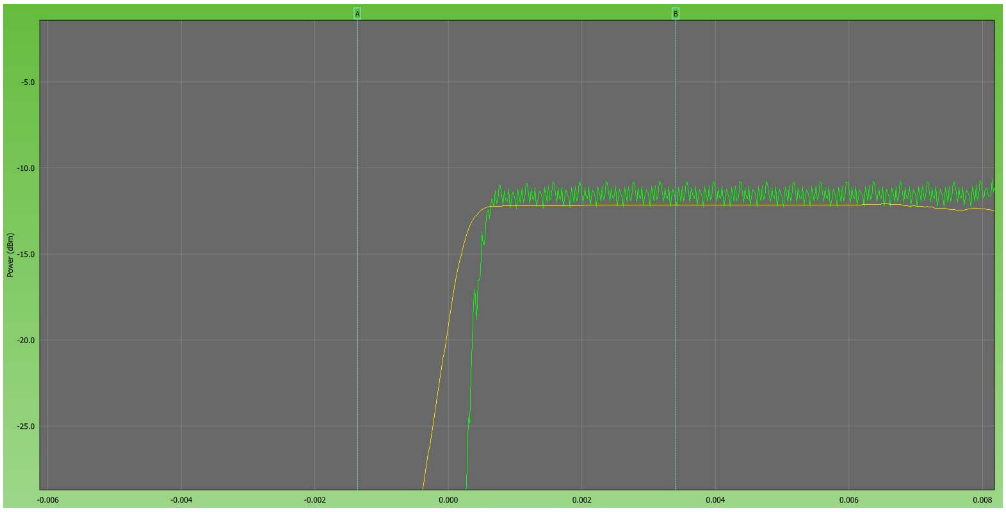


Figure 8-11. Zoomed Trace

4. The Pan control allows you to "pan" the viewing window left and right and up and down when displaying a zoomed trace.

5. To pan, right click in the graph area and select "Pan".

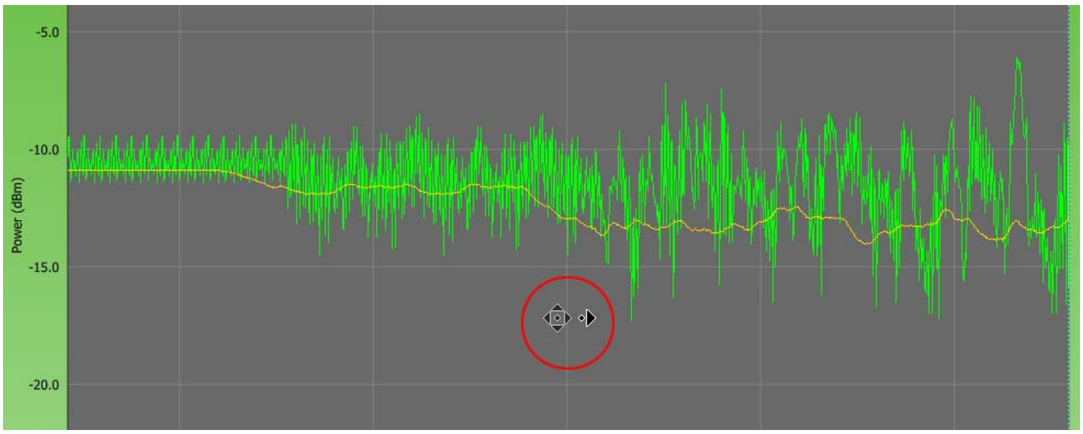


Figure 8-12. Panning a Zoomed Trace

6. A four-pointed symbol is displayed initially. As you move the mouse cursor away from this symbol it changes to an arrow indicating the direction of pan. The further you move this arrow from the starting position, the faster the rate of pan.

7. To stop panning, click in the graph area.

8. To cancel the zoom, right click in the graph area and select "Cancel Zoom" from the pop-up menu.

8-7 Using Gates

You can use up to eight gates to obtain measurements from a specific section of a captured packet.

Gates have a “type” definition that can be set to “packet” or “user”. In “user” mode, you define the start and stop positions. The start position is set by specifying a time offset from the start of a packet. The stop position is set by specifying the total gate width. In “packet’” mode, the gate values are set automatically to encompass the entire packet.

Gate 1 cannot be disabled and is permanently set to “packet”. It is assigned by default to all measurements that require a gate, but it can be unassigned if required.

1. Click the button on the measurement bar to display a **Gate Configuration** dialog such as the one shown below.

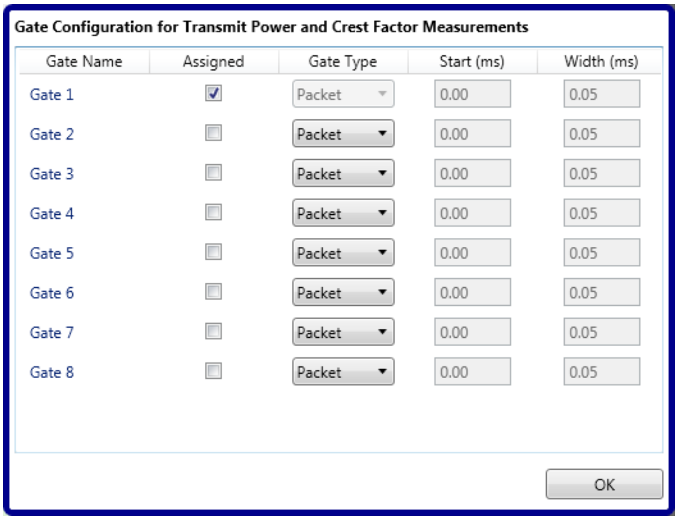


Figure 8-13. Gate Configuration Dialog for CCDF Measurements

2. Select the required number of gates (up to eight) and set the start time and total gate width.
3. Set “Gate Type” to “Packet” or “User”. If set to “User”, set a start position and a total gate width.
4. Results for each of the selected gates display in the numerical results. If graphical results are available, a color coded superimposed trace displays for each of the selected gates.

8-8 Using Markers

Most graphical results tabs include markers that you can use to read data at a particular point of interest within the results.

Figure 8-14. Markers

1. Click on the markers and drag them to the required position.
2. Marker values are read from the **Markers** dialog located in the top right corner of the tab. Click the down arrow to open the dialog.

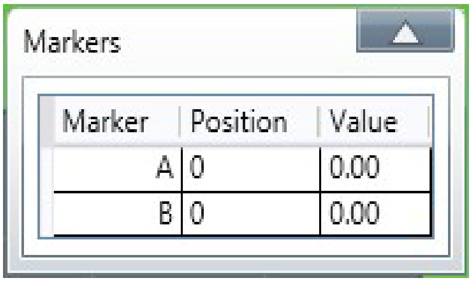


Figure 8-15. Markers dialog

3. If you set more than one gate, you will need to select the gate for which marker data is read and displayed.

8-9 Capture Power Profile

Capture power profile is a diagnostic tool that allows you to view the power profile of a complete capture, including the gaps between packets.

1. Select **Tools** > **Diagnostics** > **View Capture Power Profile...**

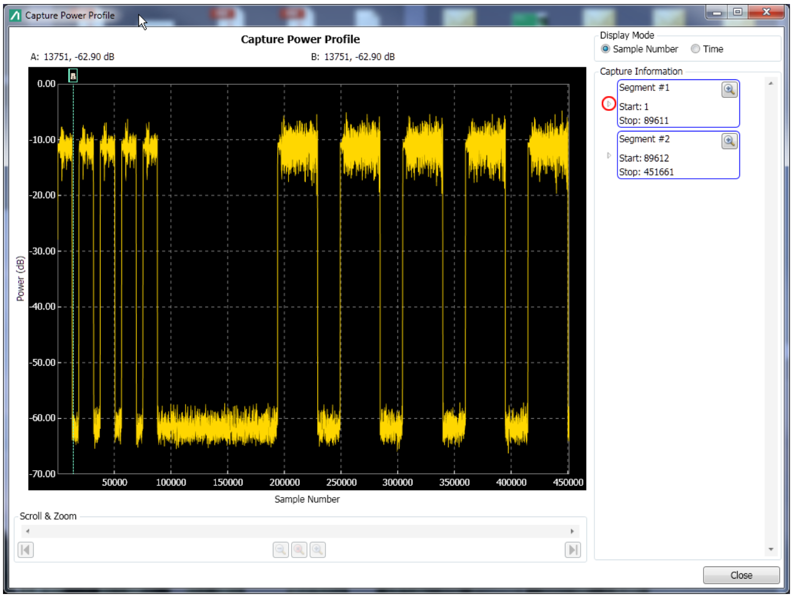


Figure 8-16. Capture Power Profile Window

2. Initially, the graph area shows the complete capture.
3. You can set the x-axis annotation as either sample number or time using the Display Mode options at the top of the window.

4. The Capture Information section lists information about segments within the capture. You can click on the small arrow to the left of a segment to see the packets captured within the segment.

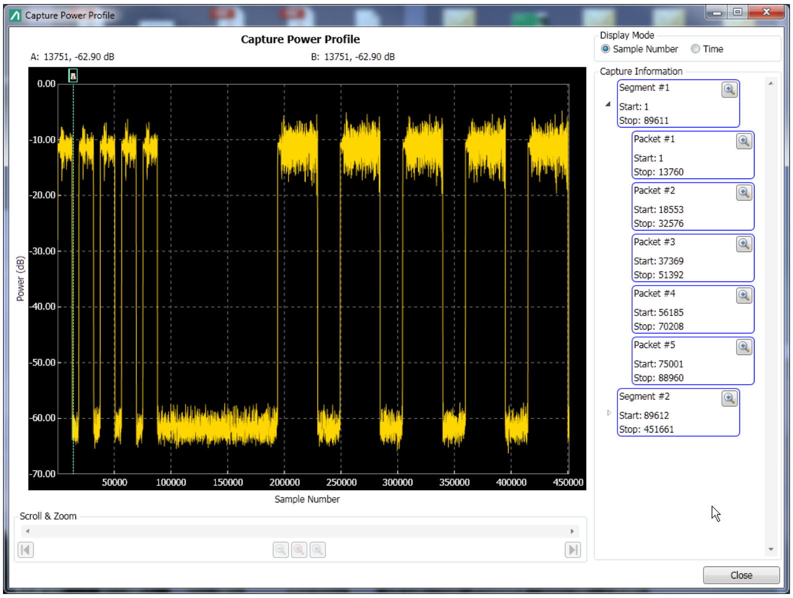


Figure 8-17. Expanded Capture Information

5. You can click on the zoom symbol associated with either a segment or an individual packet to see just that part of the capture within the graph window.

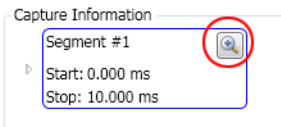


Figure 8-18. Click Zoom Button to View an Individual Segment or Packet

6. The controls below the graph window allow you to zoom in to areas of interest within the profile.

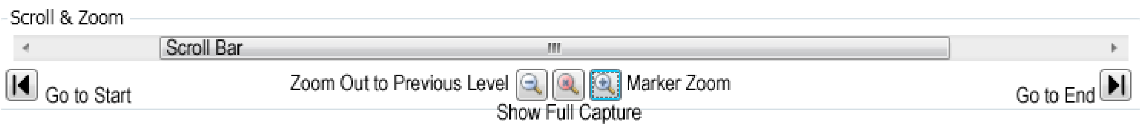


Figure 8-19. Scroll & Zoom Controls

7. There are two ways to view a feature of interest on the trace in more detail. You can position the A and B markers on the trace by clicking and dragging with the mouse and then clicking the **Marker Zoom** button. The second method is to left click and drag with the mouse to create a rectangular zoom area. Release the mouse button to zoom in.
8. Use the **Go to Start** or **Go to End** buttons to position the viewing window at the beginning or end of the capture, or use the scroll bar to pan through the capture data.
9. When viewing a zoomed trace, click the **Zoom Out to Previous Level** button to zoom out to the previous view. This is useful if you have zoomed in several times.
10. Click the **Show Full Capture** button to return to viewing the entire capture.

8-10 Saving Results

Graphical and numerical results can be saved to a .csv file.

1. Right click anywhere within the results area.
2. Select **Save Graph Data** or **Save Results Data** from the pop-up menu.
3. Results are saved to a csv file that you can open within a spreadsheet program such as Microsoft Excel.

8-11 Printing Results

Graphical and numerical results can be printed.

1. Right-click anywhere within the results area.
2. Select **Print Graph Image** or **Save Graph Data** from the pop-up menu.

Chapter 9 — Single Waveform Receiver Testing

9-1 Receiver Testing

CombiView enables you to configure the vector signal generator (VSG) within your MT8870A's modules. The VSG facilitates receiver testing for the CW, wireless LAN, and *Bluetooth* standards.

To use the VSG you must purchase and register the MV8870xxA waveform option for the wireless standard that you are testing. Eight options are available:

- Option MV887030A: for WLAN 802.11b/g/n/a
- Option MV887031A: for WLAN 802.11ac
- Option MV887032A: for WLAN 802.11p
- Option MV887033A: for WLAN 802.11ax
- Option MV887040A: for *Bluetooth*
- Option MV887040A-001: for *Bluetooth* (DLE, BLE, BLR)
- Option MV887040A-002: for *Bluetooth* (BLE)
- Option MV887040A-003: for *Bluetooth* (BLR)

Purchasing the required option provides you with two ways to use the VSG:

- You can select a waveform file from any of the preconfigured files that are supplied with each option.
- You can use the **Waveform File Generator** to generate your own waveform file for a wireless standard that matches the option or options that you have purchased. If you generate a waveform file for a wireless standard for which you have not purchased the required option, it will not be possible to transfer the file to the instrument's ARB memory.

9-2 Transmitting Preconfigured Packets to the DUT

1. Within the SRW Applet, select **VSG** > **Configure VSG** to open the **VSG Settings** dialog shown below.

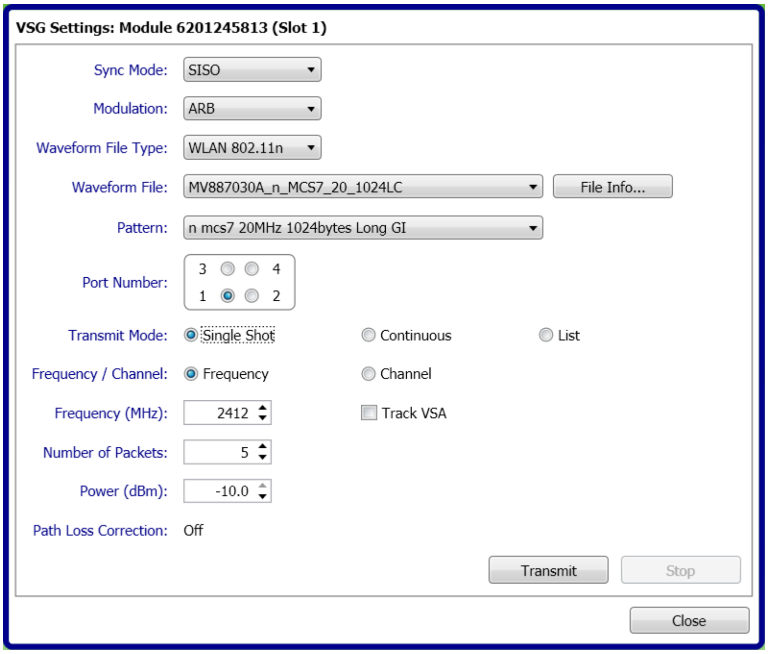


Figure 9-1. VSG Settings

2. At **Modulation** select **ARB**.
3. At **Waveform File Type**, select the wireless standard to match the data that you are transmitted to the DUT.
4. At **Waveform File**, select the waveform to be transmitted.
5. At **Pattern**, set the data pattern.

Note	Most short range wireless waveform files contain a single pattern. Waveform files for generating MIMO signals contain a separate pattern for each spatial stream.

6. Select the **Port Number**.
7. At **Transmit Mode**, select either Single Shot to transmit a fixed number of packets, or Continuous to transmit packets continuously.
8. At **Frequency / Channel**, select either Frequency or Channel and then enter the frequency (MHz) or channel number in the text box.
9. If **Transmit Mode** is set to Single Shot, enter the **Number of Packets** to be transmitted.
10. Click **Transmit** to transmit the packets to the DUT.

9-3 Creating Custom Waveform Files

1. From the CombiView menu select **VSG > Generate Waveform Files** to open the window shown in Figure 9-2.

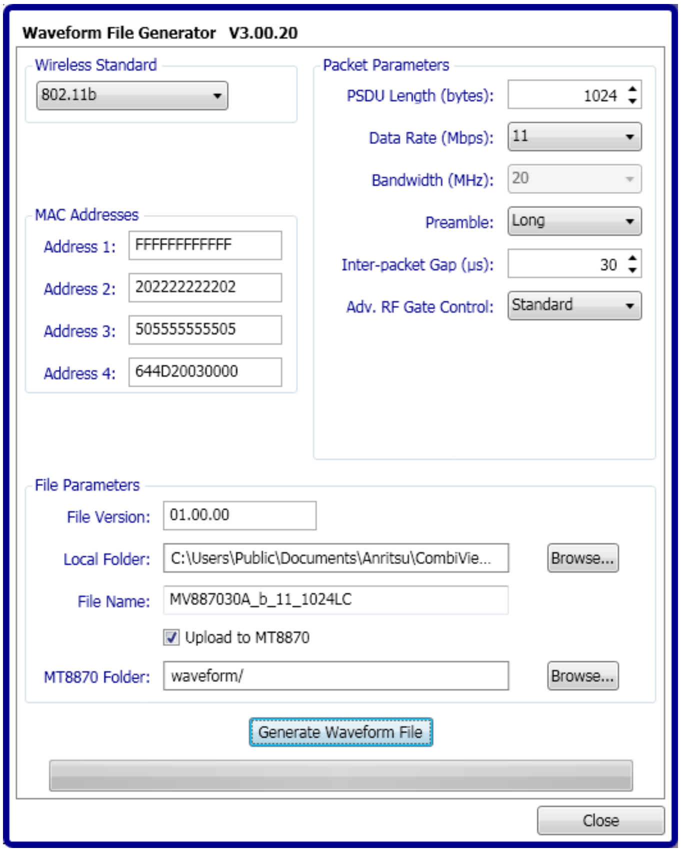


Figure 9-2. Waveform File Generator

2. Set the **Wireless Standard** to match the option or options that you have purchased.
3. A filename for the new waveform file is created automatically. By convention the last character is "C" for "Custom".
4. If you want to load the new waveform file to an MT8870 immediately, ensure that "Upload to MT8870" is selected.
5. Configure the waveform as required and click **Generate Waveform File**.

9-4 Managing Waveform Files

The Waveform File Manager allows you to transfer waveform files between a PC and an MT8870 and organize files in sub-folders.

1. From the CombiView menu select **VSG > Manage Waveform Files** to open the window shown in Figure 9-3.

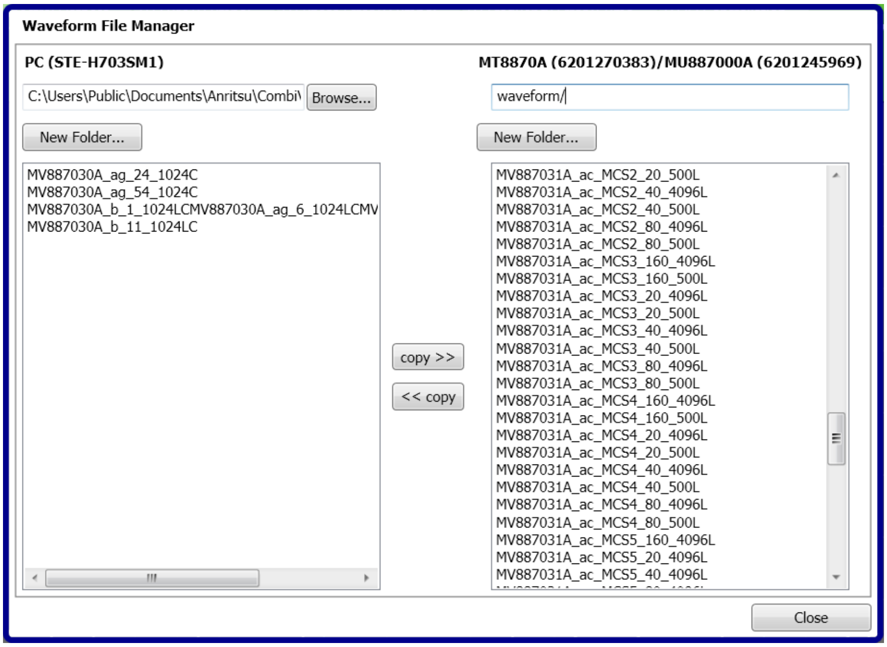


Figure 9-3. Waveform File Manager

2. The left panel shows waveform files on your PC. Click Browse to locate the folder containing waveform files. The panel displays waveform files and sub-folders. Sub-folder names end with a "\" character. You can navigate to a sub-folder by double clicking its file name. To return to the previous level click "\..".
3. The right panel shows waveform file on the instrument. The panel displays waveform files and sub-folders. Sub-folder names end with a "/" character. You can navigate to a sub-folder by double clicking its file name. To return to the previous level click "/..".
4. To transfer a file from the PC to the MT8870, highlight the file in the left hand panel and click **copy >>**.
5. To transfer a file from the MT8870 to the PC, highlight the file in the right hand panel and click **<< copy**.
6. To delete a file, highlight it and press the Delete key. When prompted, click **Yes** to confirm deletion.

9-5 Calculating the Error Rate

You can calculate receiver sensitivity by using the chipset vendor's software to count the number of packets or bits received in comparison to the number that you transmitted.

Bluetooth Measurements

The receiver sensitivity for Bluetooth basic rate and enhanced data rate signals is based on the calculation of Bit Error Rate (BER). BER is an expression of the number of bits that were received in error. It is calculated using the formula below:

(1- (Number of bits correctly received / Number of bits sent)) x 100%.

The receiver sensitivity for Bluetooth low energy signals is based on the calculation of Packet Error Rate (PER). PER is an expression of the number of packets that were received in error. It is calculated using the formula below:

(1- (Number of packets correctly received / Number of packets sent)) x 100%.

WLAN Measurements

DUT receiver measurements are based on the calculation of Packet Error Rate (PER) or Frame Reception Rate (FRR). PER is an expression of the number of packets that were received in error. It is calculated using the formula below:

(1- (Number of packets correctly received / Number of packets sent)) x 100%.

FRR is an expression of the number of packets that were successfully received. FRR is specified by the CTIA and Wi-Fi Alliance in the CWG Test Plan used to evaluate the RF Performance of Wi-Fi Mobile Converged Devices. FRR is calculated using the formula below:

(Number of packets correctly received / Number of packets sent) x 100%.

Note	Full details of receiver testing and the waveform files are provided in the Short Range Wireless Waveform Options Manual.

9-6 Generating a List of Waveforms

CombiView enables you to set up the vector signal generator to generate a list of different signals. You can define each signal in the list to have a different waveform file, a different number of packets, a different frequency or power level, or be output from a different port.

You can use this mode to simulate the behavior of a DUT that can generate multiple waveforms. See Chapter 4, “Multiple Waveform Transmitter Testing”

1. Within the SRW Applet, select **VSG > Configure VSG** to open the **VSG Settings** dialog.
2. At **Transmit Mode** select **List**. The dialog form displays controls for setting up the list as shown below.

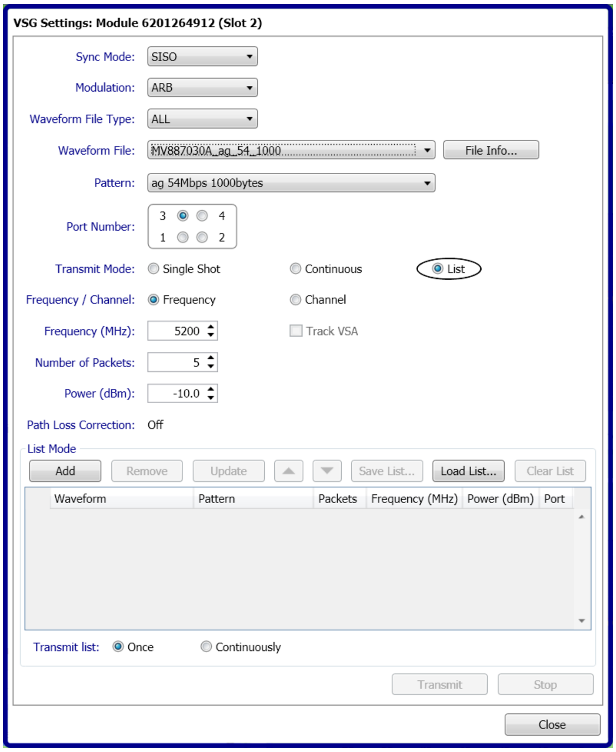


Figure 9-4. VSG List Mode

3. Select a waveform file, port number, frequency or channel, number of packets and power level in the usual way, then click **Add** to add the settings to the list.

.

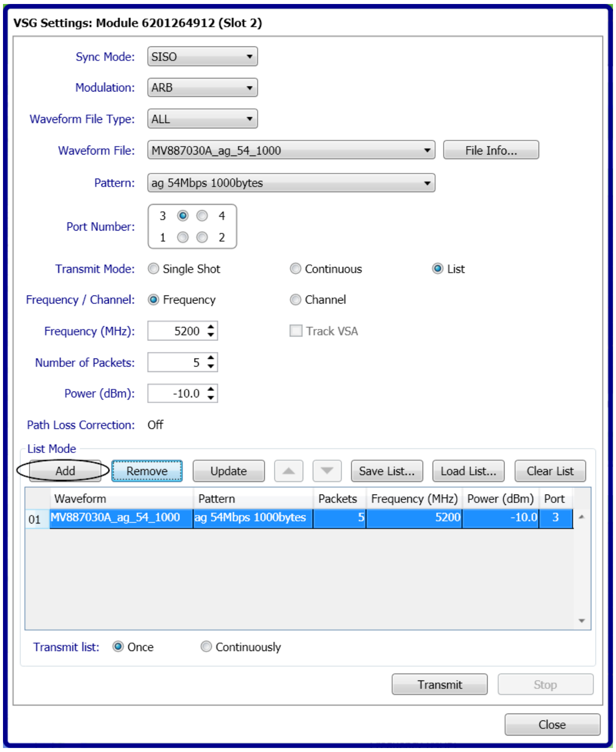


Figure 9-5. Adding a Waveform to the List

4. Continue to set up and **Add** waveforms until the list is complete.
5. At **Transmit List** select **Once** to transmit the list once, or **Continuously** to loop repeatedly through the list.
6. Click **Transmit** to transmit the list.
7. To change an item in the list, click to highlight it, change the settings (such as waveform file, frequency, number of packets, etc.) then click **Update**.
8. You can save a list definition to a file using **Save List...**, and recall it again using **Load List...**
9. To remove an entry in the list, click to highlight it and click **Remove**.
10. To remove all entries in the list, click **Clear List** and confirm when prompted.
11. To change the position of an entry in the list, click to highlight it then use the up and down arrows as shown in the figure below.

.

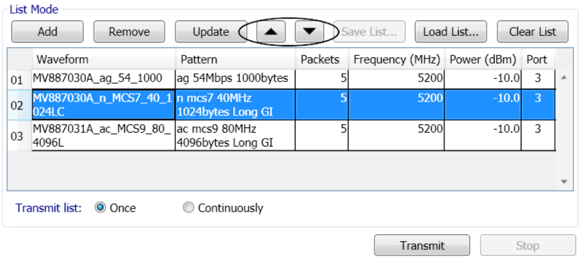


Figure 9-6. List Controls

Chapter 10 — True MIMO Receiver Testing

10-1 True MIMO

In a true (or real) MIMO measurement system, all data streams are transmitted simultaneously from the test instrument to the DUT.

True MIMO receiver testing requires a dedicated vector signal generator (VSG) for each of the spatial streams. On the MT8870A true MIMO receiver testing therefore requires a dedicated MU887000A module for each of the streams being transmitted. This is shown in figure below.

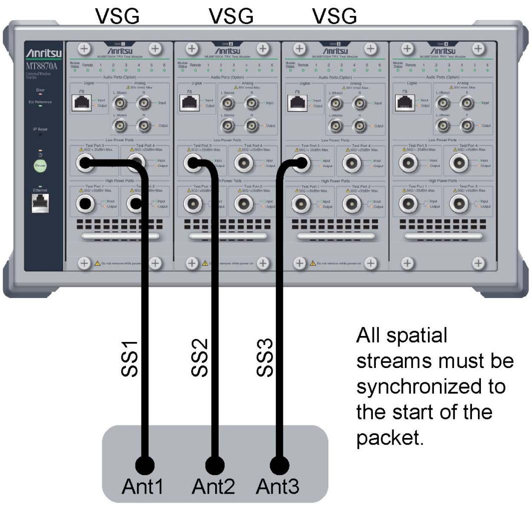


Figure 10-1. True MIMO Receiver Testing

10-2 Receiver Testing

CombiView enables you to configure the vector signal generator (VSG) within your MT8870A's modules. The VSG facilitates receiver testing for the CW, wireless LAN, and *Bluetooth* standards.

To use the VSG you must purchase and register the MV8870xxA waveform option for the wireless standard that you are testing. Eight options are available:

- Option MV887030A: for WLAN 802.11b/g/n/a
- Option MV887031A: for WLAN 802.11ac
- Option MV887032A: for WLAN 802.11p
- Option MV887033A: for WLAN 802.11ax
- Option MV887040A: for *Bluetooth*

- Option MV887040A-001: for *Bluetooth* (DLE, BLE, BLR)
- Option MV887040A-002: for *Bluetooth* (BLE)
- Option MV887040A-003: for *Bluetooth* (BLR)

Purchasing the required option enables you to select a waveform file from any of the preconfigured waveform files.

10-3 Synchronizing Data Streams

In true MIMO receiver testing, all spatial streams are synchronized to the start of the packet. To achieve this you must use a SRW Applet for each of the MT8870A modules in use. The data streams are then synchronized using a master / slaves relationship.

Module 1 is set up as the master and the remaining modules are set up as slaves. If you are testing with a single instrument there can be a maximum of three slaves. If you are testing with two instruments (8 modules in total), there can be a maximum of seven slaves (three internal and four external).

Note	If you are using two instruments, you need to make a trigger connection between them. Connect a BNC to BNC lead between the Trigger 1 input/output connectors on the back panels of your instruments.

1. From the CombiView Manager, open a SRW Applet for each of the spatial streams that you are transmitting to the DUT.

Note	Section 2-6 explains how each MT8870A module displays within the CombiView Manager device tree and how it is highlighted on the image of the MT8870A.

2. From the SRW Applet for module number 2, Select **VSG** > **Configure VSG** to open the VSG Settings dialog shown below.

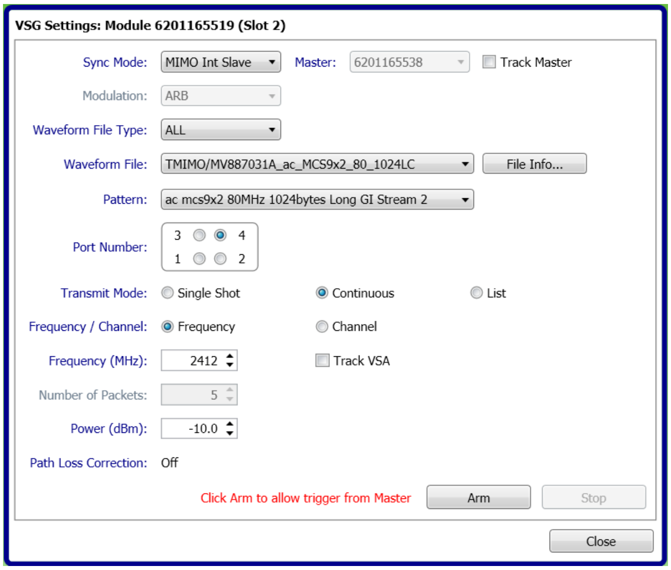


Figure 10-2. VSG Settings

3. Set **Sync Mode** to **MIMO Int Slave.**

4. Select and configure the waveform.
5. Select the VSG port that you are using to transmit to the DUT.
6. Repeat this process for the other SRW Applets except for the module 1 applet.
7. For the module 1 applet, set **Sync Mode** to **MIMO Master**, then select and configure the waveform.
8. Click **Arm** in all the slave applets.
9. Click Trigger in the master (module 1) applet.

Transmission of all spatial streams (master and slaves) is synchronized to the start of the packet so that receiver testing can be performed under true MIMO conditions.

10-4 Calculating the Error Rate

You can calculate receiver sensitivity by using the chipset vendor's software to count the number of packets or bits received in comparison to the number that you transmitted.

DUT receiver measurements are based on the calculation of Packet Error Rate (PER) or Frame Reception Rate (FRR). PER is an expression of the number of packets that were received in error. It is calculated using the formula below:

(1- (Number of packets correctly received / Number of packets sent)) x 100%.

FRR is an expression of the number of packets that were successfully received. FRR is specified by the CTIA and Wi-Fi Alliance in the CWG Test Plan used to evaluate the RF Performance of Wi-Fi Mobile Converged Devices. FRR is calculated using the formula below:

(Number of packets correctly received / Number of packets sent) x 100%.

Note	Full details of receiver testing and the waveform files are provided in the Short Range Wireless Waveform Options Manual.

Chapter 11 — Sequential MIMO Receiver Testing

11-1 Sequential MIMO

In sequential MIMO RX testing a SISO signal is transmitted to each DUT antenna port in turn.

On the MT8870A, sequential MIMO receiver testing can be performed using a single MU887000A module with each port on that module transmitting to a different antenna on the DUT. This is shown in figure below.

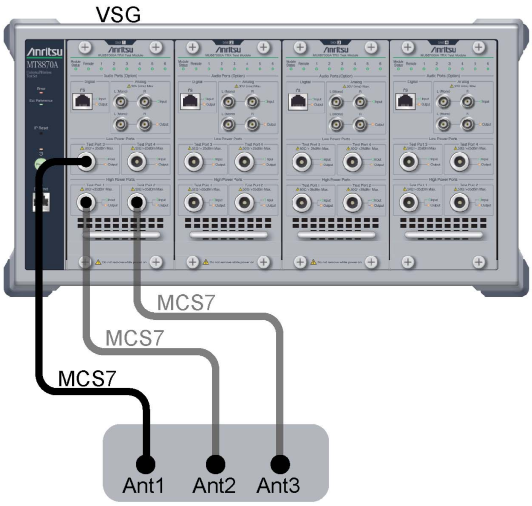


Figure 11-1. Sequential MIMO Receiver Testing

11-2 Receiver Testing

CombiView enables you to configure the vector signal generator (VSG) within your MT8870A's modules. The VSG facilitates receiver testing for the CW, wireless LAN, and *Bluetooth* standards.

To use the VSG you must purchase and register the MV8870xxA waveform option for the wireless standard that you are testing. Eight options are available:

- Option MV887030A: for WLAN 802.11b/g/n/a
- Option MV887031A: for WLAN 802.11ac
- Option MV887032A: for WLAN 802.11p
- Option MV887033A: for WLAN 802.11ax
- Option MV887040A: for *Bluetooth*

- Option MV887040A-001: for *Bluetooth* (DLE, BLE, BLR)
- Option MV887040A-002: for *Bluetooth* (BLE)
- Option MV887040A-003: for *Bluetooth* (BLR)

Purchasing the required option enables you to select a waveform file from any of the preconfigured waveform files.

11-3 Transmitting Packets to Antenna 1

1. Within the SRW Applet, select **VSG** > **Configure VSG** to open the VSG Settings window shown below.

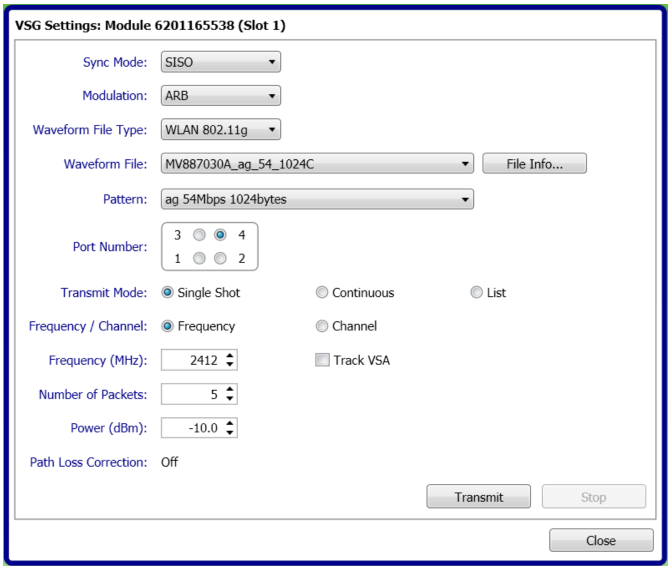


Figure 11-2. VSG Settings

2. At **Sync Mode** select **SISO**.
3. At **Modulation** select **ARB**.
4. At **Waveform File Type**, select the wireless standard to match the data being transmitted to the DUT.
5. At **Waveform File**, select the waveform to be transmitted.
6. At **Pattern**, set the data pattern.
7. Select the port being used to connect to the first antenna on the DUT.
8. Set the frequency or channel.
9. Set the number of packets to be transmitted.
10. Click **Transmit** to transmit the specified number of packets to the DUT.

11-4 Calculating the Error Rate

You can calculate receiver sensitivity by using the chipset vendor's software to count the number of packets or bits received in comparison to the number that you transmitted.

DUT receiver measurements are based on the calculation of Packet Error Rate (PER) or Frame Reception Rate (FRR). PER is an expression of the number of packets that were received in error. It is calculated using the formula below:

(1- (Number of packets correctly received / Number of packets sent)) x 100%.

FRR is an expression of the number of packets that were successfully received. FRR is specified by the CTIA and Wi-Fi Alliance in the CWG Test Plan used to evaluate the RF Performance of Wi-Fi Mobile Converged Devices. FRR is calculated using the formula below:

(Number of packets correctly received / Number of packets sent) x 100%.

Note	Full details of receiver testing and the waveform files are provided in the Short Range Wireless Waveform Options Manual.

11-5 Transmitting Packets to Antenna 2

After calculating the error rate for antenna 1, change ports and repeat the process for the other spatial streams.

Chapter 12 — Composite MIMO Receiver Testing

12-1 Composite MIMO

On the MT8870A, composite MIMO receiver testing can be performed using a single test port on a single MU887000A module. A SISO signal is transmitted to all DUT antenna ports in parallel as shown in figure below.

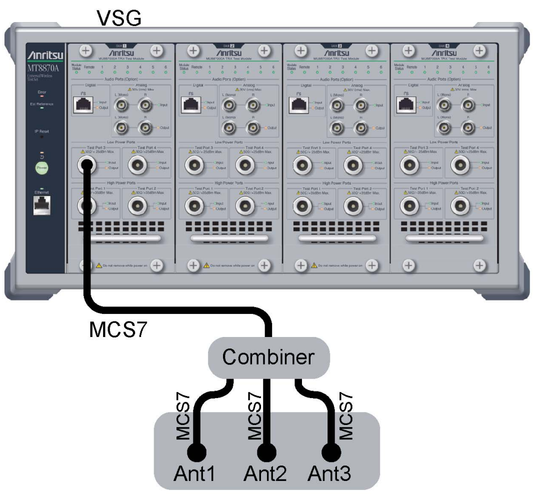


Figure 12-1. Composite MIMO Receiver Testing

12-2 Transmitting Packets to the DUT

1. Within the SRW Applet, select **VSG** > **Configure VSG** to open the VSG Settings window shown below.

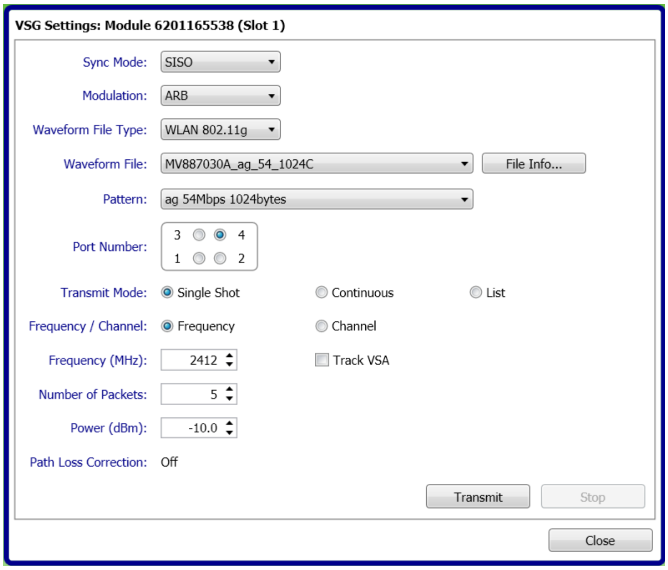


Figure 12-2. VSG Settings

2. At **Sync Mode** select **SISO**.
3. At **Modulation** select **ARB**.
4. At **Waveform File**, select the waveform to be transmitted.
5. At **Pattern**, set the data pattern.
6. Select the port being used to connect to the DUT.
7. Set the frequency or channel.
8. Set the number of packets to be transmitted.
9. Click **Transmit** to transmit the specified number of packets to the DUT.

12-3 Calculating the Error Rate

You can calculate receiver sensitivity by using the chipset vendor's software to count the number of packets or bits received in comparison to the number that you transmitted.

DUT receiver measurements are based on the calculation of Packet Error Rate (PER) or Frame Reception Rate (FRR). PER is an expression of the number of packets that were received in error. It is calculated using the formula below:

(1- (Number of packets correctly received / Number of packets sent)) x 100%.

FRR is an expression of the number of packets that were successfully received. FRR is specified by the CTIA and Wi-Fi Alliance in the CWG Test Plan used to evaluate the RF Performance of Wi-Fi Mobile Converged Devices. FRR is calculated using the formula below:

(Number of packets correctly received / Number of packets sent) x 100%.

Note	Full details of receiver testing and the waveform files are provided in the Short Range Wireless Waveform Options Manual.

Chapter 13 — Setting Path Loss

13-1 Creating a Path Loss Table

CombiView provides a path loss correction table that you can use to compensate for RF loss in the test system or cabling.

1. In the menu bar of the SRW Applet, click **Path Loss** > **Configure Correction**.

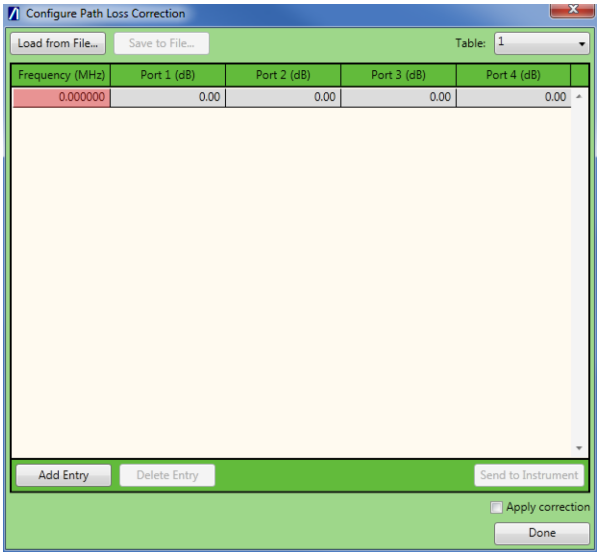


Figure 13-1. Configure Path Loss Correction

2. In the **Configure Path Loss Correction** dialog, select a table number from the "Table" drop-down in the upper-right corner.
3. In the path loss correction table, click the cell in the frequency column (highlighted in pink) and enter the frequency at which your first path loss correction will be made.
4. Click the cells of the test port or ports that you are using and enter the amount of correction that is required to compensate for the loss.

Notes	Cells that display in red have been set to a value outside of the permissible range. These settings must be corrected before the path loss correction data can be sent to the instrument.

5. If required, add additional lines to the table by clicking **Add Entry** and repeating the steps above.

6. Click **Send to Instrument** to send the table data to the MT8870A.

Note	The data is sent to a volatile location on the MT8870A and is deleted when the MT8870A is turned off.

13-2 Data Handling

The MT8870A uses linear interpolation to calculate correction values for frequencies between the points that you have defined in the table. The following rules are applied:

- The correction value defined for the lowest frequency is applied at that frequency and all lower frequencies.
- The correction value defined for the highest frequency is applied at that frequency and all higher frequencies.
- If the table contains only one entry, the correction value for that entry is applied across the entire frequency range of the instrument.

13-3 Using a Path Loss Table

To use a path loss table during measurements, open the required table from the “Table” drop-down and then select the “Apply correction” check box. Alternatively, in the menu bar of the SRW Applet, click **Path Loss** > **Apply Correction**. An indicator at the bottom of the SRW Applet tells you at a glance whether path loss correction is turned on or off.

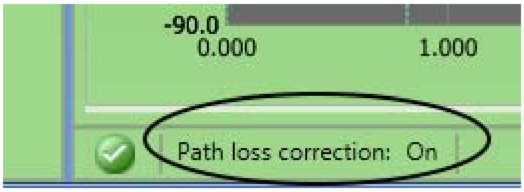


Figure 13-2. Path Loss Correction Indicator

13-4 Saving Path Loss Data

You can save your path loss table data to a .csv file for use in the future.

1. Click **Save to File** in the **Configure Path Loss Correction** dialog to save the table data to a .csv file on your PC or network.
2. You can reuse saved files by clicking **Load from File**.

Chapter 14 — Demonstrating CombiView

14-1 Running CombiView in Simulation Mode

You can use CombiView in a simulation mode even if you have not connected to an instrument or purchased the required applications. This is useful for familiarizing yourself with the software before use.

When you enable simulation mode you can select the wireless standard and configure the settings in exactly the same manner as when using CombiView in a real test environment.

Follow the steps below to run CombiView in simulation mode.

1. Double-click the **CombiView** icon generated during installation.
2. In the **CombiView Manager** click **Tools** > **Simulation Mode**.

   The words "Simulation Mode" display in the CombiView title bar when simulation mode is enabled.

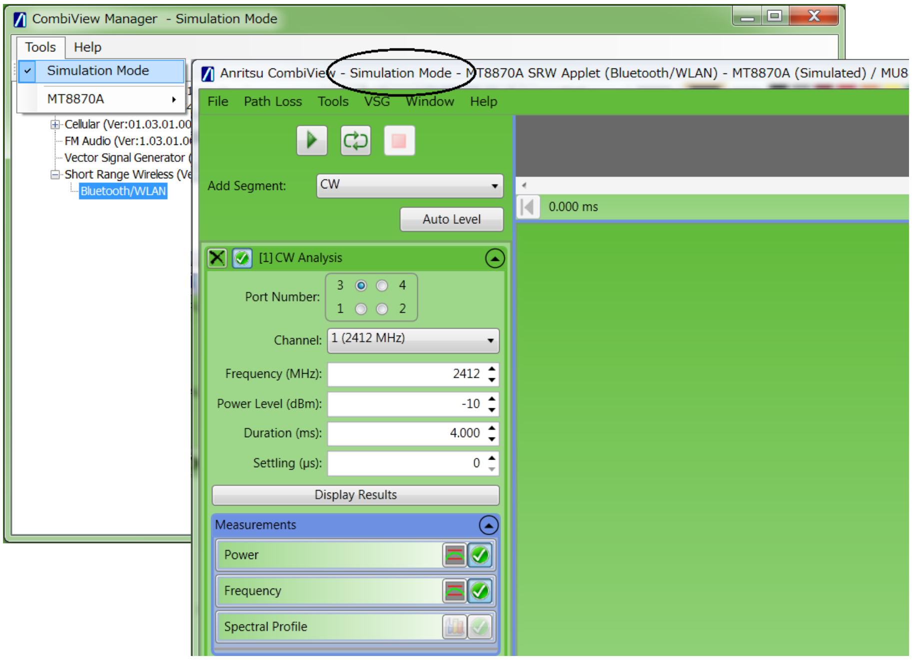


Figure 14-1. Simulation Mode

Chapter 15 — Upgrading the Firmware

15-1 Firmware Upgrade

1. Install the Utility Tool.

Note	Full details of how to install and use the Utility Tool are provided in Chapter 8 of the MU887000A Operation Manual.

2. From the **CombiView Manager** select **Tools** > **MT8870A** > **Utility Tool**.
3. Select the interface by clicking **IPv4** or **GPIB** and wait for the function tree to be populated.
4. Click **Upgrade Firmware (All Unit)** in the function tree.
5. Click **Browse** and select the upgrade file supplied by Anritsu.
6. Click **Upgrade**.

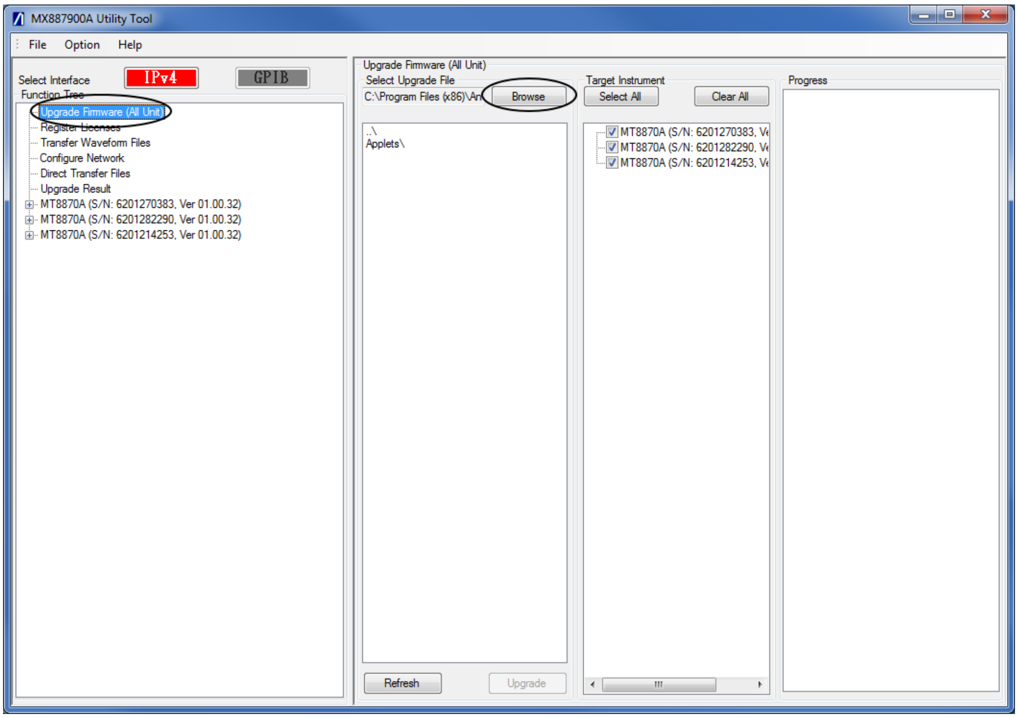


Figure 15-1. Upgrade Firmware

Chapter 16 — Registering License Options

16-1 Enabling Options

Options that you order with the MT8870A are pre-loaded and registered by Anritsu. Options that you purchase later must be enabled by registering the activation code supplied by Anritsu. Follow the procedure below.

1. Install the Utility Tool.

Note	Full details of how to install and use the Utility Tool are provided in Chapter 8 of the MU887000A Operation Manual.

2. From the **CombiView Manager** select **Tools** > **MT8870A** > **Utility Tool**.
3. Select the interface by clicking **IPv4** or **GPIB** and wait for the function tree to be populated.
4. Click **Register Licenses** in the function tree.
5. Click **Browse** and select the license file supplied by Anritsu.
6. Click **Register**.

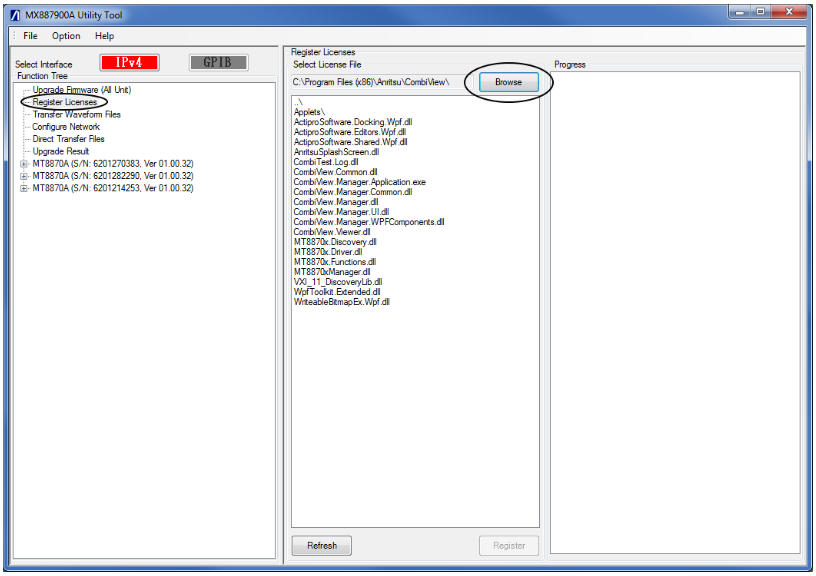


Figure 16-1. Register Licenses

Appendix A —WLAN Setting Definitions

A-1 General Configuration Settings (A to Z)

After Settling

Specifies how the instrument will analyze captured measurement data when the trigger mode is set to level and a non-zero settling time is used.

"Start Analysis" means that analysis of the captured data will begin immediately after the settling time. If the settling time has ended part way through a captured packet, the system may report an error because it is unable to analyze an incomplete packet.

"Sync to Next Packet" means that after the settling time has ended, the system will search through the captured data until it finds the start of the next packet before starting analysis. See also Settling and Trigger Mode.

Capture Mode

Selects whether data capture for a segment is timed or based upon a count of the actual packets received. Select "Timed" to specify a Duration in milliseconds. Select "Packet Count" to count packets up to the number specified in the "Number of Packets" setting. The capture segment will then terminate.

Channel

Set the channel at which data is transmitted from the DUT. The "Frequency (MHz)" setting will update to reflect the selected channel.

Data Rate (802.11g/a/b only)

Specify the data rate at which data is transmitted from the DUT. The available data rates may differ depending on the selected wireless standard.

Downconversion Method

This advanced function allows the downconversion method used within the receiver to be changed. The setting affects whether the instrument's receiver local oscillator (LO) is set to a frequency higher than the input RF (high side injection) or lower than the input RF (low side injection.)

The default setting is "Automatic", but the choice of LO_LOWER (low side injection) or LO-UPPER (high side injection) can be specified. This setting has no effect on WLAN 80+80 and 160 MHz full span spectrum measurements. For these cases the downconversion method is always determined automatically.

Note

Because this setting is intended for advanced users, it is not visible by default among the analysis settings for a segment. To make the setting visible:

1. From the menu bar select **Tools** > **Advanced Configuration...**
2. On the Advanced Configuration Settings ensure that the "Allow Setting of Downconversion Method" check box is checked.
3. Click **Close**.

Duration

Set the capture period. This should be long enough to capture the required number of packets. If you know the exact packet duration and the relationship between the trigger point and the start of the first packet, you can set the capture duration to exactly encompass the required number of packets. It may however be more convenient to set a duration that is known to sufficiently exceed the time needed to capture the required number of packets.

Frequency

Select the frequency at which data is being transmitted from the DUT. If the frequency you enter corresponds to a standard channel, the "Channel" settings will update to show this.

GI + LTF size (802.11ax only)

At "Guard Interval" select the Guard Interval and HE-LTF size.

Guard Interval (802.11n/ac only)

At "Guard Interval" select the long or short guard interval. (For 802.11n, this is applicable only if "PPDU Format" is set to "HT Mixed".)

MCS Index (802.11n/ac/ax only)

802.11n/ac data rates are determined by a Modulation and Coding Scheme (MCS). MCS values were defined in the IEEE standard to simplify the numerous factors that can influence achievable data rates.

Number of Packets

Set the number of packets to be measured. The specified number is reflected in the number of bold packets that display in the packet area at the top of the SRW Applet.

If the specified capture duration is longer than the total length of the specified number of packets, more packets will be captured than are actually analyzed.

Packets to Skip

Sets the number of packets to disregard during analysis, counting from the start of the capture segment. Some DUTs generate packets that are out of specification under certain conditions, such as when performing an internal calibration process. This setting allows those packets to be disregarded during analysis. See also **Settling**.

PD Threshold (dB)

The packet detector identifies power bursts within the capture data.

The packet detector threshold specifies the power level at which the packet detector will recognize the start of a packet. It is specified relative to the input power level.

The packet detector threshold is -20 dB by default, but can be set in the range 0 to -60 dB in 1 dB steps.

Port Number

The port number on the MT8870A being used to connect to the DUT.

Power Level

Set the expected average power at which packets are transmitted by the DUT. You can set the power automatically by clicking **Auto Level**.

PPDU Format (802.11ax only)

Select the format at which measurements are performed. The items within the drop-down are defined below.

SU:	All data is transmitted in HE-SU PPDU format.

PPDU Format (802.11n only)

Select the format at which measurements are performed. The items within the drop-down are defined below.

HT Mixed:	Data is transmitted with both legacy formatted and HT formatted preambles. Legacy devices receiving the data are unable to read the payload but can avoid collision by knowing when the channel is busy. Ensuring backwards compatibility in this manner reduces data throughput considerably.
HT Greenfield:	All data is transmitted in high-throughput format and cannot be read by 802.11b/g/a legacy devices.

PPDU Type (802.11n/ac/ax only)

Select the channel bandwidth at which data is transmitted from the DUT. The items within the drop-down are detailed below.

20 MHz:	Data is transmitted over a signal with 20 MHz bandwidth.
40 MHz:	Data is transmitted over two adjacent signals with 20 MHz bandwidth.
40 MHz Upper:	Data is transmitted over a signal with 20 MHz bandwidth in the upper side band of a 40 MHz channel. (11n only)
40 MHz Lower:	Data is transmitted over a signal with 20 MHz bandwidth in the lower side band of a 40 MHz channel. (11n only)
40 MHz Duplicate:	Data is transmitted twice using two adjacent signals with 20 MHz bandwidth. (11n only)
80 MHz:	Data is transmitted over a signal with 80 MHz bandwidth. (11ac/ax only)
160 MHz:	Data is transmitted over a signal with 160 MHz bandwidth. (11ac only)

Reference File (Composite MIMO only)

Select the reference file generated using the Reference File Generator. The reference data file enables the measurement algorithms to successfully decode the spatial streams from the composite signal.

Settling

Set a delay between the start of the captured data and the start point at which data is analyzed and measurement are taken. By setting a long delay you can eliminate the first few packets and allow the DUT to settle. See also **Packets to Skip**

Trigger Delay

“Trigger Delay” is enabled only when “Trigger Mode” is set to “Level”. Set a time delay between the trigger point and the start point at which data is captured for analysis. You can set a positive or negative trigger delay. Refer to the figure below.

Trigger Level

Set the power level that serves as the trigger when “Trigger Mode” is set to “Level”. Trigger level is defined relative to power level. Refer to the figure on the following below.

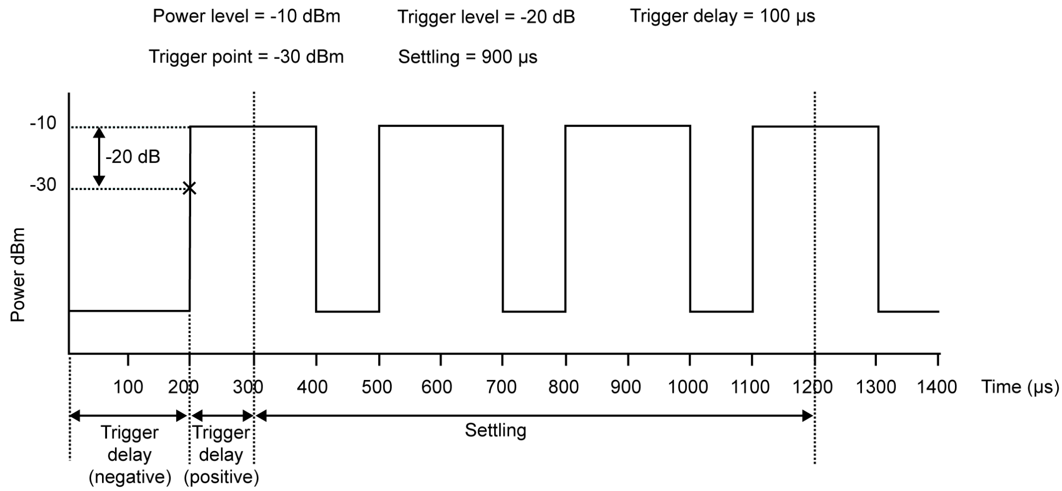


Figure A-1. Trigger Related Settings

Trigger Mode

Select “Immediate” or “Level” trigger mode. If set to “Immediate”, triggering is performed continuously. If set to “Level”, triggering is performed at the power level specified at the “Trigger Level” item.

A-2 EVM Analysis Settings

Calculation Method

User:	EVM is calculated over the analysis length specified.
Preamble Header:	EVM is calculated using the data transmitted in the preamble and header.

Mode

Full Packet:	Perform measurements on the entire packet.
User:	Perform measurements on the number of symbols specified by the user.

Length (Chips)

Specify the number of chips over which calculations are made.

Length (Symbols)

Specify the number of symbols over which calculations are made.

A-3 Chip Clock Analysis Settings

Length (Chips)

Specify the number of chips over which calculations are made.

A-4 Filter Settings

Allows the user to specify a filtering type for use during EVM analysis of DSSS modulated signals.

Filtering Type:

None:	No filtering is applied when calculating EVM.
Gaussian:	The Gaussian filter is selected and the user can set the “Gaussian Filter BT Value”.
RRC:	RRC (Root Raised Cosine) is selected and the user can set the “RRC Filter Alpha Value”.

RRC Filter Alpha Value

Set the alpha setting to a value between 0.3 and 1.0 in steps of 0.01.

Gaussian Filter BT Value

Set the filter to a value between 0.3 and 1.0 in steps of 0.1.

A-5 Symbol Clock Analysis Settings

Mode

Full Packet:	Perform measurements on the entire packet.
User:	Perform measurements on the number of symbols specified by the user.

Length (Symbols)

Specify the number of symbols over which calculations are made.

A-6 Channel Estimation Settings

For OFDM signals, channel estimation is performed during the initial receiver synchronization process.

Long Training Sequence:	Estimation uses the long training sequence.
Full Packet:	Estimation uses the full packet.

A-7 Frequency Correction Settings

For OFDM signals, frequency correction is performed during reception of the short and long training fields. Additional options are available as follows:.

STF:	Frequency correction is based on the short training field.
LTF:	Frequency correction is based on the short and long training fields. This conforms to the IEEE standard and is the default setting.
SIG:	Frequency correction is based on the short and long training fields and the SIG field.
Data:	Frequency correction is based on the short and long training fields, the SIG field and the payload data.

A-8 Pilot Tracking Settings

For OFDM signals, pilot sub-carriers are used to assist with receiver synchronization.

Mode

Phase:	The demodulation process tracks the pilot phase over the specified EVM analysis length.
Phase and Amplitude:	The demodulation process tracks both the pilot phase and amplitude over the specified EVM analysis length.

A-9 Spectral Profile Settings

Spectrum Window

Set the window type used for spectrum analysis measurements in the active segment.

Flat Top:	The flat top window has the effect of merging adjacent frequency bins together to produce a spectrum with a smoother appearance. There is a loss of absolute power measurement accuracy, but the relative power level of closely-spaced signals is faithfully reproduced.
Gaussian:	The Gaussian window gives the most accurate absolute power measurement at a spot frequency provided that the signal being measured coincides with the centre of a frequency bin. However if the signal lies midway between bins, the power measurement accuracy is lower than would be obtained with a flat top window because of the sharp cut-off of this type of filter. For the same reason, the relative power level of closely-spaced signals is less accurately reproduced, but there is less leakage between adjacent bins so that finer detail can be seen.

Full Mask Enable

Enable or disable full span spectral mask measurements. This function affects the span over which spectrum measurements are checked against the mask limits. By default this setting is enabled and the mask is applied across the full span of the measurement, in compliance with the IEEE standard.

Full Span Enable

Enable full span 802.11ac (80 MHz) measurements. When enabled, spectrum measurements returned by the instrument cover a span of +/- 140 MHz for 802.11ac (80 MHz). When this setting is disabled, spectrum measurements of 802.11ac signals will be limited to a maximum span of +/- 80 MHz.

Note: Full span spectrum measurements are obtained by tuning the instrument’s receiver to frequencies above and below the carrier and acquiring measurement data separately at each frequency. For this reason, measurement acquisition time will be longer when this function is enabled.

Appendix B —Bluetooth Setting Definitions

B-1 General Configuration Settings (A to Z)

After Settling

Specifies how the instrument will analyze captured measurement data when the trigger mode is set to level and a non-zero settling time is used.

“Start Analysis” means that analysis of the captured data will begin immediately after the settling time. If the settling time has ended part way through a captured packet, the system may report an error because it is unable to analyze an incomplete packet.

“Sync to Next Packet” means that after the settling time has ended, the system will search through the captured data until it finds the start of the next packet before starting analysis. See also Settling and Trigger Mode.

Bluetooth Address

Set the address of the Bluetooth device being tested.

Channel

Set the channel at which data is transmitted from the DUT. The “Frequency (MHz)” setting will update to reflect the selected channel.

Capture Mode

Selects whether data capture for a segment is timed or based upon a count of the actual packets received. Select “Timed” to specify a Duration in milliseconds. Select “Packet Count” to count packets up to the number specified in the “Number of Packets” setting. The capture segment will then terminate.

Duration

Set the capture period. This should be long enough to capture the required number of packets. If you know the exact packet duration and the relationship between the trigger point and the start of the first packet, you can set the capture duration to exactly encompass the required number of packets. It may however be more convenient to set a duration that is known to sufficiently exceed the time needed to capture the required number of packets.

Downconversion Method

This advanced function allows the downconversion method used within the receiver to be changed. The setting affects whether the instrument's receiver local oscillator (LO) is set to a frequency higher than the input RF (high side injection) or lower than the input RF (low side injection.)

The default setting is "Automatic", but the choice of LO_LOWER (low side injection) or LO-UPPER (high side injection) can be specified. This setting has no effect on WLAN 80+80 and 160 MHz full span spectrum measurements. For these cases the downconversion method is always determined automatically.

Note

Because this setting is intended for advanced users, it is not visible by default among the analysis settings for a segment. To make the setting visible:

1. From the menu bar select **Tools** > **Advanced Configuration...**
2. On the Advanced Configuration Settings form ensure that the "Allow Setting of Downconversion Method**"** check box is checked.
3. Click **Close**.

Frequency

Select the frequency at which data is being transmitted from the DUT. If the frequency you enter corresponds to a standard channel, the "Channel" settings will update to show this.

Mode

Specify the type of Analysis Mode that is applied.

In "Standard" mode, measurements are made by closely following the SIG Standard Test Case definitions mandated in the RF Test Specification documents.

In "Speed: Decode Hdr." mode, the MT8870A tries to perform as many Bluetooth measurements as possible from a single packet type captured. The packets in the capture are identified by decoding the packet header.

In "Speed: Ignore Hdr." mode, the MT8870A estimates the packet type and payload length from analysis of the IQ data length and IQ data modulation characteristics. The fields decoded from the packet header are ignored. This mode can be used to obtain measurements for packet types that may not be specified in a SIG Standard Test Case, or in cases when the DUT does not fully support Bluetooth direct mode testing.

Number of Packets

Set the number of packets to be measured. The specified number is reflected in the number of bold packets that display in the packet area at the top of the SRW Applet.

If the specified capture period is longer than the total length of the specified number of packets, more packets will be captured than are actually analyzed.

Packet Type

Set the packet type being transmitted from the DUT.

Packets to Skip

Sets the number of packets to disregard during analysis, counting from the start of the capture segment. Some DUTs generate packets that are out of specification under certain conditions, such as when performing an internal calibration process. This setting allows those packets to be disregarded during analysis. See also **Settling**.

Payload Length

Specify the length of the payload data in bytes. Each Bluetooth packet type is designed to support a different range of payload length between 0 bytes and a maximum number of user payload bytes.

Payload Type

Select the type of payload used in the data being transmitted from the DUT.

PD Threshold (dB)

The packet detector identifies power bursts within the capture data.

The packet detector threshold specifies the power level at which the packet detector will recognize the start of a packet. It is specified relative to the input power level.

The packet detector threshold is -20 dB by default, but can be set in the range 0 to -60 dB in 1 dB steps.

Port Number

The port number on the MT8870A being used to connect to the DUT.

Power Level

Set the expected average power at which packets are transmitted by the DUT. You can set the power automatically by clicking **Auto Level**.

Settling

Set a delay between the start of the captured data and the start point at which data is analyzed and measurements are taken. By setting a long delay you can eliminate the first few packets and allow the DUT to settle. See also Packets to Skip.

Trigger Delay

"Trigger Delay" is enabled only when "Trigger Mode" is set to "Level". Set a time delay between the trigger point and the start point at which data is captured for analysis. You can set a positive or negative trigger delay. Refer to the figure below.

Trigger Level

Set the power level that serves as the trigger when "Trigger Mode" is set to "Level". Trigger level is defined relative to power level. Refer to the figure on the following below.

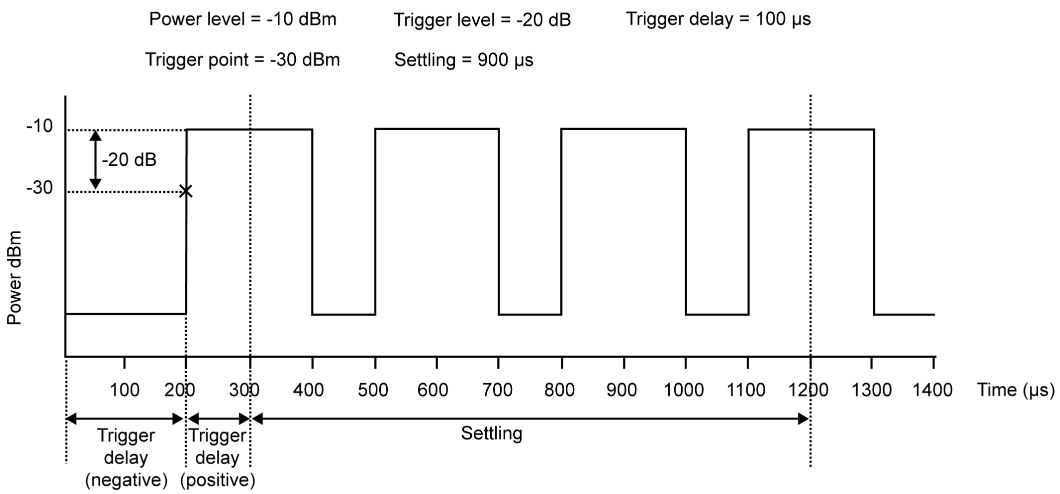


Figure B-1. Trigger Related Settings

Trigger Mode

Select "Immediate" or "Level" trigger mode. If set to "Immediate", triggering is performed continuously. If set to "Level", triggering is performed at the power level specified at the "Trigger Level" item.

B-2 Spectral Profile Settings

Spectrum Window

Set the window type used for spectrum analysis measurements in the active segment.

Flat Top: The flat top window has the effect of merging adjacent frequency bins together to produce a spectrum with a smoother appearance. There is a loss of absolute power measurement accuracy, but the relative power level of closely-spaced signals is faithfully reproduced.

Gaussian: The Gaussian window gives the most accurate absolute power measurement at a spot frequency if the signal being measured coincides with the centre of a frequency bin. However if the signal lies midway between bins, the power measurement accuracy is lower than would be obtained with a flat top window because of the sharp cut-off of this type of filter. For the same reason, the relative power level of closely-spaced signals is less accurately reproduced, but there is less leakage between adjacent bins so that finer detail can be seen.

Appendix C —CW Setting Definitions

Channel

Select the channel at which data is being transmitted from the DUT.

Duration

This is the capture period over which power measurements are averaged.

Frequency

This is the port number on the MT8870A being used to connect to the DUT.

Port Number

The port number on the MT8870A being used to connect to the DUT.

Power Level

This is the expected average power level of the signal. You can set the power level automatically by clicking Auto Level.

Settling

Set a delay between the start of the captured data and the start point at which data is analyzed and measurement are taken. By setting a delay you can eliminate the first part of the capture from the measurement.

Appendix D —PC Regional Settings

The CombiView software is designed to operate on Windows XP or Windows 7 in an English, Japanese, or Chinese language environment. We cannot guarantee performance if you run CombiView on any other system.

Operation difficulties may be experienced if CombiView is operated on a PC running in a language environment, such as Swedish and German, where a comma is used as the decimal symbol (e.g., 3,6), instead of a point (e.g., 3.6).

Follow the appropriate procedure below to change the decimal symbol to a point (.).

D-1 Windows XP

1. Open the **Control Panel** from the Windows **Start** menu.
2. Click **Regional and Language Options**.
3. Click **Customize**.
4. Select the point (.) setting from the “Decimal Symbol” drop-down field.

D-2 Windows 7

1. Open the **Control Panel** from the Windows **Start** menu.
2. Click **Region and Language**.
3. Click the **Formats** tab.
4. Click **Additional Settings**.
5. Click the **Numbers** tab.
6. Select the point (.) setting from the “Decimal symbol” drop-down field.

Appendix E —Terminology Glossary

E-1 Terminology Glossary

Table E-1. Terminology Glossary

Term	Meaning
2LE	*Bluetooth* low energy 2 Mbps
BER	Bit Error Rate
Bluetooth LE, BLE	*Bluetooth* low energy
BLR	*Bluetooth* Long Range (also known as *Bluetooth* LE Coded)
BR	Basic Rate (*Bluetooth*)
BT	*Bluetooth* H
DUT	Device Under Test. The equipment being tested by the MT8870A.
EDR	Enhanced Data Rate (*Bluetooth*)
EVM	Error Vector Magnitude
FRR	Frame Repetition Rate
GPIB	General Purpose Interface Bus
IEEE	Institute of Electrical and Electronics Engineers
LE Coded	*Bluetooth* low energy long range achieved by the use of convolutional forward error correction encoding and pattern mapping techniques. Also known as BLR.
MCS	Modulation and Coding Scheme
PPDU	PLCP Protocol Data Unit
VSA	Vector Signal Analyzer
VSG	Vector Signal Generator
WLAN	Wireless Local Area Network

AUSTRALIA ANRITSU PTY. LTD. Unit 21, 21-35 Ricketts Road Mount Waverley Victoria 3168 Australia Telephone: +61-3-9558-8177 Fax: +61-3-9558-8255	**BRAZIL** ANRITSU ELETRONICA LTDA. Praça Amadeu Amaral, 27 - 1 Andar 01327-010-Bela Vista-São Paulo-SP Brazil Telephone: +55-11-3283-2511 Fax: +55-11-3288-6940	**CANADA** ANRITSU ELECTRONICS LTD. 700 Silver Seven Road, Suite 120, Kanata, ON K2V 1C3, Canada Telephone: +1-613-591-2003 Fax: +1-613-591-1006
CHINA ANRITSU SHANGHAI SERVICE CENTER 2F, 8B-2 Section Factory Building, No. 211, Fu Te Rd. (N). China(Shanghai) Pilot Free Trade Zone, Pudong, Shanghai 200131, P.R. China Telephone: +86-21-5868-0228 Fax: +86-10-5868-0558	**DENMARK** ANRITSU A/S Torveporten 2 2500 Valby Denmark Telephone: +45-7211-2200 Fax: +45-7211-2210	**FINLAND** ANRITSU AB Teknobulevardi 3-5 FI-01530 Vantaa Finland Telephone: +358-20-741-8100 Fax: +358-20-741-811
FRANCE Anritsu S.A. 12, Avenue du Québec Bâtiment Ires 1- Silic 612, 91140 VILLEBON SUR YVETTE, France Telephone: +33-1-60-92-15-50 Fax: +33-1-64-46-10-65	**GERMANY** Anritsu GmbH Nemetschek Haus Konrad-Zuse-Platz 1 81829 München Germany Telephone: +49-89-442308-0 Fax : +49-89-442308-55	**HONG KONG** ANRITSU COMPANY LTD. Units 1006-7, 10/F, Greenfield Tower, Concordia Plaza, No. 1 Science Museum Road, Tsim Sha Tsui East, Kowloon, Hong Kong Telephone: +852-2301-4980 Fax: +852-2301-3545
INDIA ANRITSU India Private Limited 2nd & 3rd Floor,#837/1,Binnamangla 1st Stage Indiranagar, 100ft Road, Bengaluru - 560038 India Telephone: +91-80-4058-1300 Fax: +91-80-4058-1301	**ITALY** ANRITSU Sp.A Via Paracelso 4 CD Colleoni Agrate Brianza, 20041 Milano Italy Telephone: +39-39-657021 Fax: +39-39-6056396	**JAPAN** Anritsu Corporation 5-1-1 Onna, Atsugi-shi, Kanagawa 243-8555 Japan Telephone: +81-46-223-1111 Fax: +81-46-296-1264
KOREA ANRITSU CORPORATION LTD. 5FL, 235 Pangyoyeok-ro Bundang-gu, Seongnam-si, Gyeonggi-do, 13494 Korea Telephone: +82-31-696-7750 Fax: +82-31-696-7751	**SINGAPORE** ANRITSU PTE. LTD. 11 Chang Charn Road #04-01, Shriro House Singapore 159640 Telephone: +65-6282-2400 Fax : +65-6282-2533	**SWEDEN** Anritsu AB Kistagången 20B, 164 40 KISTA, Sweden Telephone: +46-8-534-707-00 Fax: +46-8-534-707-30
TAIWAN ANRITSU CO., LTD. 7F, NO.316, Sec.1 NeiHu Rd., Taipei, 114 Taiwan, R.O.C Telephone: +886-2-8751-1816 Fax: +886-2-8751-1817	**UNITED KINGDOM** Anritsu EMEA LTD 200 Capability Green, Luton, Bedfordshire, LU1 3LU U.K. Telephone: +44-1582-433200 Fax: +44-1582-731303	**UNITED STATES** ANRITSU COMPANY 1155 East Collins Blvd., Richardson, TX 75081, U.S.A. Toll Free: 1-800-ANRITSU (267-4878) Telephone: +1-972-644-1777 Fax: +1-972-671-1877