Operation Manual

MT8860B
WLAN Test Set

Anritsu

Operation Manual

MT8860B
WLAN Test Set

The MT8860B is discontinued and has been replaced by the MT8860C.

Sustaining software releases for the MT8860B shall be developed at the discretion of Anritsu

This manual provides details of the operation and functionality of the following software versions:-

MT8860B: 10.0
LANLook: 10.0

/Anritsu

DECLARATION OF CONFORMITY

Manufacturer's Name: Anritsu Limited MMD-E

Manufacturer's Address: Rutherford Close
Stevenage, Hertfordshire
United Kingdom

declares that the prodcut specified below:

Product Name: Wireless LAN Test Set

Model Number: MT8860B

conforms to the requirement of:

EMC: Council Directive 89/336/EEC as amended by the Council Directive 92/31/EEC & 93/68/EEC
LVD: Council Directive 73/23/EEC as amended by the Council Directive 93/68/EEC

Electromagnetic Interference:

Emissions:	EN61326: 1997/A3: 2004	Class A
Immunity:	EN61326: 1997/A3: 2004	
	IEC61000-4-2 (ESD)	Class B
	IEC61000-4-3 (EMF)	Class A
	IEC61000-4-4 (BURST)	Class B
	IEC61000-4-5 (SURGE)	Class B
	IEC61000-4-6 (CRF)	Class A
	IEC61000-4-11 (V dip/short)	Class C
Voltage Harmonice:	EN61000-3-2: 2000	Class A
	EN61000-3-3: 1995 + Amendment 2001	

Electrical Safety Requirement:

LVD EN61010-1:2001 (Pollution Degree 2)

Anritsu Limited 27th September 2006

Nich Orchiston,
Quality Assurance Manager

European Contact For Anritsu product EMC & LVD information, contact Anritsu LTD, Rutherford Close, Stevenage Herts, SG1 2EF UK, (FAX 44-1438-740202)

Materials Declaration for the People's Republic of China

环保使用期限

<table>
<tr><td>⬤40</td><td>这个标记是根据 2006/2/28 公布的「电子信息产品污染控制管理办法」以及 SJ/T 11364-2006「电子信息产品污染控制标识要求」的规定，适用于在中国销售的电子信息产品的环保使用期限。仅限于在遵守该产品的安全规范及使用注意事项的基础上，从生产日起算的该年限内，不会因产品所含有害物质的泄漏或突发性变异，而对环境污染，人身及财产产生深刻地影响。
注）电池的环保使用期限是5年。</td></tr>
</table>

产品中有毒有害物质或元素的名称及含量

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 [Cr(VI)]	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷线路板 (PCA)	×	○	×	×	○	○
机壳、支架 (Chassis)	×	○	×	×	○	○
其他（电缆、风扇、连接器等） (Appended goods)	×	○	×	×	○	○
○：表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求以下。 ×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T11363-2006 标准规定的限量要求。						

Equipment marked with the Crossed-out Wheelie Bin symbol complies with the European Parliament and Council Directive 2002/96/EC (the "WEEE Directive") in the European Union.

For Products placed on the EU market after August 13, 2005, please contact your local Anritsu representative at the end of the product's useful life to arrange disposal in accordance with your initial contract and the local law.

CE Conformity Marking

Anritsu affixes the CE Conformity marking onto its conforming products in accordance with Council Directives of The Council Of The European Communities in order to indicate that these products conform to the EMC and LVD directive of the European Union (EU).

$$C\hspace{-0.5em}\in$$

C-tick Conformity Marking

Anritsu affixes the C-tick marking onto its conforming products in accordance with the electromagnetic compliance regulations of Australia and New Zealand in order to indicate that these products conform to the EMC regulations of Australia and New Zealand.

N274

Notes On Export Management

This product and its manuals may require an Export License or approval by the government of the product country of origin for re-export from your country.

Before you export this product or any of its manuals, please contact Anritsu Company to confirm whether or not these items are export-controlled.

When disposing of export-controlled items, the products and manuals need to be broken or shredded to such a degree that they cannot be unlawfully used for military purposes.

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Company uses the following symbols to indicate safety-related information. For your own safety, please read the information carefully *before* operating the equipment.

Symbols Used in Manuals

Danger	
	This indicates a very dangerous procedure that could result in serious injury or death, or loss related to equipment malfunction, if not performed properly.

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

Caution	
	This indicates a hazardous procedure that could result in 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* operating the equipment. Some or all of the following five symbols may or may not 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.
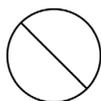
 This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.
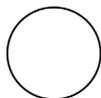
 This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.

 This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.

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

This indicates that the marked part should be recycled.

For Safety

Warning	Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. There is a risk of personal injury if operations are performed without heeding the advice in the operation manual. In addition, the equipment performance may be reduced. Moreover this alert mark is sometimes used with other marks and descriptions indicating other dangers.
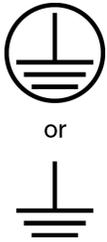
Warning or	When supplying power to this equipment connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Warning WARNING ⚠	This equipment can not be repaired by the operator. Do not attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Caution	Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.
	Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

Index

Chapter 1 — General Information

1-1　About this Manual

This manual provides set-up and operational information for the MT8860B WLAN Test Set.

All procedures detailed in this manual apply equally to the IEEE 802.11b and IEEE 802.11g wireless LAN standards unless otherwise stated.

Comments on this Manual

Every effort has been made to ensure that this manual is thorough, easy to use, and free from errors. However, to ensure continued improvement, we would welcome your comments on this, or any other Anritsu document.

Please contact us at the address below if you have any comments, good or bad, find any errors or omissions, or have any suggestions on how our documentation could be improved further.

wlan.support@anritsu.com

Your comments will be logged and reviewed, and whenever possible, will be reflected in a subsequent release of the document.

Software Versions

This manual provides details of the operation and functionality of the following software versions:

MT8860B:　　10.0

LANLook:　　10.0

Some of the features documented in this manual may not be available to users of software versions prior to those detailed above. Follow the procedure below to check the versions of the software you are using.

　1. Start LANLook by selecting [Programs] > [Anritsu] > [LANLook] from the Windows [Start] menu.

　2. Establish a remote connection (GPIB or Ethernet) with the MT8860B. Refer to chapter 5 for details.

　3. Select [About Anritsu LANLook] from the LANLook [Help] menu. Check the MT8860B and LANLook version numbers that display in the dialog.

Note	A remote connection with the MT8860B is required in order to display the firmware version. The procedure for establishing a remote connection is given in chapter 5.

Note	LANLook is provided free of charge on the product CD shipped with the MT8860B. Refer to chapter 3 of this manual for installation details.

Notification of Software Release

The MT8860B software is periodically updated as new features are added to meet market demands. To receive automatic notification of software releases, send a blank e-mail with the subject heading of "MT8860B Software Notification Request" to wlan.support@anritsu.com. You will receive an e-mail when new software is available to download.

Associated Documentation

In addition to this manual, the following document is also available on the Product CD shipped with the MT8860B Wireless LAN Test Set.

Table 1-1. Associated Documentation

Part number	Document
13000-00202	MT8860B WLAN Test Set Remote Programming Manual

The above document is in pdf format and can be viewed using Adobe Reader™ , a freeware program that can be downloaded from http://www.adobe.com/.

Conventions

The following conventions have been adopted in this manual.

Table 1-2. Notation Conventions

Item	Convention
MT8860B	The official name of the product detailed in this manual is the MT8860B WLAN Test Set. This name may be shortened to MT8860B throughout this manual.
DUT	The term "DUT" is used to refer to the Device Under Test.
802.11	IEEE802.11 may be shortened to 802.11 throughout this manual.
802.11b/g	The term 802.11b/g may be used in this manual where both the 802.11b and 802.11g standards are equally applicable.
PER / FER	The IEEE 802.11b specification uses the term "frame error rate" (FER) whilst the specifications for 802.11g refers to "packet error rate" (PER). For the sake of convenience, the term "packet error rate" or PER is used throughout this manual.
[Anritsu LANLook]	The titles of windows and dialog boxes that appear within LANLook are enclosed in square brackets.
"Ad-Hoc (MT8860B Joins)"	Text that appears in windows or dialog boxes is enclosed in quotation marks when used within a body of text.
"Test Port In/Out"	Text that appears on the MT8860B front or rear panels is enclosed in quotation marks when used within a body of text.
Client software	The term "client software" is used to refer to the software supplied with the WLAN device under test and used to make the mode, connection, and encryption settings for the device.

Table 1-2.   Notation Conventions

Item	Convention
Test mode software	The term "test mode software" is used to refer to the proprietary software required to control the Tx and Rx operation of the WLAN device under test. This software is supplied by the chipset vendor.
>	A chevron (>) may be used to indicate that the user should select the items or keys in sequential order.
DSSS data rates	This refers to data rates of 1, 2, 5.5, and 11 Mbps.
OFDM data rates	This refers to data rates of 6, 9, 12, 18, 24, 36, 48, and 54 Mbps.

1-2   Product Description

The MT8860B is an integrated WLAN test set for testing WLAN devices operating in the Industrial Scientific and Medical (ISM) frequency band. The standard MT8860B is fully compliant with transmitter and receiver testing for 802.11b. Option 13 adds support for 802.11g transmitter and receiver testing. Operation of the MT8860B is controlled from either the software packages supplied with the product (LANLook and LANTest), or from the user's own test program.
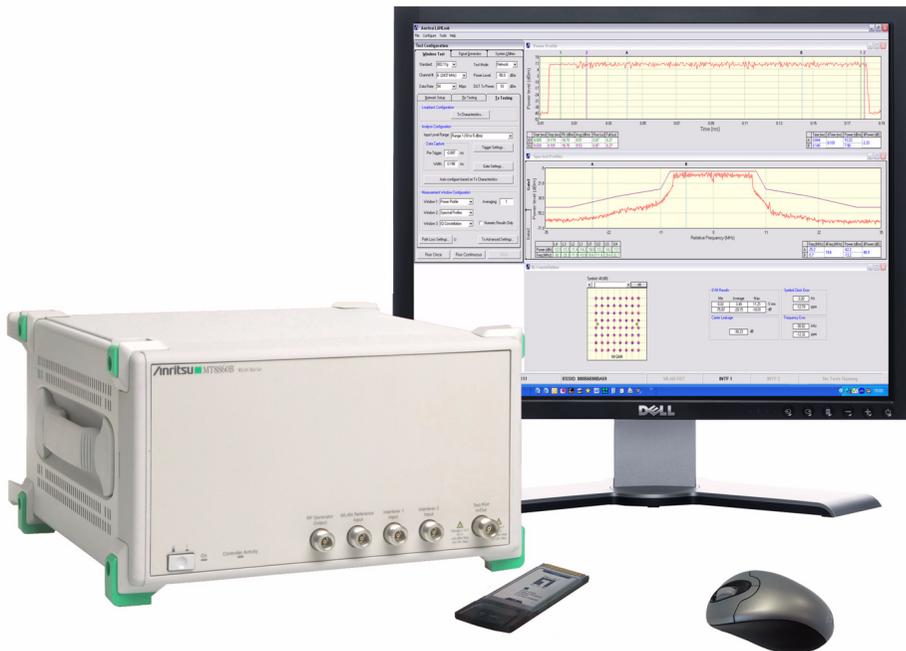
Figure 1-1.   MT8860B with LANLook Software Package

MT8860B Features

- Two test modes: "Network" and "Direct", allow the user to make both Tx and Rx measurements either with or without a WLAN connection with the DUT.
- High-speed transmitter and receiver testing for 802.11b as standard and for 802.11g when ordered with option 13.
- Operation in Network mode supports transmitter and receiver testing without use of DUT control software.
- Integrated reference radio for calibrated packet error rate measurements.
- Automatic assignment of DUT IP address using built-in DHCP server.
- Measurement results output to LANLook for graphical and numerical display.
- Supports EVM measurements with constellation diagrams.
- Inputs for external reference radio and interfering signal source.
- Dedicated WLAN signal generator.
- Supports GPIB and Ethernet remote interfaces.

Options and Accessories

Table 1-3.   Options and Accessories

Number	Item
MT8860C-001 (option 1)	Rack mount kit (CANNOT be ordered with option 2)
MT8860C-002 (option 2)	Front panel handles (CANNOT be ordered with option 1)
MT8860B-013 (option 13)	Software Option – IEEE 802.11g TX/RX measurement suite
MT8860B-098 (option 98)	Standard calibration to ANSI/NCSLI Z540-1 (Certificate of calibration only)
MT8860B-099 (option 99)	Premium calibration to ANSI/NCSLI Z540-1 (Certificate of calibration with test report and uncertainty data included)
2000-1613	Bluetooth / dual band WLAN antenna and adapter
2000-1548-R	N-type termination plug (6 GHz, 50 Ω)
2100-2	GPIB cable, 2m
2000-1371	Ethernet cable
3-806-152	Cat 5E cross-over patch cable
B0329G	Protective cover (CANNOT be ordered with option 1 or option 2)
13000-00201	MT8860B WLAN Test Set Operation Manual
13000-00202	MT8860B WLAN Test Set Remote Programming Manual

Test Methodology Overview

The MT8860B supports two test modes: Network test mode and Direct test mode.

In "Network" test mode, client software is used to control the WLAN device. A network connection between the MT8860B and WLAN device is first established, after which both Tx and Rx testing can be performed.

In "Direct" test mode, the test mode software is used to configure and control the WLAN device for Tx and Rx testing without the need to establish a network connection between the MT8860B and WLAN device.

Technical Overview

The internal structure of the MT8860B is illustrated in the following two figures. The first figure shows the MT8860B with the front panel removed and the four detachable cards visible inside. The second figure is a representation of the interaction and structure of each card.
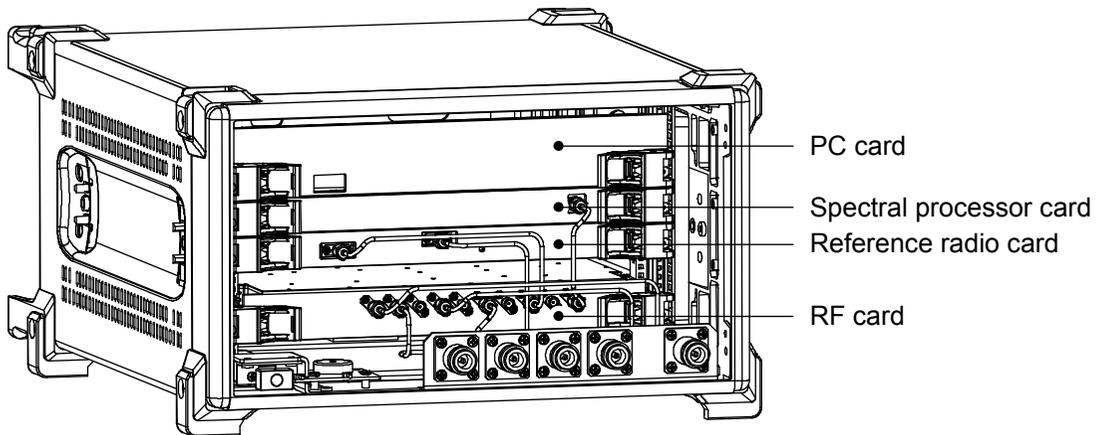
Figure 1-2.   MT8860B Internal Structure
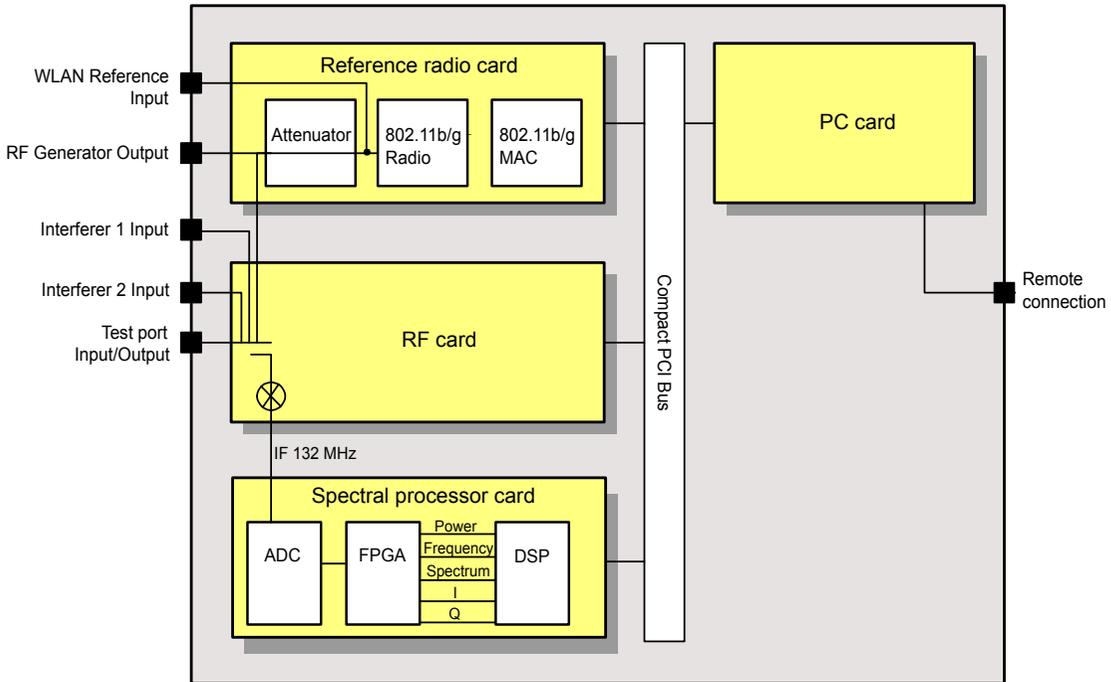
Figure 1-3. MT8860B Internal Cards

Reference Radio Card

The reference radio card houses the following three components.

- Attenuator: The output from the internal 802.11 reference radio passes through the 80 dB attenuator, allowing the user to set the calibrated signal levels at the test port between 0 and -100 dBm.

- 802.11b/g reference radio: The reference radio provides the correct signal characteristics for receiver testing.

- MAC: A WLAN protocol stack enables connection and communication with the DUT using 802.11b/g protocol.

RF Card

The signal from the DUT is fed into the RF/IF card where it is mixed down to an IF of 132 MHz. The RF sample from the attenuator is converted to a suitable IF for AD conversion, and an automatic gain control (AGC) is used to maintain stable input to the ADC and provide a power level signal used in power measurements.

Spectral Processor Card

The spectral processor card serves the following roles.

- Analog to Digital Converter (ADC): The ADC converts the incoming 132 MHz signal to a digital value.

- Field Programmable Gate Array (FPGA): The FPGA runs a Pipelined Fourier Transform (PFT), and calculates the power, frequency, spectral content, I, and Q values.

- Digital Signal Processor (DSP): The DSP processes the data from the FPGA to calculate average or peak power and to perform other measurement processing. The output data is then made available to the PC card.

CPU Card

The CPU card controls all the management functions of the MT8860B. It interprets the commands received over the external interface bus, and formats data for transmission over the bus to LANLook or to the alternative software in use.

What is LANLook?

LANLook is a PC based software package used to control the MT8860B during testing and graphically display the measurement results. LANLook is supplied as standard with each MT8860B ordered and communicates with the instrument by means of an Ethernet or GPIB interface. The LANLook source code is also supplied and users may alternatively wish to use this as a base from which to develop their own program to exactly match requirements.

Note	It should be noted that all data processing and measurement is performed by the MT8860B. LANLook is simply a tool to configure the test conditions and then read back the measurement results for display.
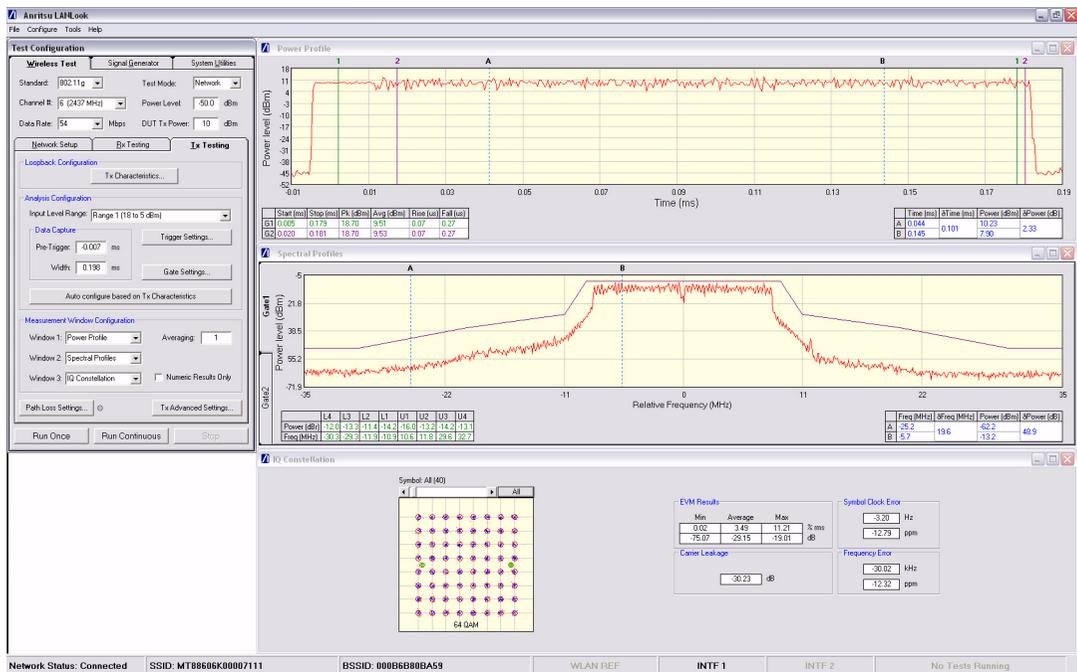
Figure 1-4. LANLook Window Showing Tx Measurement Traces

LANLook Features

- Perform transmitter and receiver testing with or without a WLAN connection with the DUT.
- Perform testing without the need for user input of remote command strings.
- Configure the MT8860B for testing in an infrastructure or Ad-Hoc connection.
- Monitor measurement results numerically and graphically.
- Run in either Windows XP or Windows Vista (32 bit) environment.
- Save traces as image or data files.
- LANLook and the LANLook source code supplied free of charge with each MT8860B.
- WLAN signal generator functionality.

Chapter 2 — Preparation for Use

2-1　Operating Environment

The MT8860B is designed to function within the temperature range of 5°C to 40°C with a humidity level of <75%, non-condensing.

2-2　Power Requirements

The MT8860B is operated from an AC line power. The MT8860B is intended as an Installation (Overvoltage) Category II, Insulation Category I device.

AC Line Power

The MT8860B operates on AC input power of 85-264V, 47-63 Hz, 100 VA maximum. The MT8860B automatically configures itself for the voltage applied.

Fuses

The MT8860B AC input line is protected by an externally accessible fuse. This fuse should be replaced only by qualified service personnel, and only with a fuse of the same type and rating (2A, 250V, slow blow).

Grounding

The MT8860B must be properly grounded. Failure to ground the instrument could be hazardous to operating personnel. The instrument is properly grounded during AC line operation when the plug is connected to a properly installed three-prong receptacle.

2-3　Unpacking the Product

1. Inspect the shipping container for signs of damage. If the container is damaged, or if the cushioning material shows signs of stress, notify the carrier and your Anritsu Customer Service Center. Retain the shipping materials for inspection.

2. Check the contents of the shipment against the list of shipped items (detailed on the following page). Notify your local sales representative or Anritsu Customer Service Center if anything appears to be missing or damaged. Retain all damaged items for inspection.

3. Check the instrument for mechanical and electrical operation. If the MT8860B is damaged mechanically, notify your local sales representative or Anritsu Customer Service Center.

Package Contents

Your MT8860B is shipped with the following items. Check that all listed items are present, and contact Anritsu if they cannot be found.

Table 2-1.   Package Contents

Item	Part number	Quantity
MT8860B		1
Power cable	For US: 800-427 For UK: 800-428 For EU 800-429 For Japan: 1-3566913	1
Operation manual (hardcopy)	13000-00201	1
Remote Programming manual (hardcopy)	13000-00202	1
Product CD containing :-		1
LANLook software	62157	1
Source code for LANLook		1
LANTest Production test software	66910	1
LANTest Operation Manual (pdf)	13000-00260	1
Source code for LANTest		1
Operation manual (pdf)	13000-00201	1
Remote programming manual (pdf)	13000-00202	1

Note	The LabView and LabWindows instrument drivers are available for free download from the National Instruments website at the following link. http://sine.ni.com/apps/utf8/niid_web_display.model_page?p_model_id=9940

2-4   Preparing for Storage

1. Clean the MT8860B prior to storage and pack it using moisture-absorbing desiccant crystals.

2. Store the unit in a temperature controlled environment maintained at between -20°C and 70°C, with a maximum humidity of <75% at 40°C, non-condensing.

2-5   Preparing for Shipment

1. Wrap the MT8860B to protect the finish.

2. Position the MT8860B in the original shipping container.

Note	If the original shipping container is no longer available, use a strong corrugated cardboard container that is at least 15 cm larger than the MT8860B.

3. Insert cushioning material between the MT8860B and the container. Pack the cushioning material tightly.

4. Seal the container carefully; use shipping tape or an industrial stapler.

5. Return the container to the appropriate Anritsu service center. The address of your local service centre can be found at http://www.anritsu.com/Contact.asp.

Chapter 3 — LANLook Installation

3-1   Required Operating Environment

The following environment is required to install and run LANLook successfully.

- Intel-based PC with Pentium processor or equivalent.
- Microsoft Windows XP or Windows Vista (32 bit) operating system.
- English, Chinese, or Japanese language environment.
- CD-ROM drive (if installing LANLook from the supplied CD).
- 16 MB RAM minimum.
- PC display settings of 1024 x 768 or greater.
- For GPIB remote interface:
    - National Instruments GPIB interface card (recommended) or GPIB card that is VISA compatible or has NI-488.2 support. (Refer to Appendix B in the Remote Programming Manual for details of the GPIB controller configuration.)
- For Ethernet remote interface:
    - Typically there are four ways in which the MT8860B can be connected to a LAN. Refer to Appendix G for details.

3-2   Installation Procedure

Note	If using a GPIB remote interface, the GPIB card and drivers must be installed on the PC before installing LANLook.
	Previously installed versions of LANLook should be uninstalled before following the procedure below.

1. Insert the Product CD into the drive on the PC. The [MT8860B Applications and Manuals] window displays automatically.
2. Click "LANLook 10.0" in the menu on the left of the window and select "Installation" from the pop-up menu.

3. The "Licence Agreement" dialog displays. Read the agreement and if you agree to the terms select "I agree" and click [Next>].

Figure 3-1. Licence Agreement

4. A dialog displays to specify the folder for installation. By default, LANLook is installed to C:\Program Files\LANLook. Click [Next>] to install to the specified directory, or click [Browse…] to specify a different location for the installation.

Figure 3-2. Install Location

5. Click [Next>] at the "Confirm Installation" dialog to start the installation.
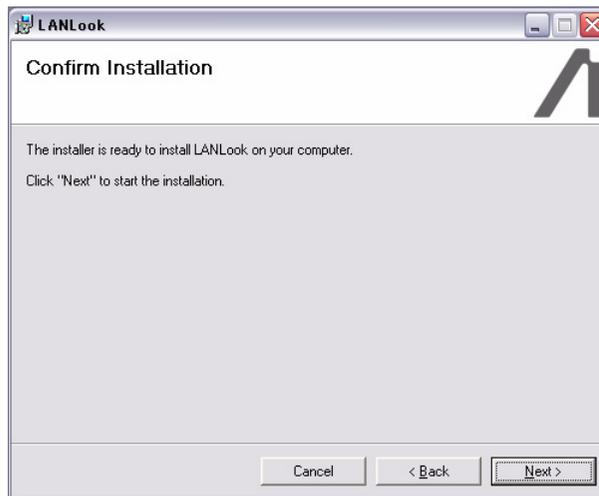
Figure 3-3.   Confirm Installation

6. The progress of the installation is shown in the dialog below.
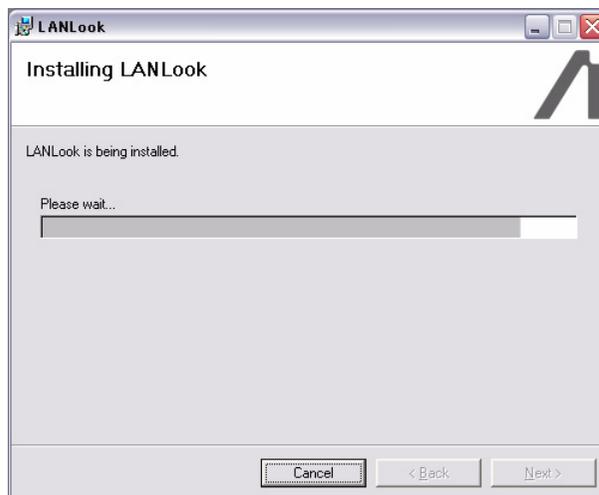
Figure 3-4.   Installing LANLook

7. The dialog shown below displays when the installation is complete.
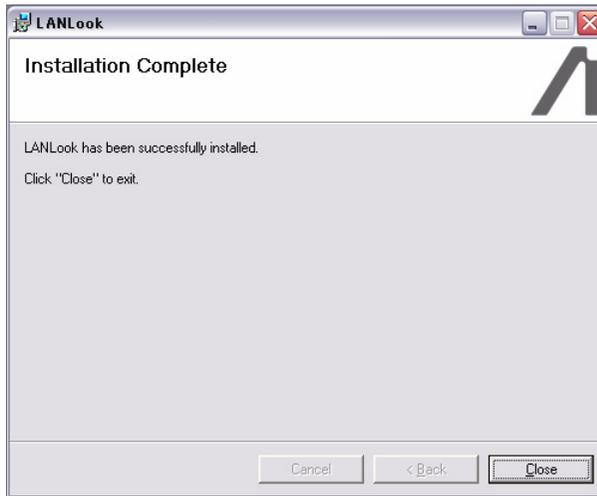
Figure 3-5.   Installation Complete

Note	A message may display during the installation to ask whether the user wishes to overwrite certain .ocx or .dll files. Users are advised not to overwrite any such files.

Chapter 4 — Instrument Overview

4-1   Configuring the MT8860B and the DUT

Follow the steps below to configure the MT8860B for use.

1. Insert the power cable to the rear of the MT8860B (connector L in the Rear Panel figure on p4-3) and attach to the mains power supply.

2. Connect the remote interface cable from the rear of the MT8860B to the PC.

- If using GPIB, connect the GPIB cable from the connector on the MT8860B's rear panel (connector A in the figure on p4-3) to the GPIB interface on the PC.

- If using Ethernet, refer to Appendix G for connection details.

3. Connect an RF cable from the test port on the front of the MT8860B (connector C in the MT8860B Front Panel figure on p4-2) to the DUT.

Note	An antenna option (2000-1613) is also available as an alternative to an RF cable.

4. Install the DUT client software on the PC and configure the channel and operating mode settings in line with the testing requirements.

5. Connect the DUT to the PC using the appropriate interface.

6. Press the power button on the front of the MT8860B. The MT8860B emits a beeping sound to indicate that the internal PC has not located a mouse or keyboard.

7. It takes approximately two minutes for the PC within the MT8860B to boot up. During this time the status of the unit is indicated by the "On" and "Controller Activity" LEDs.

a. When the unit is first turned on, both the "On" and "Controller Activity" LEDs are lit.

b. After approximately two minutes, the "ON" LED starts to flash with the "Controller Activity" LED still lit.

c. The "On" LED stops flashing and turns fully on, and the "Controller Activity" LED turns off.

8. Start LANLook by clicking the desktop icon, or by accessing the Windows programs directory and selecting [Anritsu] > [LANLook].

4-2   Front Panel Layout
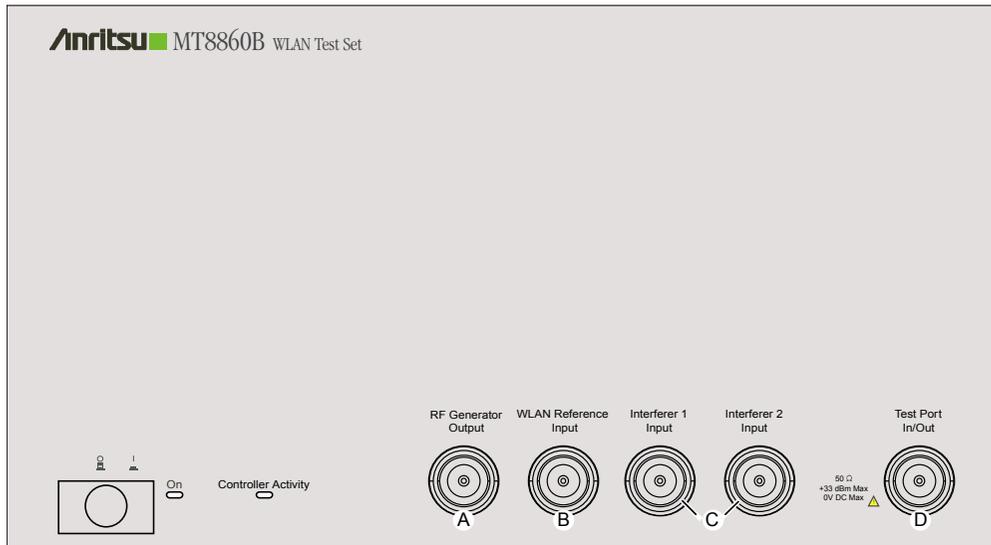
Figure 4-1.   MT8860B Front Panel

A	RF Generator Output	Reserved
B	WLAN Reference Input	Used for input of an external reference radio.
C	Interferer 1 Input Interferer 2 Input	Used for input of an interference signal when performing adjacent channel measurements.
D	Test Port Input / Output	Used for connection of the DUT and during use of signal generator mode.

4-3   Rear Panel Layout
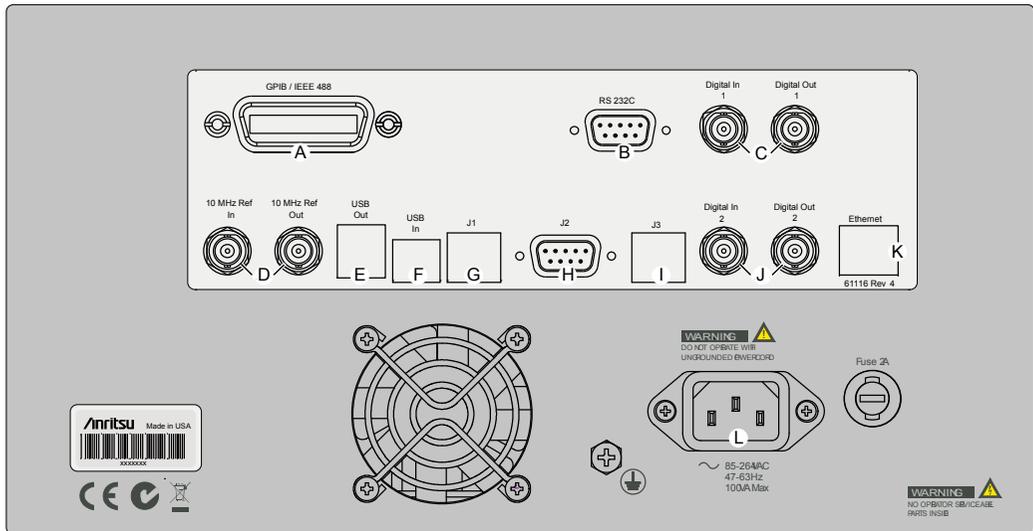
Figure 4-2.   MT8860B Rear Panel

A	GPIB / IEEE488 connector	Standard General Purpose Interface Bus connector used to connect through GPIB to other test equipment and to a host computer. The MT8860B is compatible with IEEE488.1 and IEEE488.2 requirements.
B	RS232 serial connector	For use in future applications.
C	Digital In / Out 1	Definable digital input and output.
D	10 MHz Ref In / Out	Used for input / output of the external 10 MHz reference signal.
E	USB Out	For use in future applications.
F	USB In	For use in future applications.
G	J1	For use in future applications.
H	J2	For use in future applications.
I	J3	For use in future applications.
J	Digital In / Out 2	Definable digital input and output.
K	Ethernet	Ethernet connector for remote operation.
L	AC main power input	85-264 VAC, 47- 63 Hz, 100 VA maximum. The MT8860B automatically configures itself for the voltage applied. Once connected to the main power the instrument can be switched on using the switch on the front panel.

Chapter 5 — Remote Operation and Wireless Setup

Note	For demonstration purposes LANLook can be run in "Simulation mode" without establishing a remote connection. Simulation mode is activated by default when LANLook is started. A message displays in the LANLook status bar when LANLook is running in simulation mode.

5-1   Establishing a Remote Connection

GPIB and Ethernet interfaces are available for use in establishing a remote connection.

Remote Operation using the GPIB Interface

1. Check that the MT8860B has finished booting up and that the GPIB cable for remote operation is in place between the PC and the MT8860B.

2. Start LANLook and click [System Utilities] tab > [MT8860x Remote] tab.

3. Select "GPIB" at the "Remote Interface" setting as shown in the figure below.
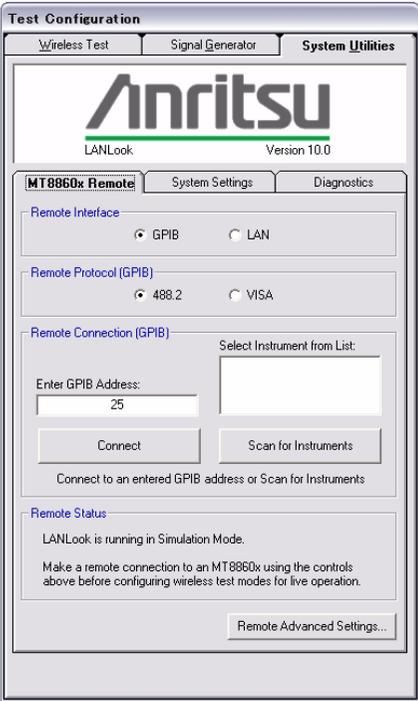
Figure 5-1.   [System Utilities] Tab for GPIB

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4. Select the "Remote Protocol".

    488.2:   Select if using a National Instruments GPIB card.

    VISA: Select "VISA" (Virtual Instrument Software Architecture) to enable use of a non National Instruments GPIB card. Ensure that VISA support has been enabled for the card in use.

5. Click [Scan for Instruments] to acquire a serial number and GPIB address for each of the instruments found on the bus.

6. Select the required unit from the list and click [Connect].

7. A connection is established. Check that the connection status reads, "Connection Established".

8. Information relating to the GPIB hardware in use can be displayed by clicking [Remote Advanced Settings...] to open the dialog below.

Figure 5-2.   [Remote Advanced Settings] Dialog

Timing: Users of certain non 488.2 GPIB cards may find that operational difficulties are experienced if the card in question is unable to attain the required operation speed. This can be averted by setting a forced delay in GPIB communication. Select the "Insert delay in GPIB communication" check box and specify the required delay in the entry box below.

488.2 / VISA Info /   Information about the installed 488.2, VISA driver, and VISA COM
VISA COM Info   displays in the appropriate area.

Remote Operation using the Ethernet Interface

1. Check that the MT8860B has finished booting up and that the Ethernet cable for remote operation is in place between the PC or hub and the MT8860B.

	If connecting via a hub or switch, connect a standard Ethernet patch cable from the PC to the hub.
Note	If connecting directly to the MT8860B, connect a cross-over patch cable from the PC to the port on the rear of the MT8860B.
	Refer to Appendix G for details on setting up the LAN interface.

2. Start LANLook and click [System Utilities] tab > [MT8860x Remote] tab.

3. Select "LAN" at the "Remote Interface" setting as shown in the figure below
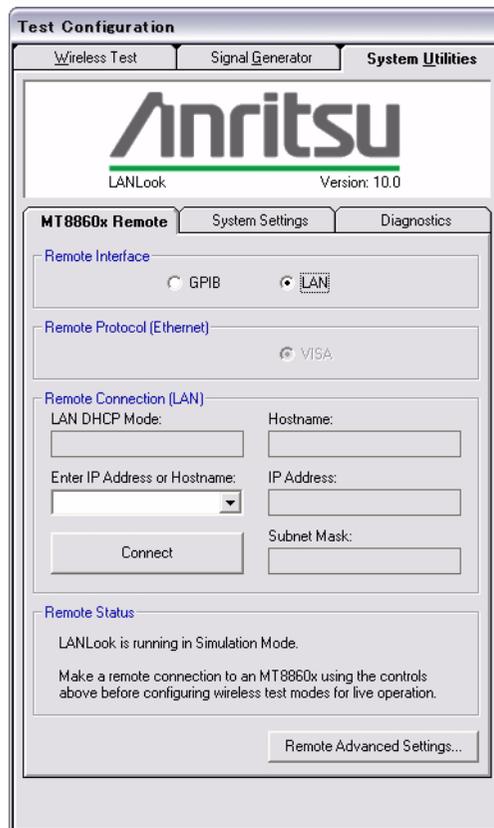
Figure 5-3.　　[System Utilities] Tab for LAN

	Refer to chapter 12 for information on changing the remote LAN configuration.
Note	Refer to the fault finding section in Appendix G if difficulties are experienced establishing a remote connection.

4. Enter the IP address or hostname in the text box and click [Connect].

5. A connection is established and the "Hostname", "IP Address", and "Subnet Mask" fields are populated. Check that the connection status reads, "Connection Established".

6. Information relating to the GPIB hardware in use can be displayed by clicking [Remote Advanced Settings...] to open the dialog below.

Remote Advanced Settings

Timing

☐ Insert delay in GPIB communication:

Delay: [20] ms.

488.2 Info

Company: National Instruments Corporation

gpib-32.dll. version 02.02.00.3210

VISA Info

Company: National Instruments

visa32.dll. version 4.0.0f0

VISA COM Info

Company: VXIplug&play Systems Alliance

GlobMgr.dll. version: 3.0.1 (Build 1)

OK

Figure 5-4.   [Remote Advanced Settings] Dialog

Timing: Applicable to GPIB communication only.

488.2 / VISA Info /   Information about the installed 488.2, VISA driver, and VISA COM
VISA COM Info   displays in the appropriate area.

5-2   Configuring the Wireless Setup

With a remote connection established as detailed above, the wireless setup must now be configured.

1. Click the [Wireless Test] tab.

2. The wireless settings display at the top of this tab as shown in the figure below.
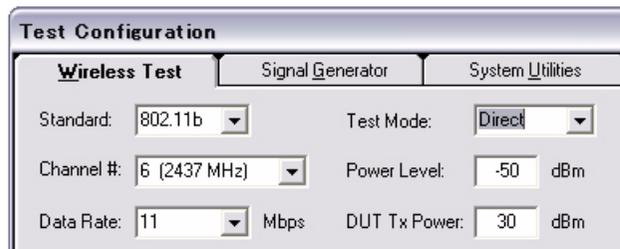
Figure 5-5.   Wireless Setup

3. At "Standard" select the IEEE standard to be used during testing.

4. At "Channel #" select the WLAN channel on which measurements will be performed. The channels for each of the WLAN standards are shown in the table on the following page.

5. At "Data Rate" select the data rate at which measurements will be performed. The rate can be selected freely from those available but is set by default to the highest rate available in the currently selected IEEE standard (11 Mbps for 802.11b and 54 Mbps for 802.11g).

6. At "Test Mode" select either "Network" or "Direct".

   Selecting "Network" allows the user to perform both Tx and Rx testing after first establishing a WLAN connection with the DUT. Refer to chapters 6 to 8 for full details of how to establish a connection and perform testing in Network mode.

   Selecting "Direct" allows the user to perform both Tx and Rx testing without the need to establish a WLAN connection with the DUT. Refer to chapters 9 and 10 for full details of how to perform testing in Direct mode.

7. At "Power Level" specify the "Power Level" that is transmitted by the MT8860B. The value should represent the signal level required at the antenna / RF connector of the DUT.

8. At "DUT Tx Power" specify the power that the DUT is expected to transmit. The value should represent the signal level at the antenna / RF connector of the DUT.

The table below shows the supported channels and data rates for each of the IEEE standards.

Table 5-1.   IEEE Channels, Frequencies, and Data Rates

IEEE Standard	Supported channels				Supported data rates (Mbps)
	Channel	Frequency (MHz)	Channel	Frequency (MHz)	
802.11b	1	2412	8	2447	1, 2, 5.5, 11
	2	2417	9	2452	
	3	2422	10	2457	
	4	2427	11	2462	
	5	2432	12	2467	
	6	2437	13	2472	
	7	2442	14	2484	
802.11g	1	2412	8	2447	1, 2, 5.5, 11,
	2	2417	9	2452	6, 9, 12, 18, 24, 36,
	3	2422	10	2457	48, 54
	4	2427	11	2462	
	5	2432	12	2467	
	6	2437	13	2472	
	7	2442			

Chapter 6 — Establishing a WLAN Connection

6-1 WLAN Architectures

The IEEE802.11 specification identifies two kinds of WLAN architectures, "Ad-Hoc" and "infrastructure".

Ad-Hoc Network Architecture

In an Ad-Hoc network, the WLAN enabled devices form an on-the-fly network with no fixed access points and with every node in the network able to communicate freely with any of the other nodes. This sort of Ad-Hoc network is typical of that established during a meeting of employees passing data between laptops.
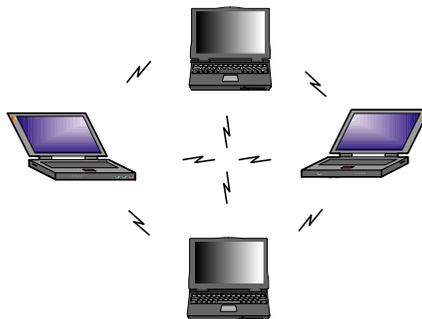
Figure 6-1.   Ad-Hoc WLAN Architecture

Infrastructure Network Architecture

Infrastructure networks can be split into the following two distinct types.

Type 1: Basic Service Set (BSS)

As shown in the figure below, this architecture uses a dedicated bridge, known as an access point, to enable the mobile units to communicate freely with devices on a conventional wired network. This type of architecture is now increasingly common in the home or small office environment.
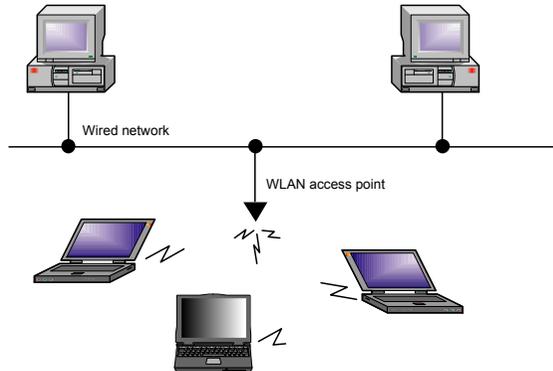
Figure 6-2.   BSS Infrastructure WLAN Architecture

Type 2: Extended Basic Service Set (EBSS)

A configuration with a number of BSSs connected to a common wired network backbone is referred to as an Extended Basic Service Set. This may be common in a large company where multiple access points are utilized to create a powerful multiple-cell configuration covering a considerable area.
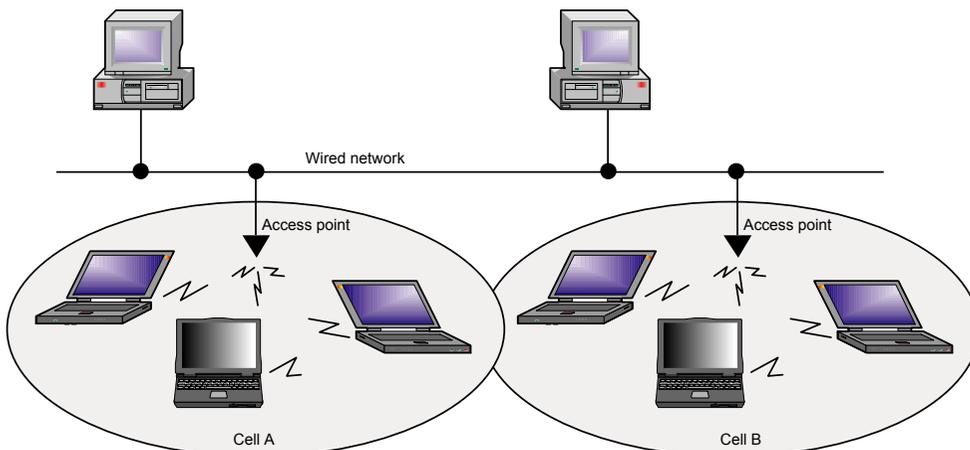
Figure 6-3.   EBSS Infrastructure WLAN Architecture

6-2   Establishing a WLAN Connection with the DUT

As detailed in the previous chapter, a WLAN connection with the DUT is required only when the user has selected "Network" at the LANLook "Test Mode" setting.

Note	To perform testing without establishing a WLAN connection, select "Direct" at the "Test Mode" setting and refer to the explanations in chapters 9 and 10 of this manual.

In Network mode there are four MT8860B role settings available: two in which a network is created by the MT8860B ('Ad-Hoc (MT8860B creates)' and 'Infrastructure (AP)'), and two in which the MT8860B joins a network already in existence ('Ad-Hoc (MT8860B joins)' and 'Infrastructure (STA)').

Figure 6-4.   MT8860B Role Settings

Note	Users should note that not all 802.11g wireless devices support use of Ad-Hoc mode. When testing 802.11g devices Anritsu recommend setting the MT8860B role to one of the infrastructure settings shown on the right in the figure above.

Ad-Hoc (MT8860B creates) / Infrastructure (AP)
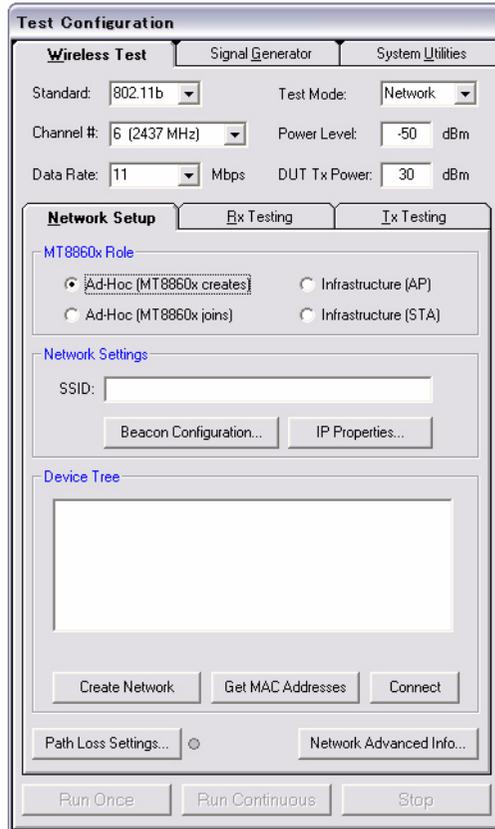
Figure 6-5.   [Network Setup] Tab

In these modes the MT8860B creates a new WLAN network for the device to join. The
difference between the modes lies in the nature of the WLAN architecture. In the "Ad-Hoc
(MT8860B creates)" connection there are no access points, in the "Infrastructure (AP)"
connection the MT8860B takes on the role of an access point.

   1. Click the [Wireless Test] tab and [Network Setup] sub-tab. Select either "Ad-Hoc
   (MT8860B creates)" or "Infrastructure (AP)" as required.

   2. At the "SSID" field, enter a Service Set Identifier for the network to be established . The
   SSID must be a sequence of no more than 32 letter or numbers. It represents the name
   of the network to be created and is broadcast to all devices within range.

3. Click [Beacon Configuration...] to display the dialog shown below. Make the required settings as detailed in the table below and click [OK] when complete.
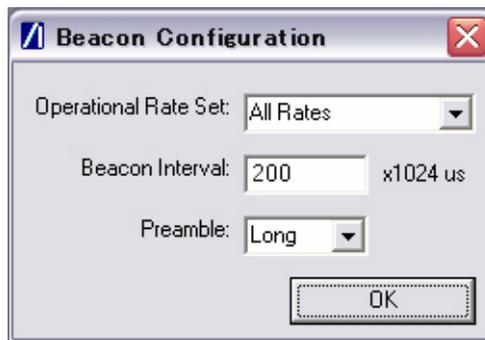
Figure 6-6.   [Beacon Configuration] Dialog

Operational Rate Set:	This setting is used to select the data rates that the MT8860B is capable of supporting. The three selections (defined below) allow the user to control the data rate table in the beacon management frames. This is particularly useful during transmitter testing in network mode to ensure that data is returned from the DUT at the same rate at which it was sent. By default the DUT will always transmit at the fastest rate in the All Rates table selection. Single Rate selection is recommended if the DUT needs to be tested at rates other than the fastest rate, but the user may need to check whether this or the Multiple Rates setting works best with the DUT.
	All Rates: All supported rates are included in the beacon.
	Multiple Rates: All rates up to and including the desired data rate are included in the beacon.
	Single Rate: Only the desired rate is included in the beacon.
Beacon interval:	The beacon interval is the amount of time between beacon frame transmissions. The range is 20 to 1000 time units, where one time unit is 1024 microseconds. If the beacon interval is changed the user must press the enter key on the keyboard to enable the new value.
Preamble:	For data rates of 2, 5.5 and 11 Mbps, long and short preamble options are available. The long setting represents a preamble with 144 bits, and the short with 72. A short preamble setting equates to more payload data being transmitted with each packet for a given timeslot. For 1 Mbps a long preamble is used.

Note	Preamble settings are not applicable for OFDM data rates.

4. Click [IP Properties...] to display the dialog shown below. Make the required settings as detailed in the table below and click [OK] when complete.
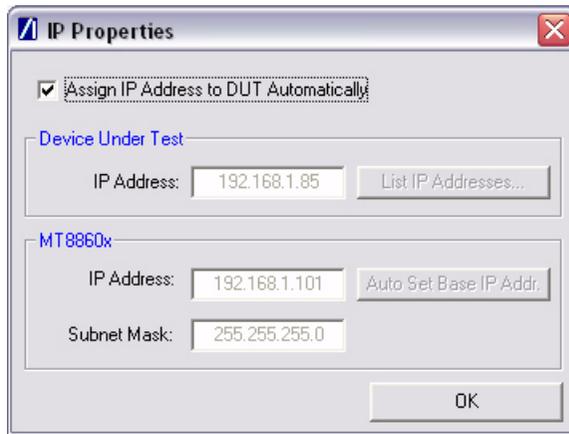
Figure 6-7.   [IP Properties] Dialog

Assign IP Address to DUT Automatically:	When selected the MT8860B automatically assigns an IP address to the DUT. The assignment process is initiated by the DUT and occurs when a network is established. If the DUT is on a static IP address, the IP properties can be configured manually by clearing this check box. The subnet mask and IP addresses for the MT8860B and DUT can then be entered.
IP Address: (Device Under Test)	Enter the IP address of the DUT. If the address is not known or not currently correct, click [List IP Addresses…] and select the IP address from the list of network devices detected. (Use of [List IP Addresses…] is only possible if the DUT is connected to the same PC as that running LANLook.)
IP Address: (MT8860B)	Specify the IP address of the MT8860B. Ensure that the first three sections of the IP address are the same as those of the DUT IP address (e.g., 192.168.168). If this is not the case, click [Auto Set Base IP Addr.] to reset the address after correctly entering the DUT IP address.
Subnet Mask:	Enter or confirm the subnet mask. The subnet mask is used to determine where the network number in the IP address ends and where the node number begins.

5. If required, a signal level correction table can be used to compensate for test system and cable loss effects. Refer to chapter 12 for details.

6. Press [Create Network] to display the specified SSID address within the "Device Tree" field.

7. Confirm that the "DUT Tx Power" is correct for the DUT output power.

8. Use the client software supplied with the DUT to locate and join the network created.

9. When the DUT has joined the network, select the SSID name within the "Device Tree" and click [Get MAC Addresses] to display the MAC address.
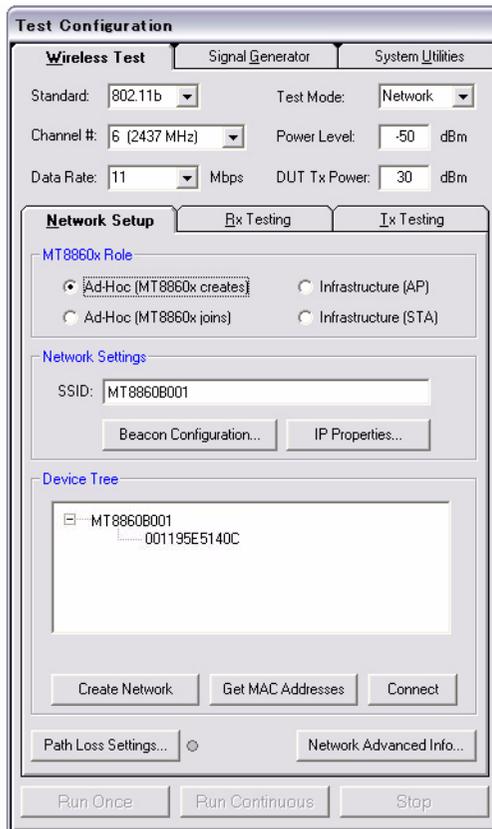
Figure 6-8.   [Network Setup] Tab with MAC Address in Device Tree

10. Select the MAC address and click [Connect] to establish the connection. When a connection is established the word "Connected" appears in the task bar at the bottom of the [Anritsu LANLook] window. The SSID and BSSID also display in the task bar.

Note	If "Assign IP Address to DUT Automatically" is selected in the [IP Properties] dialog, an additional progress indicator dialog displays.

Figure 6-9.   Task Bar

Note	The BSSID shown at the right of the task bar above is an address that uniquely identifies each Basic Service Set (BSS). For infrastructure networks, the BSSID is the MAC address of the access point (AP). For Ad-Hoc networks, the BSSID is generated randomly by the station (STA) that creates the network.

Ad-Hoc (MT8860B joins) / Infrastructure (STA)
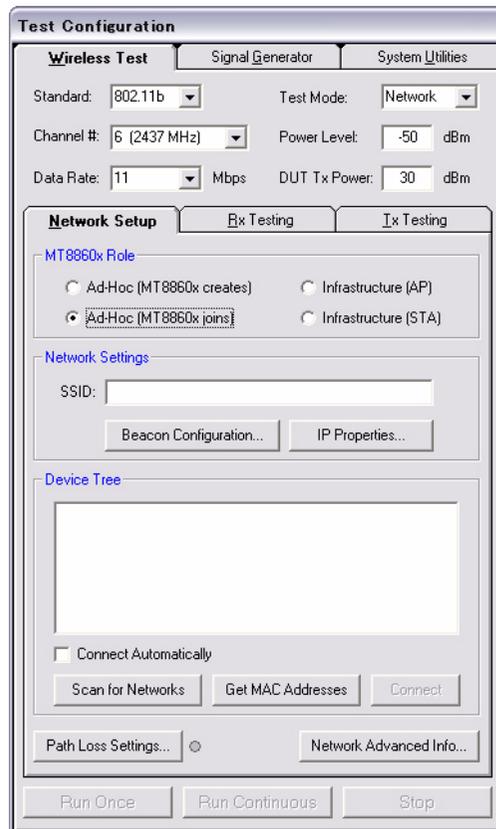
Figure 6-10. [Network Setup] Tab

In these modes the MT8860B joins a network created by the DUT. The difference between the modes lies in the nature of the WLAN architecture. In the Ad-Hoc connection there are no access points, in the infrastructure connection the DUT becomes the access point and the MT8860B takes on the role of one of the stations (STA) within the network.

1. Click the [Wireless Test] tab and the [Network Test] sub-tab. Select either "Ad-Hoc (MT8860B joins)" or "Infrastructure (STA)".

2. Click [Beacon Configuration...] to display the dialog shown below. Make the required settings as detailed in the table below and click [OK] when complete.
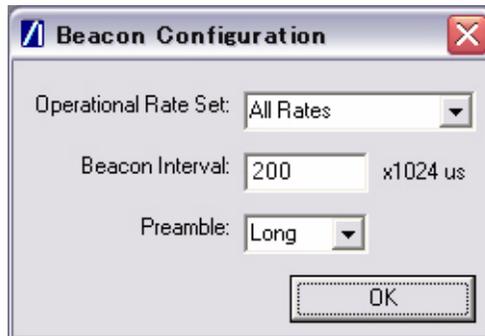
Figure 6-11. [Beacon Configuration] Dialog

Operational Rate Set:	This setting is used to select the data rates that the MT8860B is capable of supporting. The three selections (defined below) allow the user to control the data rate table in the beacon management frames. This is particularly useful during transmitter testing in network mode to ensure that data is returned from the DUT at the same rate at which it was sent. By default the DUT will always transmit at the fastest rate in the All Rates table selection. Single Rate selection is recommended if the DUT needs to be tested at rates other than the fastest rate, but the user may need to check whether this or the Multiple Rates setting works best with the DUT.	
	All Rates:	All supported rates are included in the beacon.
	Multiple Rates:	All rates up to and including the specified data rate are included in the beacon.
	Single Rate:	Only the desired rate is included in the beacon.
Beacon interval:	The beacon interval is not applicable when "Ad-Hoc (MT8860B joins)" or "Infrastructure (STA)" is selected.	
Preamble:	For data rates of 2, 5.5 and 11 Mbps, long and short preamble options are available. The long setting represents a preamble with 144 bits, and the short with 72. A short preamble setting equates to more payload data being transmitted with each packet for a given timeslot.	

Note	Preamble settings are not applicable for OFDM data rates.

3. Click [IP Properties...] to display the dialog shown below. Make the required settings as detailed in the table below and click [OK] when complete.
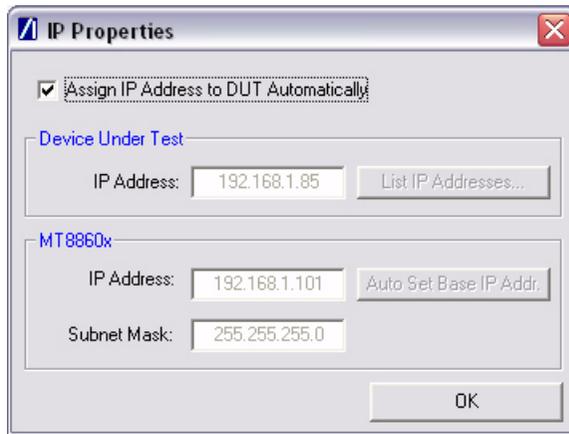
Figure 6-12. [IP Properties] Tab

Assign IP Address to DUT Automatically:	When selected the MT8860B automatically assigns an IP address to the DUT. The assignment process is initiated by the DUT and occurs when a network is established. If the DUT is on a static IP address, the IP properties can be configured manually by clearing this check box. The subnet mask and IP addresses for the MT8860B and DUT can then be entered.
Note	When the MT8860x Role is configured to Infrastructure (STA), the IP Properties should be configured manually.
IP Address: (Device Under Test)	Enter the IP address of the DUT. If the address is not known or not currently correct, click [List IP Addresses…] and select the IP address from the list of network devices detected. (Use of [List IP Addresses…] is only possible if the DUT is connected to the same PC as that running LANLook.)
IP Address: (MT8860B)	Specify the IP address of the MT8860B. Ensure that the first three sections of the IP address are the same as those of the DUT IP address (e.g., 192.168.168). If this is not the case, click [Auto Set Base IP Addr.] to reset the address after correctly entering the DUT IP address.
Subnet Mask:	Enter or confirm the subnet mask. The subnet mask is used to determine where the network number in the IP address ends and where the node number begins.

4. Use the client software supplied with the DUT to establish a network at the required transmission rate and on the required channel. The SSID of the network is also specified in the client mode software.

5. Join the network established above using either of the methods detailed below.

- Select the "Connect Automatically" check box. The MT8860B scans for networks and connects to the first MAC address of the first network that responds. The [Scan for Networks] and [Get MAC Address] buttons are grayed out when "Connect Automatically" is selected.

- Click [Scan for Networks] to display a list in the "Device Tree" of all addresses found. Select the required network address and click [Get MAC Addresses]. Double click the MAC address, or select it and click [Connect].

6. When a connection is established the word "Connected" appears in the task bar at the bottom of the [Anritsu LANLook] window. The SSID and BSSID also display in the task bar.

Network Status: Connected | SSID: MT8860B001 | BSSID: 000B6B358186

Figure 6-13. Task Bar

Note	If "Assign IP Address to DUT Automatically" is selected in the [IP Properties] dialog, an additional progress indicator dialog displays.

Chapter 7 — Transmitter Testing in Network Mode

7-1 Test Methodology and Settings

In Network mode, the MT8860B uses a "Packet Loopback" technique whereby packets containing a control message are transmitted by the MT8860B to the DUT. The control message instructs the DUT to retransmit the data received. The packets returned by the DUT are then captured by the MT8860B built-in transmitter analyser. The major advantage of this method of testing is that the user is not required to use the chipset vendor's control software to configure the DUT to transmit.
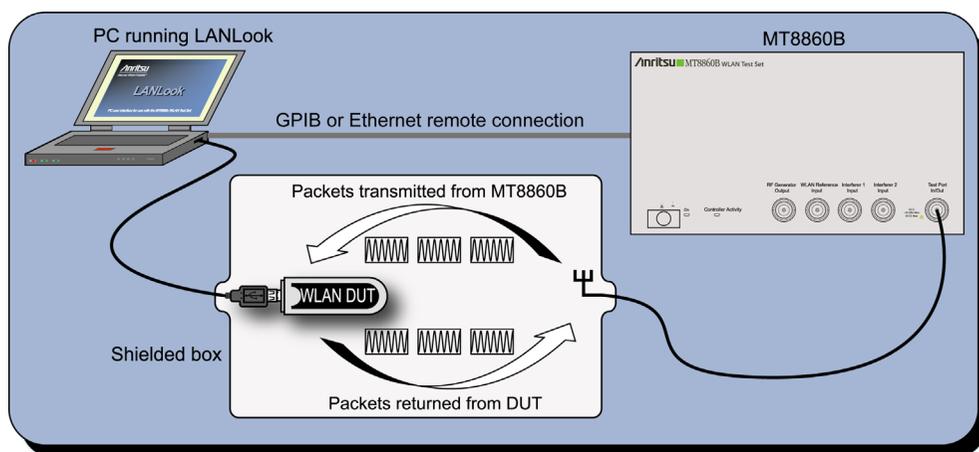
Figure 7-1. Transmitter Testing in Network Mode

    1. Establish a remote connection between the MT8860B and PC as detailed in chapter 5.

Note	A WLAN connection with the DUT is required in order to perform Tx testing in Network mode. Refer to the previous chapter in this manual for a full explanation of how to establish a WLAN connection.

    2. Set the standard, channel, data rate, and power to match the required DUT transmission characteristics. Satisfactory test results will not be achieved if the MT8860B performs measurements on a different channel or at a different data rate to that of the signal being transmitted by the DUT.

3. A WLAN device determines its transmission rate using factors such as link quality, received signal strength (RSSI) and PER. By configuring the operational rate setting of the MT8860B reference radio, the DUT's Tx rate can be locked to the required value. Refer to page 6-8 for further details.

Note	Despite a theoretical maximum data rate of 54 Mbps for 802.11g devices, in reality certain such devices may only support rates of up to 11 Mbps when in an Ad-Hoc connection. This restriction is completely device dependent but to avoid potential problems Anritsu recommends the use of an infrastructure setting when testing 802.11g devices.

4. Click the [Tx Testing] tab shown below.
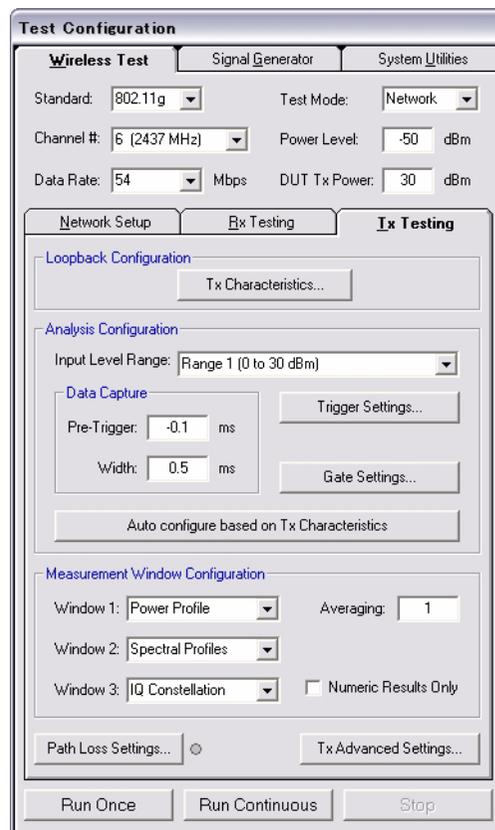
Figure 7-2.   [Tx Testing] Tab

Loopback Configuration

1. Click [Tx Characteristics…] to display the dialog shown below. This dialog is used to specify the expected Tx characteristics of the DUT. The packet structure settings define the data transmitted by the MT8860B which is subsequently looped back from the DUT.
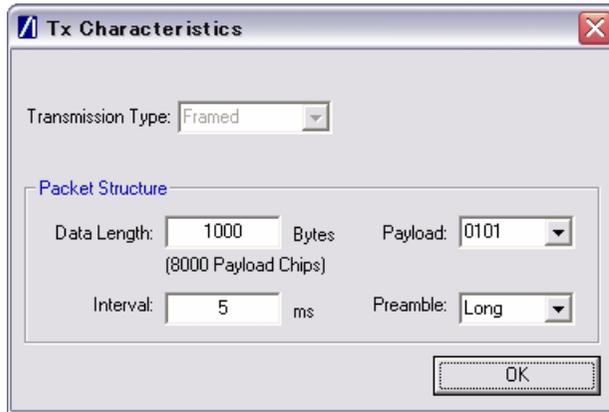
Figure 7-3.   [Tx Characteristics] Dialog

Transmission Type: This function is not applicable in Network Mode. The transmission type will always be framed.

Data Length: The maximum and minimum packet length is dependent upon the data rate as detailed below.

Table 7-1.   Minimum and Maximum Data Length by Data Rate

Data rate	Minimum data length (bytes)	Maximum data length (bytes)
1	60	600
2	60	1250
5.5	80	1500
11	155	1500
6	50	1500
9	75	1500
12	100	1500
18	145	1500
24	195	1500
36	280	1500
48	385	1500
54	435	1500

Note	For DSSS rates, the minimum value equates to 110 us (1210 chips). For OFDM data rates, the minimum value equates to 64 us (16 symbols). The maximum data length values for 1 Mbps and 2 Mbps equate to 5 ms.

Interval: The interval specified represents the time between frames transmitted from the MT8860B reference radio to the DUT.

Payload: Defines the bit sequence pattern of the dummy data in the payload. There are six options available in the drop down list, ZEROS, 0101, 1010, PN7, RANDOM, and COUNT. The required payload is determined by the test that the user wishes to perform.

Preamble: For data rates of 2, 5.5 and 11 Mbps, long and short preamble options are available. The long setting represents a preamble with 144 bits, and the short with 72. A short preamble setting equates to more payload data being transmitted with each packet for a given timeslot. For 1 Mbps a long preamble is used.

Note	Preamble settings are not applicable for OFDM data rates.

Analysis Configuration

1. Configure the MT8860B as required to allow analysis of the data being looped back from the DUT. Settings can be made in two ways:-

Manually: The MT8860B can be configured manually using the "Analysis Configuration" settings.
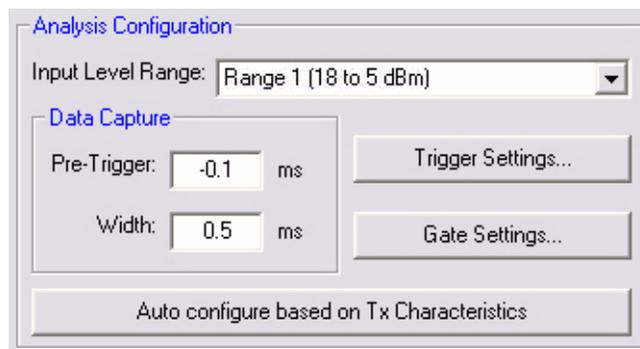
Refer to steps 8 to 11 below.

Automatically: The Tx analyser settings of the MT8860B can be configured automatically by clicking [Auto configure based on Tx Characteristics].

> Auto configure based on Tx Characteristics

When used, all of the settings within "Analysis Configuration" are configured automatically based upon the settings made in the [Tx Characteristics] dialog.

If using the auto configure button jump to step 11 in the procedure below.

2. Select the power level range at "Input Level Range".

Table 7-2.   Input Level Ranges for 802.11b and 802.11g

	Range
Range 1	0 to 30 dBm
Range 2	-20 to 10 dBm
Range 3	-60to -18 dBm
Auto Range Low	-20 to 30 dBm
Auto Range HIgh	-60 to 10 dBm

Note	"Input Level Range" can be set to "Auto Range Low" to prevent damage to the MT8860B input that may be caused when, for example, a sudden power change occurs from range 3 to + 27 dBm. As each MT8860B is uniquely calibrated, the ranges shown above may vary slightly for each instrument.

3. Specify the "Data Capture" settings as detailed below.

Pre-Trigger: Enter a value at the "Pre-Trigger" item as required. The "Pre-trigger" item is used to specify the time in milliseconds for which data is captured prior to the trigger point. Enter a negative value between –5.95 and 0.

Width: Enter the time period after the pre-trigger during which measurement data is captured. Enter a value in milliseconds within the range of 0.01 to 5.95.

4. Click [Trigger Settings…] to display the dialog below.

Figure 7-4.   [Trigger Settings] Dialog

Source: The trigger source item specifies the mechanism used to trigger
               measurement within each incoming packet.

RF: Triggering is enabled at the power level specified at the
               "Level" item.

Note	There are three other "Source" options available but in Network mode, to ensure analysis is correctly performed on the packet, "Source" must be set to "RF".

Edge: Select whether triggering is performed on the rising or falling edge of
               the pulse.

Level: Specify the power level.

5. Click [Gate Settings…] to display the dialog below.
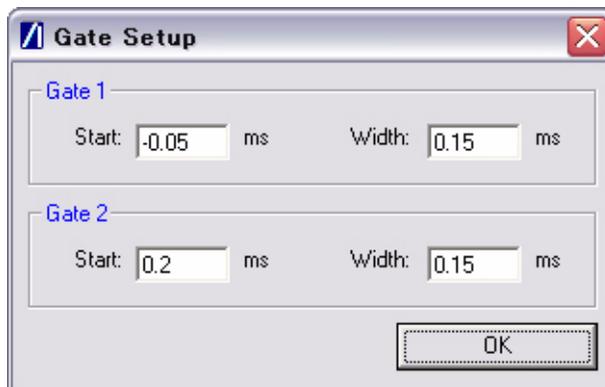
Figure 7-5.   [Gate Setup] Dialog

The position of the measurement gates can be defined by entering the start positions
and the total gate width.

Measurement Window Configuration

1. In the "Measurement Window Configuration" frame, select the test results to be displayed in LANLook windows 1 (top), 2 (middle), and 3 (bottom). As shown below, the transmitter tests available differ depending on the selected wireless standard and data rate.

Table 7-3.   Available Transmitter Tests by Wireless Standard

802.11b / 802.11g (DSSS data rates)	802.11g (OFDM data rates)
Power profiles	Power profiles
Frequency profiles	CCDF profiles
IQ constellation	EVM vs Sub-Carrier
Spectral profiles	EVM vs Symbol
	IQ constellation
	Spectral profiles
	Spectral flatness

The user can display the results for up to three transmitter measurements simultaneously and each of the measurements gives access to a number of different statistics. The user can also select the order in which the individual test result windows display.

2. At the "Averaging" entry box specify the number of trigger events that are averaged before data is output to LANLook or remote interface.

3. If trace results are not required select "Numeric Results Only" to replace the trace window(s) with a single window of numeric result tables.

Path Loss Settings

If required, a signal level correction table can be used to compensate for test system and cable loss effects. Refer to chapter 12 for details.

Tx Advanced Settings

For Power Profile, Spectrum Profile and EVM related measurements additional configuration settings can be specified. These can be accessed by clicking [Tx Advanced Settings…]

Power Profile Settings

Click [Power Profile Settings] to display the dialog below.

Figure 7-6.   Power Profile Settings

Measurement Type:	When a Power Profile Measurement (see 7.2) is selected, both the Peak and Average power is displayed in a table below the power profile trace. By selecting the Measurement Type to be either 'Rise & Fall Times' or 'Crest Factor', additional rise / fall or crest factor data is included in the numeric results table.
Display trace in Max-Min Mode:	When 'Display trace in Max-Min format' is selected, LANLook displays both the maximum and minimum values for each display point on the power profile trace. Each of the maximum and minimum values is joined by a line to give a broad trace such as that shown in the example below
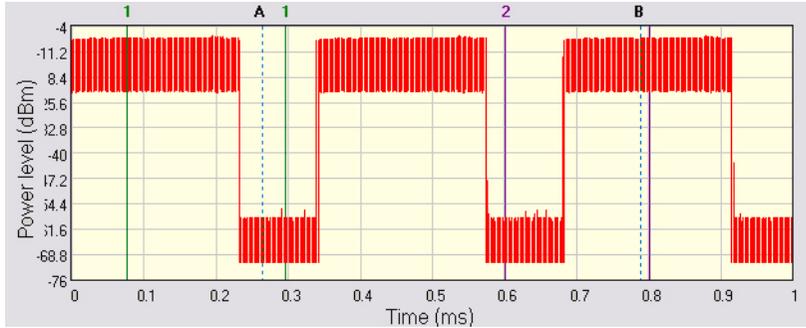
Figure 7-7.   Max-Min Power Profile

Displaying the max-min data in this way can be useful to monitor the effect that modulation changes between the preamble and payload have on the power level of an OFDM signal.

Spectral Profile Settings

Click [Spectral Profile Settings] to display the dialog below.
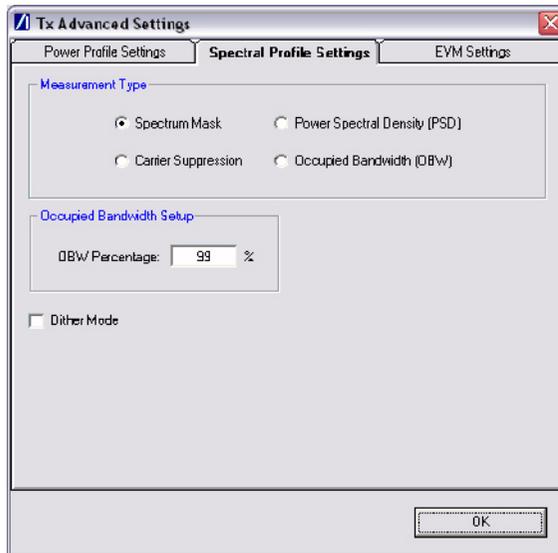
Figure 7-8.   Spectral Profile Settings

Measurement Type: Four types of spectral profile data can be individually displayed beneath the spectral profile trace;

- Spectrum Mask
- Carrier Suppression (DSSS Only)
- Power Spectral Density (PSD)
- Occupied Bandwidth (OBW)

OBW Percentage   Set the required power percentage that is to be used when the Occupied Bandwidth Measurement type is selected.

Dither Mode   Dither mode can be used to determine whether spurs in the spectral data are originating from the MT8860B or from the DUT. If generated internally, spurs are removed by making three measurements using differing down conversion offsets.

EVM Settings

Click [EVM Settings] to display the dialog below.

Figure 7-9. EVM Settings

Analysis Lengths: EVM, chip clock and symbol clock measurements are performed over the analysis lengths specified

Table 7-4. DSSS and OFDM EVM and Clock Statistics

	Minimum	Maximum	Default
DSSS EVM	220	11000	1000
DSSS Chip Clock	3300	30250	5500
OFDM EVM	16	500	40
OFDM Symbol Clock	16	500	55

Filtering: Allows the user to specify a filtering type for use during EVM analysis of DSSS modulated signals. Three filter selections are available:

	None:	No filtering is applied when calculating EVM.
	Gaussian:	The Gaussian filter is selected and the user can set the 'BT' value to a value between 0.3 and 1.0 in steps of 0.1.
	Root Nyquist:	Root Nyquist (Root Raised Cosine) is selected and the user can set the 'Alpha' value to a value between 0.3 and 1.0 in steps of 0.01.
Pilot Tracking:	For OFDM signals, pilot sub-carriers are used to assist with receiver synchronization.	
	Phase Only:	The demodulation process tracks the pilot phase over the specified EVM analysis length.
	Phase & Magnitude	The demodulation process tracks both the pilot phase and amplitude over the specified EVM analysis length.
Channel Estimation:	For OFDM signals, channel estimation is performed during the initial receiver synchronization process. Long training sequence or full packet channel estimation can be selected.	
Auto-configure analysis lengths	The analysis length values can be automatically configured by selecting "Auto configure Analysis Length" .When selected, the analysis lengths (applicable for the selected WLAN standard) are automatically configured to a valid value when the "Auto configure based on Tx Characteristics" operation is performed.	

1. Click [Run Once] or [Run Continuous] to display the measurement results within LANLook.

2. Tests can be repeated after changing the "Wireless Mode" settings within LANLook. However, users should understand that the response of the DUT will depend upon the network type selected (infrastructure / Ad-Hoc) and the DUT type (AP / STA). The "Wireless Mode" settings determine the conditions under which the MT8860B performs measurements. The settings are used to configure the internal reference radio and to select the modulation format for EVM analysis. Satisfactory results will not be acquired if the specified conditions do not match those of the DUT transmitter.

   Each of the test types available are explained over the following pages.

   - Power profile measurements
   - Frequency measurements
   - CCDF measurements
   - Spectral profile measurements
   - IQ constellation measurements
   - EVM vs sub-carrier measurements
   - EVM vs symbol measurements
   - Spectral flatness measurements

7-2   Power Profile Measurements

The power profile utilizes two gates to measure the peak and average power within any section on the trace. The samples within a gate are included in the average and peak power measurements. To see changes in power level due to modulation, a capture time of less than 100 μs is required. For longer capture times the displayed data point is an average of all samples within the time period.
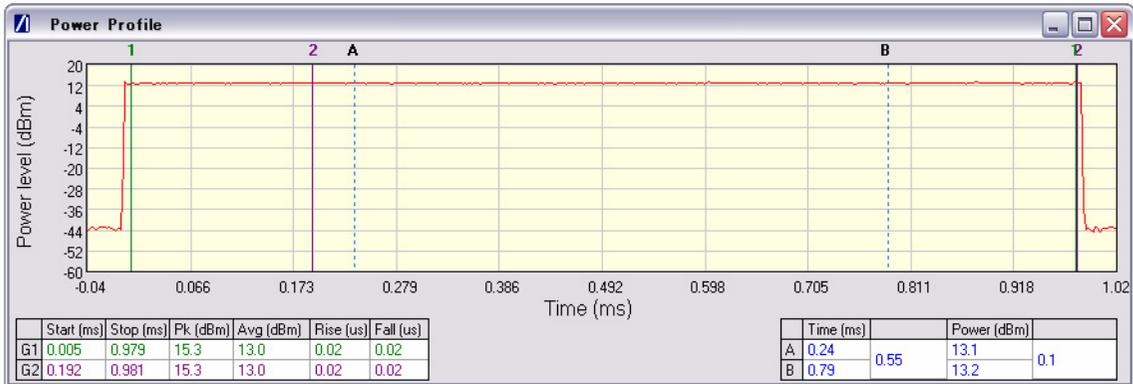
Figure 7-10. [Power Profile] Window

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "Power Profile" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Run Once] or [Run Continuous].

Peak Transmitter Power

The peak power values display in the "Pk (dBm)" column of the table directly beneath the power profile trace. Peak power is the absolute maximum of the packet within the gate width period.

Average Transmitter Power

The average values display in the "Avg (dBm)" column of the table directly beneath the power profile trace. The maximum allowable output power is specified by the regulatory body for the region in question. Refer to the table below.

Table 7-5.   Maximum Transmit Power by Wireless Standard and Regulatory Domain

	Maximum Transmit Power
Europe	100 mW (EIRP) (20 dBm)
Japan	10 mW/MHz (10 dBm/MHz)
USA	1000 mW (30 dBm)

As is the case for all power measurements, the average power is calculated from within the specified gate area only.

Transmit Power-On Ramp

The power-on ramp values display in the "Rise (us)" column of the table directly beneath the power profile trace. If the "Rise" column does not appear in the table, click [Tx Advanced Settings...], click the [Power Profile Settings] tab and select "Rise & Fall Times" from the "Measurement Type" frame.

When making this measurement the entire packet (burst) duration must be contained with the capture period and the measurement gate must be positioned within the burst. The MT8860B locates the rise and fall on either side of the gate.

For IEEE 802.11b, the specification states that the power-on ramp for the region between 10% and 90% of maximum power must not exceed 2 µs. This is shown in the figure below.

For IEEE 802.11g the specification does not specifically define any requirements for the power-on or power-down ramps, however, it would be expected that performance would not be worse than that of 802.11b.

Figure 7-11. Transmit Power-On Ramp

Transmit Power-Down Ramp

The power-down ramp values display in the "Fall (us)" column of the table directly beneath the power profile trace. If the "Fall" column does not appear in the table, click [Tx Advanced Settings...], click the [Power Profile Settings] tab and select "Rise & Fall Times" from the "Measurement Type" frame.

The IEEE 802.11b specification states that, as shown in the figure below, the power-down ramp for the region between 10% and 90% of maximum power must not exceed 2 μs.
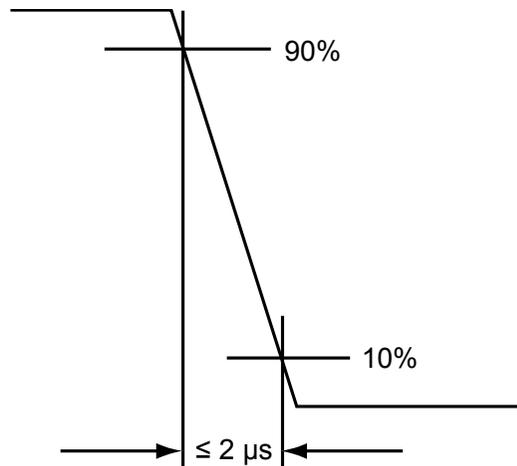
Figure 7-12. Transmit Power-Down Ramp

Note	The minimum capture frame that can be set is 10μs. This is 1 μs/division and gives a marker resolution of 0.1μs.

Crest Factor (OFDM data rates only)

The crest factor values display in the "CF (dB)" column of the table directly beneath the power profile trace. If the "CF" column does not appear in the table, click [Tx Advanced Settings...], click the [Power Profile Settings] tab and select "CF" from the "Measurement Type" frame.

The crest factor represents the difference in dB between the peak and average power of the signal within the gate.

Frequency Measurements (DSSS data rates only)

Frequency data is not valid until 50µs after a trigger event. When measuring frequency, users are advised to ensure that the start of the gate is at least 50µs from the trigger. The displayed frequency value is the average within the gate. For spot frequency measurements, use the marker.

Figure 7-13. [Frequency Profile] Window

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "Frequency Profile" from one of the drop-down fields in the "Measurements" frame.

4. Click [Run Once] or [Run Continuous].

Average Carrier Frequency and Offset

The IEEE specification states that the transmitted centre frequency tolerance be ±25 ppm maximum. For example, 2412 MHz ± 25 ppm = ± 60.3 kHz; 2484 MHz ± 25 ppm = ± 62.1 kHz.

7-3   CCDF Measurements (OFDM Data Rates Only)

The Complementary Cumulative Distribution Function (CCDF) profile allows the user to ascertain the percentage of samples for which the power level specified by the markers is greater than the average power. The profile output contains 120 entries representing the power level (in dB) above the mean in 0.1 dB steps (0-12 dB above the mean). Each entry contains the percentage of time that the signal was less than this number of dB above the mean.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "CCDF Profiles" from one of the drop-down fields in the "Measurements" frame.

4. Click [Run Once] or [Run Continuous].
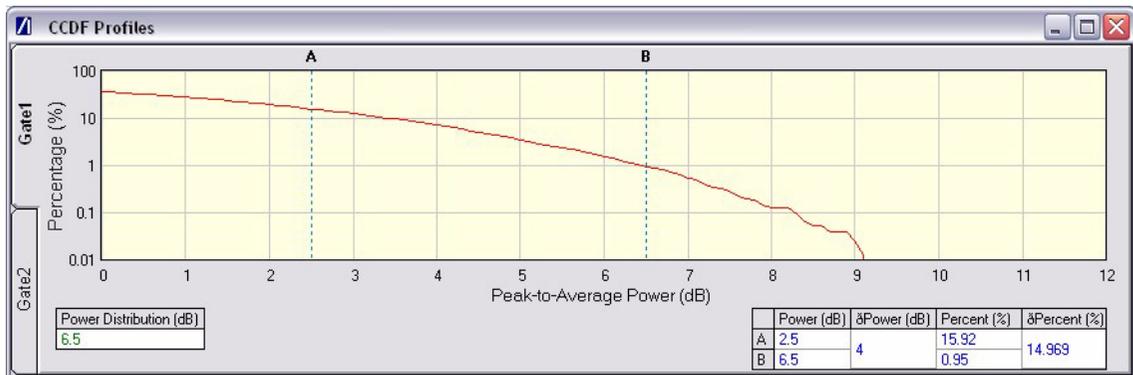
Figure 7-14. [CCDF Profiles] Window

7-4   Spectrum Profile Measurements

The displayed spectrum is a time generated spectrum measurement as defined by gates 1 and 2 in the [Power Profile] trace. Four types of spectral profile data can be individually displayed beneath the profile:

- Spectrum Mask
- Carrier Suppression
- Power Spectral Density (PSD)
- Occupied Bandwidth (OBW)

Spectrum Mask

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Spectrum Mask" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].

   The MT8860B applies the spectral mask for the selected WLAN standard.   The results tables beneath the trace are used to display the pass / fail status for each of the mask elements. The minimum gate time for spectrum updates is 50μs. Longer gates have more spectrum samples giving the effect of point-to-point averaging.

   ### 802.11b / 802.11g (DSSS Data Rates)

Figure 7-15. [Spectral Profiles] Window with Mask

The figure above shows a typical spectral profile for DSSS data rates.

The "L2", "L1", "U1", and "U2" values that display in the table beneath the spectral profile represent the difference in power level between the maximum point within each segment of the trace and the maximum point of the entire spectrum. The segments on the left side of the trace are, from left to right, "L2" and "L1". The segments on the right side of the trace are, from left to right, "U1" and "U2".

Spectrum mask compliance

The transmitted spectral products must be less than –30 dBr (dB relative to the SINx/x peak) for:-

f_c – 22 MHz < f < f_c –11 MHz; and

f_c + 11 MHz < f < f_c + 22 MHz;

and less than –50 dBr for:-

f < f_c – 22 MHz; and

f > f_c + 22 MHz.

Where f_c is the channel center frequency.

The transmit spectral mask is shown below.

Figure 7-16. Spectrum Mask Compliance for DSSS

Note	Information on how to edit the spectrum mask can be found in chapter 12.

802.11g (OFDM Data Rates)
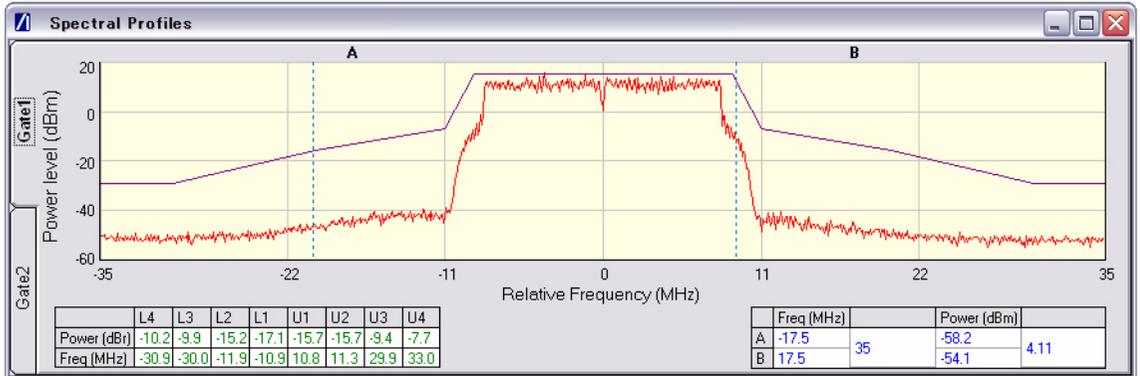
Figure 7-17. [Spectral Profile] Window

The figure above shows a typical spectral profile for 802.11g. The table below the trace displays the frequency in each of the respective mask sections at which the DUT is closest to the mask or, if the mask is exceeded, the frequency at which the mask is exceeded by the greatest margin.

The transmitted signals must fall within the confines of the mask defined in the figure below.

Figure 7-18. Spectral Mark Compliance for OFDM

Carrier Suppression (DSSS only)

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Carrier Suppression" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].

   The table within the spectral profile window beneath the trace changes to display the carrier suppression results.

Note	The IEEE standard states that the measurement is made with the DUT configured to transmit DQPSK modulation using a "01" repeating data sequence and with the scrambler disabled. In Network Mode operation it is not possible to disable the scrambler. It is therefore recommended that the carrier suppression measurement be performed in Direct Mode when the DUT is configured using control software supplied by the chipset vendor.

The RF carrier suppression, measured at the channel center frequency, must be at least 15 dB below the peak SIN(x)/x power spectrum.
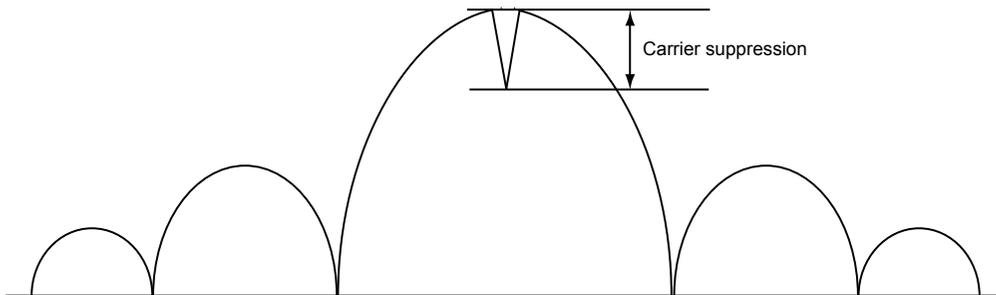
Figure 7-19. Carrier Suppression

Power Spectral Density (PSD)

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Power Spectral Density" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].
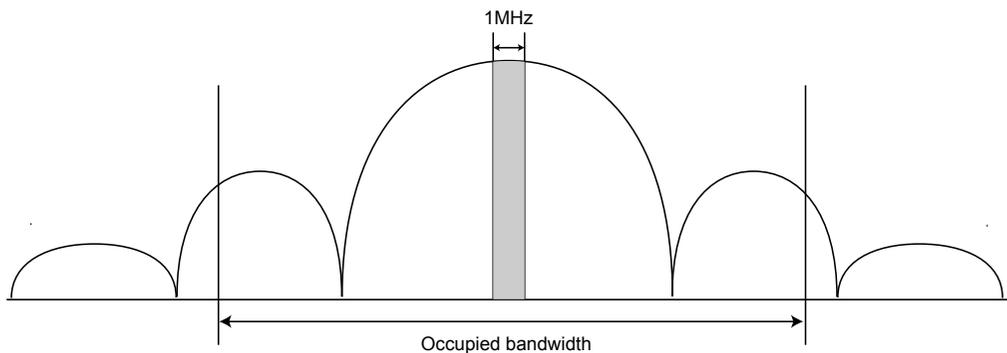
Figure 7-20. Power Spectral Density

The table within the spectral profile window changes to display the power spectral density result.

Occupied Bandwidth

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Occupied Bandwidth" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].The table beneath the trace within the [Spectral Profiles] window changes to display the OBW results. The value within the "OBW" cell of the table indicates the frequency within which the specified percentage of power is contained.

Figure 7-21. Occupied Bandwidth

7-5   IQ Constellation Measurements (EVM Analysis)

The IEEE 802.11 specification uses a metric called Error Vector Magnitude (EVM) as a measure of modulation quality. EVM is a measure of the difference between the ideal symbol position and the measured symbol position. The difference between these two positions is referred to as the error vector and is shown in the figure below by the distance "e".

EVM is an excellent measure of overall transmitter quality and a high EVM reading typically results in similarly high packet error rate.
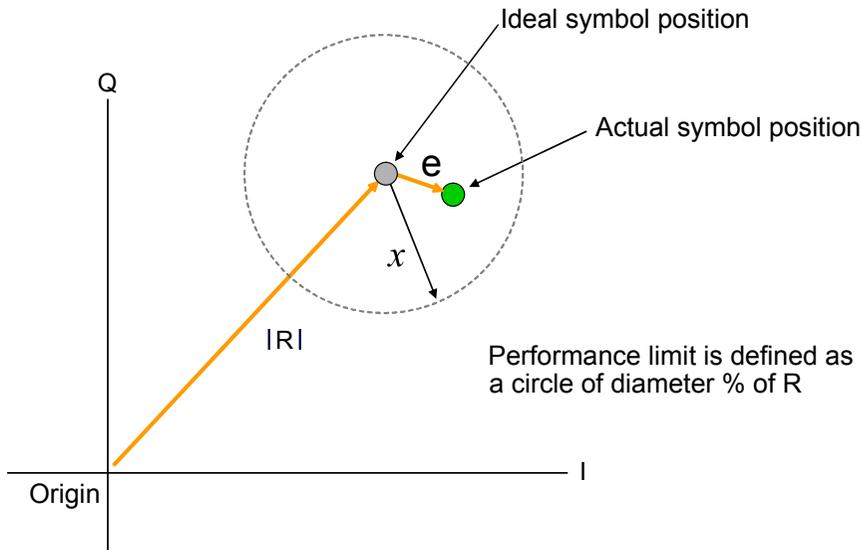
Figure 7-22. EVM Explanation

The following points should be considered when performing IQ constellation / EVM measurements.

- The transmitted signal must contain an 'off' period, i.e. it must not be a continuous transmission.
- The EVM analysis is performed on the first burst found after the trigger, including the pre trigger delay.
- The gate positions do not effect the EVM analysis.
- The EVM analysis is performed over a specified number of chips/symbols. To configure the analysis length, click [Tx Advanced Settings] > [EVM Settings] tab.
- The burst captured must contain at least the specified number of chips/symbols.
- Independent analysis lengths for the DSSS and OFDM data rates are provided.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "IQ Constellation" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Run Once] or [Run Continuous] to run IQ constellation measurements on the packet payload.

Note	The IQ constellation displayed by LANLook is determined by the WLAN Standard and Data Rate settings. If the data rate does not match the rate of transmission from the DUT, it is possible that the analysed data will be mapped onto the wrong constellation.

802.11b / 802.11g (DSSS Data Rates)

The 802.11b specification defines two modulation techniques.

DBPSK   DQPSK
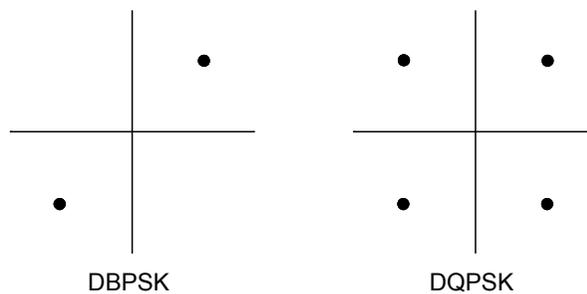
Figure 7-23. DSSS Modulation

The DSSS data rates and associated modulation methods are illustrated in the table below.

Table 7-6.   DSSS Data Rates and Modulation Methods

Data Rate (Mbps)	Modulation	Spreading / coding scheme
1	DBPSK	11 chip Barker sequence
2	DQPSK	11 chip Barker sequence
5.5	DQPSK	CCK
11	DQPSK	CCK

Note	Users should note that although IQ constellation measurements can be performed at a data rate of 1 Mbps (DBPSK modulation), the IEEE 802.11b specification stipulates that the measurement should be made using DQPSK modulation.
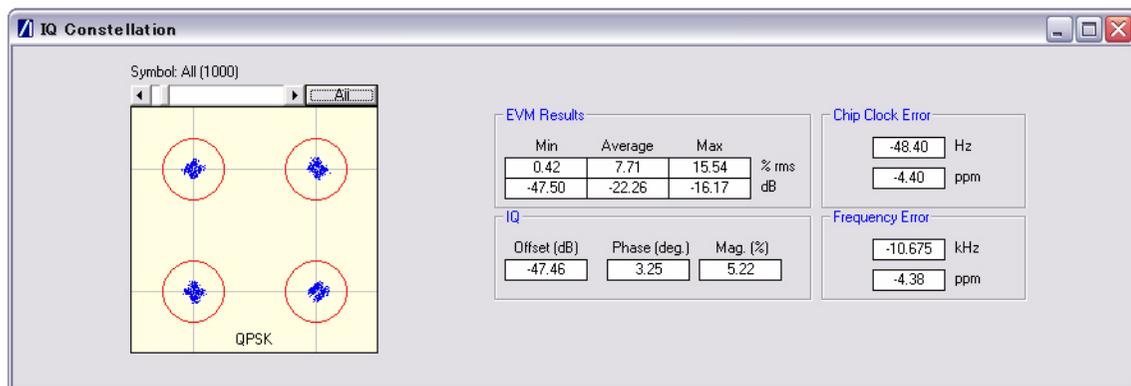
Figure 7-24. [IQ Constellation] Window showing DQPSK Constellation

The screen capture above shows a typical DQPSK constellation. The statistic of most interest to the user is the "Max" value that displays at the "EVM Results" field. The 802.11b specification stipulates that the worst-case vector error magnitude should not exceed 35%.

Chip Clock Error

The chip clock error measurement results are also displayed in the dialog above. The 802.11b specification stipulates that the chip clock frequency tolerance shall be better than ±25 ppm.

Frequency Error

The center frequency measurement results are also displayed in the dialog above. The 802.11g specification stipulates that the center frequency tolerance shall be better than ±25 ppm.

802.11g (OFDM Data Rates)

Each of the OFDM sub-carriers can be modulated using any of the following four techniques.

Figure 7-25. OFDM Modulation

The OFDM packet structure is shown in the figure below. In addition to the modulation constellations, the MT8860B can be used to display graphical results for EVM vs sub-carrier and EVM vs. symbol . These may be of particular use when a detailed analysis of the cause of distortion is required.
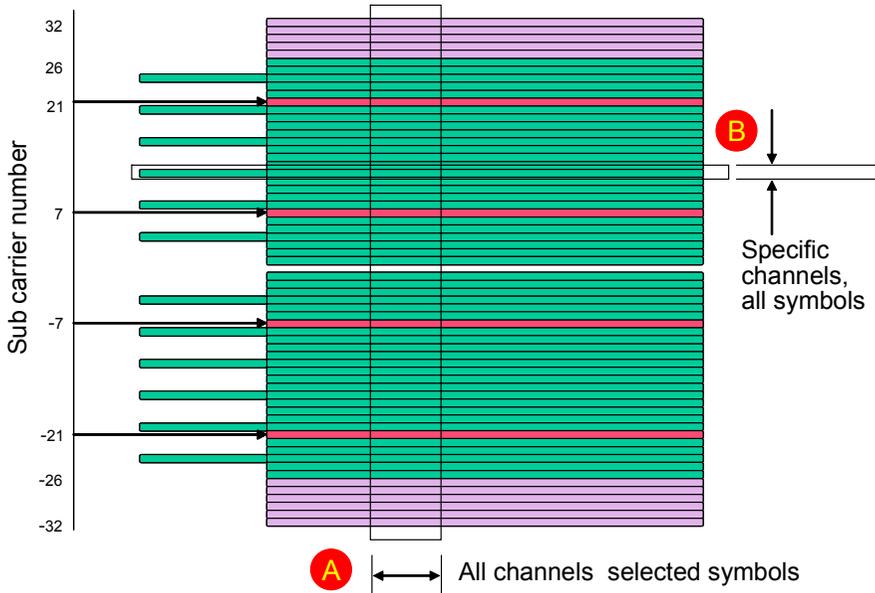
Figure 7-26. OFDM Packet Structure

The OFDM data rates and associated modulation methods are illustrated in the table below.

Table 7-7.   OFDM Data Rates and Modulation Methods

Data Rate (Mbps)	Modulation
6	BPSK
9	BPSK
12	QPSK
18	QPSK
24	16QAM
36	16QAM
48	64QAM
54	64QAM
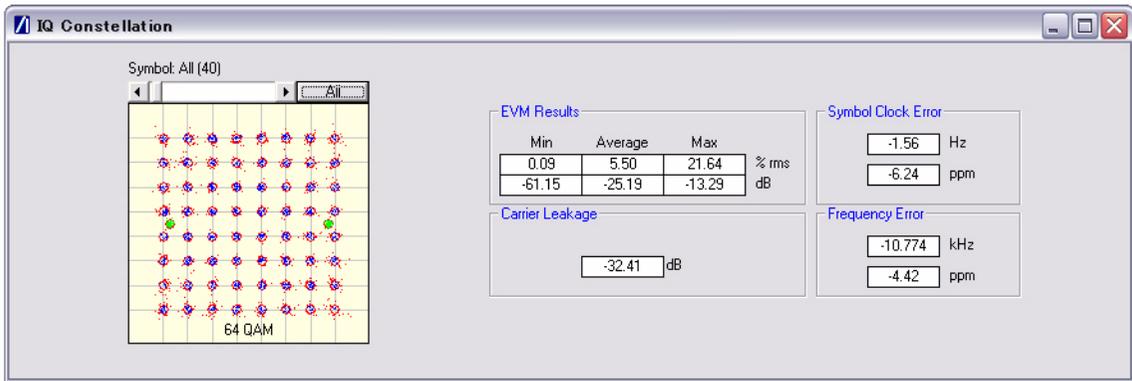
Figure 7-27. [IQ Constellation] Window showing 64 QAM Constellation

The screen capture above shows a 64 QAM constellation. The statistic of most interest to the user is the "Average" value that displays at the "EVM Results" field. Set the average to 20 to make measurements as specified in the IEEE standard.

Table 7-8.　　Maximum Permissible EVM Values Per Data Rate

Data Rate (Mbps)	EVM (dB)	EVM (% RMS)
6	-5	56.2
9	-8	39.8
12	-10	31.6
18	-13	22.3
24	-16	15.8
36	-19	11.2
48	-22	7.9
54	-25	5.6

Symbol Clock Error

The symbol clock error measurement results are also displayed in the dialog above. The 802.11g specification stipulates that the symbol clock frequency tolerance shall be ±25 ppm maximum.

Frequency Error

The center frequency measurement results are also displayed in the dialog above. The 802.11g specification stipulates that the center frequency tolerance shall be better than ±25 ppm.

Carrier Leakage

The carrier leakage measurement results are also displayed in the dialog above. Carrier leakage is measured during the 8 µs phase and is relative to the average power of the -16 to +16 sub-carriers.

7-6   EVM vs Sub-Carrier Measurements (OFDM only)

Although not a defined measurement of the IEEE, the EVM vs Sub-Carrier measurement is a powerful analysis tool that displays the average and max / min EVM for each OFDM channel.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Test] tab (see Table 7.3).

3. Select "EVM vs Sub-Carrier" from one of the drop-down fields in the "Measurements Window Configuration" frame.

4. Click [Run Once] or [Run Continuous] to display a trace such as that shown below. The vertical green lines at ± 7 and ± 21 are the pilot carriers, the blue bars are the maximum and minimum values and the horizontal trace shows the average EVM.

Figure 7-28. [EVM vs Sub Carrier] Window

7-7   EVM vs Symbol Measurements (OFDM only)

Although not a defined measurement of the IEEE, the EVM vs Symbol measurement is a powerful analysis tool that displays the average and max / min EVM for each symbol in the gate.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "EVM vs Symbol" from one of the drop-down fields in the "Measurements" frame.

4. Click [Run Once] or [Run Continuous] to display a trace such as that shown below.
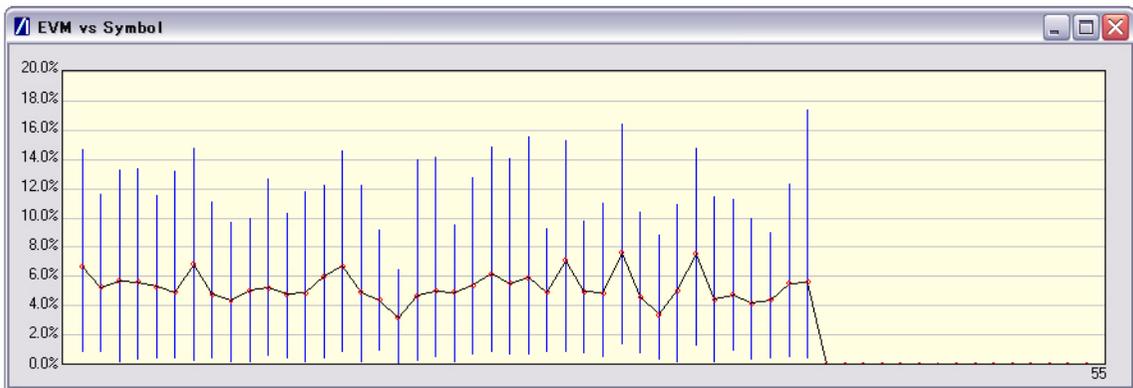
Figure 7-29. [EVM vs Symbol] Window

7-8   Spectral Flatness Measurements (OFDM only)

The spectral flatness measurement provides the user with a display of RF level vs sub-carrier over the measurement range.

The IEEE 802.11 specification stipulates acceptable values for the average energy of the constellations in each of the sub-carriers. For lines -16 to -1 and 1 to 16 the average energy of any individual sub-carrier should deviate no more than ± 2 dB from their average energy of all 32 central sub-carriers. For lines -26 to -17 and 17 to 26 the average energy of the constellations in each of the spectral lines should deviate no more than +2/-4 dB from the average energy of spectral lines -16 to -1 and 1 to 16. The data for this test is measured over the 8µs channel estimation period of the packet while all 52 sub-carriers are on.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 7.3).

3. Select "Spectral Flatness" from one of the drop-down fields in the "Measurements" frame.

4. Click [Run Once] or [Run Continuous].

Figure 7-30. [Spectral Flatness] Window

The spectral mask (shown by the horizontal lines) is split into three sections; an upper limit with a default setting of +2.0 dB, a lower side limit with a default setting of -4.0 dB, and a lower centre limit with a default setting of -2.0 dB. Each of the spectral mask sections can be moved freely to the required position and the dB value appears in a small pop-up next to the cursor when the line is being moved. The new limit values are sent automatically to the MT8860B when the user releases the mouse button. Channel measurements that fall outside of the limits of the mask display in red and also carry a small label that appears near the cursor to say how many times that channel failed.

7-9   Numeric Results of Transmitter Measurements

Transmitter measurement results can also be viewed as numeric data. Viewing the results in this format is slightly quicker as it requires less remote data than when viewing the traces graphically.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select "Numeric Results Only" in the "Measurement Window Configuration" frame.

3. Click [Run Once] or [Run Continuous] to view the results. The figure below shows the numeric results window for an OFDM data rate.

Tx Tests Numerical Results

Power	Start	Stop	Peak	Average	Crest Factor	Rise	Fall	Distribution
Gate 1	0.005 ms	0.179 ms	18.29 dBm	9.50 dBm	8.79 dB	0.07 us	0.27 us	6.50 dB
Gate 2	0.02 ms	0.181 ms	18.29 dBm	9.51 dBm	8.78 dB	0.07 us	0.27 us	6.50 dB

EVM	Minimum	Average	Maximum
% rms	0.06 %	3.84 %	14.42 %
dB	-64.75 dB	-28.31 dB	-16.82 dB

IQ Analysis	802.11g OFDM		802.11 b/g DSSS	
Carrier Leakage / IQ Offset	-30.49 dB		n/a	
Phase Error	n/a		n/a	
Magnitude Error	n/a		n/a	
Frequency Tolerance	-37.88 kHz	-15.54 ppm	n/a	n/a

Clock Error	802.11g OFDM (Symbol Clock)	802.11 b/g DSSS (Chip Clock)
Hz	-3.11 Hz	n/a
ppm	-12.46 ppm	n/a

Spectrum Mask	Status
Gate 1	PASS
Gate 2	PASS

Spectrum Mask	L4	L3	L2	L1	U1	U2	U3	U4
Gate 1 Power (dBr)	-14.6	-14.0	-13.2	-15.2	-17.2	-15.6	-17.0	-14.1
Gate 2 Power (dBr)	-13.4	-13.5	-12.1	-14.2	-15.8	-13.6	-15.9	-13.8
Gate 1 Frequency (MHz)	-31.6	-20.4	-11.9	-10.7	10.6	11.8	29.6	30.5
Gate 2 Frequency (MHz)	-31.6	-20.4	-11.9	-10.9	10.9	11.8	28.0	31.3

Spectrum Data	Spectral Density	Occupied Bandwidth	Carrier Suppression	Spectral Flatness
Gate 1	-0.73 dBm/MHz	16.4 MHz	-	PASS
Gate 2	-0.71 dBm/MHz	16.4 MHz	-	n/a

Figure 7-31. [Tx Tests Numeric Results] Window

Chapter 8 — Receiver Testing in Network Mode

8-1   Test Methodology and Settings

In Network mode with the packet type set to "Unicast", packets are transmitted to the DUT under the conditions specified. The DUT returns acknowledgments (ACKs) to notify the MT8860B of the receipt of each packet, and this data is utilized to calculate the PER. This combination of settings has the advantage to the user that PER calculations are made entirely within the MT8860B and it is not necessary to use the DUT client software.

In Network mode with the packet type set to "Broadcast", packets are transmitted on a fixed channel to all devices that are in a connection. In broadcast mode the DUT(s) do not return ACKs to the MT8860B and instead the PER is calculated by using the DUT client software.
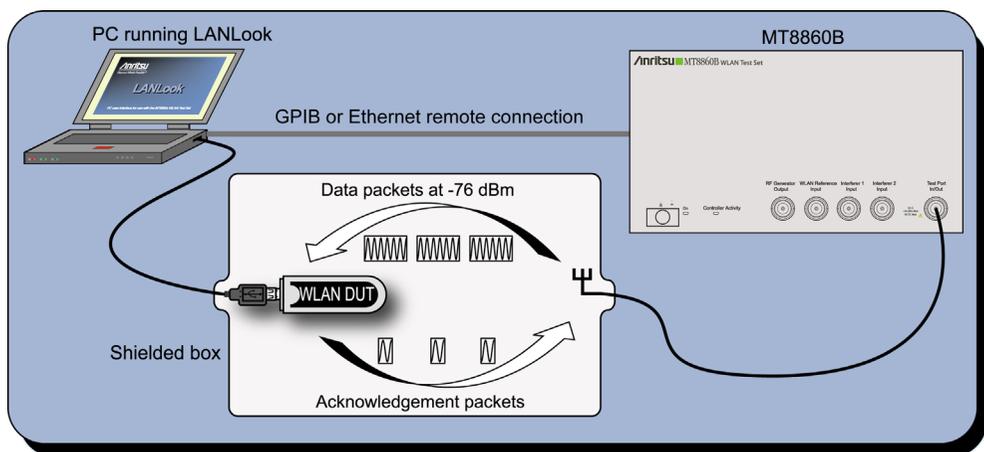
Figure 8-1.   Receiver Testing in Network Mode (Unicast)

All DUT receiver measurements are based on the calculation of Packet Error Rate (PER). PER is defined as follows.

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

802.11 PER Specifications

For DSSS data rates, the IEEE 802.11b specification states that the packet error rate (PER) must not exceed 8% for an input level no greater than -76 dBm measured at the antenna connector. The specification recommends that the test is performed using an 11 Mbps CCK modulated signal with a PSDU length of 1024 bytes.

For the OFDM data rates, the IEEE 802.11g specification states that the packet error rate (PER) shall be less than 10% at a PSDU length of 1000 bytes for the input levels indicated in the table below. Input levels are specific for each data rate and are measured at the antenna connector. A noise figure (NF) of 10 dB and an implementation loss of 5 dB are assumed.

Table 8-1.   Sensitivity and Rejection by Data Rate

Data rate (Mbps)	Minimum sensitivity (dBm)	Adjacent channel rejection (dB)	Alternate adjacent channel rejection (dB)
6	–82	16	32
9	–81	15	31
12	–79	13	29
18	–77	11	27
24	–74	8	24
36	–70	4	20
48	–66	0	16
54	–65	–1	15

1. Establish a remote connection between the MT8860B and PC as detailed in chapter 5.

Note	A WLAN connection with the DUT is required in order to perform Rx testing in Network mode. Refer to chapter 6 of this manual for a full explanation of how to establish a WLAN connection.

2. Make the required settings on the [Wireless Test] tab as shown below.
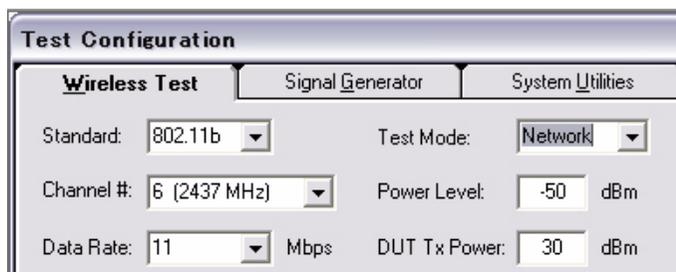
Figure 8-2.   Wireless Setup

3. Ensure that the "Test Mode" is set to "Network".

4. Click the [Rx Testing] tab shown below.
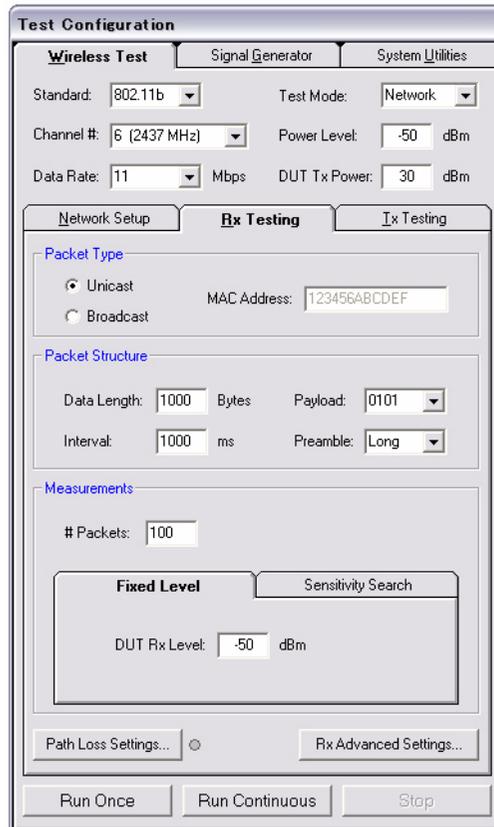
Figure 8-3.   [Rx Testing] Tab

5. Specify the type of transmission to be sent from the MT8860B to the device.

Unicast: This is the default setting in which the MT8860B transmits packets
                  to a single DUT.

Broadcast: In broadcast mode the MT8860B transmits packets on a fixed
                  channel to all devices that are in a connection. The 802.11 standard
                  specifies the broadcast address as FF-FF-FF-FF-FF-FF. In
                  broadcast mode the DUT(s) do not return ACKs to the MT8860B.
                  Instead, the PER is calculated using the DUT client software to
                  confirm that the count of received packets has been incremented.
                  Broadcast mode is suitable when connecting to and sequentially
                  testing multiple units in a line. Table and trace PER information is
                  not displayed in broadcast mode and the user is notified of this
                  when [Run Once] is clicked.

6. Specify the packet structure at the following items.

Data Length: The data length of the packet can be set to any value between 60 and 1500 bytes.

Interval: The interval specified represents the time in ms between frame transmissions.

Payload: Defines the bit sequence pattern of the dummy data in the payload. There are six options available in the drop down list, ZEROS, 0101, 1010, PN7, RANDOM, and COUNT.

Preamble: For data rates of 2, 5.5 and 11 Mbps, long and short preamble options are available. The long setting represents a preamble with 144 bits, and the short with 72. A short preamble setting equates to more payload data being transmitted with each packet for a given timeslot. For 1 Mbps a long preamble is used.

Note	Preamble settings are not applicable for OFDM data rates.

7. Specify the number of packets to be transmitted and the expected DUT Tx Power.

\# Packets: Specify the number of packets to be transmitted. Enter a value within the range of 1 and 10,000.

8. If required, a signal level correction table can be used to compensate for test system and cable loss effects. Refer to chapter 12 for details.

Follow the instructions over the following pages to perform the required measurements.

- Measuring PER at a fixed power level
- Measuring PER at a varying power level
- Measuring PER in broadcast mode
- Measuring PER with adjacent channel interference

8-2   Measuring PER at a Fixed Power Level
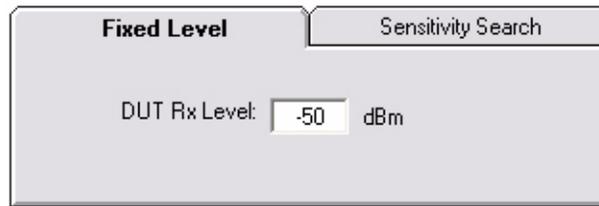
Figure 8-4.   PER Setting

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Click the [Fixed Level] tab shown above.

3. Set the required MT8860B transmission power level at the "DUT Rx Level" setting.

4. Click [Run Once] to display a table of PER numeric results, or click [Run Continuous] to display both the numeric results table and a PER history trace as shown below.
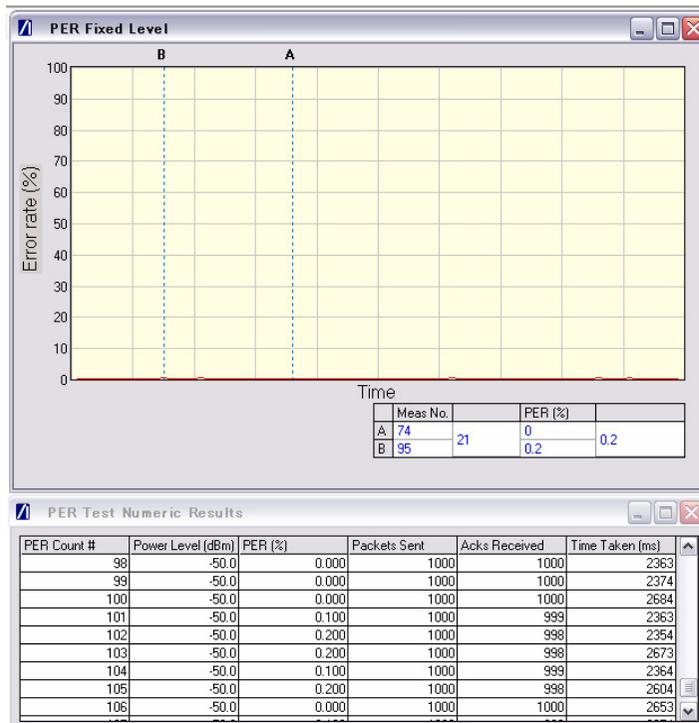
Figure 8-5.   PER at Fixed Power Level

Note	The MT8860B does not retry packets for which an ACK is not returned.

The trace above shows how the PER fluctuates over time for each measurement at the specified power. This is useful in analysis of performance over time or to monitor DUT resilience whilst applying conditions such as extreme temperatures or channel noise.

8-3   Measuring PER at a Varying Power Level

In this test the transmission power from the MT8860B is stepped down by a specified amount to find the point at which an acceptable PER threshold is reached.
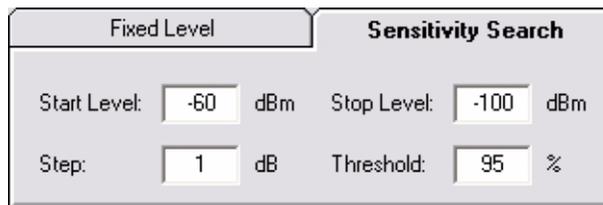
Figure 8-6.   PER Setting for Sensitivity Search

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Click the [Sensitivity Search] tab shown above and enter appropriate values as explained below.

Start Level:	Specify the initial power transmitted to the DUT.
Stop Level:	Specify the final power transmitted to the DUT.
Step:	Specify the power step between the start and stop levels. The specified number of packets is measured at each power level before stepping on to the next level.
Threshold:	Specify a PER percentage limit at which testing will be stopped as the receiver sensitivity level has exceeded the defined limit.

3. Click [Run Once] to display a PER plot such as that shown below.

Note	The [Run Continuous] button is not available when performing a sensitivity search.
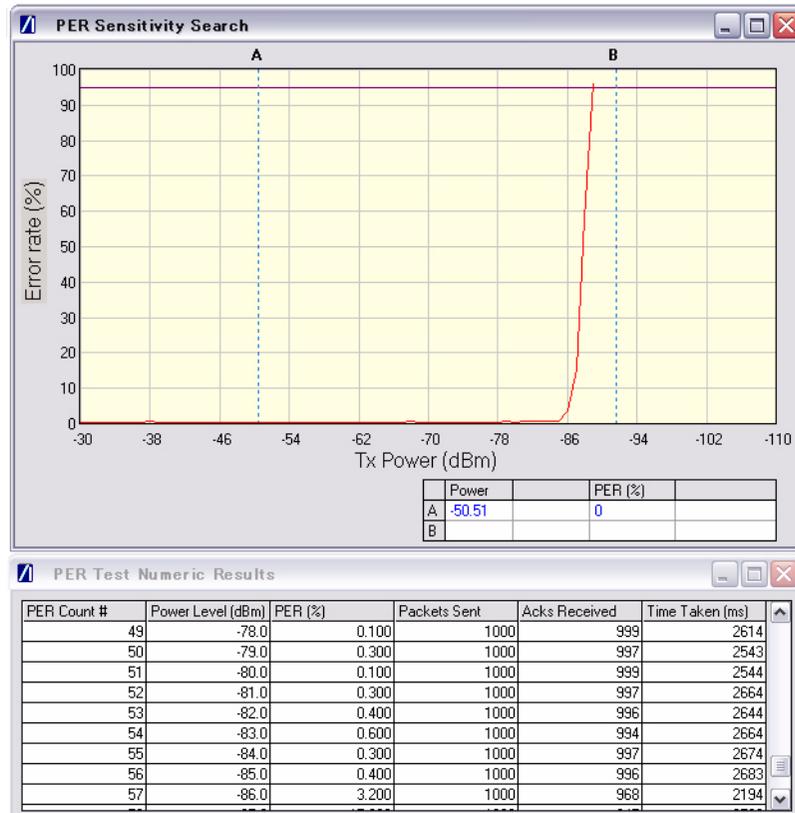
Figure 8-7.   PER Sensitivity Search

8-4   Measuring PER with Channel Interference
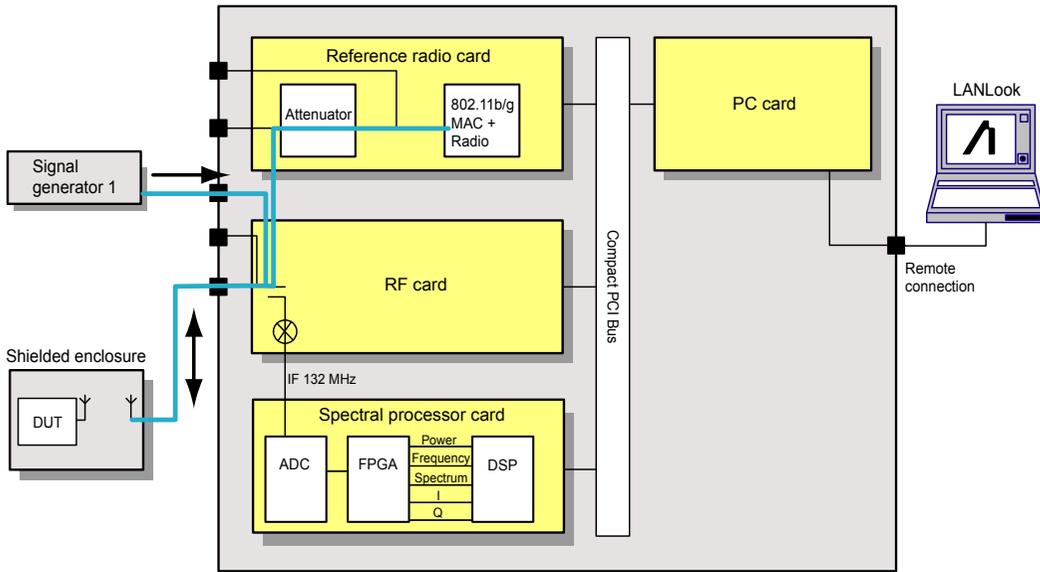
Figure 8-8.   PER with Channel Interference

In addition to the normal test configuration detailed earlier, an external signal generator can be coupled to the MT8860B to measure adjacent or alternate channel rejection.

Adjacent Channel Rejection Specifications

For DSSS data rates, adjacent channel rejection is defined between any two channels with 25 MHz separation. The adjacent channel rejection must be equal to or better than 35 dB, with a PER of 8% using 11 Mbps CCK modulation and a PSDU length of 1024 bytes.
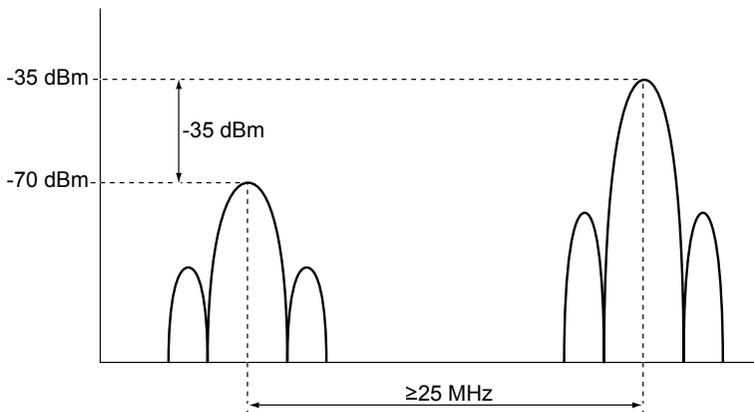
Figure 8-9.   Adjacent Channel Rejection

For OFDM data rates, the adjacent channel rejection shall be measured by setting the desired signal's strength 3 dB above the rate-dependent sensitivity specified in the table below and raising the power of the interfering signal until 10% PER is caused for a PSDU length of 1000 bytes. The power difference between the interfering and the desired channel is the corresponding adjacent channel rejection. The interfering signal in the adjacent channel shall be a conformant OFDM signal, unsynchronized with the signal in the channel under test.

Table 8-2. Sensitivity and Rejection Values Per Data Rate

Data rate (Mbps)	Minimum sensitivity (dBm)	Adjacent channel rejection (dB)	Alternate adjacent channel rejection (dB)
6	-82	16	32
9	-81	15	31
12	-79	13	29
18	-77	11	27
24	-74	8	24
36	-70	4	20
48	-66	0	16
54	-65	-1	15

1. Connect a signal generator to either of the interferer inputs on the front of the MT8860B.

2. Set the signal generator to transmit on the required channel.

3. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

4. Click [Rx Advanced Settings] and select the interferer check box to match the interferer port in use on the front of the MT8860B.

Figure 8-10. Rx Advanced Settings

5. Set the required transmission power level on the [Fixed Level] tab in the "Measurements" frame.

6. Click [Run Once].

Note	The typical path loss from the interferer input to the test port is 22 dB.

Chapter 9 — Transmitter Testing in Direct Mode

A WLAN connection with the DUT is not required in order to perform Tx testing in Direct mode. When Direct mode is selected the Network setup settings within LANLook are no longer applicable and are replaced by a message to this end.

9-1   Test Methodology and Settings

In Direct mode, control software supplied by the chipset vendor is used to configure the DUT to transmit continuously on a defined channel and data rate. The MT8860B spectral processor is then tuned to the same channel and triggers continuously or from the power burst rising edge. The advantage to the user of testing in the mode is that tests can be conducted without the need to establish a WLAN connection between the MT8860B and the DUT.
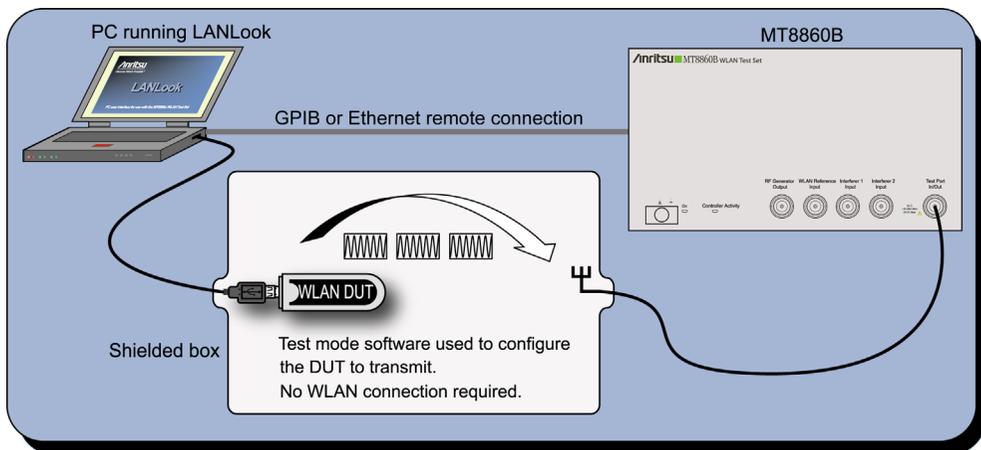
Figure 9-1.   Transmitter Testing in Direct Mode

1. Establish a remote connection between the MT8860B and PC as detailed in chapter 5.

2. Set the "Test Mode" to "Direct" (see Figure 9-2 below).

3. Make the required wireless test settings on the [Wireless Test] tab. The settings made here determine the conditions under which the MT8860B will perform measurements. Ensure that the settings in this pane match the required DUT transmission characteristics. Satisfactory test results will not be achieved if the MT8860B is attempting to perform measurements on a different channel or at a different data rate to that of the signal being transmitted by the DUT.
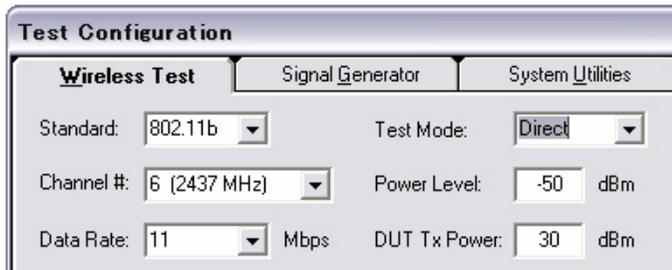
Figure 9-2.

4. Click the [Tx Testing] tab shown below.
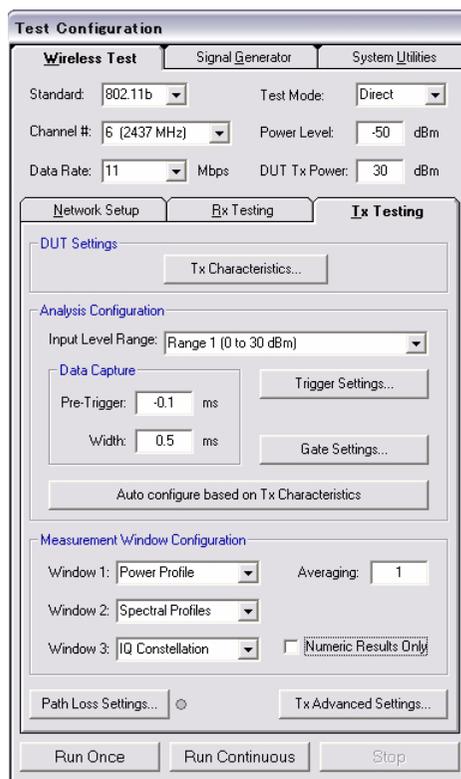
Figure 9-3.   [Tx Testing] Tab

DUT Settings

1. Click [Tx Characteristics…] to display the dialog shown below. This dialog is used to specify the expected Tx characteristics of the DUT. The packet structure settings define the data transmitted by the MT8860B and subsequently looped back from the DUT.
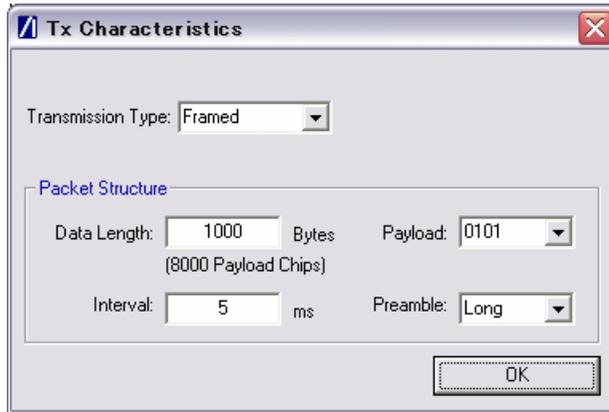
Figure 9-4.   [Tx Characteristics] Dialog

Transmission Type: Select either a "framed" or "continuous" transmission type.

Data Length: The maximum and minimum packet length is dependent upon the data rate as detailed below.

Table 9-1.   Minimum and Maximum Data Length by Data Rate

Data Rate	Minimum data length (bytes)	Maximum data length (bytes)
1	60	600
2	60	1250
5.5	80	3440
11	155	6875
6	50	3750
9	75	5625
12	100	7500
18	145	11250
24	195	15000
36	280	22500
48	385	30000
54	435	33750

Interval: The interval specified represents the time between frames transmitted by the DUT.

Payload: Defines the bit sequence pattern of the dummy data in the payload. There are six options available in the drop down list, ZEROS, 0101, 1010, PN7, RANDOM, and COUNT. The required payload is determined by the test that the user wishes to perform.

Preamble: For data rates of 2, 5.5 and 11 Mbps, long and short preamble options are available. The long setting represents a preamble with 144 bits, and the short with 72. A short preamble setting equates to more payload data being transmitted with each packet for a given timeslot. For 1 Mbps a long preamble is used.

Note	Preamble settings are not applicable for OFDM data rates.

Analysis Configuration

1. Configure the MT8860B as required to allow analysis of the data being transmitted from the DUT. Settings can be made in two ways:-

Manually: The MT8860B can be configured manually using the "Analysis Configuration" settings.
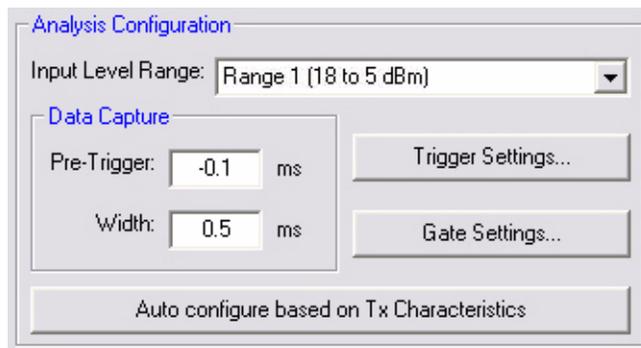
Refer to steps 7 to 10 below.

Automatically: The Tx analyser settings of the MT8860B can be configured manually by clicking [Auto configure based on Tx Characteristics].

When used, all of the settings within "Analysis Configuration" are configured automatically based upon the settings made in the [Tx Characteristics] dialog.

If using the auto configure button jump to step 11 in the procedure below.

2. Select the power level range at "Input Level Range".

Table 9-2.   Input Level Ranges for 802.11b and 802.11g

	Range
Range 1	0 to 30 dBm
Range 2	-20 to 10 dBm
Range 3	-60to -18 dBm
Auto Range Low	-20 to 30 dBm
Auto Range HIgh	-60 to 10 dBm

Note	"Input Level Range" can be set to "Auto Range Low" to prevent damage to the MT8860B input that may be caused when, for example, a sudden power change occurs from range 3 to + 27 dBm. As each MT8860B is uniquely calibrated, the ranges shown above may vary slightly for each instrument.

3. Specify the "Data Capture" settings as detailed below.

Pre-Trigger: Enter a value at the "Pre-Trigger" item as required. The "Pre-trigger" item is used to specify the time in milliseconds for which data is captured prior to the trigger point. Enter a negative value between −5.95 and 0.

Width: Enter the time period after the pre-trigger during which measurement data is captured. Enter a value in milliseconds within the range of 0.01 to 5.95.

4. Click [Trigger Settings…] to display the dialog below.

Figure 9-5.   [Trigger Settings] Dialog

Source: The trigger source item specifies the mechanism used to trigger measurement within each incoming packet. There are four options available.

     RF: Triggering is enabled at the power level specified at the "Level" item.

External: The signal to trigger measurement is supplied from the external BNC connect ("Digital In 1") on the rear of the MT8860B.

Free run: Triggering is performed continuously.

Video: Auto trigger from the RF power at the IF of the MT8860B.

Edge: Select whether triggering is performed on the rising or falling edge of the pulse.

Level: Specify the power level.

5. Click [Gate Settings…] to display the dialog below.
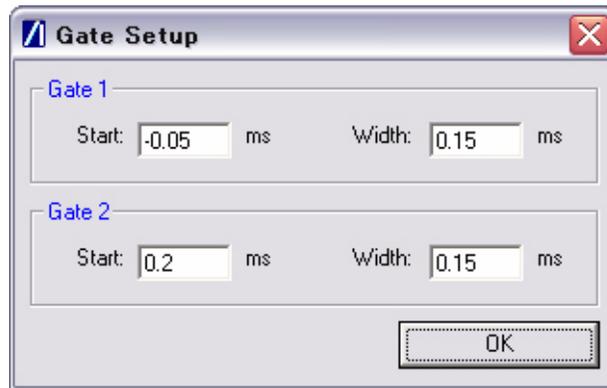
Figure 9-6.   [Gate Setup] Dialog

The position of the measurement gates can be defined by entering the start positions and the total gate width.

Measurement Configuration

1. In the "Measurement Window Configuration" frame, select the test results to be displayed in LANLook windows 1 (top), 2 (middle), and 3 (bottom). As shown below, the transmitter tests available differ depending on the selected wireless standard and data rate.

Table 9-3.   Available Transmitter Tests by Wireless Standard

802.11b / 802.11g (DSSS data rates)	802.11g (OFDM data rates)
Power profiles	Power profiles
Frequency profiles	CCDF profiles
IQ constellation	EVM vs Sub-Carrier
Spectral profiles	EVM vs Symbol
	IQ constellation
	Spectral profiles
	Spectral flatness

The user can display the results for up to three transmitter measurements simultaneously and each of the measurements gives access to a number of different statistics. The user can also select the order in which the individual test result windows display.

2. At the "Averaging" entry box specify the number of trigger events that are averaged before data is output to LANLook or remote interface.

3. If trace results are not required select "Numeric Results Only" to replace the trace window(s) with a single window of numeric result tables.

Path Loss Settings

If required, a signal level correction table can be used to compensate for test system and cable loss effects. Refer to chapter 12 for details.

Tx Advanced Settings

For Power Profile, Spectrum Profile and EVM related measurements additional configuration settings can be specified. These can be accessed by clicking [Tx Advanced Settings…]

Power Profile Settings

Click [Power Profile Settings] to display the dialog below.

Figure 9-7. Power Profile Settings

Measurement Type:	When a Power Profile Measurement (see 7.2) is selected, both the Peak and Average power is displayed in a table below the power profile trace. By selecting the Measurement Type to be either 'Rise & Fall Times' or 'Crest Factor', additional rise / fall or crest factor data is included in the numeric results table.
Display trace in Max-Min Mode:	When 'Display trace in Max-Min format' is selected, LANLook displays both the maximum and minimum values for each display point on the power profile trace. Each of the maximum and minimum values is joined by a line to give a broad trace such as that shown in the example below

Figure 9-8.   Max-Min Power Profile

Displaying the max-min data in this way can be useful to monitor the effect that modulation changes between the preamble and payload have on the power level of an OFDM signal.

Spectral Profile Settings

Click [Spectral Profile Settings] to display the dialog below.
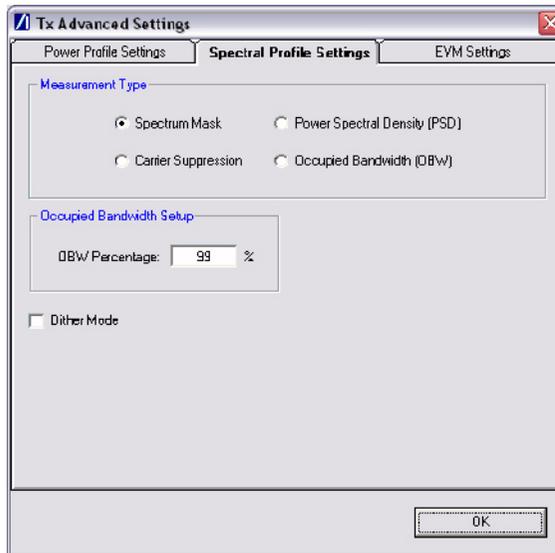
Figure 9-9.   Spectral Profile Settings

Measurement Type: Four types of spectral profile data can be individually displayed beneath the spectral profile trace;

- Spectrum Mask
- Carrier Suppression (DSSS Only)
- Power Spectral Density (PSD)
- Occupied Bandwidth (OBW)

OBW Percentage   Set the required power percentage that is to be used when the Occupied Bandwidth Measurement type is selected.

Dither Mode   Dither mode can be used to determine whether spurs in the spectral data are originating from the MT8860B or from the DUT. If generated internally, spurs are removed by making three measurements using differing down conversion offsets.

EVM Settings

Click [EVM Settings] to display the dialog below.

Figure 9-10. EVM Settings

Analysis Lengths: EVM, chip clock and symbol clock measurements are performed over the analysis lengths specified

Table 9-4.   DSSS and OFDM EVM and Clock Statistics

	Minimum	Maximum	Default
DSSS EVM	220	11000	1000
DSSS Chip Clock	3300	30250	5500
OFDM EVM	16	500	40
OFDM Symbol Clock	16	500	55

Filtering: Allows the user to specify a filtering type for use during EVM analysis of DSSS modulated signals. Three filter selections are available;

                        None: No filtering is applied when calculating EVM.

Gaussian:	The Gaussian filter is selected and the user can set the 'BT' value to a value between 0.3 and 1.0 in steps of 0.1.
Root Nyquist:	Root Nyquist (Root Raised Cosine) is selected and the user can set the 'Alpha' value to a value between 0.3 and 1.0 in steps of 0.01.

Pilot Tracking:	For OFDM signals, pilot sub-carriers are used to assist with receiver synchronization.
Phase Only:	The demodulation process tracks the pilot phase over the specified EVM analysis length.
Phase & Magnitude	The demodulation process tracks both the pilot phase and amplitude over the specified EVM analysis length.

Channel Estimation:	For OFDM signals, channel estimation is performed during the initial receiver synchronization process. Long training sequence or full packet channel estimation can be selected.
Auto-configure analysis lengths	The analysis length values can be automatically configured by selecting "Auto configure Analysis Length" .When selected, the analysis lengths (applicable for the selected WLAN standard) are automatically configured to a valid value when the "Auto configure based on Tx Characteristics" operation is performed.

1. Click [Run Once] or [Run Continuous] to display the measurement results within LANLook.

2. Tests can be repeated after changing the "Wireless Mode" settings within LANLook. However, users should understand that the response of the DUT will depend upon the network type selected (infrastructure / Ad-Hoc) and the DUT type (AP / STA). The "Wireless Mode" settings determine the conditions under which the MT8860B performs measurements. The settings are used to configure the internal reference radio and to select the modulation format for EVM analysis. Satisfactory results will not be acquired if the specified conditions do not match those of the DUT transmitter.

   Each of the test types available are explained over the following pages.

   • Power profile measurements

   • Frequency measurements

   • CCDF measurements

   • Spectral profile measurements

   • IQ constellation measurements

   • EVM vs sub-carrier measurements

   • EVM vs symbol measurements

   • Spectral flatness measurements

9-2   Power Profile Measurements

The power profile utilizes two gates to measure the peak and average power within any section on the trace. The samples within a gate are included in the average and peak power measurements. To see changes in power level due to modulation, a capture time of less than 100 µs is required. For longer capture times the displayed data point is an average of all samples within the time period.
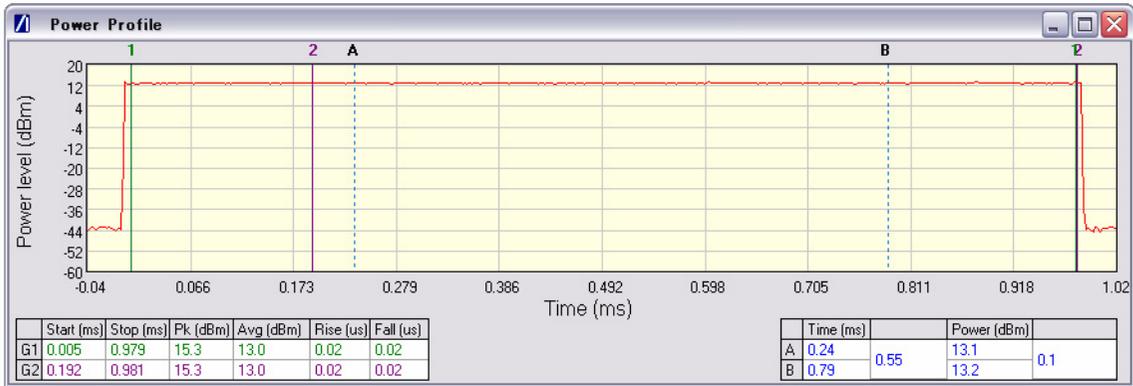
Figure 9-11. [Power Profile] Window

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "Power Profile" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Run Once] or [Run Continuous].

Peak Transmitter Power

The peak power values display in the "Pk (dBm)" column of the table directly beneath the power profile trace. Peak power is the absolute maximum of the packet within the gate width period.

Average Transmitter Power

The average values display in the "Avg (dBm)" column of the table directly beneath the power profile trace. The maximum allowable output power is specified by the regulatory body for the region in question. Refer to the table below.

Table 9-5.   Maximum Transmit Power by Wireless Standard and Regulatory Domain

	Maximum Transmit Power
Europe	100 mW (EIRP) (20 dBm)
Japan	10 mW/MHz (10 dBm/MHz)
USA	1000 mW (30 dBm)

As is the case for all power measurements, the average power is calculated from within the specified gate area only.

Transmit Power-On Ramp

The power-on ramp values display in the "Rise (us)" column of the table directly beneath the power profile trace. If the "Rise" column does not appear in the table, click [Tx Advanced Settings...], click the [Power Profile Settings] tab and select "Rise & Fall Times" from the Measurement Type frame.

When making this measurement the entire packet (burst) duration must be contained with the capture period and the measurement gate must be positioned within the burst. The MT8860B locates the rise and fall on either side of the gate.

For IEEE 802.11b, the specification states that the power-on ramp for the region between 10% and 90% of maximum power must not exceed 2 µs. This is shown in the figure below.

For IEEE 802.11g the specification does not specifically define any requirements for the power-on or power-down ramps, however, it would be expected that performance would not be worse than that of 802.11b.

Figure 9-12. Transmit Power-On Ramp

Transmit Power-Down Ramp

The power-down ramp values display in the "Fall (us)" column of the table directly beneath the power profile trace. If the "Fall" column does not appear in the table, click [Tx Advanced Settings...], click the [Power Profile Settings] tab and select "Rise & Fall Times" from the Measurement Type frame.

The IEEE 802.11b specification states that, as shown in the figure below, the power-down ramp for the region between 10% and 90% of maximum power must not exceed 2 µs.
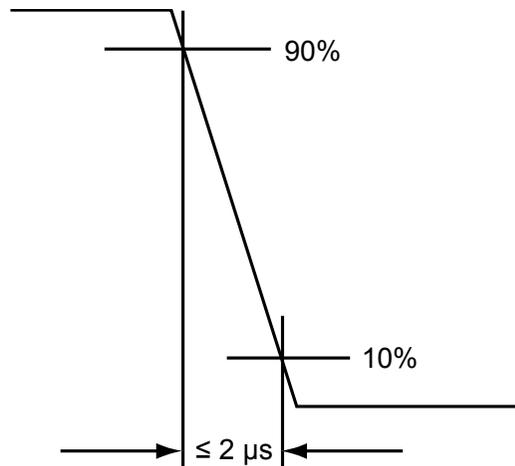
Figure 9-13. Transmit Power-Down Ramp

Note	The minimum capture frame that can be set is 10µs. This is 1 µs/division and gives a marker resolution of 0.1µs.

Crest Factor (OFDM data rates only)

The crest factor values display in the "CF (dB)" column of the table directly beneath the power profile trace. If the "CF" column does not appear in the table, click [Tx Advanced Settings...], click the [Power Profile Settings] tab and select "CF" from the Measurement Type frame.

The crest factor represents the difference in dB between the peak and average power of the signal within the gate.

Frequency Measurements (DSSS data rates only)

Frequency data is not valid until 50µs after a trigger event. When measuring frequency, users are advised to ensure that the start of the gate is at least 50µs from the trigger. The displayed frequency value is the average within the gate. For spot frequency measurements, use the marker.

Figure 9-14. [Frequency Profile] Window

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "Frequency Profile" from one of the drop-down fields in the "Measurements" frame.

4. Click [Run Once] or [Run Continuous].

Average Carrier Frequency and Offset

The IEEE specification states that the transmitted centre frequency tolerance be ±25 ppm maximum. For example, 2412 MHz ± 25 ppm = ± 60.3 kHz; 2484 MHz ± 25 ppm = ± 62.1 kHz.

9-3   CCDF Measurements (OFDM Data Rates Only)

The Complementary Cumulative Distribution Function (CCDF) profile allows the user to ascertain the percentage of samples for which the power level specified by the markers is greater than the average power. The profile output contains 120 entries representing the power level (in dB) above the mean in 0.1 dB steps (0-12 dB above the mean). Each entry contains the percentage of time that the signal was less than this number of dB above the mean.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "CCDF Profiles" from one of the drop-down fields in the "Measurements" frame.

4. Click [Run Once] or [Run Continuous].
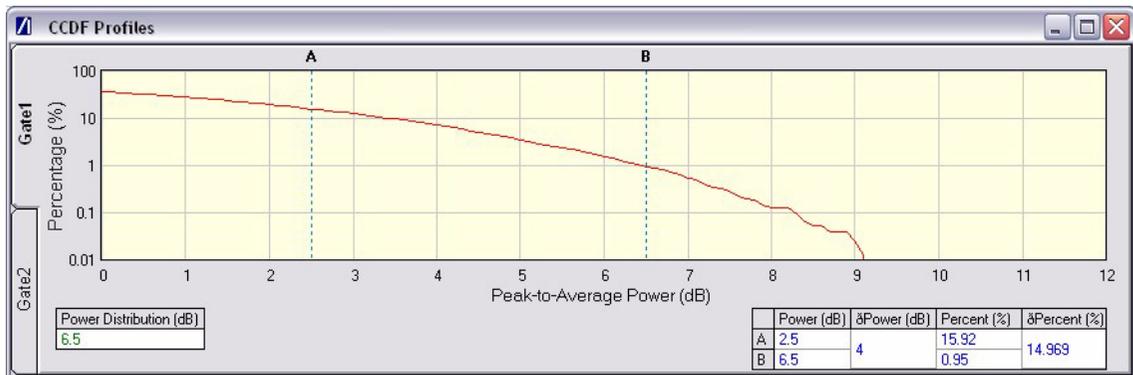
Figure 9-15. [CCDF Profiles] Window

9-4   Spectrum Profile Measurements

The displayed spectrum is a time generated spectrum measurement as defined by gates 1 and 2 in the [Power Profile] trace. Four types of spectral profile data can be individually displayed beneath the profile:

- Spectrum Mask
- Carrier Suppression
- Power Spectral Density (PSD)
- Occupied Bandwidth (OBW)

Spectrum Mask

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Spectrum Mask" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].

   The MT8860B applies the spectral mask for the selected WLAN standard.   The results tables beneath the trace are used to display the pass / fail status for each of the mask elements. The minimum gate time for spectrum updates is 50μs. Longer gates have more spectrum samples giving the effect of point-to-point averaging.

   ### 802.11b / 802.11g (DSSS Data Rates)

Figure 9-16. [Spectral Profiles] Window with Mask

The figure above shows a typical spectral profile for DSSS data rates.

The "L2", "L1", "U1", and "U2" values that display in the table beneath the spectral profile represent the difference in power level between the maximum point within each segment of the trace and the maximum point of the entire spectrum. The segments on the left side of the trace are, from left to right, "L2" and "L1". The segments on the right side of the trace are, from left to right, "U1" and "U2".

Spectrum mask compliance

The transmitted spectral products must be less than −30 dBr (dB relative to the SINx/x peak) for:-

f_c − 22 MHz < f < f_c −11 MHz; and

f_c + 11 MHz < f < f_c + 22 MHz;

and less than −50 dBr for:-

f < f_c − 22 MHz; and

f > f_c + 22 MHz.

Where f_c is the channel center frequency.

The transmit spectral mask is shown below.

Figure 9-17. Spectrum Mask Compliance for DSSS

Note	Information on how to edit the spectrum mask can be found in chapter 12.

802.11g (OFDM Data Rates)
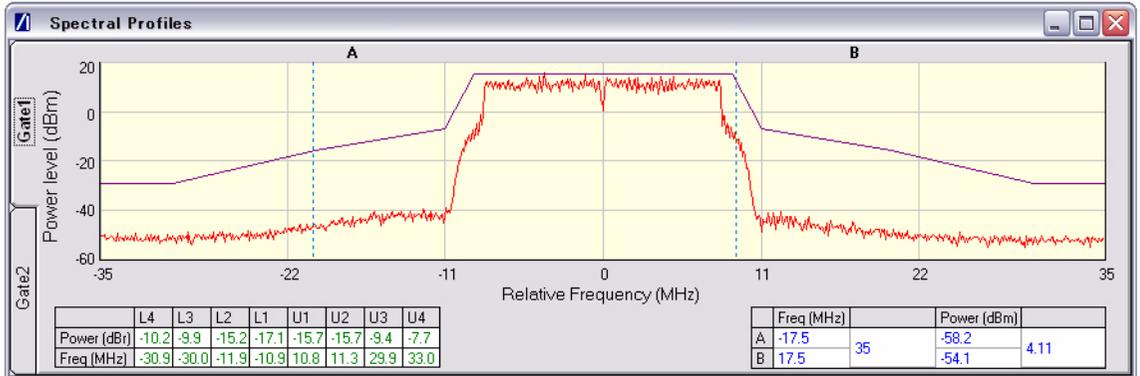
Figure 9-18. [Spectral Profile] Window

The figure above shows a typical spectral profile for 802.11g. The table below the trace displays the frequency in each of the respective mask sections at which the DUT is closest to the mask or, if the mask is exceeded, the frequency at which the mask is exceeded by the greatest margin.

The transmitted signals must fall within the confines of the mask defined in the figure below.

Figure 9-19. Spectral Mark Compliance for OFDM

Carrier Suppression (DSSS only)

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Carrier Suppression" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].

   The table within the spectral profile window beneath the trace changes to display the carrier suppression results.

Note	The IEEE standard states that the measurement is made with the DUT configured to transmit DQPSK modulation using a "01" repeating data sequence and with the scrambler disabled.

The RF carrier suppression, measured at the channel center frequency, must be at least 15 dB below the peak SIN(x)/x power spectrum.
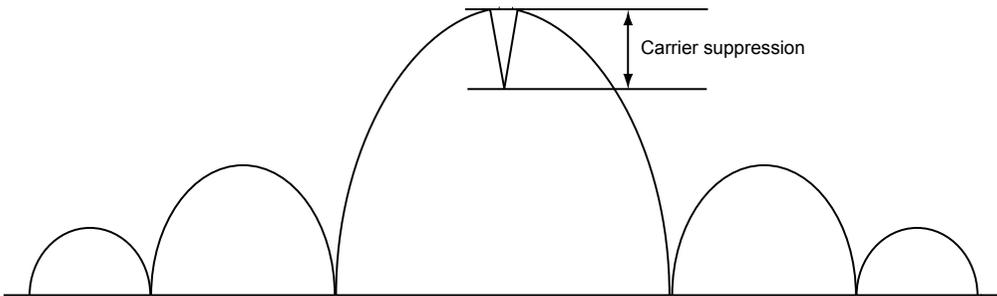
Figure 9-20. Carrier Suppression

Power Spectral Density (PSD)

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Power Spectral Density" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].
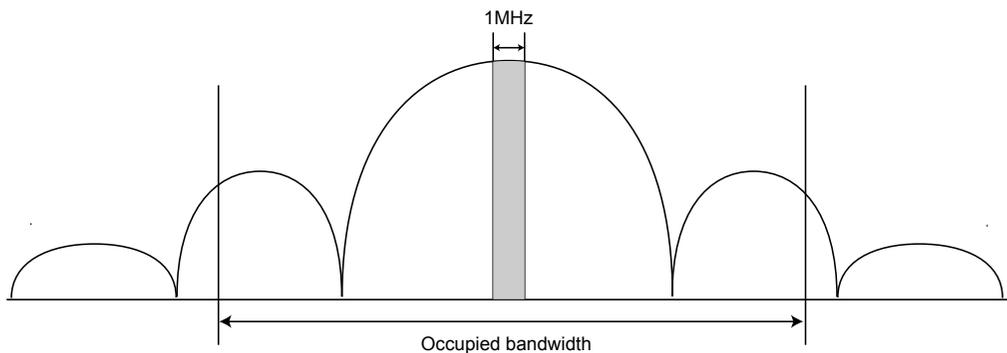
Figure 9-21. Power Spectral Density

The table within the spectral profile window changes to display the power spectral density result.

Occupied Bandwidth

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "Spectral Profiles" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Tx Testing] tab > [Tx Advanced Settings...] > [Spectral Profile Settings] tab.

5. Select "Occupied Bandwidth" from the "Measurement Type" frame.

6. Click [Run Once] or [Run Continuous].The table beneath the trace within the [Spectral Profiles] window changes to display the OBW results. The value within the "OBW" cell of the table indicates the frequency within which the specified percentage of power is contained.

Figure 9-22. Occupied Bandwidth

9-5   IQ Constellation Measurements (EVM Analysis)

The IEEE 802.11 specification uses a metric called Error Vector Magnitude (EVM) as a measure of modulation quality. EVM is a measure of the difference between the ideal symbol position and the measured symbol position. The difference between these two positions is referred to as the error vector and is shown in the figure below by the distance "e".

EVM is an excellent measure of overall transmitter quality and a high EVM reading typically results in similarly high packet error rate.
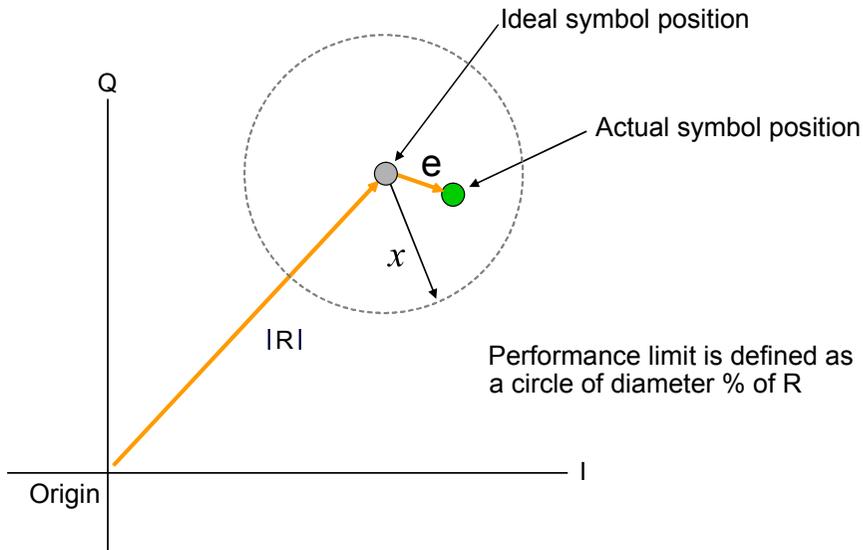
Figure 9-23. EVM Explanation

The following points should be considered when performing IQ constellation / EVM measurements.

- The transmitted signal must contain an 'off' period, i.e. it must not be a continuous transmission.
- The EVM analysis is performed on the first burst found after the trigger, including the pre trigger delay.
- The gate positions do not effect the EVM analysis.
- The EVM analysis is performed over a specified number of chips/symbols. To configure the analysis length, click [Tx Advanced Settings...] > [EVM Settings] tab.
- The burst captured must contain at least the specified number of chips/symbols.
- Independent analysis lengths for the DSSS and OFDM data rates are provided.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "IQ Constellation" from one of the drop-down fields in the "Measurement Window Configuration" frame.

4. Click [Run Once] or [Run Continuous] to run IQ constellation measurements on the packet payload.

Note	The IQ constellation displayed by LANLook is determined by the WLAN Standard and Data Rate settings. If the data rate does not match the rate of transmission from the DUT, it is possible that the analysed data will be mapped onto the wrong constellation.

802.11b / 802.11g (DSSS Data Rates)

The 802.11b specification defines two modulation techniques.
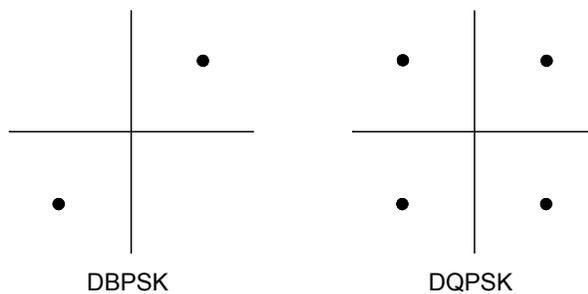
Figure 9-24. DSSS Modulation

The DSSS data rates and associated modulation methods are illustrated in the table below.

Table 9-6.   DSSS Data Rates and Modulation Methods

Data Rate (Mbps)	Modulation	Spreading / coding scheme
1	DBPSK	11 chip Barker sequence
2	DQPSK	11 chip Barker sequence
5.5	DQPSK	CCK
11	DQPSK	CCK

Note	Users should note that although IQ constellation measurements can be performed at a data rate of 1 Mbps (DBPSK modulation), the IEEE 802.11b specification stipulates that the measurement should be made using DQPSK modulation.

Figure 9-25. [IQ Constellation] Window showing DQPSK Constellation

The screen capture above shows a typical DQPSK constellation. The statistic of most interest to the user is the "Max" value that displays at the "EVM Results" field. The 802.11b specification stipulates that the worst-case vector error magnitude should not exceed 35%.

Chip Clock Error

The chip clock error measurement results are also displayed in the dialog above. The 802.11b specification stipulates that the chip clock frequency tolerance shall be better than ±25 ppm.

Frequency Error

The center frequency measurement results are also displayed in the dialog above. The 802.11g specification stipulates that the center frequency tolerance shall be better than ±25 ppm.

802.11g (OFDM Data Rates)

Each of the OFDM sub-carriers can be modulated using any of the following four techniques.

Figure 9-26. OFDM Modulation

The OFDM packet structure is shown in the figure below. In addition to the modulation constellations, the MT8860B can be used to display graphical results for EVM vs sub-carrier and EVM vs. symbol . These may be of particular use when a detailed analysis of the cause of distortion is required.
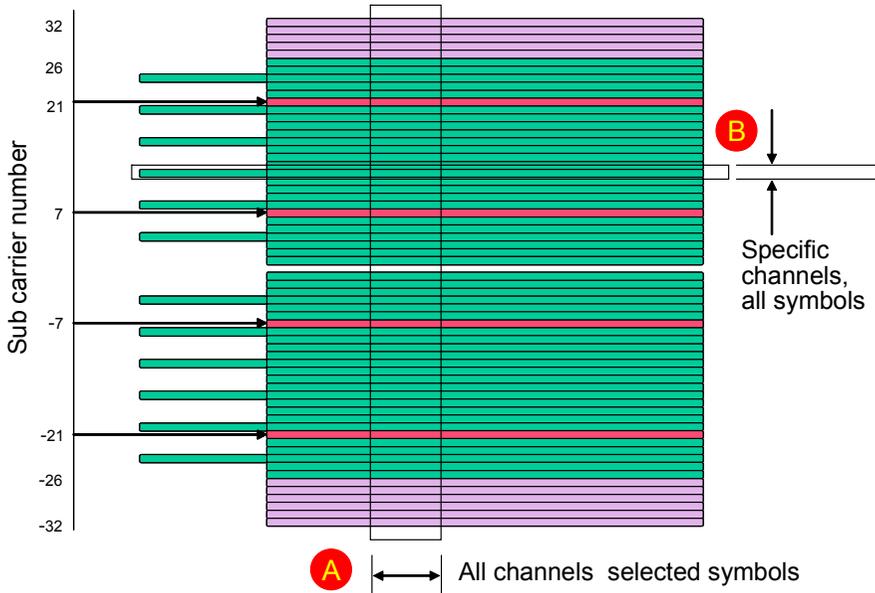
Figure 9-27. OFDM Packet Structure

The OFDM data rates and associated modulation methods are illustrated in the table below.

Table 9-7. OFDM Data Rates and Modulation Methods

Data Rate (Mbps)	Modulation
6	BPSK
9	BPSK
12	QPSK
18	QPSK
24	16QAM
36	16QAM
48	64QAM
54	64QAM
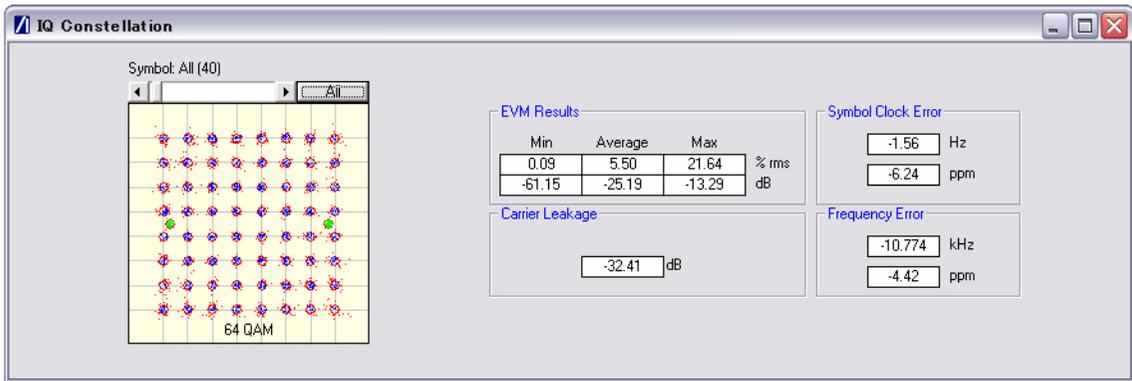
Figure 9-28. [IQ Constellation] Window showing 64 QAM Constellation

The screen capture above shows a 64 QAM constellation. The statistic of most interest to the user is the "Average" value that displays at the "EVM Results" field. Set the average to 20 to make measurements as specified in the IEEE standard.

Table 9-8.   Maximum Permissible EVM Values Per Data Rate

Data Rate (Mbps)	EVM (dB)	EVM (% RMS)
6	-5	56.2
9	-8	39.8
12	-10	31.6
18	-13	22.3
24	-16	15.8
36	-19	11.2
48	-22	7.9
54	-25	5.6

Symbol Clock Error

The symbol clock error measurement results are also displayed in the dialog above. The 802.11g specification stipulates that the symbol clock frequency tolerance shall be ±25 ppm maximum.

Frequency Error

The center frequency measurement results are also displayed in the dialog above. The 802.11g specification stipulates that the center frequency tolerance shall be better than ±25 ppm.

Carrier Leakage

The carrier leakage measurement results are also displayed in the dialog above. Carrier leakage is measured during the 8 µs phase and is relative to the average power of the -16 to +16 sub-carriers.

9-6   EVM vs Sub-Carrier Measurements (OFDM only)

Although not a defined measurement of the IEEE, the EVM vs Sub-Carrier measurement is a powerful analysis tool that displays the average and max / min EVM for each OFDM channel.

   1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

   2. Select the appropriate WLAN standard from the [Wireless Test] tab (see Table 9.3).

   3. Select "EVM vs Sub-Carrier" from one of the drop-down fields in the "Measurements Window Configuration" frame.

   4. Click [Run Once] or [Run Continuous] to display a trace such as that shown below. The vertical green lines at ± 7 and ± 21 are the pilot carriers, the blue bars are the maximum and minimum values and the horizontal trace shows the average EVM.

Figure 9-29. [EVM vs Sub Carrier] Window

9-7   EVM vs Symbol Measurements (OFDM only)

Although not a defined measurement of the IEEE, the EVM vs Symbol measurement is a powerful analysis tool that displays the average and max / min EVM for each symbol in the gate.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

3. Select "EVM vs Symbol" from one of the drop-down fields in the "Measurements" frame.

4. Click [Run Once] or [Run Continuous] to display a trace such as that shown below.
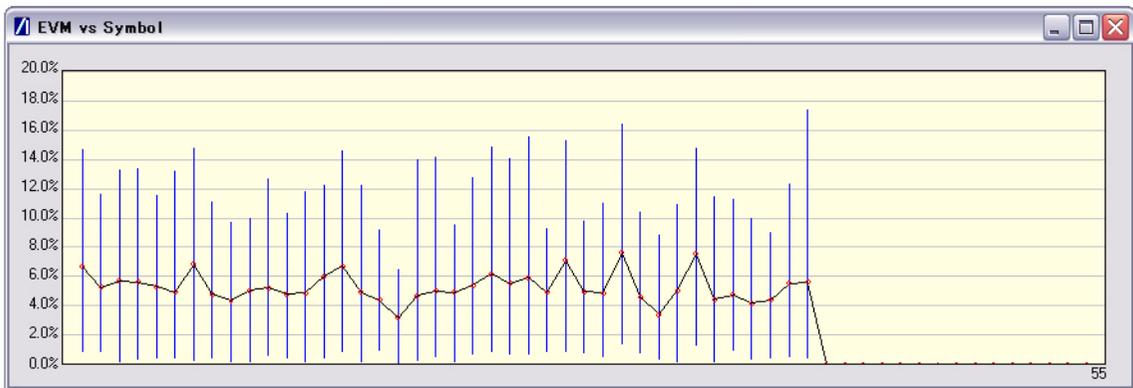
Figure 9-30. [EVM vs Symbol] Window

9-8   Spectral Flatness Measurements (OFDM only)

The spectral flatness measurement provides the user with a display of RF level vs sub-carrier over the measurement range.

The IEEE 802.11 specification stipulates acceptable values for the average energy of the constellations in each of the sub-carriers. For lines -16 to -1 and 1 to 16 the average energy of any individual sub-carrier should deviate no more than ± 2 dB from their average energy of all 32 central sub-carriers. For lines -26 to -17 and 17 to 26 the average energy of the constellations in each of the spectral lines should deviate no more than +2/-4 dB from the average energy of spectral lines -16 to -1 and 1 to 16. The data for this test is measured over the 8µs channel estimation period of the packet while all 52 sub-carriers are on.

    1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

    2. Select the appropriate WLAN standard from the [Wireless Setup] tab (see Table 9.3).

    3. Select "Spectral Flatness" from one of the drop-down fields in the "Measurements" frame.

    4. Click [Run Once] or [Run Continuous].

Figure 9-31. [Spectral Flatness] Window

The spectral mask (shown by the horizontal lines) is split into three sections; an upper limit with a default setting of +2.0 dB, a lower side limit with a default setting of -4.0 dB, and a lower centre limit with a default setting of -2.0 dB. Each of the spectral mask sections can be moved freely to the required position and the dB value appears in a small pop-up next to the cursor when the line is being moved. The new limit values are sent automatically to the MT8860B when the user releases the mouse button. Channel measurements that fall outside of the limits of the mask display in red and also carry a small label that appears near the cursor to say how many times that channel failed.

9-9 Numeric Results of Transmitter Measurements

Transmitter measurement results can also be viewed as numeric data. Viewing the results in this format is slightly quicker as it requires less remote data than when viewing the traces graphically.

1. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

2. Select "Numeric Results Only" in the "Measurement Window Configuration" frame.

3. Click [Run Once] or [Run Continuous] to view the results. The figure below shows the numeric results window for an OFDM data rate.

Tx Tests Numerical Results

Power	Start	Stop	Peak	Average	Crest Factor	Rise	Fall	Distribution
Gate 1	0.005 ms	0.179 ms	18.29 dBm	9.50 dBm	8.79 dB	0.07 us	0.27 us	6.50 dB
Gate 2	0.02 ms	0.181 ms	18.29 dBm	9.51 dBm	8.78 dB	0.07 us	0.27 us	6.50 dB

EVM	Minimum	Average	Maximum
% rms	0.06 %	3.84 %	14.42 %
dB	-64.75 dB	-28.31 dB	-16.82 dB

IQ Analysis	802.11g OFDM		802.11 b/g DSSS	
Carrier Leakage / IQ Offset	-30.49 dB		n/a	
Phase Error	n/a		n/a	
Magnitude Error	n/a		n/a	
Frequency Tolerance	-37.88 kHz	-15.54 ppm	n/a	n/a

Clock Error	802.11g OFDM (Symbol Clock)	802.11 b/g DSSS (Chip Clock)
Hz	-3.11 Hz	n/a
ppm	-12.46 ppm	n/a

Spectrum Mask	Status
Gate 1	PASS
Gate 2	PASS

Spectrum Mask	L4	L3	L2	L1	U1	U2	U3	U4
Gate 1 Power (dBr)	-14.6	-14.0	-13.2	-15.2	-17.2	-15.6	-17.0	-14.1
Gate 2 Power (dBr)	-13.4	-13.5	-12.1	-14.2	-15.8	-13.6	-15.9	-13.8
Gate 1 Frequency (MHz)	-31.6	-20.4	-11.9	-10.7	10.6	11.8	29.6	30.5
Gate 2 Frequency (MHz)	-31.6	-20.4	-11.9	-10.9	10.9	11.8	28.0	31.3

Spectrum Data	Spectral Density	Occupied Bandwidth	Carrier Suppression	Spectral Flatness
Gate 1	-0.73 dBm/MHz	16.4 MHz	-	PASS
Gate 2	-0.71 dBm/MHz	16.4 MHz	-	n/a

Figure 9-32. [Tx Tests Numeric Results] Window

Chapter 10 — Receiver Testing in Direct Mode

A WLAN connection with the DUT is not required in order to perform Rx testing in Direct mode. When Direct mode is selected the Network setup settings within LANLook are no longer applicable and are replaced by a message to this end.

10-1 Test Methodology and Settings

When testing the Rx sensitivity of a device in Direct Mode, the MT8860B is configured to transmit a specified number of data packets. After the final packet has been transmitted, a baseband register (internal to the DUT) is read. This register contains the number of packets received without error. The PER is then calculated from the number of packets sent by the MT8860B and the number received without error.
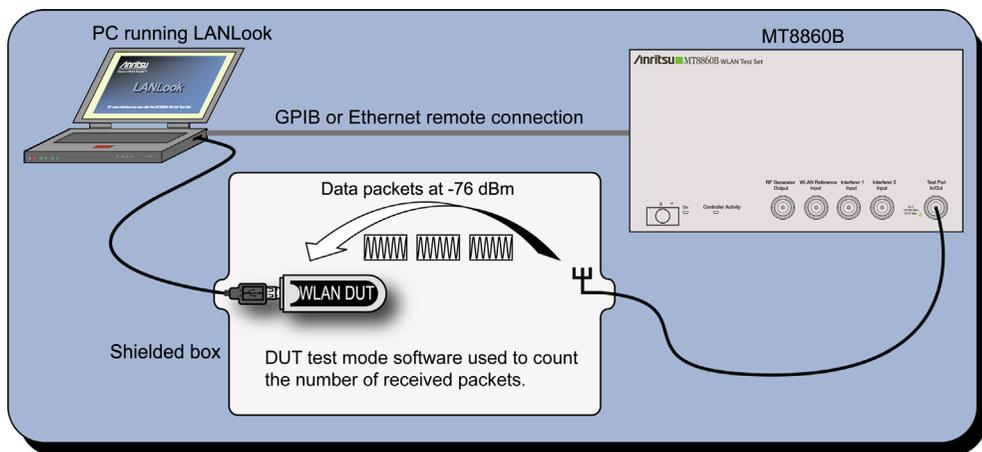
Figure 10-1. Receiver Testing in Direct Mode

All DUT receiver measurements are based on the calculation of Packet Error Rate (PER). PER is defined as follows.

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

802.11 PER Specifications

For DSSS data rates, the IEEE 802.11b specification states that the packet error rate (PER) must not exceed 8% for an input level no greater than -76 dBm measured at the antenna connector. The specification recommends that the test is performed using an 11 Mbps CCK modulated signal with a PSDU length of 1024 bytes.

For the OFDM data rates, the IEEE 802.11b specification states that the packet error rate (PER) shall be less than 10% at a PSDU length of 1000 bytes for the input levels indicated in the table below. Input levels are specific for each data rate and are measured at the antenna connector. A noise figure (NF) of 10 dB and an implementation loss of 5 dB are assumed.

Table 10-1. Sensitivity and Rejection by Data Rate

Data rate (Mbps)	Minimum sensitivity (dBm)	Adjacent channel rejection (dB)	Alternate adjacent channel rejection (dB)
6	–82	16	32
9	–81	15	31
12	–79	13	29
18	–77	11	27
24	–74	8	24
36	–70	4	20
48	–66	0	16
54	–65	–1	15

1. Establish a remote connection between the MT8860B and PC as detailed in chapter 5.

2. Make the required settings on the [Wireless Test] tab as shown below.

Figure 10-2. Wireless Setup

3. Click the [Rx Testing] tab shown below.
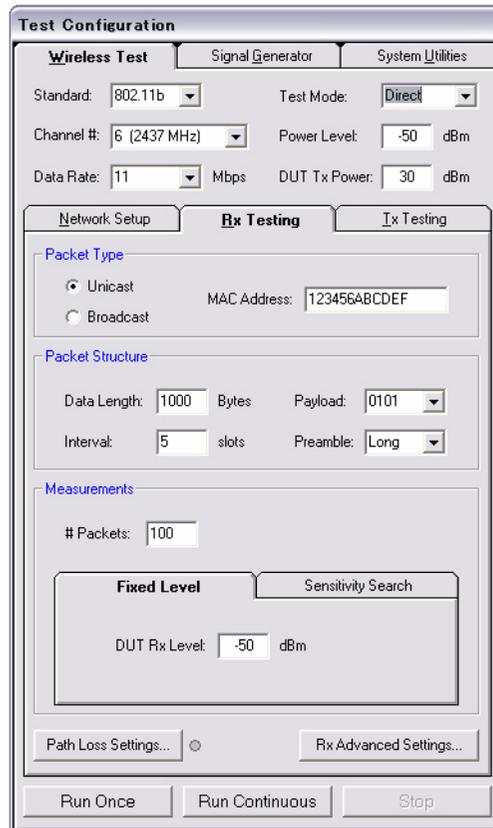
Figure 10-3. [Rx Testing] Tab

4. Specify the type of transmission to be sent from the MT8860B to the device.

Unicast:	This is the default setting in which the MT8860B transmits packets with a unique MAC address specified by the user.
Broadcast:	In broadcast mode the MT8860B transmits packets using the broadcast address (FF-FF-FF-FF-FF-FF).
MAC Address:	The unique 12 digit hexadecimal MAC address.

5. Specify the packet structure at the following items.

Data Length:	The data length of the packet can be set to any value between 60 and 1500 bytes.
Interval:	The interval specified represents the number of slots between frame transmissions. For transmission of DSSS modulated data, each slot is equal to 20 µs, for transmission of OFDM modulated data, each slot is equal to 9 µs.

Payload: Defines the bit sequence pattern of the dummy data in the payload. There are six options available in the drop down list: ZEROS, 0101, 1010, PN7, RANDOM, and COUNT. The required payload is determined by the test that the user wishes to perform.

Preamble: For data rates of 2, 5.5 and 11 Mbps, long and short preamble options are available. The long setting represents a preamble with 144 bits, and the short with 72. A short preamble setting equates to more payload data being transmitted with each packet for a given timeslot. For 1 Mbps a long preamble is used.

Note	Preamble settings are not applicable for OFDM data rates.

6. Specify the number of packets to be transmitted.

Packets: Specify the number of packets to be transmitted. Enter a value within the range of 1 and 10,000.

7. If required, a signal level correction table can be used to compensate for test system and cable loss effects. Refer to chapter 12 for details.

8. Follow the instructions over the following pages to perform the required measurements.

- Measuring PER at a fixed power level
- Measuring PER at a varying power level
- Measuring PER in broadcast mode
- Measuring PER with adjacent channel interference

10-2   Measuring PER at a Fixed Power Level
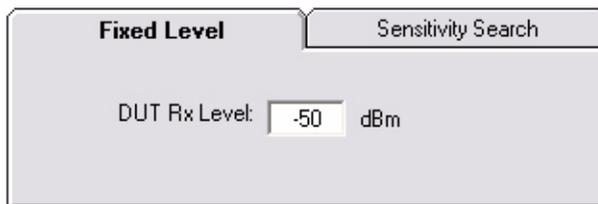
Figure 10-4. PER Setting

1. Follow the instructions in "Test Methodology and Settings" at the start of this chapter.

2. Click the [Fixed Level] tab shown above.

3. Set the required MT8860B transmission power level at the "DUT Rx Level" setting.

4. Click [Run Once] to initiate the transmission of packets.

5. Use the chipset vendor's test mode software to read the number of packets successfully received by the DUT.

10-3   Measuring PER with Channel Interference
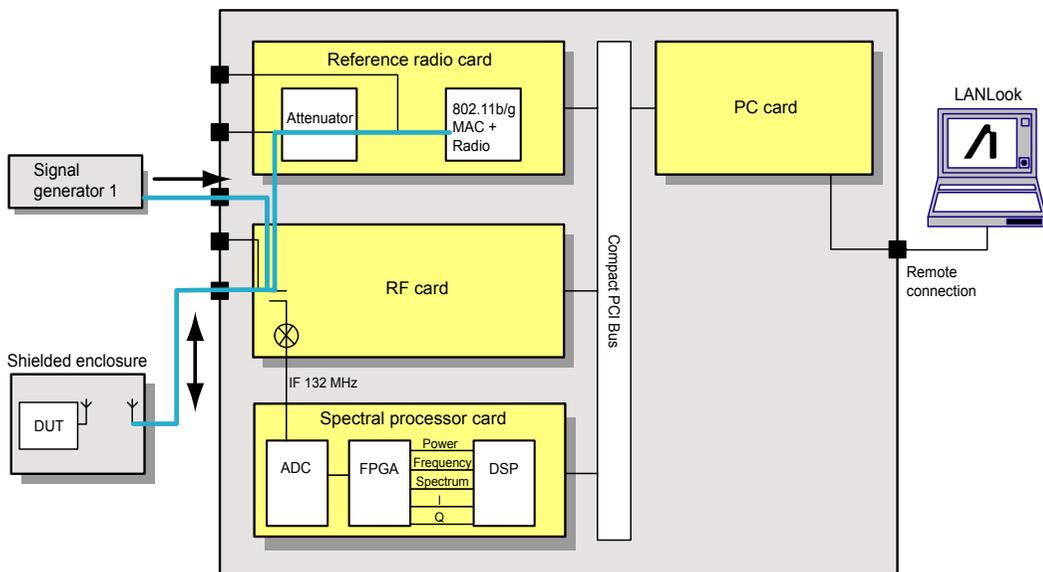
Figure 10-5. PER with Channel Interference

In addition to the normal test configuration detailed earlier, an external signal generator can be coupled to the MT8860B to measure adjacent or alternate channel rejection.

Adjacent Channel Rejection Specifications

For DSSS data rates, adjacent channel rejection is defined between any two channels with 25 MHz separation. The adjacent channel rejection must be equal to or better than 35 dB, with a PER of 8% using 11 Mbps CCK modulation and a PSDU length of 1024 bytes.
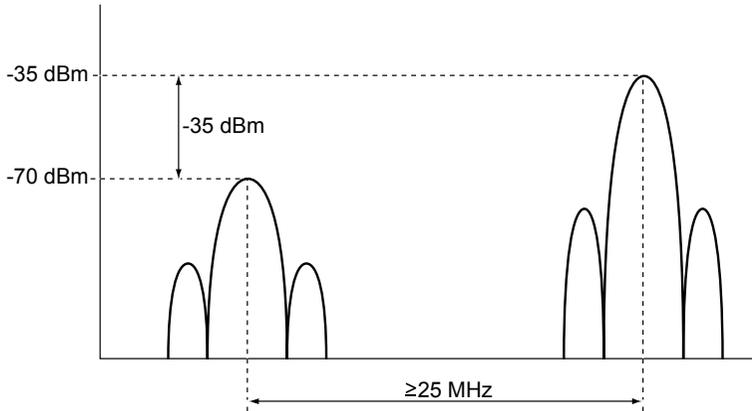
Figure 10-6. Adjacent Channel Rejection

For OFDM data rates, the adjacent channel rejection shall be measured by setting the desired signal's strength 3 dB above the rate-dependent sensitivity specified in the table below and raising the power of the interfering signal until 10% PER is caused for a PSDU length of 1000 bytes. The power difference between the interfering and the desired channel is the corresponding adjacent channel rejection. The interfering signal in the adjacent channel shall be a conformant OFDM signal, unsynchronized with the signal in the channel under test.

Table 10-2. Sensitivity and Rejection Values Per Data Rate

Data rate (Mbps)	Minimum sensitivity (dBm)	Adjacent channel rejection (dB)	Alternate adjacent channel rejection (dB)
6	-82	16	32
9	-81	15	31
12	-79	13	29
18	-77	11	27
24	-74	8	24
36	-70	4	20
48	-66	0	16
54	-65	-1	15

1. Connect a signal generator to either of the interferer inputs on the front of the MT8860B.

2. Set the signal generator to transmit on the required channel.

3. Follow the instructions detailed in "Test Methodology and Settings" at the start of this chapter.

4. Click [Rx Advanced Settings] and select the interferer check box to match the interferer port in use on the front of the MT8860B.

Figure 10-7. Rx Advanced Settings

5. Set the required transmission power level on the [Fixed Level] tab in the "Measurements" frame.

6. Click [Run Once].

Note	The typical path loss from the interferer input to the test port is 22 dB.

Chapter 11 — Using the WLAN Reference Input

11-1 Overview

The MT8860B is provided with a WLAN reference input connector. This allows DUT receiver measurements to be performed using an external WLAN device instead of the internal reference radio. In this mode of operation, only the leveling loop and attenuator hardware of the MT8860B are used to provide a calibrated signal level at the Test Port Connector. In order that the correct signal level is produced at the test port connector, the following test conditions must be used –

- The average power at the WLAN reference input must be in the range +12 dBm to + 18dBm.
- The packets generated by the WLAN device must be > 110 us in length.
- The "Tx ON" signal from the WLAN device must be connected to the rear panel BNC connector "Digital 2 In".

Note	No measurements are supported by MT8860B in this mode of operation.
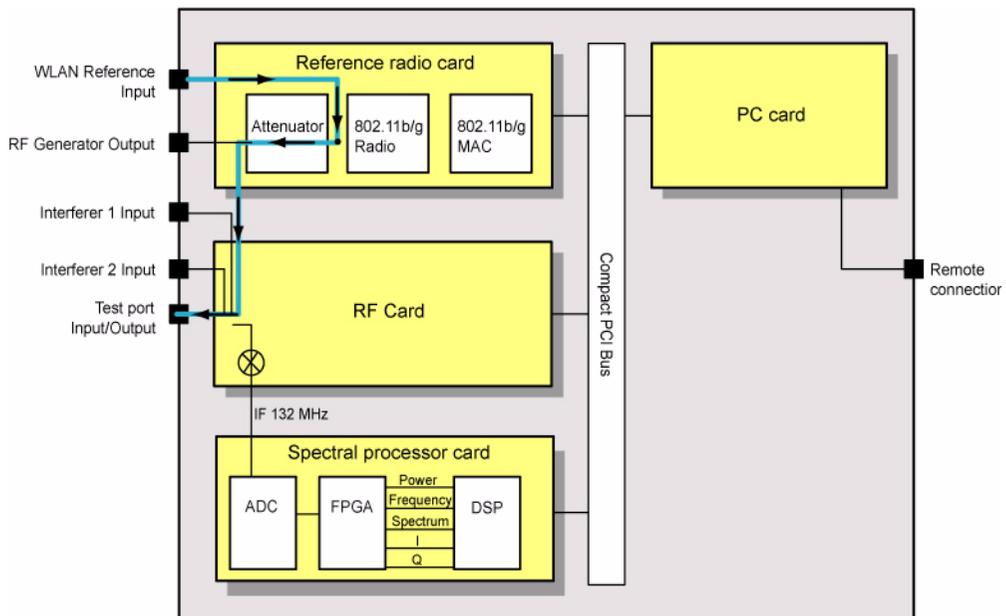
Figure 11-1. WLAN Reference Input

11-2   Procedure

1. Establish a remote connection between the MT8860B and the PC as detailed in chapter 5.

2. Make the required wireless test settings.
The wireless test settings are used to apply the correct calibration for the selected channel number. Ensure that the settings in this pane match the transmission characteristics of the external WLAN device.

3. From LANLook, click the [Rx Testing] tab shown below.
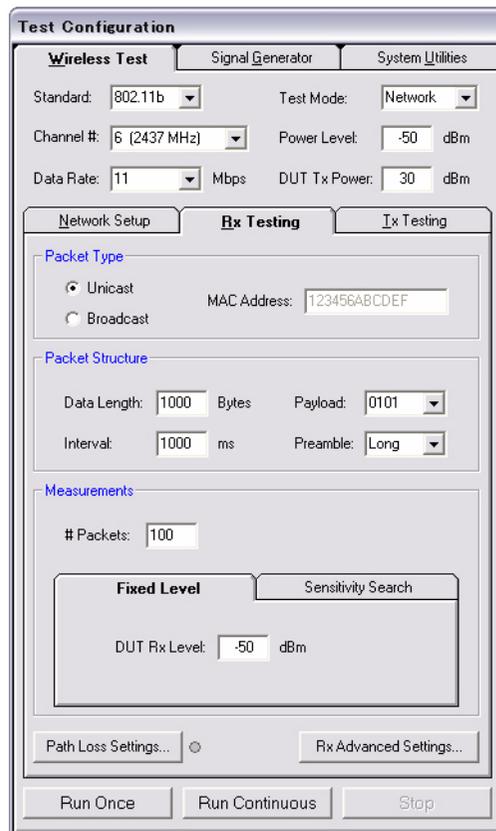
Figure 11-2. [Rx Testing] Tab

4. Click [Rx Advanced Settings...] at the bottom of the page and set the Reference Radio to "External" as shown below.
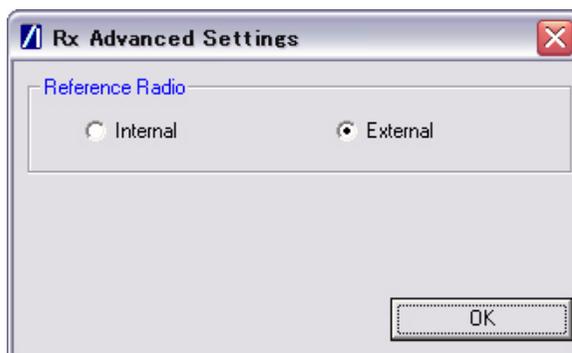
Figure 11-3. [Rx Advanced Settings] Dialog

5. Click [OK]. The Rx testing tab now has the following appearance.
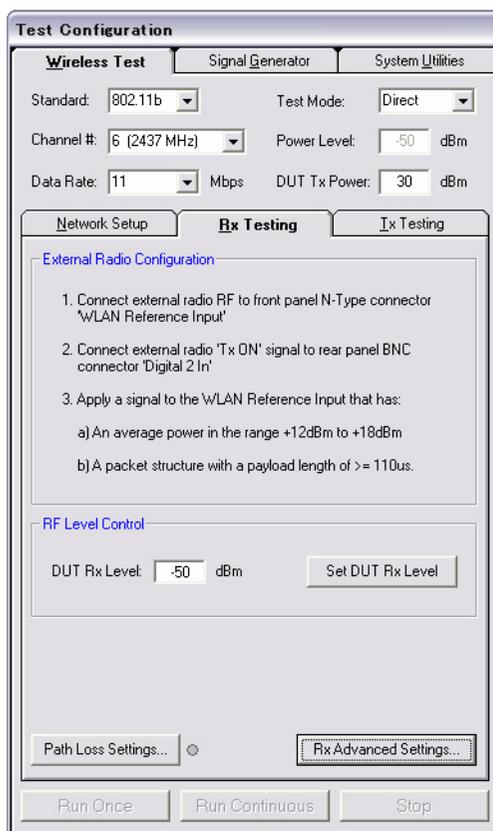
Figure 11-4. [Rx Testing] Tab

6. At the "DUT Rx Level" setting, specify the required power level at the test port connector.

7. If required, a signal level correction table can be used to compensate for test system and cable loss effects. Refer to chapter 12 for details.

8. Click the [Set DUT Rx Level] button. The MT8860B performs a leveling operation to produce the power level specified.

Chapter 12 — Common Procedures

This chapter provides a quick reference to a number of simple procedures with which users will need to gain familiarity. The procedures are listed in alphabetical order based upon the most logical topic heading.

12-1   10 MHz Reference Source

The user can choose to use an external reference source by making a connection to the "10 MHz Ref In" port on the rear of the MT8860B and following the procedure below.

    1. Open LANLook and click the [System Utilities] tab.

    2. The [System Utilities] tab contains three further tabs. Click the [System Settings] tab to display the page shown below.
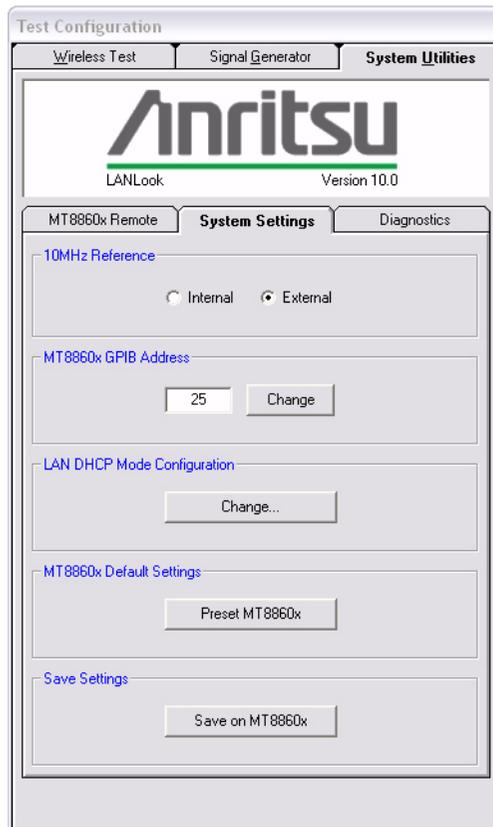
Figure 12-1. [System] Tab

3. In the "10 MHz Reference" pane, change the reference source to "External".

Note	An external 10 MHz reference source must be applied to the rear panel BNC prior to selecting the external mode of operation. If the external 10 MHz source is selected but not applied the MT8860B uses the internal reference.

12-2　CCDF - Setting Percentages (OFDM data rates only)

The CCDF profile (Complementary Cumulative Distribution Function) allows the user to ascertain the percentage of samples for which the power level specified by the markers is greater than the average power. The CCDF percentage is set to 99% by default. This value can be changed as specified below.

Note	Users should note that in order for the power distribution to be updated correctly, it is necessary to send the new percentage setting to the MT8860B by pressing [Run Once] or [Run Continuous].

1. If measurements are in progress, click [Stop].

2. Right click the [CCDF profile] plot and select [Set CCDF Percentage] from the pop-up menu that displays.

3. Specify the required percentage in the [CCDF Setup] dialog that displays.

4. Click [Run Once] or [Run Continuous] to commence measurement and send the new CCDF percentage to the MT8860B.

5. The results of the calculation are returned in the "Power distribution" table beneath the CCDF trace. In the example of the figure below, the CCDF setup was left at the default setting of 99% and a power distribution of 6.5 dBs was returned. This tells the user that for all the samples captured, 99% were no greater than 6.5 dB above the average power OR 1% exceeded the average power by at least 6.5 dB.
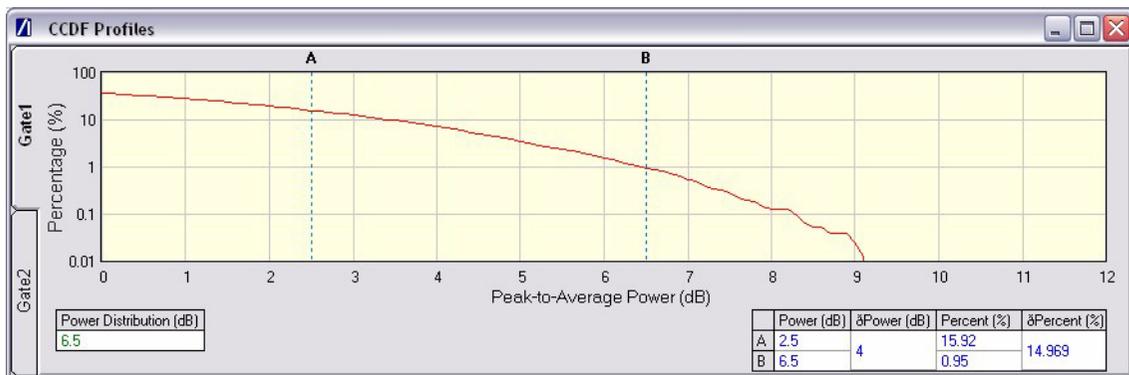
Figure 12-2. [CCDF Profile] Window

12-3   Crest Factor / Rise/Fall Data - Selecting

The user can display either crest factor or rise/fall data in the [Power Profile] window.

1. Click the [Tx Testing] tab.

2. Click [Tx Advanced Settings...].

3. Click the [Power Profile Settings] tab.

4. Select "Rise & Fall Times" or "Crest Factor".

12-4   Default Settings - Returning to

1. Start up LANLook and display the [System Utilities] tab.

2. The [System Utilities] tab contains three further tabs. Click the [System Settings] tab.

3. Click [Preset] to return the MT8860B to its default settings.

Note	When the [Preset] button is clicked the MT8860B is returned to its default settings without further warning. Give due consideration before using this function.

12-5   Diagnostics Tool

The diagnostics tool can be used to generate a log of events for analysis if operational difficulties are experienced. The diagnostics tool can be used regardless of whether or not LANLook is being used as the control system. Follow the procedure below to generate a log of GPIB events.

1. Replicate the series of events leading up to the occurrence of the error.

2. Select [Launch Diagnostics Tool] from the [Tools] menu to display the window shown below.

3. Check that the correct instrument has been identified and that the remote address is correct.

4. Click [Get Log] to generate the log in the main "Log file detail" area of the dialog.

Note	If problems are experienced during log generation, click [Device clear] to clear the input and output queues and release an abort request to the system. If the generated log is too long, click [Delete Log] to delete the current data log from within the MT8860B. Once deleted, replicate the problem again and then click [Get Log] to generate a new, shorter log.
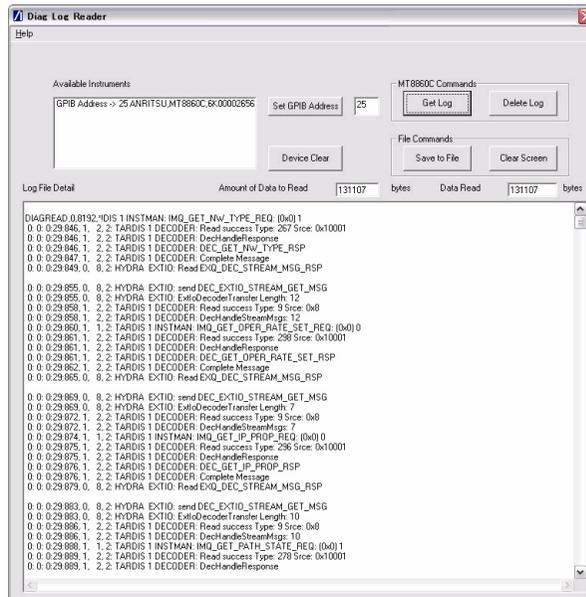
Figure 12-3. [Diag Log Reader] Dialog

5. Once the log has been generated, click [Save to File] to save the log as a text file.

6. Send the text file to Anritsu for analysis.

Note	For those using an Ethernet remote connection, a diagnostics log can be viewed by opening a web browser and typing http://A000xxxx/DiagLogFile1.txt (where xxxx is the four digits after the zeros in the MT8860B serial number). Once generated, the file in the browser can be saved as a text or html file and sent to Anritsu for analysis.

12-6   Gates - Positioning

Two gates display on the [Power Profile] and [Frequency Profile] test result windows. The gate start and stop positions are shown by vertical lines denoted by the numbers 1 and 2. The boundaries of gate 1 display in green, and those of gate 2 in purple. Gates can be positioned using either of the methods detailed below.

Method 1: Dragging Gates

1. Position the mouse pointer directly above any position on any the vertical gate lines.

2. Click and drag the gate as required whilst still holding down the mouse button.

3. The gate values that display in the table beneath the trace are automatically updated.
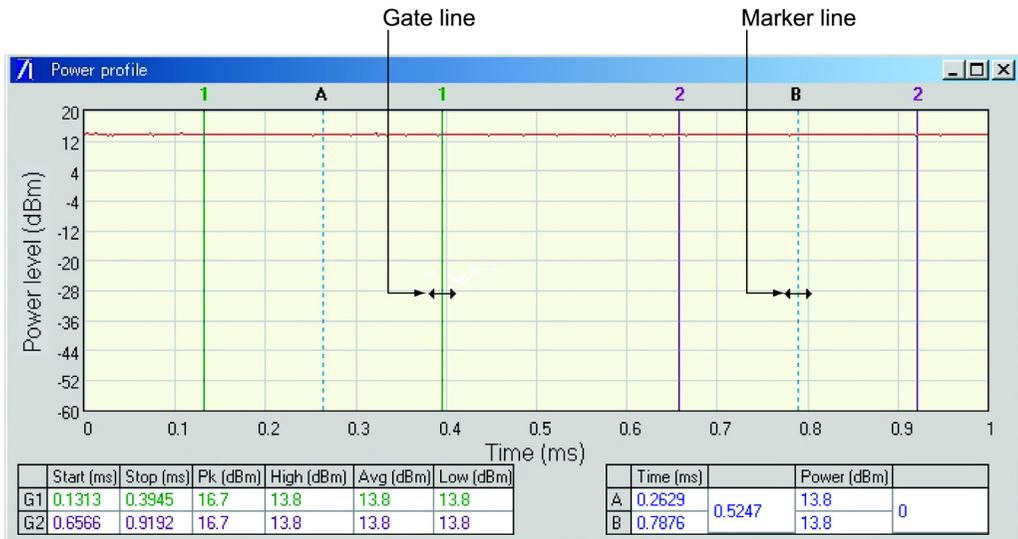
Figure 12-4.   Positioning Gates

Method 2: Entering Gate Width

    1. Click [Gate Settings…] on the [Tx Testing] sub-tab to display the dialog below.
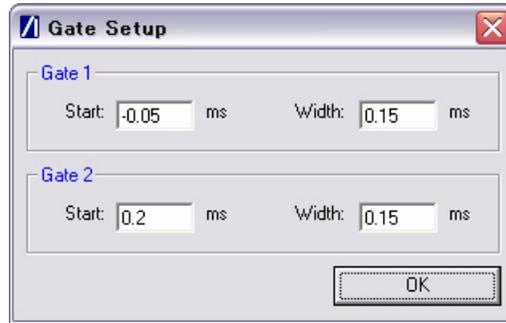
Figure 12-5.   [Gate Setup] Dialog

    2. Enter the gate delay position (start) and the total gate width as required in the dialog shown above.

12-7   GPIB Address - Changing

1. Start LANLook and click [System Utilities] tab > [MT8860x Remote] tab.

2. Select "GPIB" at the "Remote Interface" setting.

3. Press [Scan for Instruments] to acquire a list of all GPIB addresses found.

4. Select the required address from the list and click [Connect].

5. Click the [System Settings] sub-tab to display the page below.
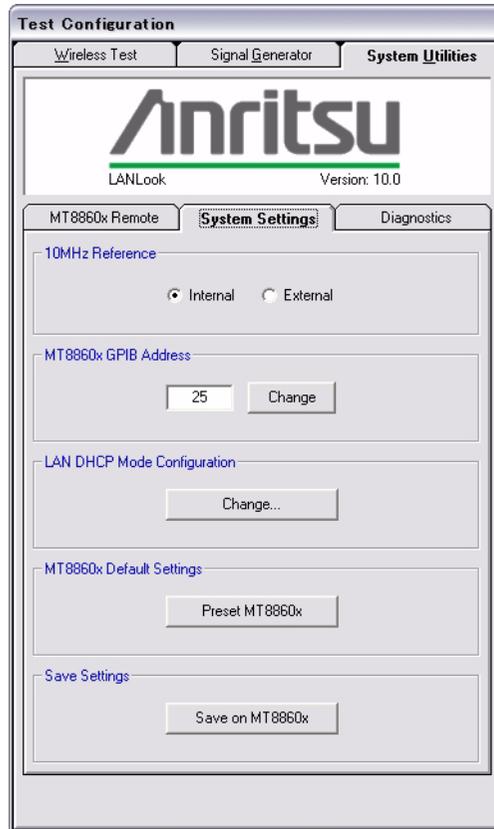
Figure 12-6. [System] Tab

6. Enter the new GPIB address of the MT8860B in the "GPIB Address" field.

7. Click [Change] to register the change at the unit.

Note	The MT8860B GPIB address cannot be changed without first establishing a GPIB connection as detailed above.

12-8   Graphs - Scaling

Power, Frequency, and Spectral Profiles

1. Right click the required plot and select either [Default scaling], [Auto scaling], or [Manual scaling] from the pop-up menu that displays.

2. For auto and default scaling, the plot changes as soon as the scaling command is selected. For [Manual scaling], a dialog displays to allow the user to specify the maximum and minimum Y-axis dBm levels. Enter the required values and click [OK].
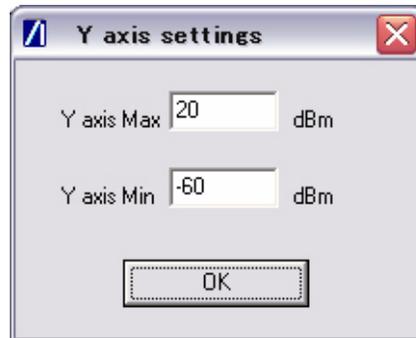
Figure 12-7. [Y-Axis Settings] Dialog

EVM Profiles

Right click the required plot and select the 5%, 10%, 20%, or 50% scale command from the pop-up menu that displays.

12-9   LAN IP Configuration - Changing

1. Start LANLook and click [System Utilities] tab > [MT8860x Remote] tab.

2. Select "LAN" at the "Remote Interface" setting.

3. Enter the IP address or hostname and click [Connect].

4. Click the [System Settings] sub-tab.

5. Click [Change...] in the "LAN DHCP Mode Configuration" frame.

6. Select "Use the following IP Address and Sub Net Mask".
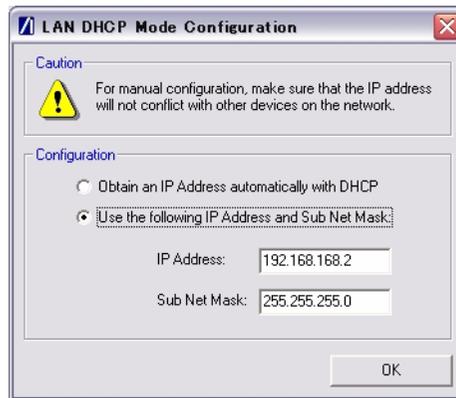
Figure 12-8. LAN DHCP Mode Configuration

7. Enter the required IP address and sub net mask and click [OK]. LANLook displays the following message.
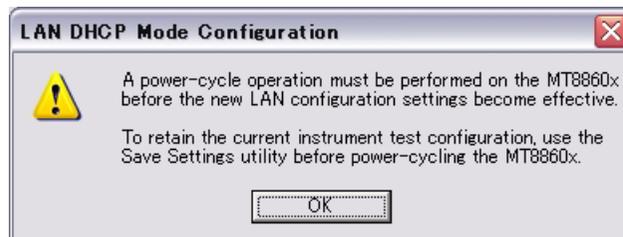
Figure 12-9. LAN DHCP Mode Configuration Warning

Note	Make sure that the new address does not already exist on the network. A power cycle operation must be performed before the new LAN configuration settings become effective.

12-10 LANLook Software - Upgrading

1. Download the latest software package from the Anritsu website. To do this, go to http:// www.eu.anritsu.com/downloads/, select "MT8860B" from the drop down list, and click [Show Downloads].

2. Select the LANLook folder, double click the .exe file and follow the instructions that display on screen.

12-11 Markers - Positioning

Two markers display on each of the test results windows. The marker positions are shown by vertical dotted lines and the letters A and B. Position the mouse pointer directly above any position on the vertical marker line.

1. Click and drag the marker as required whilst still holding down the mouse button.

2. The values that display in the table beneath the trace are automatically updated.

12-12 Markers - Zooming

1. Position the markers (the vertical dashed lines labelled "A" and "B" in the Power Profile plot below) on either side of the area to be enlarged.

2. Right click the required plot and select [Zoom to Markers] from the pop-up menu that displays.

3. Select either [Undo Zoom] or [Default Zoom] to zoom out again.
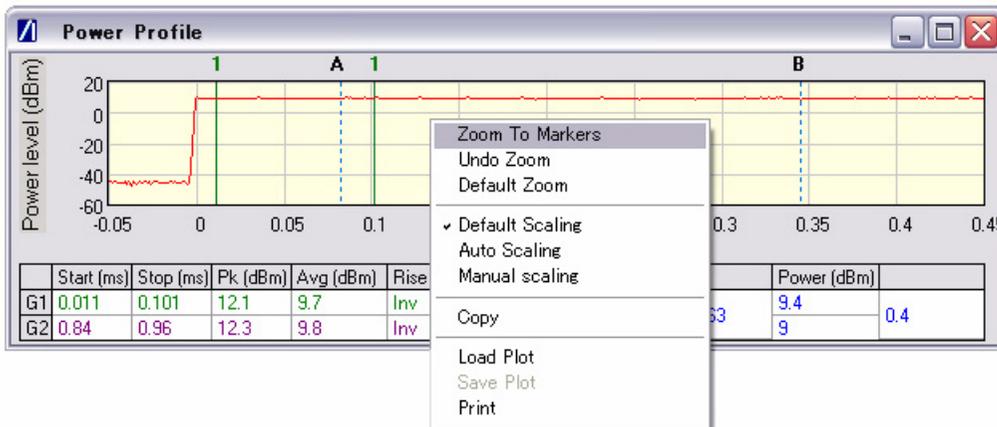
Figure 12-10. Zoom to Markers

12-13 Max-Min Power Profile - Displaying

   1. Click the [Tx Testing] tab.

   2. Click [Tx Advanced Settings...].

   3. Click the [Power Profile Settings] tab.

   4. Select "Display trace in Max-Min format".

   5. When this command is selected LANLook displays both the maximum and minimum values for each display point on the trace. Each of the maximum and minimum values is joined by a line to give a broad trace such as that shown in the example below.
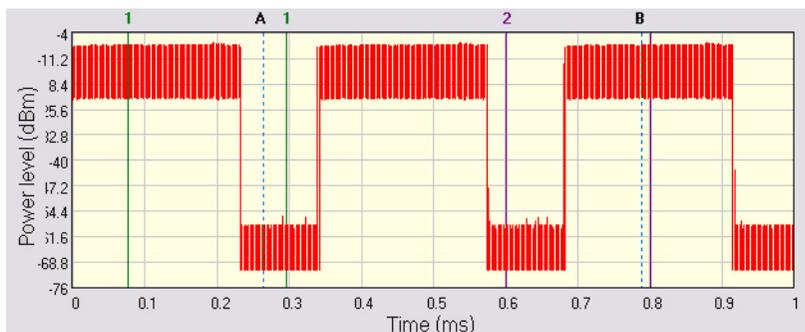
Figure 12-11. Max-Min Power Profile

Displaying the max-min data in this way can be useful to monitor the effect that modulation changes between the preamble and the payload have on the power level of an 802.11g signal.

12-14 Occupied Bandwidth - Setting

   1. Click the [Tx Testing] tab.

   2. Click [Tx Advanced Settings...].

   3. Click the [Spectral Profile Settings] tab.

   4. Enter a percentage value as required at "OBW Percentage" and click [OK].

   5. The value in the "OBW (MHz)" cell of the table beneath the spectral profile trace changes automatically to indicate the frequency within which the specified percentage of power is contained.

12-15 Options - Enabling and Disabling

Options specified at the time of the MT8860B order are installed at Anritsu prior to shipment to the customer. Customers ordering options at a later date should follow the procedure below to enable the selected options upon delivery.

1. Start LANLook and establish a remote connection between the PC and MT8860B as outlined in chapter 5.

Note	If a remote connection is not established the [Option Control] dialog displays the message, "Option control unavailable on this instrument".

2. Select [Option Control…] from the [Configure] menu on the main [Anritsu LANLook] window.
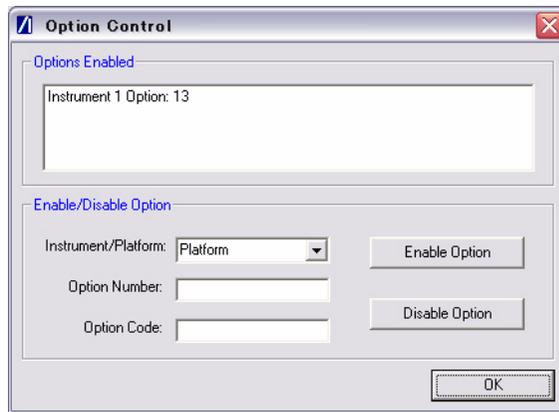
Figure 12-12.[Option Control] Dialog

3. The option code is required to enable or disable an option. Follow the instructions below to enable a new option.

Instrument/platform: Select "Instrument 1" from the drop-down menu.

Option number: Enter the number of the option, e.g., 13

Option code: Enter the option code specified on the option CD label.

4. Click [Enable Option] and then click [OK] to close the [Option Control] dialog.

Options can be disabled by selecting the required option in the "Options Enabled" list and entering the details used when the option was enabled. Select "Instrument 1", enter the option number and option code and click [Disable Option]. Click [OK] to close the [Option Control] dialog.

12-16 Path Loss Table - Configuring

The MT8860B provides a signal level correction table that can be used to compensate for test system and cable loss effects. For each channel, independent Tx and Rx path loss values can be defined. Tx loss values represent loss in the DUT Tx path; Rx loss values represent loss in the DUT Rx path.

1. Start LANLook and display the [Wireless Test] tab.

2. Click [Path Loss Settings...] at the bottom of any of the three sub-tabs to display the dialog below.
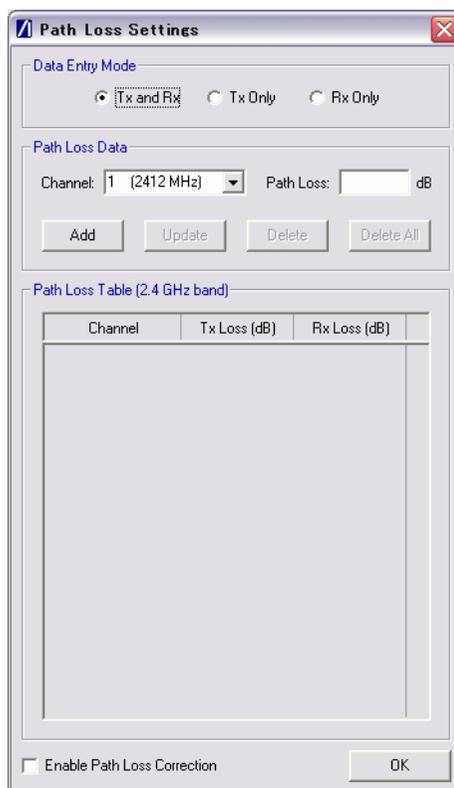
Figure 12-13. [Path Loss Table] Tab

3. Use the "Data Entry Mode" setting to select whether the path loss entries are applied to the Tx path only, the Rx path only, or both Tx and Rx paths.

4. Select the required channel from the "Channel" drop-down box.

5. Enter the path loss in the "Path Loss" entry field and press [Add].

6. The specified loss for each channel displays in the table.

7. Repeat steps 3 to 6 above to add additional lines to the table if required.

8. To enable the path loss table, select "Enable Path Loss Correction" and click [OK] when complete.

9. The LED at the side of the [Path Loss Settings...] button is lit when the path loss table is enabled and a path loss value has been specified for the selected channel number.

Figure 12-14. Path Loss Settings Indicator

Notes	Path loss entries can be deleted from the list by selecting them and clicking [Delete]. The MT8860B does not interpolate between loss values specified for non adjacent channels. Each entry within the path loss table applies to the selected channel only.

12-17 Reference Radio - Enabling

An external gold card can be used instead of the internal reference radio. Follow the procedure below to select the external card.

1. Click the [Wireless Test] tab and the [Rx Testing] sub-tab.

2. Click [Rx Advanced Settings…] at the bottom of the page to display the dialog below.
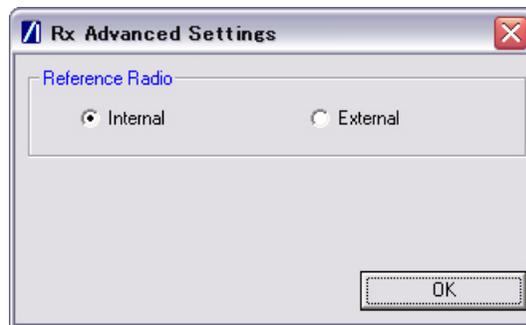
Figure 12-15. [Rx Advanced Settings] Dialog

3. Select the required setting as detailed below.

Internal: Selects the use of the calibrated reference radio within the MT8860B.

External: Selects the use of an external gold card.

Note	Refer to chapter 11 for further information on using an external radio.

12-18 Remote Commands - Transmitting from LANLook

1. Start LANLook, display the [System Utilities] tab and the [MT8860x Remote] sub-tab.

2. Select the required remote interface and establish a remote connection.

3. Click the [Diagnostics] sub-tab to display the page shown below.
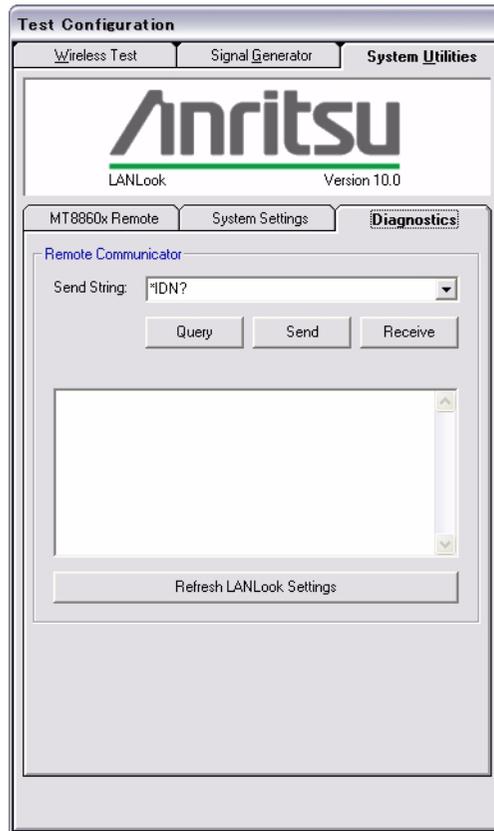
Figure 12-16. [Diagnostics] Tab

4. Enter the required command in the "Send String" text box and click [Send] or [Query].

Note	Remote commands can be transmitted to the MT8860B regardless of whether using a GPIB or LAN remote interface.

12-19 Settings - Saving to the MT8860B

Changes made to the settings within LANLook can be saved to the MT8860B at any time.
Saving the settings in this manner ensures that the changes made are retained even when
LANLook is closed and subsequently re-started.

1. Open LANLook and click the [System Utilities] tab.

2. The [System Utilities] tab contains three further tabs. Click the [System Settings] tab.

3. Click [Save on MT8860x].

Note	Settings can also be saved from a dialog that displays when the user attempts to close LANLook without having saved changes as detailed above.

12-20 Simulation Mode

Simulation data has been included in LANLook to allow the user to demonstrate or become
familiar with the functionality available. Simulation mode is enabled by default until a
WLAN connection is established with the DUT. A message displays in the LANLook status
bar whenever LANLook is running in simulation mode.

Note	Simulation mode is, as the name suggests, merely a simulation of actual operation, and as such certain commands or operations are unavailable in this mode. The [Signal Generator] tab is not available in simulation mode.

12-21 Spectral Mask - Editing (DSSS data rates only)

1. Right click in the graph area of the [Spectral Profiles] window and select [Setup Mask] from the pop-up menu to display the dialog shown below.
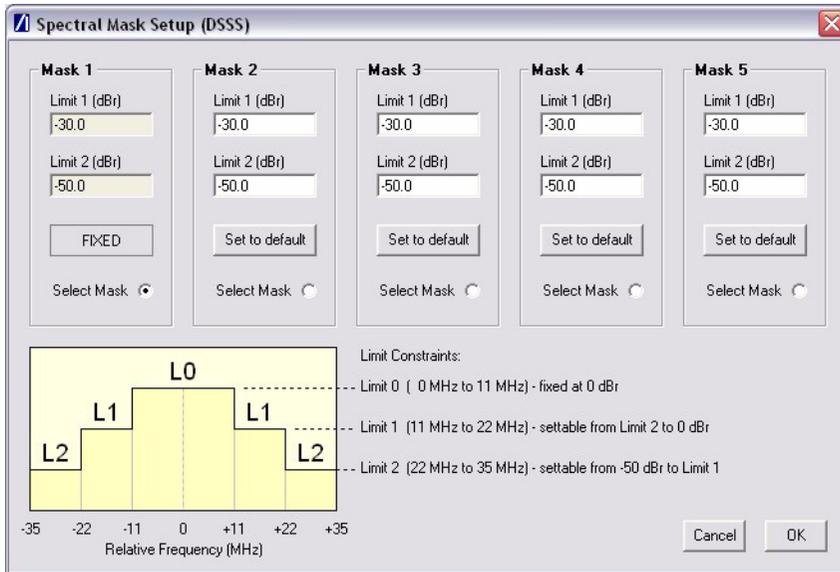
Figure 12-17. [Spectral Mask Setup (DSSS)] Dialog

2. The display area of the dialog is split into sections for each of the masks. Mask 1 is the default mask and cannot be edited.

3. Click "Select Mask" in the "Mask 2" area and enter "Limit 1" (L1) and "Limit 2" (L2) values as required. Both limits can be moved up or down and any changes made are reflected automatically in the associated limit on the opposite side of the mask. As shown in the dialog, the upper limit (shown as "L0" in the figure within the dialog) is fixed at 0 dBr.

4. Repeat this process as required for all required masks.

5. Click [OK] to save the changes and close the dialog.

12-22 Test Settings - Saving and Loading

1. To save test settings for future use, select [Save Test Settings..] from the [File] menu of the main [Anritsu LANLook] window.

2. Specify a name and location for the file to be generated in the usual windows manner.

3. Select [Load Test Settings..] from the [File] menu to load the settings saved above back into LANLook.

12-23 Traces - Copying to Clipboard

1. Maximize the main [Anritsu LANLook] window.

2. Enlarge the required plot window to the required size. The window can be enlarged to any size, but must remain within the area of the main window.

3. Right click the required plot and select [Copy] from the pop-up menu that displays.

4. The image can now be inserted into any graphical or word processing application using the paste command.

12-24 Traces - Loading from Comma Separated Value Data

1. Maximize the required trace.

2. Right click in the graph area of any of the results windows.

3. Select [Load Plot] from the pop-up menu that displays.

4. Locate the CSV file and click [OK] to display the data in the window as a plot.

Note	CSV files must be loaded into the correct window. For example, it is not possible to load the CSV file for a power profile trace into the frequency profile window.

12-25 Traces - Printing

1. Right click the required plot and select [Print] from the pop-up menu that displays.

2. The selected image is printed directly to the default printer.

12-26 Traces - Saving as Comma Separated Value Data

1. Right click the image to be saved and select the [Save Plot] command from the pop-up menu. The [Save Plot] command is not available when measurements are in progress.

1. Specify a name and location for the file in the normal Windows manner.

2. Select "CSV file" from the "File type" drop-down menu.

3. Click [Save].

12-27 Traces - Saving as Image Files

1. Right click the image to be saved and select the [Save Plot] command from the pop-up menu. The [Save Plot] command is not available when measurements are in progress.

2. Specify a name and location for the file in the normal Windows manner.

3. Select whether the image will be saved as a bitmap or JPEG file.

4. Click [Save].

12-28 Version Information - Viewing

1. Select [About Anritsu LANLook] from the [Help] menu of the main [Anritsu LANLook] window. The following window displays showing the software versions and build status.
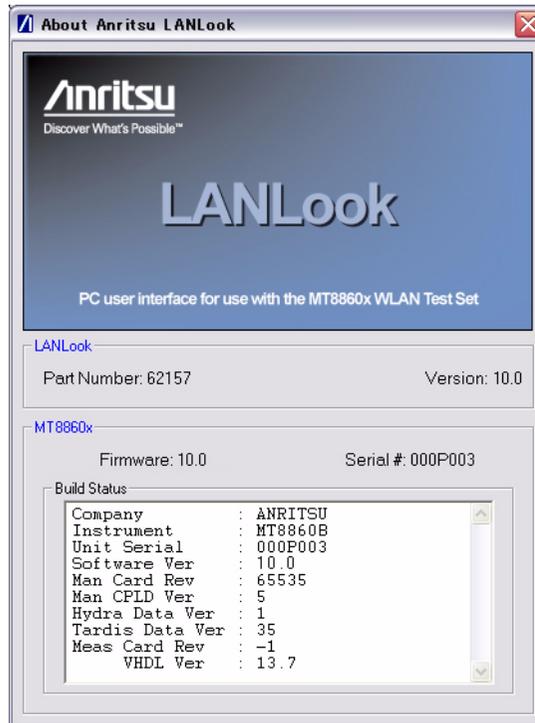
Figure 12-18. [About Anritsu LANLook] Dialog

Chapter 13 — Signal Generator

13-1   Continuous Transmit Mode

The MT8860B provides a signal generator mode of operation whereby a continuous transmit signal is generated at the test port connector. Signal generator mode may be of particular use in calculating the path loss of a test system prior to measurement operation or when testing the receiver of a DUT for RSSI (Received Signal Strength Indicator).

1. Start LANLook and display the [Signal Generator] tab as shown on the following page.

Note	Signal generator mode is unavailable if test mode is set to "Network" or reference radio is set to "External". If either of these settings have be made, the [Signal Generator] tab displays a button to allow the user to automatically reconfigure the set-up as required.

2. Select the channel on which data will be output.

3. Select the data rate. The available rates are determined by the "Tx Mode" selection.

4. Specify the required power level between -100 and 0 dBm.

5. Select the required Tx mode. The user can select between:-

- CW (single carrier) at 2.4 GHz or 5 GHz.
- Continuous modulated (100% duty cycle) 802.11b or 802.11g.
- Continuous Framed (dynamic duty cycle) 802.11b or 802.11g.
- 802.11b carrier suppression at 2 Mbps.

6. If Tx mode is set to one of the framed settings, the packet type and structure can be defined.

Figure 13-1. [Signal Generator] Tab

7. Click [Start] to commence the generation of data as defined.

Note	The "Channel", "Data Rate", "Power Level", "Packet Type", and "Packet Structure" parameters are shared between Signal Generator Mode and Wireless Test Mode. Switching between modes may cause some parameters to change in order to maintain consistency. Path Loss settings are applied to the Signal Generator output signal if enabled.

Chapter 14 — LANLook Source Code Guide

The source code for LANLook is available to the end-user for information and development purposes.

This chapter explains the structure of the LANLook source code and provides information necessary for the programmer to deploy all or part of LANLook in their own application for use with the MT8860B.

14-1   Source Code Overview

LANLook is written in Microsoft Visual Basic 6 (VB6). For most purposes the user should have VB6 installed with the latest service packs in order to view, modify and compile the software. The source code text (.bas, .frm, .cls) can be viewed in a simple text editor (e.g. Notepad) if VB6 is not available.

Ideally, the LANLook source code should be copied in its entirety from the product CD onto the user's PC hard disk. To load the source code into the VB6 development environment open the project file named LANLook.vbp. This will load all required source code files.

LANLook is structured into three layers. These are shown graphically in Figure 14-1 and can be described as follows:

- Application layer

  A set of forms and associated modules used for the graphical user interface (GUI) and to define the top-level functionality. The code in this layer is specific to LANLook in its role as a virtual front panel for the MT8860B. It is not intended for re-use.

- Interface layer

  A set of modules that provide a high level remote control API and other utility functions required by LANLook. The remote control API supports communication via a GPIB connection (with National Instruments or compatible hardware) using either a basic software driver interface (e.g. NI-488.2) or a VISA-COM interface. Remote control via an Ethernet LAN connection is also supported by the VISA-COM interface using the VXI-11 protocols defined by the IVI Foundation (http://www.ivifoundation.org).

Note	The product CD contains a licensed copy of the NI VISA Runtime Engine which may be installed by the user for use with LANLook if required. Note that the license applies only to software installed by the package on the product CD. The NI-VISA installation includes the VISA COM type libraries provided by the IVI Foundation. LANLook interfaces with the VISA COM libraries, but users developing their own code may prefer to interface directly with the NI VISA library (visa32.dll). Please consult the NI documentation or the NI website (http://www.ni.com) for further information.

• System Layer

    A set of dynamic link libraries (DLLs) that provide calls to the operating system
    functions and low-level drivers. These are either part of Microsoft Windows (tm) or
    provided by a third party vendor (e.g., National Instruments).
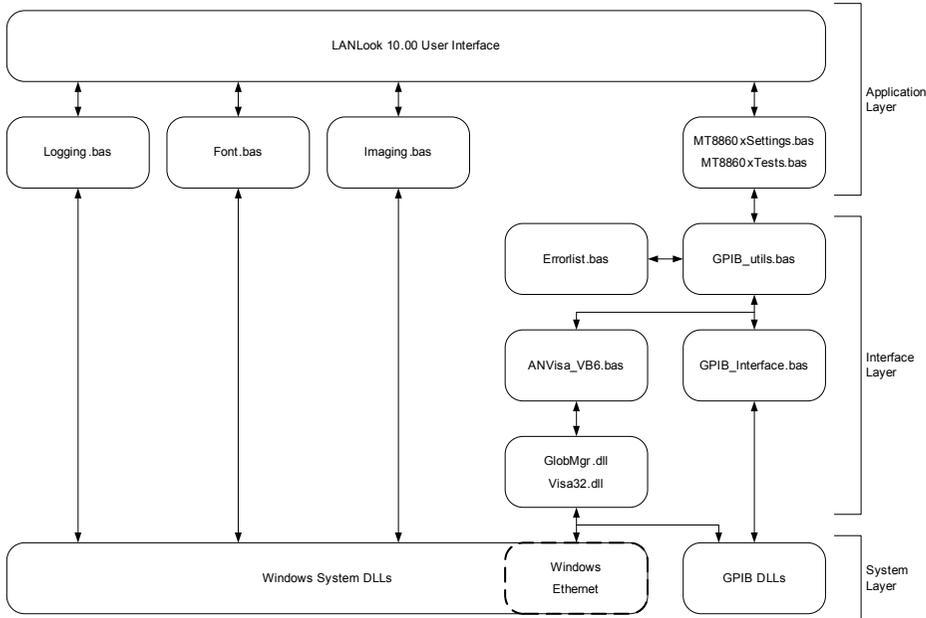
Figure 14-1. LANLook Source Code Structure

14-2   Developing with the LANLook Source Code

The interface layer (in partnership with the system/DLL layer) provides a convenient entry
point for the user to begin developing a dedicated application to communicate with the
MT8860B. The user can either make calls to the MT8860xSettings.bas and
MT8860xTests.bas modules or more directly to the GPIB_Utils module.

The MT8860xSettings.bas and MT8860xTests.bas modules provide a set of dedicated
functions for performing operations on the MT8860B. The GPIB_Utils.bas module is lower
level and provides for the sending and receiving of data via GPIB or LAN interfaces.

Functions operate on a set of global variables defined in the Globals.bas module. Before
calling any of the remote control functions, the following global variables should be
initialized:

ComInterface [enumerated type COM_TYPES]

Defines the remote control interface and protocol with the following values:

• GPIB_4882 = 0 ' GPIB using 488.2
• GPIB_VISA = 1 ' GPIB using VISA
• ENET_SOCK = 2 ' LAN using Sockets (Reserved for future use)
• ENET_VISA = 3 ' LAN using VXI-11 (VISA)

For GPIB interfaces:

- GPIB_Address [Integer] Declared in Globals.bas
- GPIB_BOARD_NUMBER Declared as a Constant (0) in Globals.bas. This should be changed if a different GPIB board number is used.

For LAN interfaces:

- Rem_IP_Hostname [String] Declared in Globals.bas. Derived from the instrument serial number as described in Appendix G.
- Rem_IP_Address [String] Declared in Globals.bas. Use standard IPv4 dot notation.
- RemIPAuto [Boolean] Declared in Globals.bas. True = Use DHCP, False = Manual IP address entry.

14-3   Using the Interface Layer MT8860xSettings Module

The MT8860xSettings.bas module contains functions for setting and requesting the MT8860B test parameters. New parameter settings are passed in the function calls. For example, the function Set_DataRate() would be called like this:

Call Set_DataRate("11")

In this module there is a global variable defined for each of the test parameters.

To request the data rate, the Req_DataRate() function would be called and the global variable TsetTxDataRate would be updated with the new value. The dialog in the application layer is also updated.

Note	LANLook performs parameter checking in the application layer. If the values of parameters passed are incorrect the MT8860B will respond with an error. This is handled in the GPIB_Utils.bas module.

14-4   Using the Interface Layer MT8860xTests Module

The MT8860xTests.bas module contains functions for running test sequences. The functions and associated tests are summarised in the table below.

Function	Associated test
Run_Fixed_PER_Test()	Runs one or a number of fixed power level PER tests.
Run_PER_Scan_Test()	Runs a single PER search test.
Run_Tx_Test()	Runs one or a number of transmitter tests.

The functions Run_Fixed_PER_Test() and Run_Tx_Test() require one of two run mode parameters that select either a single test or a continuous (repeated) test run. These are constants defined in the Globals.bas module as CONTINUOUS_TEST and SINGLE_TEST.

The Run_Fixed_PER_Test() and Run_PER_Scan_Test() functions pass the test results directly to the application layer. The Run_Tx_Test() function updates a set of global variables declared in the Globals.bas module.

Note	None of the test functions provide the facility to set the MT8860B test parameters before running a test. This must be performed by calls to functions in the MT8860xSettings.bas module.

14-5   Using the Interface Layer GPIB_Utils Module

The GPIB_Utils.bas module allows the user to send and receive GPIB data without the complications of interfacing directly with the GPIB32 dll.

There are five functions of interest in the GPIB_Utils.bas module. These are described in the table below.

Function	Description
Connect_to_device()	Establishes the GPIB connection and checks the MT8860B IDN string.
data_request()	General ASCII data request and receive.
Request_Profile_Data()	Binary profile data request and receive.
Send_Command()	General ASCII data send.
Close_GPIB()	Closes down the GPIB interface.

The application should call the Connect_to_device() function at start up and the Close_GPIB() function before closing down.

The Send_Command(), data_request() and Request_Profile_Data() functions require a number of parameters to be passed to them. These parameters are summarised in the table below.

Function(s	Parameter	Parameter description
Send_Command() and data_request()	brdid	Specifies the GPIB interface number.
Send_Command() and data_request()	addr	Specifies the GPIB address of the MT8860B.
Send_Command() and data_request()	cmd_msg	Specifies the ASCII command for the MT8860B.
data_request() and Request_Profile_Data()	Response()	A string or variable array for return data.
data_request() and Request_Profile_Data()	Count	An integer specifying the number of values returned.
data_request() and Request_Profile_Data()	timeout	A long specifying the GPIB timeout time in ms.
data_request()	Request_Type	An integer specifying the type of data request.

14-6   Examples

The Send_Command() function is used when the MT8860B is not required to return data. For example when setting the data rate:

Command_String="MEASCFG 1,TXRATE,11"

Call Send_Command(GPIB_BOARD_NUMBER, GPIB_Address, Command_String)

The data_request() function is used when the MT8860B is required to return data. The data received is then returned in the string variable My_data. This would be the case when requesting a PER measurement:

Command_String="MEASCFG? 1,MEAS,PER"

Call data_request(GPIB_BOARD_NUMBER, GPIB_Address, Command_String, My_data,My_data_cnt, Timeout, Req_Type)

The Request_Profile_Data() function is used specifically to request binary profile data. For example, to request the mean power profile:

Call Request_Profile_Data("POWER", "MEAN", My_data (),My_data_cnt, Timeout)

The first two parameters define the profile to be requested. The binary data is passed back in the floating-point variable array My_data.

Chapter 15 — Upgrading the MT8860B Firmware

Software upgrades are posted on the Anritsu website at the address given in the procedure below. To receive e-mail notification each time the software is updated, send a blank mail to wlan.support@anritsu.com with the subject heading of "MT8860B firmware upgrade notification".

15-1 Using the GPIB Bootloader Utility

Note	The following instructions are applicable when upgrading the firmware to version 10.0 or greater.
	The firmware upgrade operation will return the instrument to its factory default settings.

1. Remove the existing LANLook installation.

    1. Go to the Windows [Control Panel] and select [Add or Remove Programs].

    b. Select LANLook from the list of currently installed programs and click [Remove].

    c. Close [Add or Remove Programs] when the un-install operation is complete.

2. Install the new version of LANLook.

    1. On the PC, create the directory C:\temp\LANLook. If a directory with this name already exists, delete the existing contents.

    b. Copy the zip file containing the new release of LANLook into c:\temp\LANLook.

    c. Extract the contents of the zip file to c:\temp\LANLook. and delete the zip file. The directory should now contain two files: "LANLook.msi" and "setup.exe".

    d. Run the setup.exe to install LANLook as detailed in chapter 3.

3. Bootload the new firmware

    1. On the PC, create the directory c:\temp\MT8860B Upgrade. If a directory with this name already exists, delete the existing contents.

    b. Copy the zip file containing the new firmware into c:\temp\MT8860B Upgrade.

    c. Extract the contents of the zip file to c:\temp\MT8860B Upgrade and delete the zip file. The directory should now contain 36 files.

    d. Power-on the MT8860B and wait until the boot-up process has completed as detailed in chapter 4.

    e. Connect a GPIB cable from the GPIB interface on the PC to the MT8860B.

    f. Launch the MT8860x firmware bootloader application. Go to the Windows [Programs] directory and select Anritsu > MT8860x Bootloader.

g. Enter the GPIB address of the MT8860B and click [Check ID]. The serial number of the MT8860B and the currently installed firmware version display to the right of [Check ID].

h. Double-click the MT8860B Upgrade folder in the "Bootload Source Folder" directory tree.

i. Click [Start Transfer].

j. The message "Status: Finished, No Errors" displays when the transfer is complete.

k. Close the Bootloader utility.

l. Power-off the MT8860B.

4. Power-cycle the MT8860B.

The firmware upgrade operation is complete when the MT8860B has performed two power-on operations.

1. Power-on the MT8860B and wait until the boot-up process is complete. This is indicated by the "On" LED flashing and the "Controller Activity" LED being off.

b. Power-off the MT8860B and wait approximately 15 seconds.

c. Power-on the MT8860B again and wait until the boot-up process is complete. This is indicated by the "On" LED being fully on and the "Controller Activity" LED being off.

d. The firmware upgrade is complete and the instrument can now be used as normal.

5. Confirm the firmware version.

1. Launch LANLook from the Windows [Programs] directory by selecting [Anritsu] > [LANLook].

b. Click the [System Utilities] tab and the [MT8860x Remote] sub-tab.

c. Click [Scan for Instruments].

d. The serial number and GPIB address of the connected MT8860B displays.

e. Select the instrument from the list and click [Connect].

f. The GPIB connection is established and the settings of the MT8860B are determined.

g. Select [Help] > [About Anritsu LANLook] to display the firmware version and other build status information.

15-2   Upgrading Via Ethernet

Note	The following instructions are applicable for instruments that have firmware version 10.0 (or greater) already installed. For instruments that have firmware version 9.00 (or earlier) installed, refer to the document 'MT8860B firmware bootload (Feb 2009).pdf' The firmware upgrade operation will return the instrument to its factory default setting. The upgrade operation uses the FTP client "FileZilla". The FileZilla client is a free, Open Source FTP client for Windows. It is available for download using the URL: http://filezilla-project.org/download.php?type=client

1. Copy the new firmware to the MT8860B bootload folder.

   1. On the PC, create the directory c:\temp\MT8860B Upgrade. If a directory with this name already exists, delete the existing contents.

   b. Copy the zip file containing the new firmware into c:\temp\MT8860B Upgrade.

   c. Extract the contents of the zip file to c:\temp\MT8860B Upgrade and delete the zip file.

   The directory c:\temp\MT8860B Upgrade should now contain 36 files.

   d. Connect the MT8860B to the LAN. Refer to Appendix G for details on setting up the LAN interface.

   e. Power-on the MT8860B and wait until the boot-up process has completed as detailed in chapter 4.

   f. Launch the FileZilla Client application. Go to the Windows [Programs] directory and select [FileZilla FTP Client].

   g. Enter the following details:

   Host: <hostname or IP address>

   Username: admin

   Password: anritsu

   h. Click Quick connect.

   i. From 'Local site', select the folder c:\temp\MT8860B Upgrade.

   j. Select all 36 files that are located in the folder c:\temp\MT8860B Upgrade.

   k. Perform a Windows style 'Drag and Drop' operation. The file transfer commences.

   l. When the transfer is complete, a total of 36 files should be listed in the 'Remote Site' folder and the 'Successful transfers' reported should be 36.

2. Power-cycle the MT8860B

The firmware upgrade operation is completed when the MT8860B has performed 2 power-on operations.

> **1.** Power-on the MT8860B for the first time and wait until the boot-up process is complete. This is indicated by the "On" LED flashing while the "Controller Activity" LED turns off.
>
> **b.** Power-off the MT8860B and wait approximately 15 seconds.
>
> **c.** Power-on the MT8860B for the second time and wait until the boot-up process is complete. This is indicated by the "On" LED turned fully on (i.e. it is not flashing) and the "Controller Activity" LED turned off.
>
> **d.** The firmware upgrade operation is complete and the instrument can be used normally.

3. Confirm that the new firmware has been installed correctly.

> **1.** Open a Telnet session. Launch the Command Prompt tool from the Windows Start menu.
>
> **b.** At the command prompt, type telnet <hostname or IP address> 5024.
>
> **c.** The firmware version is displayed on the status line.
>
> **d.** Type exit at the "MT8860 >" prompt to close the Telnet session.

Appendix A Specifications

Characteristic / Parameter	Specification
Wireless Test Mode	**Standards supported:** **IEEE 802.11b-1999** **IEEE 802.11g-2003 (Option 13)** **IEEE 802.11-2007**
Supported Channels	
802.11b / 802.11g (DSSS)	Channels 1 to 14 (2412 – 2484 MHz)
802.11g (OFDM)	Channels 1 to 13 (2412 – 2472 MHz)
Data Rates and Modulation	
802.11b / 802.11g (DSSS)	1 Mbps 11-chip Barker DBPSK 2 Mbps 11-chip Barker DQPSK 5.5 Mbps CCK DQPSK 11 Mbps CCK DQPSK
802.11g (OFDM)	6, 9, 12, 18, 24, 36, 48, 54 Mbps OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
Operating Modes	Two modes of operation are supported; Network Mode and Direct Mode
Network Mode	In this mode, testing of a DUT's RX and TX characteristics are possible after first establishing a network connection between the MT8860B and the DUT
Receiver Measurements	Packet Error Rate (PER) at defined level
Unicast Packet Type	The MT8860B calculates the PER based on the number of acknowledgement (ACK) packets transmitted by DUT in response to the data packets it receives from the MT8860B
Broadcast Packet Type	MT8860B transmits data packets containing the broadcast address (FFFFFFFFFFFF). The measurement of PER is calculated externally and requires access to the DUT receive frame registers. These are normally available from the client software under "Advanced Information"
Transmitter Measurements	
Packet Loopback Mode	MT8860B forms a connection with DUT and transmits ICMP echo request packets and analyzes the echo reply packets returned by the DUT in response
Network Mode Configuration Settings	

MT8860B Role (Connection Type)	Infrastructure and Ad-Hoc
Infrastructure	Supports Access Point and Client (STA) modes
Ad-Hoc	Supports creating and joining a network
SSID (Network Name)	Supported in Access Point and Ad-Hoc creation modes (32 characters maximum)
Beacon Configuration	The MT8860B periodically transmits beacon management frames so that a connection can be established and maintained with a DUT. The following beacon parameters can be adjusted;
	Beacon Interval: 20 to 1000 (default 200)
	Operational Rate Set:: All Rates, Multiple Rates, Single Rate
	DSSS Preamble Format: Long, Short
	NOTE: The Beacon Interval represents a number of time units (TU), with 1 TU being equal to 1024μs
IP Properties	The IP settings of the DUT can be assigned manually or automatically via DHCP
Direct Mode	In this mode, the DUT is controlled directly by using the appropriate chipset vendor control software
Receiver Measurements	The MT8860B transmits a defined number of packets to the DUT. Chipset vendor control software is required to read the DUT receiver packet count register
Transmitter Measurements	The DUT is configured for continuous transmission using chipset vendor control software. The MT8860B acts as a transmitter analyzer for measurements on the packets received
802.11b Measurements	The following applies to data rates of 1, 2, 5.5 and 11 Mbps that use DSSS modulation
Transmit Power Levels	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.1)**
Definition	Average and peak power measurements derived from gate 1 or 2
Damage Level	> + 27 dBm
Dynamic Range	+24 dBm to –50 dBm average power (+27 dBm peak)
Accuracy (CW)	± 0.6dB (+24 dBm to –30 dBm)
	± 1.0 dB (-30 dBm to –50 dBm)
Resolution	dBm to 2 decimal places
Capture Width	10 μs to 5.95 ms
Time Resolution	0.1 μs marker resolution with 10 μs time window

Transmit Power Level Control	IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.2)
Definition	Peak and Average Power specification as for 18.4.7.1
Transmit Spectrum Mask	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.3)**
Definition	Spectrum measurement derived from gate 1 or 2
Gate Width	From gate 1 or 2, 50 μs to 5.95 ms
Frequency Span	70 MHz (fc ± 35 MHz)
Flatness over Frequency Span	±1 dB
Linearity	±0.8 dB (50 dB dynamic range CW measurements)
Resolution	dBr to 1 decimal place
Range (modulated carrier power)	+24 dBm to –40 dBm
Dynamic Range	>50 dB (usable dynamic range with Dither Mode set to ON)
Receiver Resolution Bandwidth	Equivalent to 100 kHz Gaussian
Noise Floor (for all supported channels)	-110 dBm (with Input Level Range 3 selected)
Spurious Specification (for all supported channels)	<-52 dBc (with Dither Mode set to ON)
Measurement Configuration	
Dither Mode	OFF - Default mode
	ON - Additional Signal processing removes spurs from the spectral measurement
Transmit Center Frequency Tolerance	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.4)**
Definition	Average Frequency of the DSSS carrier signal
Data Output Format	Hz and ppm
Accuracy	±1 kHz ± reference frequency oscillator error (ppm) for measurement gate >1 ms
Resolution	Hz to 2 decimal places, ppm to 2 decimal places
Chip Clock Frequency Tolerance	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.5)**
Definition	Frequency error relative to 11MHz chip clock. Measurement averaged over a fully coded DSSS packet with minimum payload length of 3,300 chips (300 μs)
Data Output Format	Hz and ppm
Range	±50 ppm
Resolution	Hz to 2 decimal places, ppm to 2 decimal places
Analysis Length	3,300 to 30,250 chips (default 5,500 chips)
Transmit Power-On & Power-Down Ramp	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.6)**

Definition	Time for the burst to transition from 10% to 90% or 90% to 10% of linear power
Resolution	0.1μs
Data Outputs	10%, 90% and delta values
RF Carrier Suppression	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.7)**
Definition	Relative level of the carrier to highest sideband for a 10101010 test pattern, scrambler disabled, data rate 2 Mbps
Range	As spectral mask range
Dynamic Range	As spectral mask dynamic range
Flatness	As spectral mask flatness
Linearity	As spectral mask linearity
Resolution	As spectral mask resolution
Transmit Modulation Accuracy	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.7.8)**
Definition	Peak and Average Error Vector Magnitude measurement performed as defined in 18.4.7.8 for DBPSK and DQPSK modulated packets. Measurement averaged over a fully coded DSSS packet with minimum payload length of 220 chips (20 μs)
Measurement Accuracy	<10% residual RMS EVM, +24 dBm to –45 dBm
Modulation Setting	Data rate 1, 2, 5.5 or 11 Mbps
Displayed Measurement Range	1% to 100% dependent on modulation
Measurement Configuration	
RX Filter Selection	Selectable between: None Gaussian, BT 0.3 to 1.0 (default 0.5), resolution 0.1 Root Raised Cosine, α 0.30 to 1.00 (default 0.35), resolution 0.01
Averaging	Single measurements, or averaging applied to the EVM results
Analysis Length	220 to 11,000 chips (default 1,000 chips)
Receiver Minimum Input Sensitivity	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.8.1)**
Definition	Packet Error Rate (PER) at defined power level
Power Range	See Reference Radio Transmitter section
Mode	Network: MT8860B forms a connection with the DUT. Unicast and Broadcast Packets supported Direct: MT8860B transmits defined number of packets

Data Packet Structure	Complies with 802.11 specifications for MAC header formatting, scrambling, encoding, interleaving and calculation of the appropriate CRC/FCS checksum
Number of Transmitted Packets	1 to 10,000 (default 500)
Payload Length	60 to 1,500 bytes (default 1,024 bytes)
Preamble Format	Long or Short
Payload	All 0's, 0101, Counting, PN7, 1010, Random (Payload data scrambled over the air)
Data Rates	1, 2, 5.5 or 11 Mbps
Network Mode Settings	
Inter-packet Interval	0 to 65535 ms
Inter-packet Resolution	1 ms
DUT TX Power Level	-30 to + 30 dBm
	This is the expected power level of the ACK packet transmitted by the DUT in response to a correctly received Unicast packet. This value is used by the MT8860B to calculate the amount of return path attenuation required to prevent MT8860B reference radio receiver saturation.
Direct Mode Settings	
Inter-packet Spacing	0 to 200 slots (default 5 slots)
Inter-packet Resolution	20 μs
DUT MAC Address Range	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
Receiver Maximum Input Level	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.8.2)**
Definition	Receiver PER specification as for 18.4.8.1
Receiver Adjacent Channel Rejection	**IEEE 802.11b-1999 / IEEE 802.11-2007 (18.4.8.3)**
Definition	Adjacent Channel measurements made with external modulated signal source (e.g.MG3700A) using Interferer input port
Additional Measurements	
Occupied Bandwidth (OBW)	Measures the frequency range within which the specified percentage power is contained
Occupied Bandwidth Percentage	1 to 99%
Frequency v Time	Frequency drift measured over packet transmission
Power Spectral Density (PSD)	The maximum power measured in a 1 MHz bandwidth within the occupied bandwidth of the signal

802.11g Measurements	The following applies to data rates 6, 9, 12, 18, 24, 36, 48 and 54 Mbps that use OFDM modulation
	(For DSSS data rates, please refer to the 802.11b measurement section above)
Transmit Power Levels	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.4.7.1)**
Definition	Average, peak and crest factor power measurements on OFDM modulated signals on the supported channels
Damage Level	> +27 dBm
Dynamic Range	+18 dBm to –50 dBm average power (+27 dBm peak)
Accuracy (CW)	$\pm$ 0.6 dB (+18 dBm to –30 dBm)
	$\pm$ 1.0 dB (-30 dBm to –50 dBm)
Resolution	dBm to 2 decimal places
Capture Width	10 μs to 5.95 ms
Time Resolution	0.1 μs marker resolution with 10 μs time window
Transmit Spectrum Mask	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.5.4)**
Definition	Display of Spectrum measurement derived from gate 1 or 2
Gate Width	From gate 1 or 2, 50μs to 5.95ms
Frequency Span	70 MHz (fc $\pm$ 35 MHz)
Flatness over Frequency Span	±1 dB
Linearity	±0.8 dB (50 dB dynamic range CW measurements)
Resolution	dBr to 1 decimal place
Range (modulated carrier power)	+18 dBm to –40 dBm
Dynamic Range	(Useable dynamic range for signals with 8 dB crest factor and Dither Mode set to ON)
	±11 MHz from fc 30 dB (typical 46 dB)
	± 20 MHz from fc 40 dB (typical 48 dB)
	± 30 MHz from fc 43 dB (typical 50 dB)
Receiver Resolution Bandwidth	Equivalent to 100 kHz Gaussian
Noise Floor (for all supported channels)	-110 dBm (with Input Level Range 3 selected)
Spurious Specification (for all supported channels)	< -45 dBc (with Dither Mode ON)
Measurement Configuration	
Dither Mode	OFF - Default mode
	ON - Additional Signal processing removes spurs from the spectral measurement

Transmit Center Frequency Tolerance	IEEE 802.11g-2003 / IEEE 802.11-2007 (19.4.7.2)
Definition	Average Frequency of the OFDM carrier signal
Data Output Format	Hz and ppm
Accuracy	±1 kHz ± reference frequency oscillator error (ppm) for measurement gate >1 ms
Resolution	Hz to 2 decimal places, ppm to 2 decimal places
Symbol Clock Frequency Tolerance	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.4.7.3)**
Definition	Frequency error relative to 250 kHz symbol clock as per 19.4.7.3 / 17.2.9.5. Measurement averaged over a fully coded OFDM packet with minimum payload length of 16 symbols (64 μs)
Data Output Format	Hz and ppm
Range	±40 ppm
Resolution	Hz to 2 decimal places, ppm to 2 decimal places
Analysis Length	16 to 500 symbols (default 55 symbols)
Transmitter Center Frequency Leakage	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.4.7)** **Reference IEEE 802.11a-1999 / IEEE 802.11-2007 (17.3.9.6.1)**
Definition	Measurement of the leakage of the center carrier
Data Output Format	dB
Resolution	dB to 2 decimal places
Transmitter Spectral Flatness	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.4.7)** **Reference IEEE 802.11a-1999 / IEEE 802.11-2007 (17.3.9.6.2)**
Definition	Graphical display of RF sub-carrier power level Display includes limit lines (as per 17.2.9.6.2) Overall Pass/ Fail status indicated For measurement failure, a numeric measurement result of the failing sub-carrier(s) is reported
Unit of Measurement	dBr
Transmitter Modulation Accuracy	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.7.2.7)**
Definition	Peak and Average EVM. Measurement averaged over a fully coded OFDM packet with minimum payload length of 16 symbols (64 μs)
Measurement Accuracy 802.11g	(54 Mbps, +18 dBm to -45 dBm) <2% residual RMS EVM

Modulation Setting	Data rates 6, 9, 12, 18, 24, 36, 48 or 54 Mbps
Data Output Format	Peak and Average EVM pilots only, dB or percentage
	Peak and Average EVM on each sub carrier (frequency domain), % vs sub-carrier –26 to +26
	EVM vs Symbol (time domain), % vs symbol number, 1 to specified analysis length
Measurement Configuration	
Averaging	Single measurements, or averaging applied to the EVM results
Analysis Length	16 to 500 symbols (default 40 symbols)
OFDM Pilot Tracking	User selection of Phase tracking only or Phase and Amplitude tracking (default Phase tracking only)
Channel Estimation	User selection of Long Training Sequence or Full Packet (default Long Training Sequence)
Receiver Minimum Input Sensitivity	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.5.1)**
Definition	Packet Error Rate (PER) at defined power level
Power Range	See Reference Radio Transmitter section
Mode	Network: MT8860B forms a connection with the DUT. Unicast and Broadcast Packets supported
	Direct: MT8860B transmits defined number of packets
Data Packet Structure	Adheres to relevant 802.11 specifications for MAC header formatting, scrambling, encoding, interleaving and calculation of the appropriate CRC/FCS checksum
Number of Transmitted packets	1 to 10,000 (default 500)
Payload Length	60 to 1,500 bytes (default 1,024 bytes)
Payload	All 0's, 0101, Counting, PN7, 1010, Random (Payload data is scrambled over the air)
Data Rates	6, 9, 12, 18, 24, 36, 48 or 54 Mbps
Network Mode Settings	
Inter-packet Interval	0 to 65535 ms
Inter-packet Resolution	1 ms
DUT TX Power Level	-30 to + 30 dBm
	This is the expected power level of the ACK packet transmitted by the DUT in response to a correctly received Unicast packet. This value is used by the MT8860B to calculate the amount of return path attenuation required to prevent MT8860B reference radio receiver saturation.
Direct Mode Settings	

Inter-packet Spacing	0 to 200 slots (default 5 slots)
Inter-packet Resolution	9 μs
DUT MAC Address Range	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF
Receiver Adjacent Channel Rejection	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.5.2)**
Definition	Adjacent Channel measurement made with external modulated signal source (e.g. MG3700A) using Interferer input port
Receiver Maximum Input Level	**IEEE 802.11g-2003 / IEEE 802.11-2007 (19.5.3)**
Definition	Packet Error Rate (PER) at defined power level
Additional Measurements	
CCDF	CCDF defined as percentage of samples against dB, where percentage of samples is normalized to the average power in the gate, and dB is defined as the relative value of samples greater than the average
Measurement Scales	Y-axis, Log scale, fixed values of 100, 10, 1, 0.1, 0.01%
	X-axis, dB scale, fixed values of 0 to 12dB
Occupied Bandwidth (OBW)	Measures the frequency range within which the specified percentage power is contained
Occupied Bandwidth Percentage	1 to 99%
Power Spectral Density (PSD)	The maximum power measured in a 1 MHz bandwidth within the occupied bandwidth of the signal
TX Measurement Controls	
Triggers	4 trigger sources are available; Free Run, RF, Video and External
	In Network Mode operation, the RF trigger (rising edge) must be selected
Free Run	Continuous unsynchronised
RF Edge	RF triggering on rising or falling edge, detected at RF input
	User set level
RF Edge Dynamic Range	+18 dBm to –40 dBm average power with Input Level Range set to AUTO
Video	Video triggering on rising or falling edge, detected at IF

Video Trigger Dynamic Range	+18 dBm to –50 dBm average power with Input Level Range set to AUTO
	802.11b / 802.11g (DSSS): Triggers at –10 dB below average power level
	802.11g (OFDM) : Triggers at –20dB below average power level
External	TTL input, BNC on Rear Panel
Measurement Gates	Two gates for Power, Spectrum, Frequency and CCDF measurements. Gate positions set directly by remote command
Settable Gate Range	10 µs to 5.95 ms
TX Analysis auto-configure function	Using this function, the following parameters are automatically configured by the MT8860B;
	Input Level Range
	Pre-trigger
	Capture Width
	Trigger settings
	Measurement Gate settings

Reference Radio Transmitter	**Network and Direct Modes**	
Supported Channels	802.11b / 802.11g (DSSS)	Channels 1 to 14 (2412 – 2484 MHz)
	802.11g (OFDM)	Channels 1 to 13 (2412 – 2472 MHz)
Output Power (for supported channels)	-3 to -100 dBm (settable to 0 dBm but performance unwarranted)	
Power Accuracy (for supported channels, CW, 18 to 28° C)	±1.0 dB (-3 dBm to -90 dBm)	
	±2.0 dB typical (<-90 dBm to -100 dBm)	
Settable resolution	0.1 dB	
Output Impedance	50 < 2:1 VSWR	
Frequency Accuracy	±20 ppm	
Modulation Accuracy (for supported channels, unless stated)	802.11b / 802.11g (DSSS)	<10%, RMS EVM, 11 Mbps, <-20 dBm (channels 1 to 13)
	802.11g (OFDM)	<5.6%, RMS EVM, 54 Mbps, <-20 dBm (nominal < 4%)
		Nominally <5.6%, RMS EVM, 54 Mbps, <-3 to -20 dBm

Reference Radio Receiver	**Network Mode**
Supported Channels	See Reference Radio Transmitter Section (above)
Maximum Safe Input	+27 dBm Peak Power

Damage Level	+32 dBm peak power (excluding range 3, +18 dBm)
Input VSWR (for supported channels)	Nominally <1.5:1
Minimum Receive Sensitivity (for < 1% PER)	-50 dBm (1 Mbps)
	-45 dBm (11 Mbps)
	-50 dBm (6 Mbps)
	-30 dBm (54 Mbps)
Signal Generator Mode	In this mode, MT8860B can be configured to transmit a continuous RF signal at the Test Port
	NOTE: Transmitter measurements are not supported. For receiver testing, chipset vendor control software is required to directly configure the device under test (DUT) and read the receiver packet count register
Transmit Modes	CW (single carrier)
	Continuous Framed (dynamic duty cycle)
	Continuous Modulated (100% duty cycle)
	Carrier Suppression (100% duty cycle, 0101 payload, scrambler disabled)
Supported Channels	See Reference Radio Transmitter Section (above)
Data Rates and Modulation	Applicable when the transit mode is set to Continuous Framed or Continuous Modulated
802.11b / 802.11g (DSSS)	1 Mbps 11-chip Barker DBPSK
	2 Mbps 11-chip Barker DQPSK
	5.5 Mbps CCK DQPSK
	11 Mbps CCK DQPSK
802.11g (OFDM)	6, 9, 12, 18, 24, 36, 48, 54 Mbps
	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
Data Packet Structure (Continuous Framed and Continuous Modulated)	Adheres to relevant 802.11 specifications for MAC header formatting, scrambling, encoding, interleaving and calculation of the appropriate CRC/FCS checksum
Payload Length	60 to 1,500 bytes (default 1,024 bytes)
Payload	All 0's, 0101, Counting, PN7, 1010, Random (Payload data is scrambled over the air)
Inter-packet Spacing (Continuous Framed)	0 to 200 slots (default 5 slots)

Inter-packet Resolution	802.11b / 802.11g (DSSS)	20 μs
	802.11g (OFDM)	9 μs

DUT MAC Address range	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF

Output Power (for supported channels)	See Reference Radio Transmitter Section (above)
Power Accuracy (for supported channels, CW, 18 to 28° C)	See Reference Radio Transmitter Section (above)
Settable resolution	See Reference Radio Transmitter Section (above)
Output Impedance	See Reference Radio Transmitter Section (above)
Frequency Accuracy	See Reference Radio Transmitter Section (above)
Modulation Accuracy (for supported channels, unless stated)	See Reference Radio Transmitter Section (above)
General	
Path Loss Table	Compensation for cable and system loss can be specified for each supported channel. Independent values can be specified for the TX and RX paths. When the path loss table is enabled, the TX and RX path loss values for the selected channel are applied to both the measurement results and MT8860B transmitted power level.
Reference Frequency Oscillator	10 MHz TCXO fitted as standard
Frequency	10 MHz
Aging	<±1 ppm / year, <±2.5 ppm /10 years
Drift (Temperature Coefficient)	<±0.5 ppm, 0 to +45°C
Inputs & Outputs	
Front Panel Inputs & Outputs	
Test Port In / Out	Provides connection to DUT, N-type (f), 50Ω nominal

Test Port In / Out	Maximum Input Power:	+27 dBm Peak (Input Level Ranges 1 & 2)
		+18 dBm Peak (Input Level Range 3)
	VSWR:	Nominally <1.5:1

Interferer Inputs 1 & 2	Provides input for external signal source (e.g. MG3700A), N-type (f)	
	Maximum Input Power:	+ 27 dBm
	VSWR:	Nominally <1.5:1
	Loss to Test Port In/Out: (for supported channels)	Nominally 20 dB ± 1 dB

WLAN Reference Input	Allows an external reference radio to be used for DUT receiver measurements using only the leveling loop and attenuator of MT8860B. In this mode, no measurements are supported by MT8860B. For correct leveling operation, the external radio must transmit a signal with the following characteristics;	
	Packet duration:	>110 μs
	Input Level Range:	+12 dBm to +18 dBm average power
	Maximum Input Power:	+ 27 dBm
Rear Panel Inputs & Outputs		
GPIB	All MT8860B parameters (except the supply switch) are remotely programmable. The GPIB is designed in accordance with IEEE 488.2	
Ethernet RJ45	Allows MT8860B to be remotely programmed by a LAN-connected computer. The following LAN interface protocols and related [port numbers] are supported; VXI-11 using VISA Sockets LAN [5025] TELNET [5024] File Transfer Protocol (FTP) [23]	
10 MHz out	As Reference Frequency Oscillator specification, TTL	
10 MHz in	TTL	
Digital Inputs	BNC, TTL	
Input 1	BNC, TTL input for the external trigger source	
Input 2	BNC, TTL input TX signal for External Reference radio. The TX signal must be the same length as the transmission from the external WLAN radio	
Digital Outputs		
Output 1	BNC, TTL compatible The user can select between one of the following; 1. The TX trigger signal from the internal reference radio 2. The trigger signal from the MT8860B when the signal trigger is set to RF 3. The trigger signal from the MT8860B when the signal trigger is set to Video (default setting)	

Output 2	BNC, TTL compatible
	The user can select between one of the following;
	1. The TX trigger signal from the internal reference radio (default setting)
	2. The trigger signal from the MT8860B when the signal trigger is set to RF
	3. The trigger signal from the MT8860B when the signal trigger is set to Video
Power Requirements	
AC Supply	85 to 264V
Frequency	47 to 63 Hz
Power	100 VA
Dimensions and Weight	
Dimensions (D x W x L)	180 mm x 320 mm x 350 mm
Weight	<10 kg
Rated Range of Use	
Operating Temperature Range	+5°C to +40°C
Operating Humidity	<75% non condensing
Conditions of Storage	
Temperature	-20°C to +70°C
Safety	Conforms with the product safety standard BS EN 61010-1 (Equivalent to IEC 61010-1) for class 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 2 supply
Electromagnetic Compatibility (EMC)	Conforms to the protection requirements of EN61326; RF emission and immunity class A
Order Information	
Part number	
MT8860B	WLAN Test Set with 802.11b/g measurements

Supplied Accessories	Power cable
	MT8860B WLAN Test Set Operation manual (printed copy)
	MT8860B WLAN Test Set Remote programming manual (printed copy)
	Product CD containing;
	• LANLook software
	• Source code for LANLook
	• LANTest WLAN Production Test software
	• Source code for LANTest
	• LANTest Operation Manual (pdf)
	• MT8860B WLAN Test Set Operation manual (pdf)
	• MT8860B WLAN Test Set Remote programming manual (pdf)
Options and accessories	
MT8860C-001 (option 1)	Rack mount kit (CANNOT be ordered with option 2)
MT8860C-002 (option 2)	Front panel handles (CANNOT be ordered with option 1)
MT8860B-013 (option 13)	Software Option – IEEE 802.11g TX/RX measurement suite
MT8860B-098 (option 98)	Standard calibration to ANSI/NCSLI Z540-1
	(Certificate of calibration only)
MT8860B-099 (option 99)	Premium calibration to ANSI/NCSLI Z540-1
	(Certificate of calibration with test report and uncertainty data included)
2000-1613	Bluetooth / dual band WLAN antenna and adapter
2000-1548-R	N-type termination plug (6 GHz, 50 Ω)
2100-2	GPIB cable, 2m
2000-1371	Ethernet cable
3-806-152	Cat 5E cross-over patch cable
B0329G	Protective cover (CANNOT be ordered with option 1 or option 2)
13000-00201	MT8860B WLAN Test Set Operation Manual
13000-00202	MT8860B WLAN Test Set Remote Programming Manual

Appendix B Terminology Glossary

Acronym	Meaning
ACK	Acknowledgment
AP	Access Point
BSS	Basic Service Set
BSSID	Basic Service Set Identification
CCK	Complementary Code Keying
DBPSK	Differential Binary Phase Shift Keying
DES	Data Encryption Standard
DQPSK	Differential Quadrature Phase Shift Keying
DSSS	Direct-Sequencing Spread-Spectrum
DUT	Device Under Test
EVM	Error Vector Magnitude
FER	Frame Error Ratio
GPIB	General Purpose Interface Bus
IEEE	Institute of Electrical and Electronic Engineers
ISM	Industrial Scientific and Medical
ISO	International Standards Organization
LAN	Local Area Network
MAC	Medium Access Control
OFDM	Orthogonal Frequency Division Multiplexing
PER	Packet Error Rate
RF	Radio Frequency
RSSI	Received Signal Strength Indication
RX	Receive
SSID	Service Set Identifier
STA	Station
TX	Transmit
USB	Universal Serial Bus
WLAN, W-LAN	Wireless Local Area Network
WM	Wireless Medium

Appendix C Technical Support

C-1　Contacting Support and Reporting Problems

Whilst every effort has been made to ensure the quality and reliability of this product, there may be times when operation difficulties are experienced and technical support is required.

Technical support can be obtained by sending an e-mail to our technical support team at wlan.support@anritsu.com with the details below.

- MT8860B serial number
- LANLook version (if used)
- Description of the problem
- List of error messages displayed
- Description of procedure to replicate the problem
- Details of efforts already made to correct the problem

Every effort will be made to ensure that you are contacted within one working day.

C-2　Anritsu Service Centers

A list of all Anritsu offices and service centers is provided on our internet site at the following location:- http://www.anritsu.com/Contact.asp.

Appendix D Connector Care and Handling

Follow the precautions listed below when handling or connecting cables. Complying with these precautions will guarantee longer component life and less equipment down time due to connector or device failure.

D-1 Pin Depth Mating Connectors

Destructive pin depth of mating connectors is the major cause of failure in the field. When an RF component is mated with a connector having a destructive pin depth, damage will usually occur to the RF component connector. A destructive pin depth is one that is too long in respect to the reference plane of the connector (see figure below).
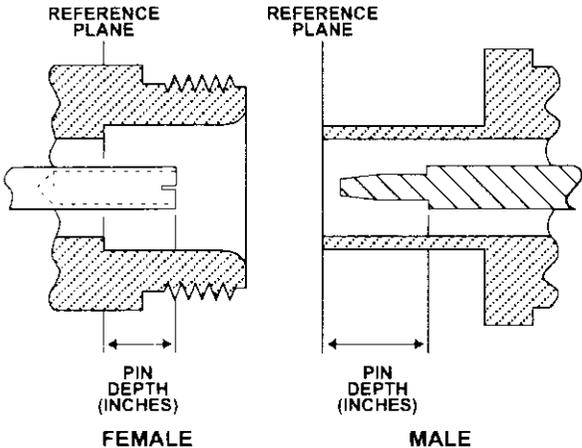
Figure D-1. N Connector Pin Depth Definition

The center pin of a precision RF component connector has a precision tolerance. The mating connectors of various RF components may not be precision types. Consequently, the center pins of these devices may not have the proper pin depth. The pin depth of DUT connectors should be measured to assure compatibility before attempting to mate them with Power Sensor connectors. An Anritsu Pin Depth Gaugeor equivalent can be used for this purpose.
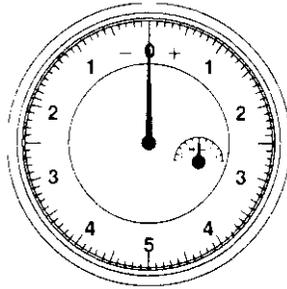
Figure D-2.   Pin Depth Gauge

If the measured connector is out of tolerance in the "+" region, the center pin is too long (see Allowable DUT connector pin depth table below). Mating under this condition will likely damage the precision RF component connector. If the test device connector measures out of tolerance in the "-" region, the center pin is too short. This should not cause damage, but it will result in a poor connection and a consequent degradation in performance.

DUT Connector Type	Anritsu Gauging Set Model	Pin Depth (inches)	Pin Depth Gauge Reading
N - Male	01-163	207 -0.000	207 +0.000
N - Female		+0.030	-0.030
WSMA - Male			
WSMA - Female	01-162	-0.000	Same as pin depth
3.5 mm - Male		-0.010	
3.5 mm - Female			

D-2   Torquing Connectors

Over torquing connectors is destructive; it may damage the connector center pin. Finger-tight is usually sufficient for Type N connectors. *Always* use a connector torque wrench (8 inch-pounds) when tightening WSMA, K or V type connectors. *Never use pliers to tighten connectors.*

D-3   Mechanical Shock

Precision connectors are designed to withstand years of normal bench handling. However, do not drop or otherwise treat them roughly. Mechanical shock will significantly reduce their service life.

D-4   Cleaning Connectors

The precise geometry that makes possible the RF component's high performance can easily be disturbed by dirt and other contamination adhering to the connector interfaces. When not in use, keep the connectors covered.

To clean the connector interfaces, use a clean cotton swab that has been dampened with denatured alcohol.

Note	Most cotton swabs are too large to fit in the smaller connector types. In these cases, it is necessary to peel off most of the cotton and then twist the remaining cotton tight. Be sure that the remaining cotton does not get stuck in the connector. Cotton swabs of the appropriate size can be purchased through a medical laboratory-type supply center.

The following are some important tips on cleaning connectors:

- Use only denatured alcohol as a cleaning solvent
- Do not use excessive amounts of alcohol as prolonged drying of the connector may be required
- Never put lateral pressure on the center pin of the connector
- If installed, do not disturb the Teflon washer on the center conductor pin
- Verify that no cotton or other foreign material remains in the connector after cleaning it
- If available, use compressed air to remove foreign particles and to dry the connector
- After cleaning, verify that the center pin has not been bent or damaged.

Appendix E PC Regional Settings

The LANLook software is designed to operate on Windows XP or Windows Vista (32-bit) in an English, Japanese, or Chinese language environment. Performance cannot be guaranteed when installed on any other system.

Operation difficulties may be experienced if LANLook 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 (.).

E-1   Windows XP

1. Open the [Control Panel] from the Windows [Start] menu.

2. Open [Regional and Language Options].

3. Click the [Customize...] button.

4. Select the point (.) setting from the "Decimal Symbol" drop-down field.

E-2   Windows Vista

1. Open the [Control Panel] from the Windows [Start] menu.

2. Open [Regional and Language Options].

3. Click the [Formats] tab.

4. Click [Customize this format...].

5. Click the [Numbers] tab.

6. Select the point (.) setting from the "Decimal symbol" drop-down field.

Appendix F Windows Firewall Settings for Tx Testing

Under normal operation, when performing transmitter testing in a network connection, the MT8860B transmits ICMP (Internet Control Message Protocol) "echo request" packets to the DUT and receives "echo reply" packets in return.

Under certain circumstances however, the security settings on the PC may prevent the DUT from receiving the "echo request" packets and, as no "echo reply" packets are received, measurement analysis cannot be performed at the MT8860B.

To prevent this from happening, the PC security settings should be modified accordingly. Different levels of protection can be maintained whilst still ensuring that the "echo request" packets are received by the DUT.

Four security setting procedures are available. One of these procedures, as detailed over the following pages, should be performed by the user to ensure that packet loop-back is unhindered.

- Disable the Windows Firewall
- Enable TCP port 445
- Allow echo request packets for all connections
- Allow echo request packets for only the DUT connection

Note	Users should follow only one of the procedures in this appendix.

F-1   Disabling the Windows Firewall

Turning off the Windows firewall completely is the easiest procedure to perform but disables all protection.

1. Select [Windows Firewall] from the Windows [Control Panel]. The [Windows Firewall] dialog displays.

2. Click the [General] tab, select "Off (not recommended)" and click [OK] to close.

Figure F-1.   [Windows Firewall] Dialog

F-2   Enabling TCP Port 445

1. Select [Windows Firewall] from the Windows [Control Panel]. The [Windows Firewall] dialog displays.

2. Click the [General] tab and clear the "Don't allow exceptions" check box.

3. Click the [Exceptions] tab, highlight "File and Printer Sharing" and click [Edit].
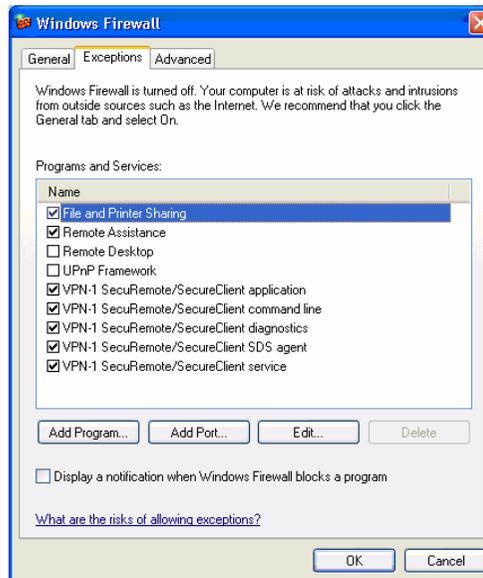
Figure F-2.   Windows Firewall Exception Settings

4. Select "TCP 445" and click [OK] to close.
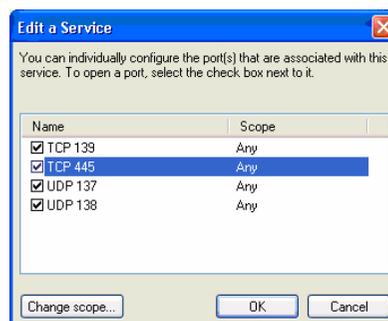
Figure F-3.   [Edit a Service] Dialog

F-3   Echo Request Packets for all Connections

1. Select [Windows Firewall] from the Windows [Control Panel]. The [Windows Firewall] dialog displays.

2. Click the [General] tab and clear the "Don't allow exceptions" check box.

3. Click the [Advanced] tab, and then click the ICMP [Settings...].
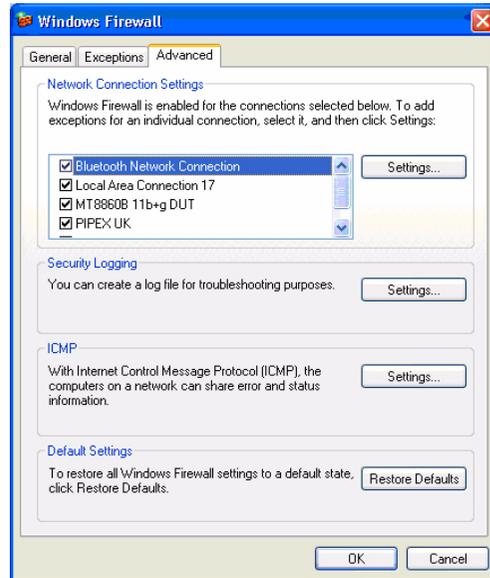
Figure F-4.   Windows Firewall Advanced Settings

4. Select "Allow incoming echo request" and click [OK] to close.
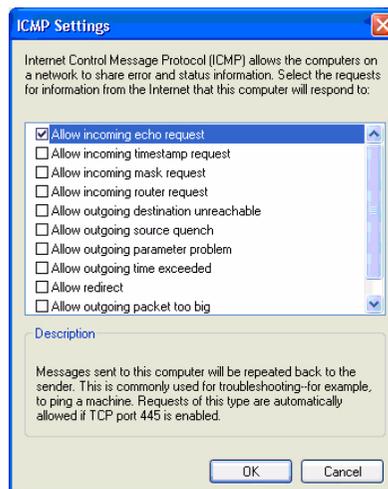
Figure F-5.   [ICMP Settings] Dialog

F-4   Echo Request Packets for DUT Only

1. Select [Windows Firewall] from the Windows [Control Panel]. The [Windows Firewall] dialog displays.

2. Click the [General] tab and clear the "Don't allow exceptions" check box.

3. Click the [Advanced] tab, scroll the network connection settings, highlight "MT8860B Demo Device (66955)" and click [Settings...].
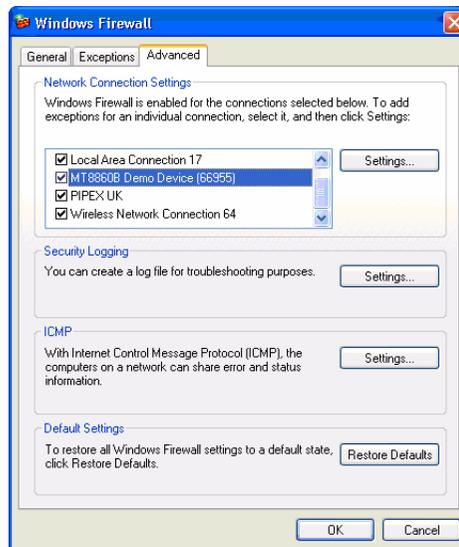
Figure F-6.   Exception Settings

4. Select the [ICMP] tab, select "Allow incoming echo request" and click [OK] to close.
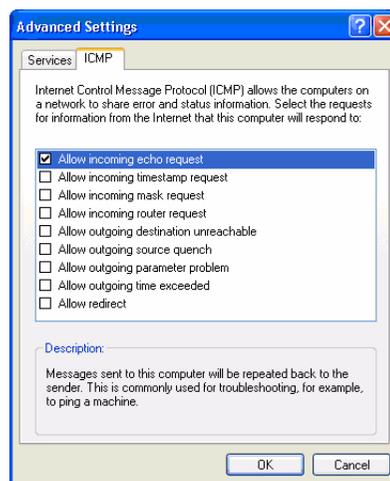
Figure F-7.   [Advanced Settings] Dialog

Appendix G Remote Operation Using LAN

LAN communication is supported by the MT8860B via the Ethernet connector on the rear panel of the instrument. It is functionally equivalent to the GPIB connector. The Ethernet connector enables the MT8860B to be remotely programmed by a LAN-connected computer. The distance between the computer (or network connection device) and the MT8860B is limited to 100 meters (10BaseT and 100BaseT).

The MT8860B supports the following LAN interface protocols and related [port numbers]:

- VXI-11 using VISA
- Sockets LAN [5025]
- TELNET [5024]
- File Transfer Protocol (FTP) [23]

VXI-11 and sockets LAN are used for general programming. A VISA installation on the controller is required for remote control over LAN when using VXI-11 protocol. TELNET is used for interactive, single command at a time instrument control. FTP is for file transfer and is only used to upgrade the instrument firmware.

Note	Only one session can be open at any given time. A message indicating that a connection is not possible will be reported if an attempt is made to open another session.

Detailed information about each LAN protocol is provided later in this appendix.

G-1   MT8860B Addressing

The MT8860B can be addressed in the following ways, depending upon:

- How the network is configured (DHCP enabled/disabled)
- How the MT8860B is configured (SYSCFG LAN,MODE MANUAL/AUTO)
    a. If the MT8860B is configured to use an AUTO IP address, but there is no DHCP server available, the MT8860B will default to the IP address 192.168.168.2
    b. If the MT8860B is configured to use an AUTO IP address and there is a DHCP server available, the IP address will be assigned automatically. If the DHCP server uses dynamic DNS to link the <hostname> with the assigned IP address, the MT8860B <hostname> may be used in place of the IP address.

The <hostname> is fixed for each MT8860B and has the format 'Axxxxxxx', where xxxxxxx represents the last 7 digits of the instrument serial number. A label located on the rear panel of the instrument provides serial number details. Use the examples shown in the table below to determine the <hostname> of the instrument.

Table G-1. Hostname Determination

Serial number	Hostname
6K0**0002643**	A0002643
000**839002**	A0839002

Note	If the DHCP server does not use dynamic DNS, the <hostname> cannot be used to communicate with the MT8860B over the LAN.

    c. If the MT8860B is configured to use a MANUAL IP address, the IP address can be configured manually using the SYSCFG LAN,ADDR command (default setting is 192.168.168.2).

Refer to the SYSCFG LAN commands in the MT8860B Remote Programming manual (13000-00202J.pdf) for further information on IP addressing.

G-2   Setting up the LAN Interface

For LAN operation, the MT8860B must be connected to the LAN and an IP address assigned to the MT8860B either manually or by using DHCP server.

Typically, there are four ways in which the MT8860B can be connected to a LAN.

Method 1: Direct connection to a "Corporate" (Enterprise) network.
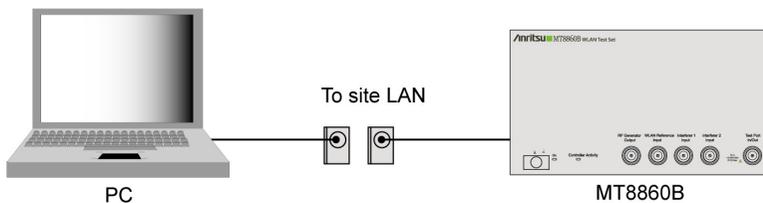
Figure G-1.   Direct Connection to Corporate Network

Method 2: Ethernet switch / hub connection to a "corporate" (Enterprise) network.
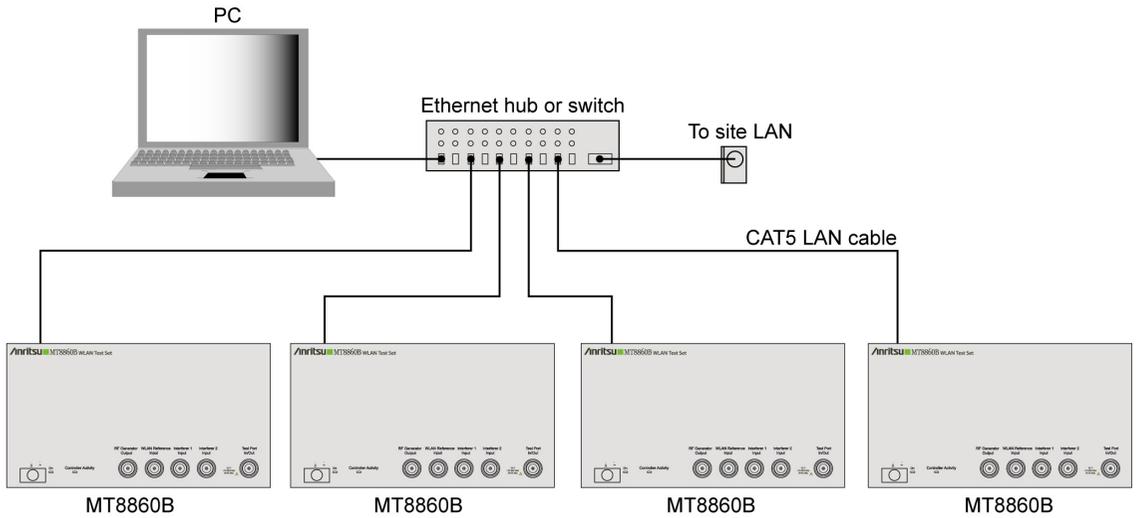
Figure G-2.   Ethernet Switch Connection to Corporate Network

Method 3: Direct connection to a private LAN.
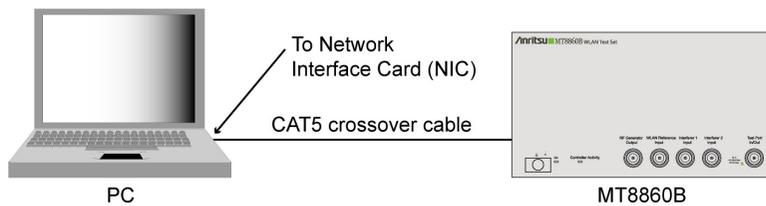
Figure G-3. Direct Connection to a Private LAN

The interface hardware does not support auto MDIX ('Auto-cross'). Consequently, when connecting the MT8860B directly to a PC, a CAT5 crossover cable must be used. It is also recommended that DHCP is disabled on both the MT8860B and PC.

Method 4: Ethernet switch / hub connection to a private LAN.
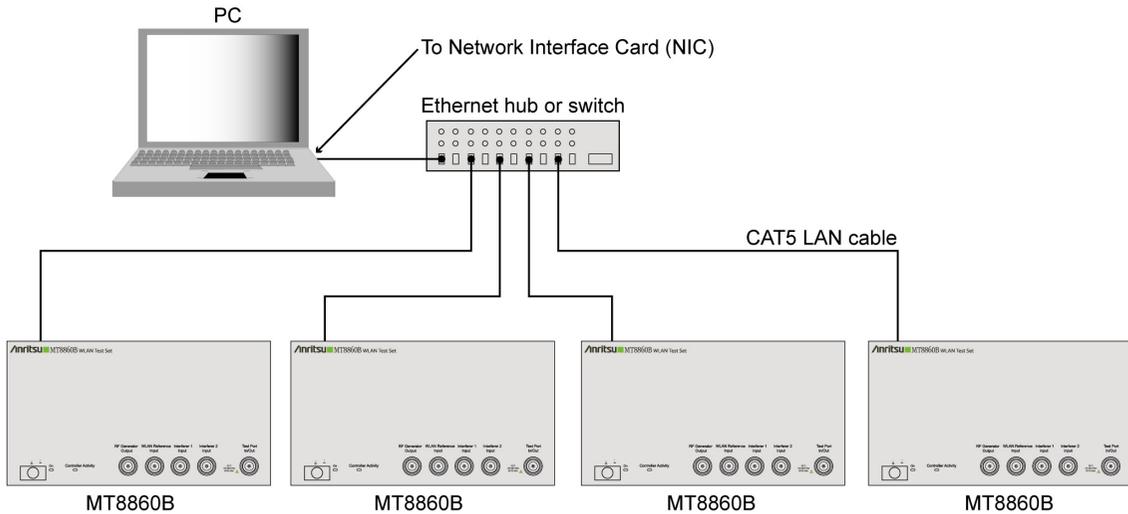
Figure G-4. Ethernet Switch Connection to Private LAN

For all methods described above, the follows steps should be taken when connecting the MT8860B to the LAN.

1. Power OFF the MT880C.

2. Connect the MT8860B as illustrated.

3. For methods 2 and 4, apply power to the Ethernet Hub or switch.

4. Power ON the MT8860B.

G-3 LAN Interface Protocols

VXI-11

The MT8860B supports the LAN interface protocol described in the VXI-11 standard. VXI-11 is an instrument control protocol based on Open Network Computing/Remote Procedure Call (ONC/RPC) interfaces running over TCP/IP. It is intended to provide GBIB capabilities such as SRQ (Service Request), status byte reading, and DCAS (Device Clear State) over a LAN interface. This protocol is a good choice when migrating from GPIB to LAN. It is recommended that the VXI-11 protocol be used for instrument communication over the LAN interface.

Note	A VISA installation on the controller is required when using VXI-11 protocol for remote control over LAN. VISA is a standard that provides input and output functions for configuring, programming and troubleshooting instrumentation systems comprising GPIB, VXI, PXI, Serial, Ethernet, and/or USB interfaces. The standard was originally defined by the VXIplug&play System Alliance but is now officially maintained by the IVI Foundation (http://www.ivifoundation.org). With the exception of some interface specific configuration functions, test programs can be written that are completely independent of the interface used.
	NI-VISA Run-Time Engine is provided on the MT8860B Product CD. NI-VISA is National Instruments implementation of the VISA I/O standard and includes software libraries, interactive utilities and configuration programs. Please visit the National Instruments Drivers and Updates page at http://www.ni.com/support/ for technical support for the NI-VISA Run-Time Engine, including the availability of upgrades. Technical support from National Instruments for the NI-VISA Run-Time Engine is subject to its then current support policy.

The example below demonstrates how a VXI-11/ VISA session can be opened using National Instruments 'Measurements & Automation Explorer' program.

1. On the PC, access the Windows programs directory and select [National Instruments] > [Measurement & Automation].
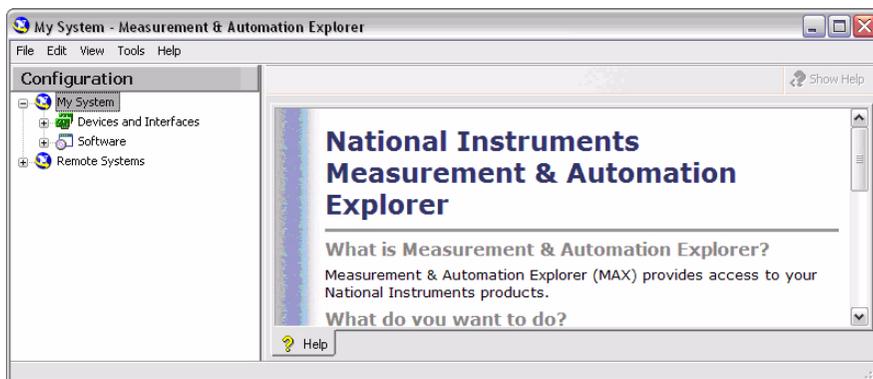
Figure G-5. [Measurement & Automation Explorer]

2. Right-click [Devices and Interfaces] and select [Create New…] from the pop-up menu.
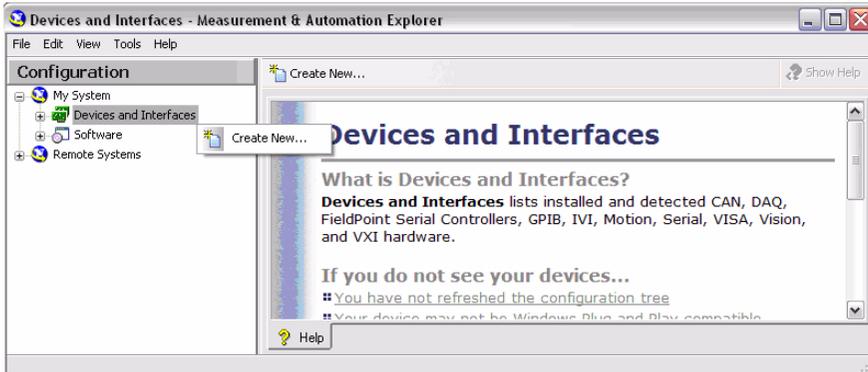
Figure G-6.   Create New

3. From the [Create New…] screen, select [VISA TCP/IP Resource], and then click [Next>].
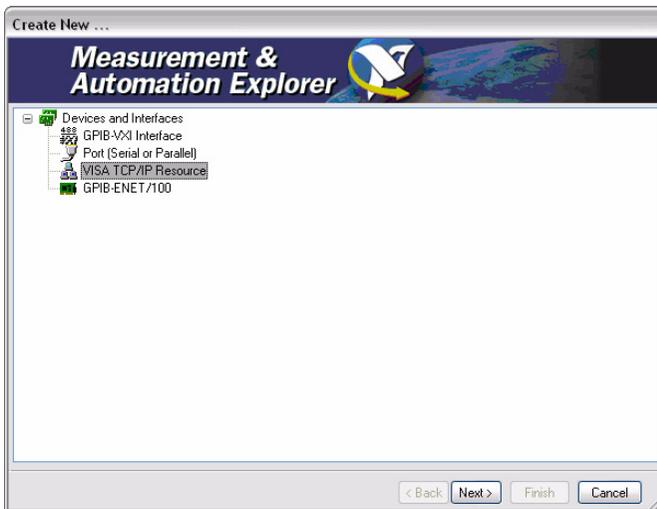
Figure G-7. VISA TCP/IP Resource

4. From the [Create New TCP/IP Resource…] screen, select "Manual Entry of LAN Instrument", and click [Next>].
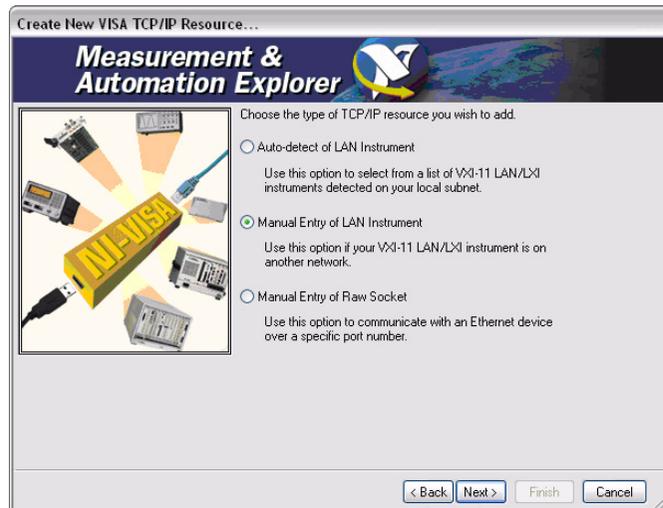
Figure G-8. [Create New VISA TCP/IP Resource]

5. Enter the hostname or IP address, and click [Validate].
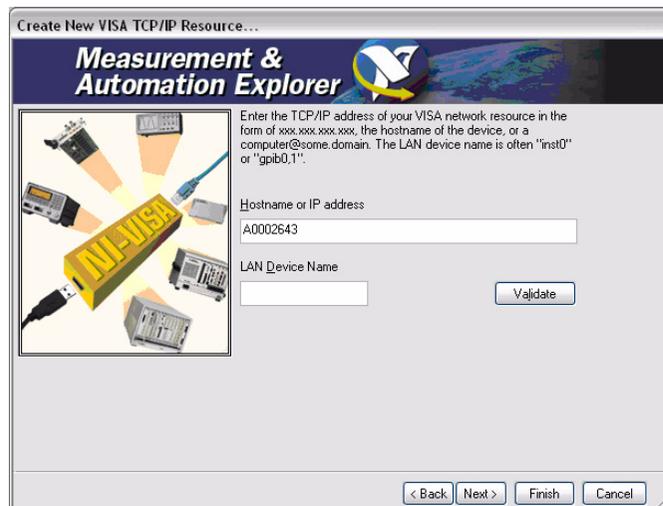
Figure G-9. Enter Hostname

6. A message indicates whether a session can be established with the MT8860B.

Figure G-10. Success

Figure G-11. Error

7. Click [OK] to close the message. From the [Create New TCP/IP Resource…] screen click [Next>]. An Alias name for the instrument can be specified. This is not the computer name. It is the name used for instrument identification within the program and displayed in the menu as an option in case of an Ethernet link.

Figure G-12. Specify Alias

8. Click [Next>].
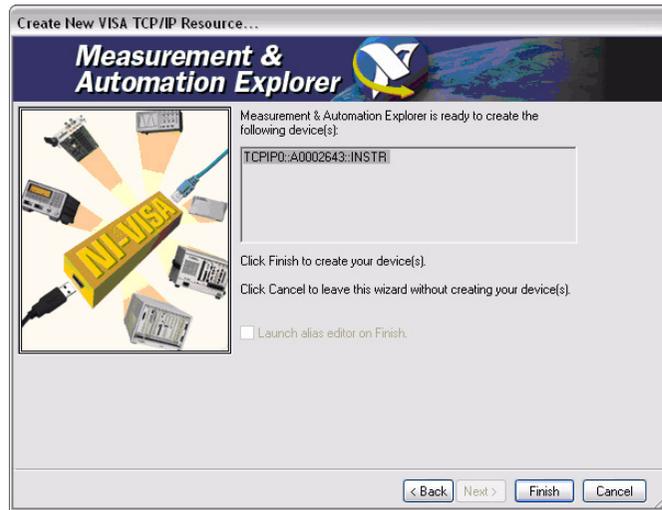
Figure G-13. Create Devices

9. Click [Finish]. The instrument is now registered and can be addressed via the resource string or alias name.
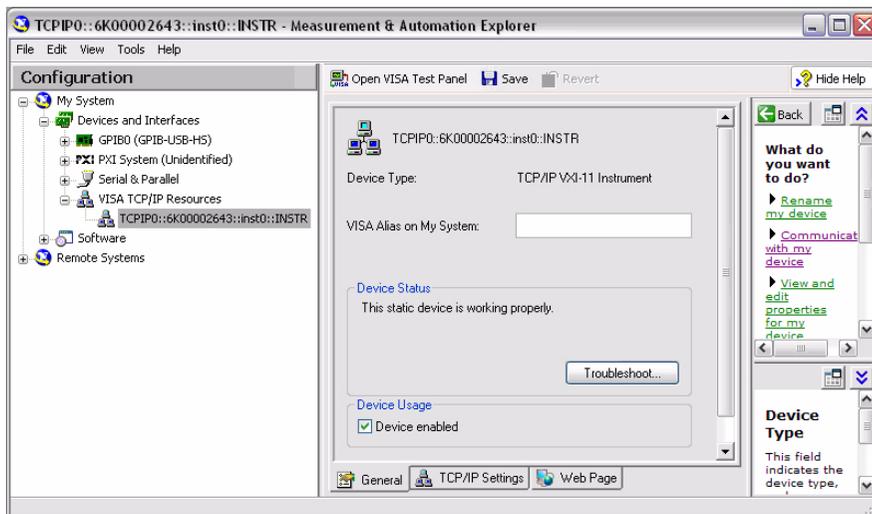
Figure G-14. [General] Tab

Clicking the [TCP/IP Settings] tab displays the following screen.
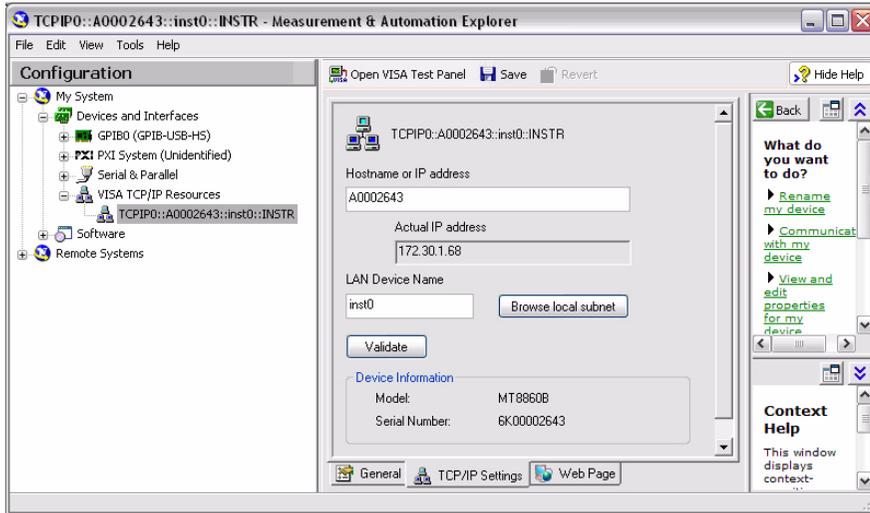
Figure G-15. [TCP/IP Settings] Tab

Clicking the [Web Page] tab displays the following screen.
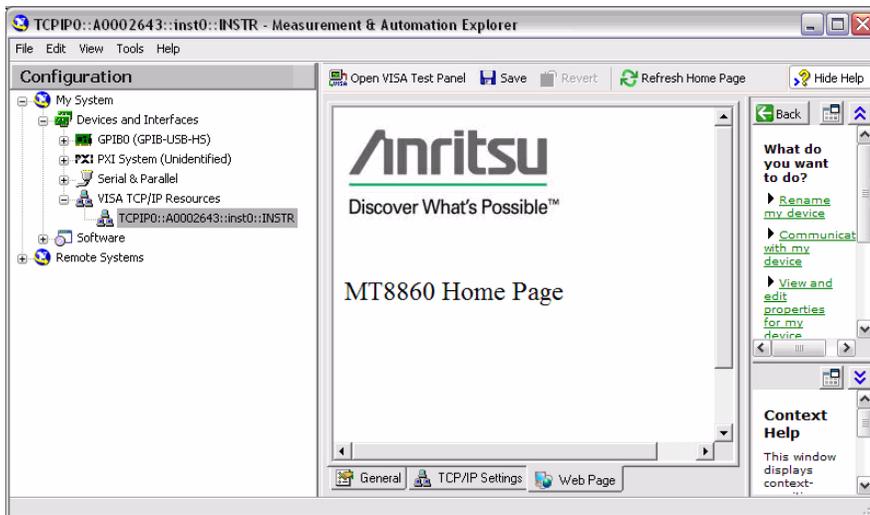
Figure G-16. [Web Page] Tab

10. To open a VISA session, click "Open VISA Test Panel".
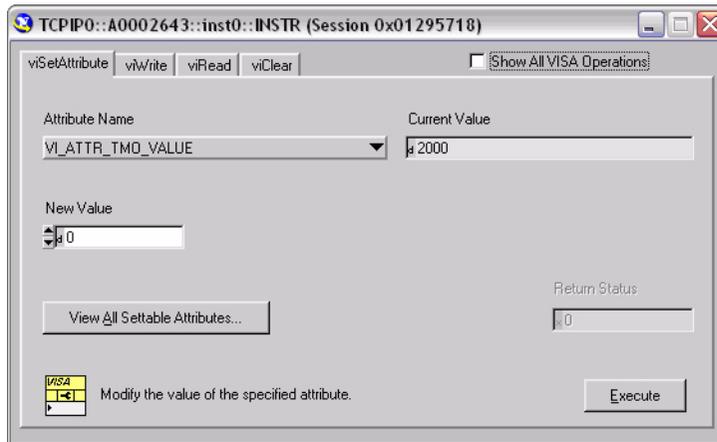
Figure G-17. VISA Test Panel

11. Commands can be sent to the instrument by selecting the viWrite. Enter the required command(s) in the Buffer window and click [Execute] to send the command(s) to the instrument.
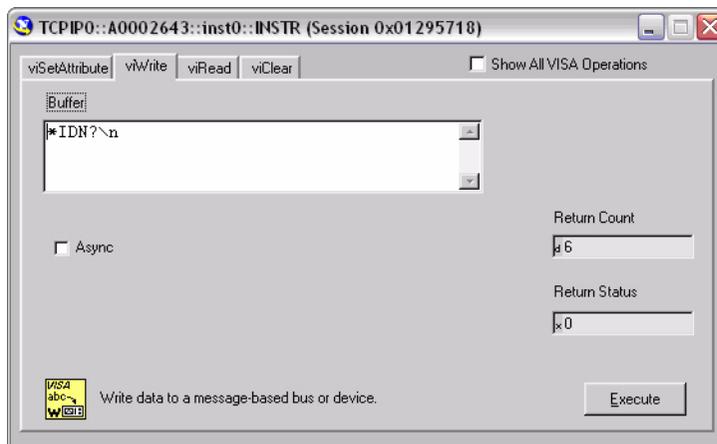
Figure G-18. ViWrite Tab

12. Message response strings can be read back from the instrument by selecting the [viRead] tab. Click [Execute] to perform a read operation.

Figure G-19. ViRead Tab

13. Close the VISA session, by selecting 'Close' from the drop-down menu.
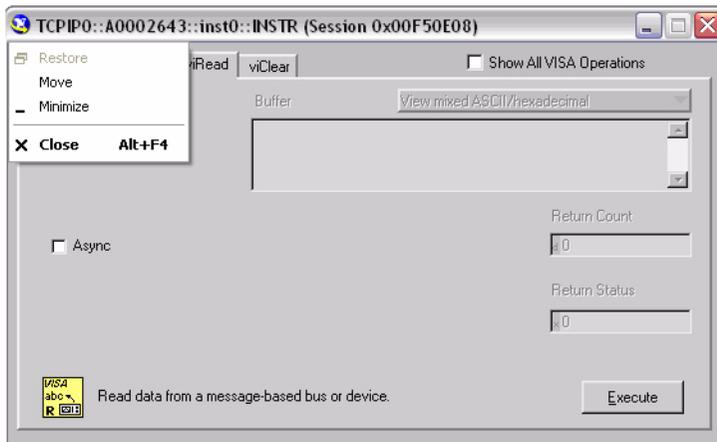
Figure G-20. Close Session

Sockets LAN [5025]

Socket LAN is a method used to communicate with the MT8860B over the LAN interface using the Transmission Control Protocol/Internet Protocol (TCP/IP). A socket is a fundamental technology used for computer networking and allows applications to communicate using standard mechanisms built into network hardware and operating systems. The method accesses a port on the MT8860B from which bi-directional communication with a network computer can be established.

Socket LAN can be described as an internet address that combines Internet Protocol (IP) with a device port number and represents a single connection between two pieces of software. The socket can be accessed using code libraries packaged with the computer operating system. MT8860B implements a socket Applications Programming Interface (API) that is compatible with Berkeley sockets, for UNIX systems, and Winsock for Microsoft systems. MT8860B is also compatible with other standard sockets APIs. MT8860B can be controlled using commands that are output to a socket connection established in your program.

An example of a Socket LAN application 'MT8860x Ethernet Communicator' is included on the MT8860B Product CD. Both source code and executable are provided.

1. Install the 'MT8860x Ethernet Communicator' application from the Product CD.

2. On the PC, access the Windows programs directory and select [Anritsu] > [MT8860x Ethernet Communicator].
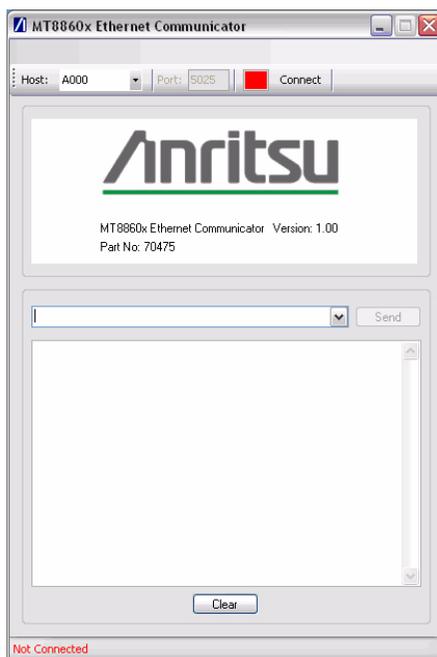
Figure G-21. Ethernet Communicator

3. Enter the <hostname or IP Address> into the "Host" edit box and click [Connect]. If another session (FTP, Telnet, VXI or Socket LAN) is in progress the application will display the following response from the server.
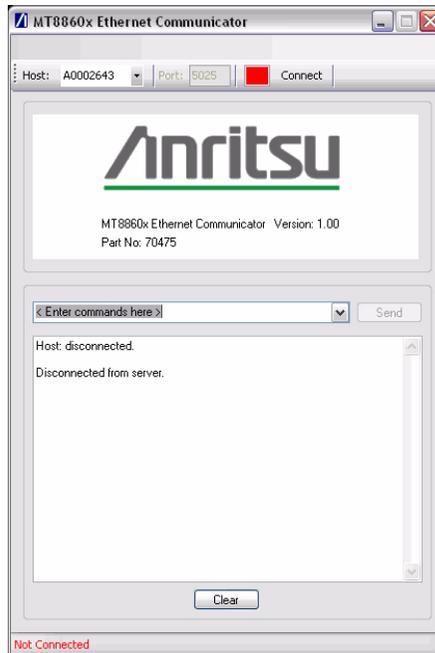
Figure G-22. Disconnected from Server

4. On a successful connection, the [Disconnect] button is shown and the connected LED flashes green. The status bar will show the IP Address of the connected unit.
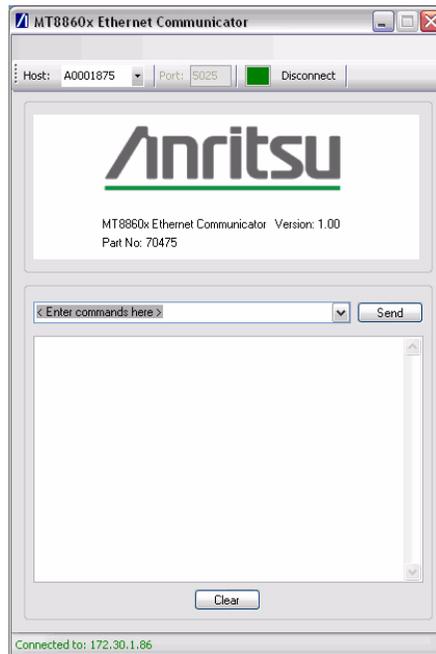
Figure G-23. Connected

5. Remote programming commands can be sent to the instrument by typing the command into the drop-down box and clicking the Send button. Transmitted commands are retained within the drop-down entry field.
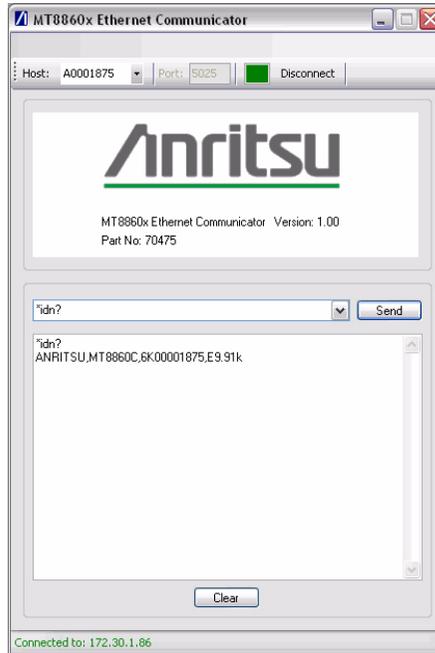
Figure G-24. Remote Commands

6. Multiple commands may be entered separated by a semi-colon (;).
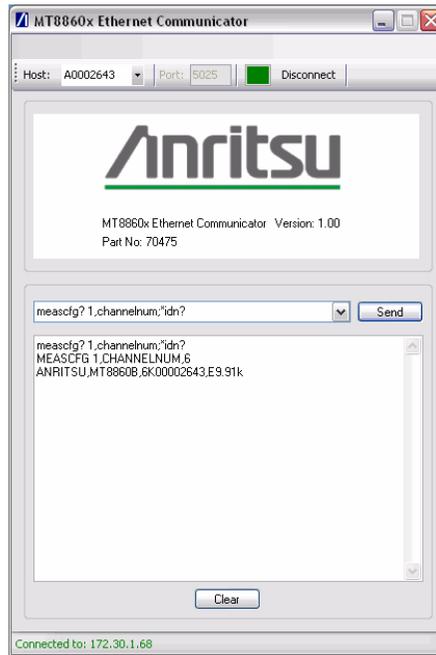
Figure G-25. Multiple Commands

7. Click [Disconnect] to close the Socket LAN session.
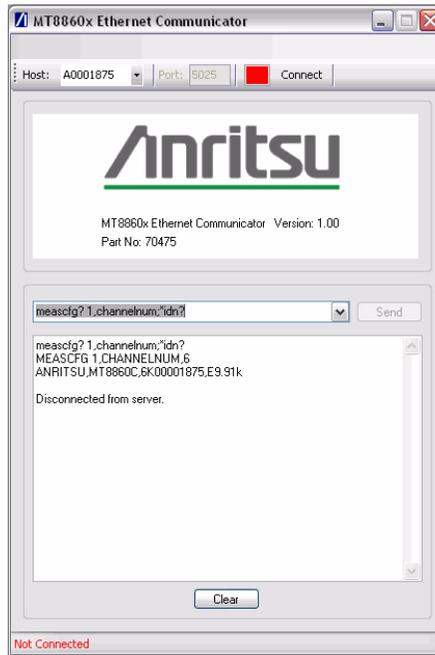
Figure G-26. Disconnected from Server

TELNET [5024]

Telnet provides a means of communicating with MT8860B over the LAN. The Telnet client run on a LAN connected computer, creates a login session on the MT8860B. A connection, established between computer and MT8860B opens a Telnet window with a command line prompt. Using the Telnet protocol to send commands to the MT8860B is similar to communicating with the MT8860B over GPIB. A connection is established with MT8860B and information is then sent to or received from the instrument using GPIB commands. Communication is interactive: one command at a time.

TELNET can be used from the command prompt window as follows:

1. On the PC, access the Windows programs directory and select [Accessories] > [Command Prompt].
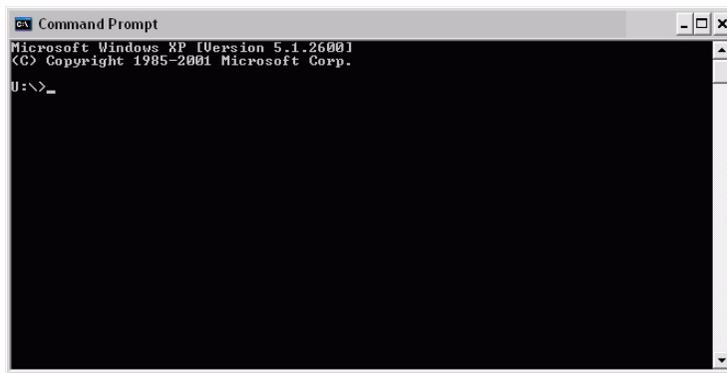
Figure G-27. Command Prompt

2. At the command prompt, type telnet <hostname or ip address> 5024.
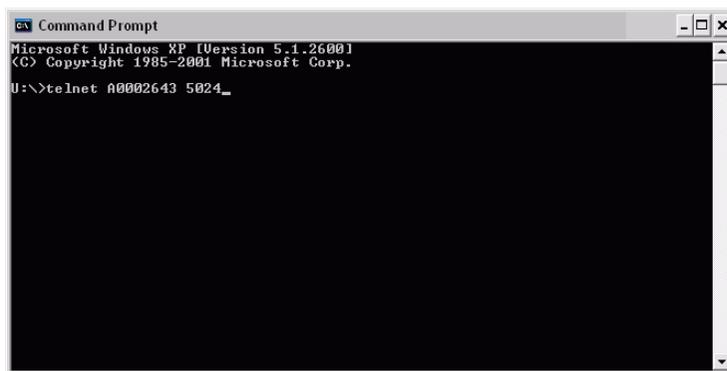
Figure G-28. Host Name or IP Address

3. At the MT8860 > prompt, enter GPIB commands (e.g. *idn?).
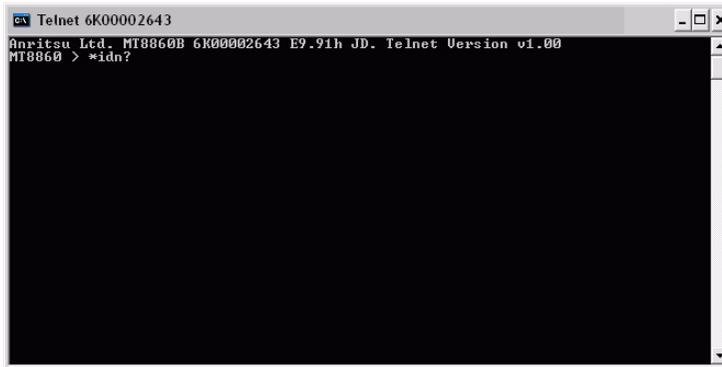
Figure G-29. GPIB String

4. The response string is returned.
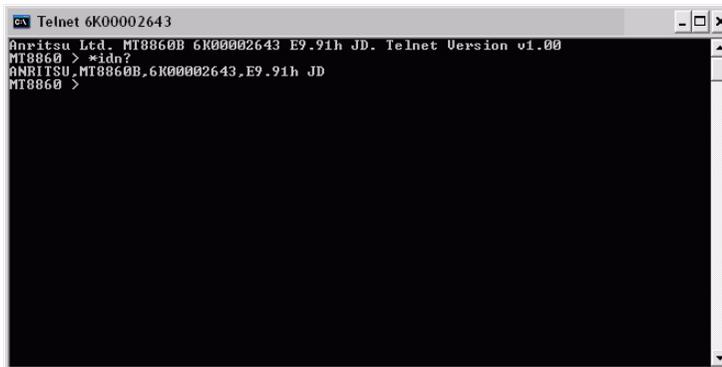
Figure G-30. Response String

5. Type exit at the MT8860 > prompt to end the Telnet session.
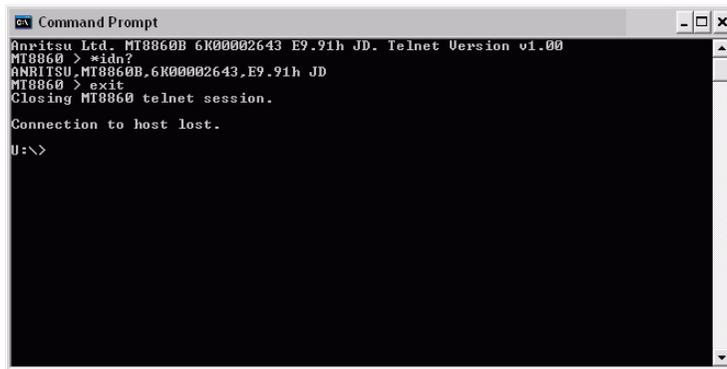
Figure G-31. Exit to End Session

File Transfer Protocol FTP [23]

FTP is provided for instrument firmware upgrade. Two methods are recommended:

- Directory browser
- FTP client, e.g., FileZilla

These utilities allow files to be copied to the MT8860B bootload folder using Windows style cut-and-paste and/or drag-and-drop operations.

Note	Microsoft provides an FTP client that can be run from a Command Prompt window. However, due to the different file formats used by MT8860B, the use of this is not advised for the firmware upgrade operation. If you wish to use this method please contact wlan.support@anritsu.com for further details.

Directory Browser

1. On the PC, open [My Computer] or [My Documents].

Figure G-32. [My Computer]

2. Type `ftp://admin:anritsu@`<hostname or IP address> in the address bar.
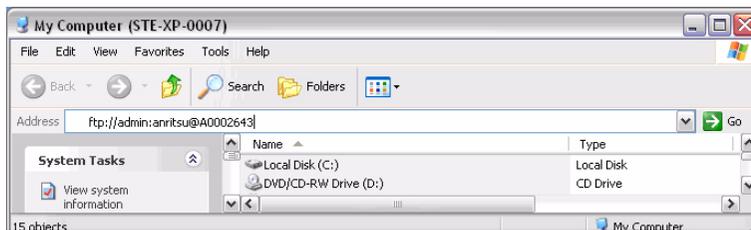
Figure G-33. Hostname or IP Address

3. The MT8860B bootload folder is now accessible.

Figure G-34. Bootload Folder

4. Files can now be copied from / to the MT8860B bootload folder.

5. Exit the window to close the session.

FileZilla Client

The FileZilla Client is a free, Open Source FTP client for Windows. It supports FTR, SFTP, and FTPS (FTP over SSL/TLS). FileZilla can be downloaded from the following location:

http://filezilla-project.org/download.php?type=client

1. Run the file filezilla.exe.
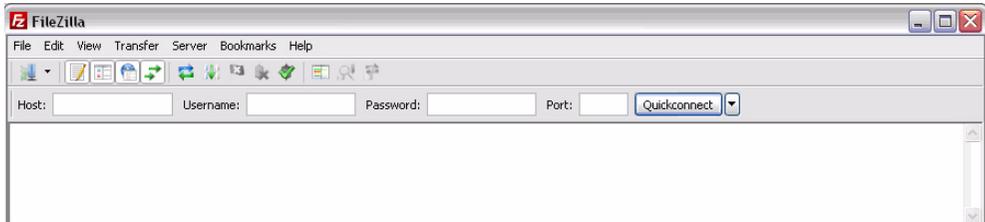
Figure G-35. [FireZilla]

2. Enter the following details:

- Host: <hostname or IP address>
- Username: admin

- Password: anritsu
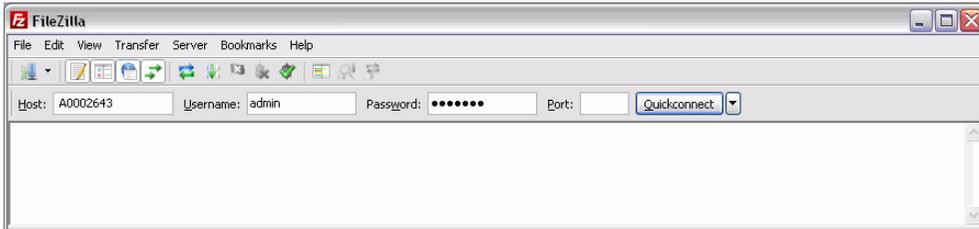
Figure G-36. Enter Host, Username, and Password

3. Click [Quickconnect].
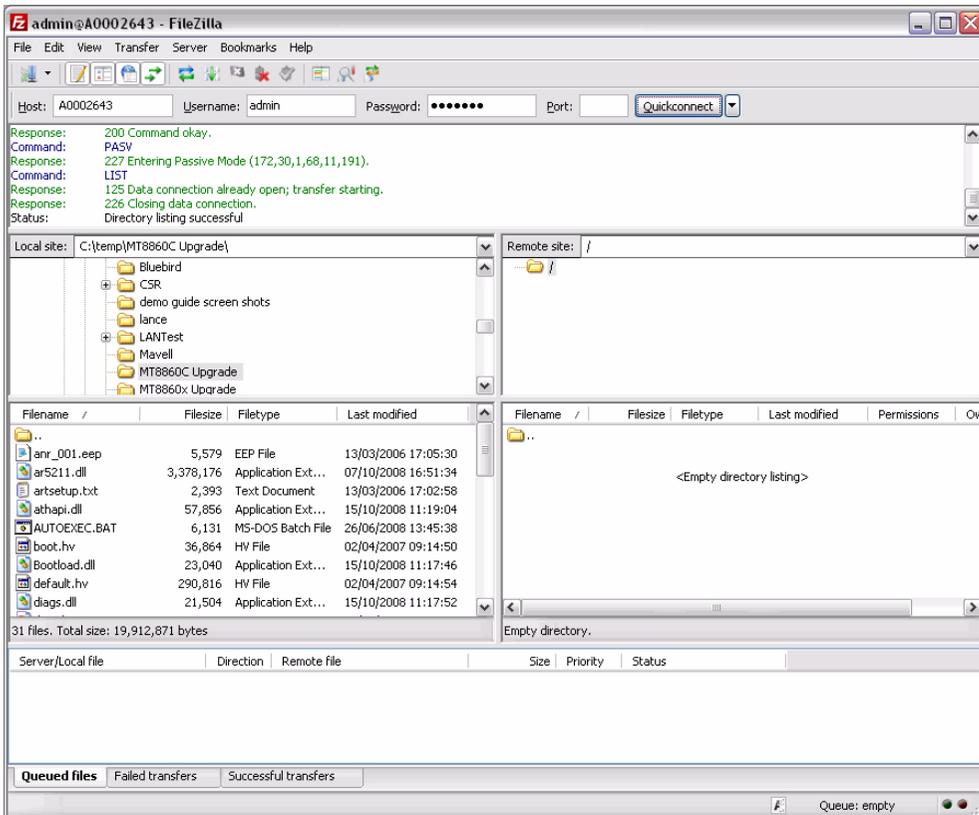
Figure G-37. Quickconnect

4. Files can now be copied from / to the MT8860B bootload folder using a simple drag-and-drop operation.

5. Exit FileZilla to close the FTP session.

Note	Filezilla does not close the FTP session. This should not be a problem as the application is used only for downloading new firmware files to the MT8860B. A power-cycle operation must be performed on the MT8860B before the new firmware becomes effective.

Instructions on how to perform a firmware upgrade using the LAN interface are provided in Chapter 15 of this manual.

G-4   Fault Finding

Follow the steps below if experiencing problems with the LAN connection on the MT8860B.

- Verify that the rear panel LAN connector green LED is flashing.
- Check the LAN configuration, making sure that the correct cable type has been used.
- Check connectivity using Ping.

Ping is a computer network tool that can be used to test whether a particular host is reachable across an IP network. It is named after the sound that a sonar makes and is inspired by the principle of echo-location.

Ping works by sending ICMP "echo request" packets to the target host and listening for ICMP "echo response" replies. Ping measures the round-trip time, records any packet loss and prints a summary of the echo response packets received.

1. On the PC, access the Windows programs directory and select [Accessories] > [Command Prompt].
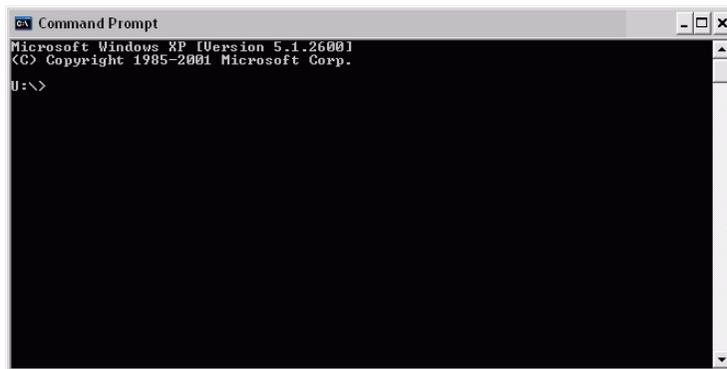
Figure G-38. [Command Prompt]

2. At the command prompt, type ping <hostname or IP address>.
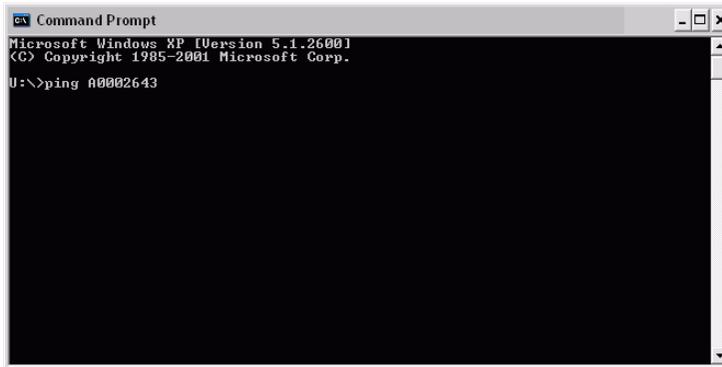
Figure G-39. Enter Hostname or IP Address

3. If the MT8860B is connected, it responds as shown below.
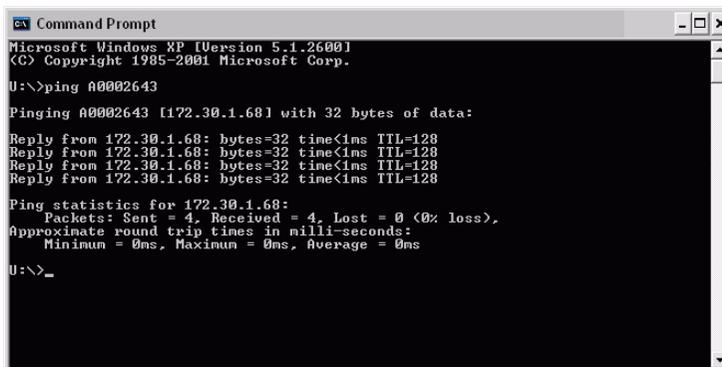
Figure G-40. Response from MT8860B

4. At the command prompt, type exit to close the MS-DOS command window.

Obtaining the LAN IP Address of the MT8860B

If the LAN DHCP mode of the MT8860B has been set to MANUAL (static) and the IP address modified from the default setting (192.168.168.2), a LAN connection to the instrument shall not be possible unless the IP address value is known.

If the IP address is not known, it can be found by:

- Using a GPIB remote interface
- Using a PC monitor keyboard and mouse
- Using a USB memory device

Method 1: Using a GPIB Remote Interface

1. Establish a GPIB connection as detailed in chapter 5.

2. Click [System Utilities] tab > [Diagnostics] tab.

3. The current LAN configuration can be determined by:

    a. In the "Send String:" field enter the remote command: SYSCFG? LAN.

    b. Click [Query].

    c. A response string containing the LAN configuration displays.

4. The LAN configuration can be modified using the remote commands: SYSCFG LAN,MODE and SYSCFG LAN,ADDR. Refer to the MT8860B Remote Programming manual for further details.

Note	LAN configuration changes become effective only after the MT8860B has been power-cycled.

Method 2: Using a PC Monitor, Mouse and Keyboard

1. Power-down (turn off) the MT8860B.

2. Connect a PC monitor to connector 'H' located on the rear panel of MT8860B.

3. Connect a keyboard to either the PS2 connector ('G') or to one of the USB Out connectors ('E') located on the rear panel of MT8860B

4. Connect a mouse to either the PS2 connector ('I') or to one of the USB Out connectors ('E') located on the rear panel of MT8860B.
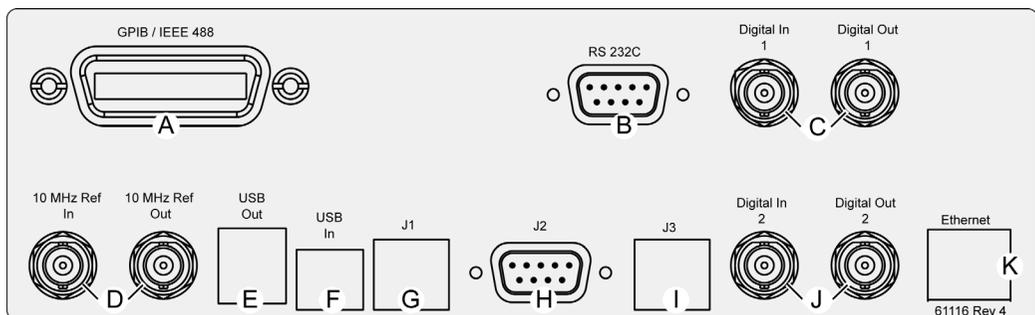
Figure G-41. MT8860B Rear Panel Connectors

5. Power-on the MT8860B.

6. When the MT8860B has finished booting up (indicated by 'On' LED turned fully on, and the 'Controller Activity' LED turned off), the following desktop displays on the PC monitor.
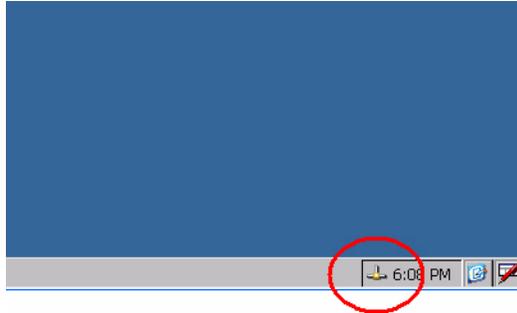
Figure G-42. System Tray

7. Double-click the network icon (circled) in the system tray (lower right of the screen). The following window displays, showing the current IP configuration.
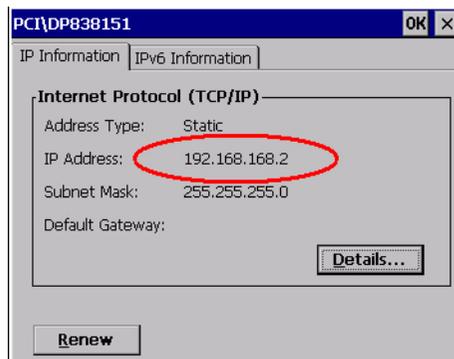
Figure G-43. IP Address Window

8. Use these IP settings to make an Ethernet connection to the unit.

9. Details on how to modify the LAN configuration are provided below. Refer to "Changing the MT8860B LAN Configuration" for details.

Method 3 –Using a USB Memory Device

This method will set the MT8860B LAN configuration to the following default values:

IP address: 192.168.168.2

Subnet Mask: 255.255.255.0

1. Power-down (turn off) the MT8860B.

2. Remove any device connected to the USB out connector ("E" in the figure below), or the PS2 connectors ("G" and "I" in the figure below).

3. Insert a USB memory device into one of the USB Out connectors ('E) located on the rear panel of the MT8860B.
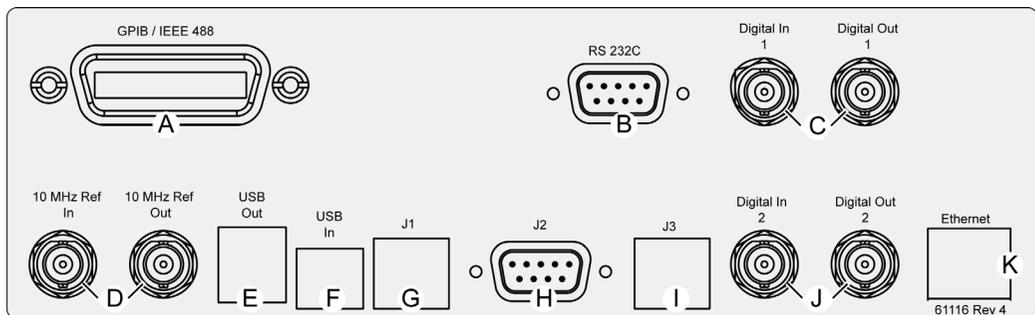
Figure G-44. MT8860B Rear Panel Connectors

4. Power-on the MT8860.

5. When the MT8860B has finished booting up (indicated by 'On' LED turned fully on, and the 'Controller Activity' LED turned off), the MT8860B IP configuration is set to the default values shown above.

6. Remove the USB memory device.

7. Using a CAT5 crossover cable, connect MT8860B to a PC.
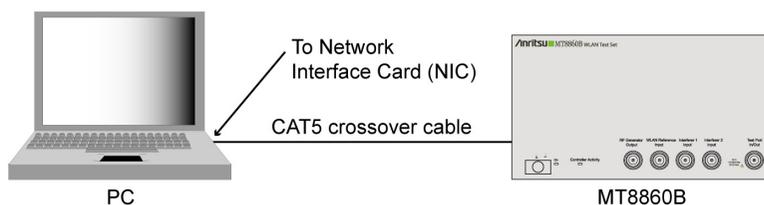
Figure G-45. CAT5 Crossover Connection

8. Details on how to modify the LAN configuration are provided below. Refer to "Changing the MT8860B LAN Configuration" below.

Changing the MT8860B LAN configuration

Before the MT8860B LAN configuration can be modified, a LAN connection must be established between a PC and MT8860B. To enable this, the IP address of the PC must be in the same subnet as the address of the MT8860B, but not use the same IP address. For example, if the IP address of the MT8860B is 192.168.168.2, the IP address of the PC must be in the range of 192.168.168.1 to 192.168.168.254 (but not 192.168.168.2) for a successful connection. To change the IP setting of the PC:

1. Access the Windows Control Panel.

2. Click the [Network and Internet Connection] icon, then select [Network Connections].

3. Right click the [Local Area Connection] icon and select [Properties].

4. Make sure the "Internet Protocol" (TCP/IP) check-box is selected.

5. Highlight "Internet Protocol (TCP/IP)", then click [Properties].

6. Select "Use the following IP address" and enter an IP address in the range of 192.168.168.1 to 192.168.168.254 (but not 192.168.168.2). Make sure you do not choose an IP address that already exists on your network.

7. Tab to the "Subnet Mask" and enter the subnet mask indicated by MT8860B (e.g., 255.255.255.0)

8. Click [OK].

9. Having configured the PC, open the LANLook software application.

10. From the [MT8860x Remote] tab, set "Remote Interface" to "LAN".

11. In the "Remote Connection (LAN)" frame, enter the IP address of MT8860B and click [Connect]. LANLook should indicate that a remote connection has been established.

Figure G-46. MT8860x Remote Tab

12. Click [System Settings] tab.
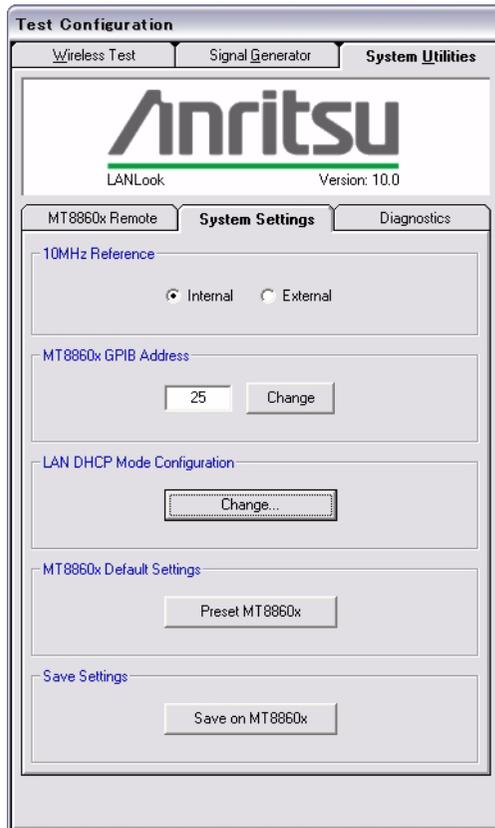
Figure G-47. System Settings Tab

13. Click [Change...] in the "LAN DHCP Mode Configuration" frame to display the dialog below.
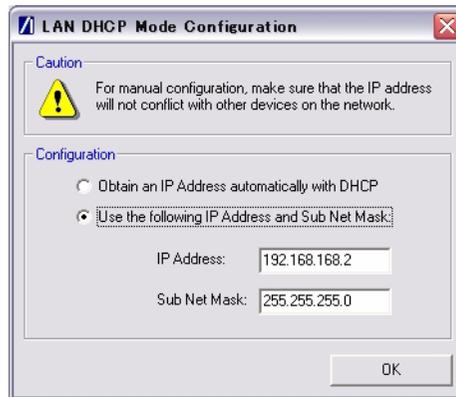
Figure G-48. LAN DHCP Mode Configuration

14. Modify the LAN Configuration settings as required and click [OK]. LANLook displays the following Message.
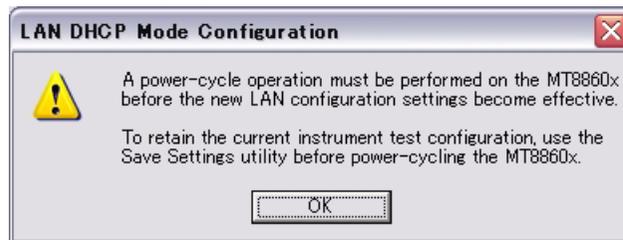
Figure G-49. Power Cycle Warning

Note	Make sure that a unique IP address is selected. An address conflict could result in unexpected and unwanted device behaviour on the network.

15. Power-down (turn off) MT8860B and close LANLook.

16. Reconfigure the IP settings of the PC so that they are compatible with the new IP configuration of MT8860B.

17. Power-on the MT8860B.

18. When the MT8860B has finished booting up (indicated by 'On' LED turned fully on, and the 'Controller Activity' LED turned off), open LANLook.

19. In the "Remote Connection (LAN)" frame, enter the IP address of MT8860B and click [Connect]. LANLook should indicate that a remote connection has been established using the new IP configuration.

Index