

# MT8855A

Bluetooth<sup>®</sup> Audio Test Set



Operation Manual

# MT8855A

## *Bluetooth* Audio Test Set

**Anritsu**

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Anritsu Company  
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USA  
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**Manufacturer's Name:** ANRITSU COMPANY

**Manufacturer's Address:** Microwave Measurement Division  
490 Jarvis Drive  
Morgan Hill, CA 95037-2809  
USA

declares that the product specified below:

**Product Name:** Bluetooth Audio Test Set

**Model Number:** MT8855A

conforms to the requirement of:

EMC Directive: 2004/108/EC  
Low Voltage Directive: 2006/95/EC

## **Electromagnetic Compatibility: EN61326: 2006**

Emissions: EN55011: 2007 Group 1 Class 1

Immunity: EN 61000-4-2:1995 +A1:1998 +A2:2001 4kV CD, 8kV AD  
EN 61000-4-3:2006 +A1:2008 3V/m  
EN 61000-4-4:2004 0.5kV SL, 1kV PL  
EN 61000-4-5:2006 0.5kV L-L, 1kV L-E  
EN 61000-4-6:2007 3V  
EN 61000-4-11:2004 100% @ 20msec

## **Electrical Safety Requirement:**

Product Safety: EN61010-1: 2001



Eric McLean, Corporate Quality Director

Morgan Hill, CA

6 MAY 2009  
Date

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[For Chinese Customers Only YLNB]

| 部件名称  | 有毒有害物质或元素 |           |           |                 |               |                 |
|---|-----------|-----------|-----------|-----------------|---------------|-----------------|
|   | 铅<br>(Pb) | 汞<br>(Hg) | 镉<br>(Cd) | 六价铬<br>[Cr(VI)] | 多溴联苯<br>(PBB) | 多溴二苯醚<br>(PBDE) |
| 印刷线路板<br>(PCA)  | ×         | ○         | ×         | ×               | ○             | ○               |
| 机壳、支架<br>(Chassis)  | ×         | ○         | ×         | ×               | ○             | ○               |
| LCD   | ×         | ×         | ×         | ×               | ○             | ○               |
| 其他(电缆、风扇、<br>连接器等)<br>(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。<br>×：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。 |           |           |           |                 |               |                 |

环保使用期限

|   |  |
|---|--|
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## Safety Symbols

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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 risk from a very dangerous condition or procedure that could result in serious injury or death and possible loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

#### Warning



This indicates a risk from a hazardous condition or procedure that could result in light-to-severe injury or loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

#### Caution



This indicates a risk from a hazardous procedure that could result in loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

### 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.



These indicate 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. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. 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.

### Warning



Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury if this equipment is lifted by one person.

### 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.

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## **Subject**





# Chapter 1 — General Information

## 1-1 About this Manual

This manual provides set-up and operational information on the MT8855A *Bluetooth* Audio Test Set and associated BlueAudio user interface software.

### 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 Anritsu 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.

bluetooth.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 firmware / software versions:

MT8855A firmware: 1.30

BlueAudio software: 1.30

Follow the procedure below to check the versions of the software in use.

1. Start BlueAudio from the desktop shortcut, or by accessing the Windows programs directory and selecting [Anritsu] > [BlueAudio].
2. Select [Help] > [About BlueAudio] from the BlueAudio menu bar.
3. Check the MT8855A and BlueAudio version numbers that display in the dialog.

**Note**

A USB connection with the MT8855A is required in order to display the firmware version. A USB cable is supplied with the instrument.

**Note**

BlueAudio is supplied as part of the MT8855A product package and can be found on the product CD. Refer to chapter 4 for installation details.

## Notification of Software Release



The MT8855A firmware and BlueAudio software will be updated as new features are added to meet market demands.

To receive automatic notification of each software release, send a blank e-mail with the subject heading, "MT8855A Software Notification Request" to [bluetooth.support@anritsu.com](mailto:bluetooth.support@anritsu.com). A notification mail will be sent automatically each time new software becomes available.

## Conventions

The following conventions have been adopted in this manual.

**Table 1-1.** Notation Conventions

| Item   | Convention   |
|--|--|
| MT8855A  | The official name of the product detailed in this manual is the MT8855A <i>Bluetooth</i> Audio Test Set. This name has been shortened to MT8855A throughout this manual. |
| DUT  | The component or product being tested is referred to as the DUT (Device Under Test) throughout this manual.  |
| [Anritsu BlueAudio]  | The titles of BlueAudio windows and dialogs are enclosed in square brackets.   |
| "MT8855A Role"   | Text appearing in windows or dialogs is enclosed in quotation marks when used within a body of text.   |
| "Analogue Output"  | Text appearing on the MT8855A front or rear panels is enclosed in quotation marks when used within a body of text.   |
| [Help] > [About BlueAudio]   | A chevron (>) is used to indicate that the user should select the commands or keys in sequence.  |
|  | The word "select" is used to describe the action of clicking a check box to insert a check mark (✓).   |
|  | The word "clear" is used to describe the action of clicking a selected check box to remove the check mark.   |

## Contacting Anritsu

Anritsu contact information can be accessed from the following link:

<http://www.anritsu.com/Contact.asp>

## 1-2 Product Description

### What is the MT8855A *Bluetooth* Audio Test Set?

The MT8855A is a test instrument used to perform high-quality audio measurements on products using the *Bluetooth* Advanced Audio Distribution Profile (A2DP), the Headset Profile (HSP), or the Hands-Free Profile (HFP). Module testing is also possible using basic SCO/eSCO connections. The MT8855A is the ideal instrument for design evaluation and manufacturing test.

Typical *Bluetooth* products that can be tested with the MT8855A include stereo and mono headsets, mobile phones, desk speakers, digital media players, car kits, and car consoles.

After establishing a *Bluetooth* connection with the DUT, the MT8855A's integrated audio generators and analyzers are used to perform measurements that include level, frequency response, and harmonic distortion.



Figure 1-1. MT8855A

### MT8855A Features

- 20 Hz to 20 kHz frequency coverage
- Measurement of frequency response, levels, and distortion
- Supports *Bluetooth* A2DP, Headset, and Hands-Free profiles
- Basic SCO/eSCO connections for module testing
- PC-installed user interface: BlueAudio
- Manual mode for R&D testing
- Auto test mode for production testing
- Audio FFT analyzer
- Integrated audio generator and analyzer
- Direct connection of accessory microphones and speakers
- BlueStart software shows how to use MT8855A class library to develop custom test programs
- PESQ and MOS measurements with option 32

## What is BlueAudio?

The BlueAudio software can be thought of as the MT8855A's front panel and is supplied with every MT8855A purchased. BlueAudio is used to configure the MT8855A for testing, specify the measurements to be run, and display the measurement results in both graphical and numeric form.

**Note** All data processing and measurements are performed by the MT8855A. BlueAudio is a tool to configure the test conditions and read back the measurement results for display and analysis.

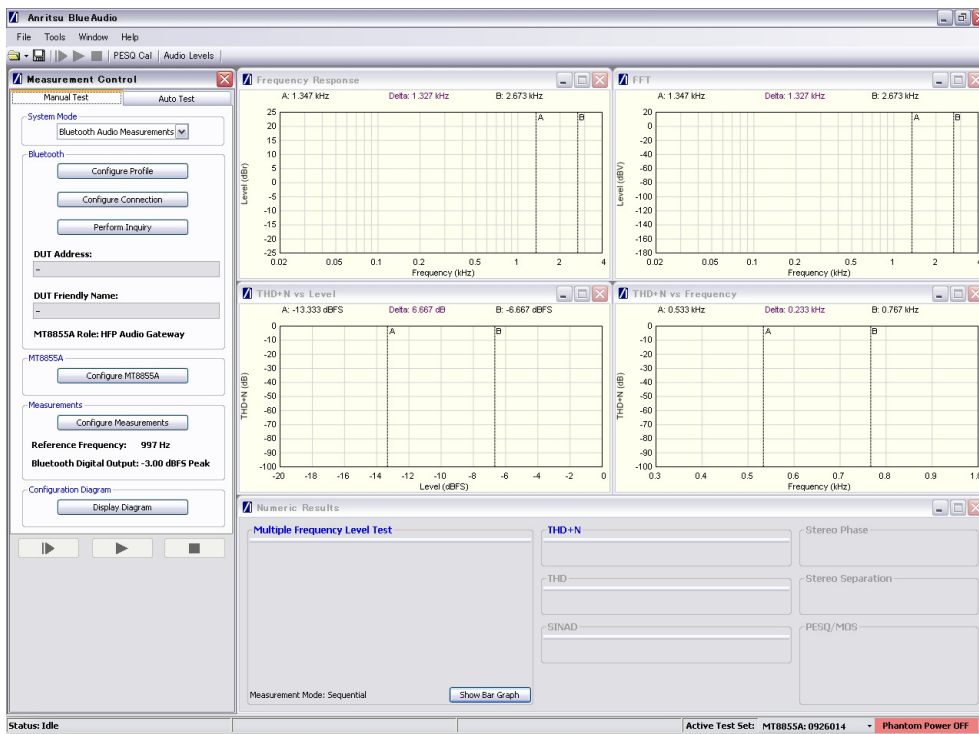


Figure 1-2. [Anritsu BlueAudio] Main Window

## BlueAudio Features

- Enables the user to configure the *Bluetooth* profile, establish a *Bluetooth* connection, configure the MT8855A, and select and define the measurements.
- Performs both numeric and graphical measurements.
- Provides two modes of operation: “Manual Test”, ideally suited for R&D testing, and “Auto Test” for production testing.
- Allows the user to develop a “Test Plan” of multiple test setups that can be saved, recalled, modified, and run whenever required.
- Detailed test report available on completion of every test plan.

## Optional Accessories

The following items are available as additional cost accessories for the MT8855A.

**Table 1-2.** Options and Accessories

| Number      | Item   |
|-------------|--|
| MT8855A-001 | Rack mount kit (single) (Refer to Appendix E)  |
| MT8855A-003 | Rack mount kit (side-by-side) (Refer to Appendix E)  |
| MT8855A-032 | PESQ/MOS measurement option  |
| MT8855A-033 | ASTS audio files   |
| MT8855A-332 | Retrofit PESQ/MOS measurements   |
| MT8855A-333 | Retrofit ASTS audio files  |
| 2000-1607-R | Standard microphone (including interface cable) (typical frequency response calibration data)                        |
| 2000-1608-R | Calibrated microphone (including interface cable) (individually calibrated frequency response data)                  |
| 2000-1612-R | Test speaker   |
| 2000-1613-R | 2.4 GHz antenna and adaptor  |
| MT8855A-098 | Standard calibration to ANSI/NCSLI Z540-1 (Certificate of calibration only)  |
| MT8855A-099 | Premium calibration to ANSI/NCSLI Z540-1 (Certificate of calibration with test report and uncertainty data included) |
| D41310      | Soft carry case  |



# Chapter 2 — Preparation for Use

## 2-1 Operating Environment

The MT8855A is designed to function within the temperature range of 5°C to 40°C with a maximum humidity of 75% at 40°C, non-condensing.

## 2-2 Power Requirements

The MT8855A is operated from an AC power line. The MT8855A is intended as an Installation (Overvoltage) Category II, Insulation Category I device.

### AC Line Power

The MT8855A operates on AC input power of 85-264 V, 47-63 Hz, 50 VA maximum. The MT8855A automatically configures itself to the voltage applied.

### Grounding

The MT8855A 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 correctly 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 MT8855A is damaged mechanically, notify your local sales representative or Anritsu Customer Service Center.



## Package Contents

The MT8855A is shipped with the following items. Check that all listed items are present and contact Anritsu if they appear to be missing.

**Table 2-1.** Package Contents

| Item                                    | Part number   | Quantity |
|---|---|----------|
| Bluetooth Audio Test Set                | MT8855A   | 1        |
| Power cord                              | Part number varies. (Appropriate cable shipped for country of order.) | 1        |
| Operation manual (hardcopy)             | 13000-00280   | 1        |
| Certificate of calibration              |   | 1        |
| USB cable for connection to PC          | 2000-1611-R   | 1        |
| XLR (f) to BNC (f) adaptor for line out | 553-525-R   | 2        |
| BNC (m) to phono (f)                    | 553-526-R   | 4        |
| Product CD containing :-                | 2300-295  | 1        |
| BlueAudio software                      | MX885501A   | 1        |
| Instrument Firmware                     | 69570   | 1        |
| Audio Tones                             | N/A   | 1        |
| Operation Manual (pdf)                  | 13000-00280   | 1        |
| Brochure                                | 11410-00496   | 1        |
| Data sheet                              | 11410-00507   | 1        |
| BlueStart software                      | 70499   | 1        |
| ASTS audio files                        | MT8855A-033   | 1        |

## 2-4 Preparing for Storage

1. Clean the MT8855A prior to storage and pack it using moisture-absorbing desiccant crystals.
2. Store the unit in a temperature controlled environment maintained at between 5°C and 40°C, with a maximum humidity of 75% at 40°C, non-condensing.

## 2-5 Preparing for Shipment

1. Wrap the MT8855A to protect the finish.
2. Position the MT8855A in the original shipping container.

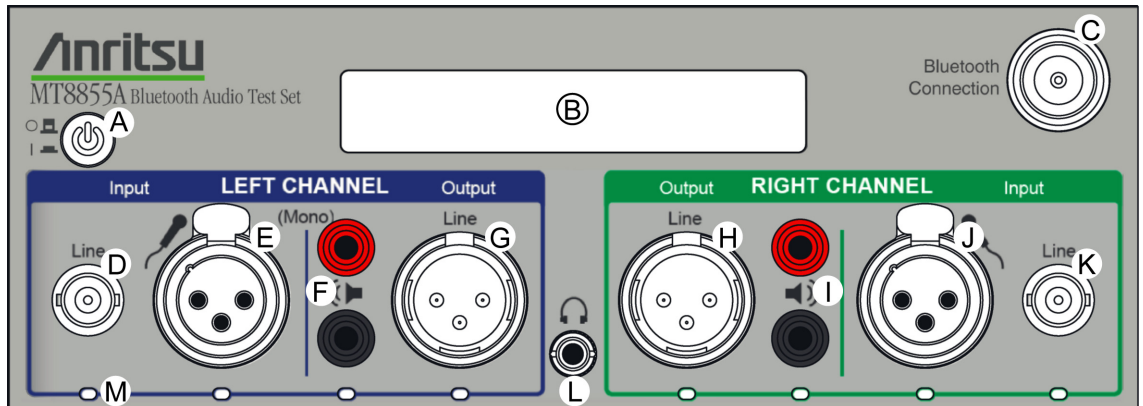
|             |  |
|-------------|--|
| <b>Note</b> | If the original shipping container is no longer available, use a strong corrugated cardboard container that is at least 15 cm larger than the MT8855A. |
|-------------|--|

3. Insert cushioning material between the MT8855A and the container. Pack the cushioning material tightly but take care to ensure that there is no pressure on the Type N RF connector.
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 center can be found at <http://www.anritsu.com/Contact.asp>.



# Chapter 3 — Instrument Overview

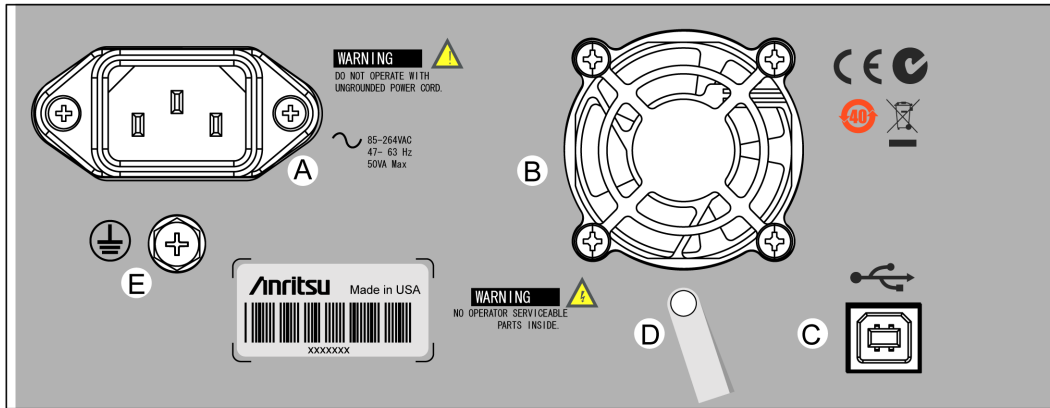
## 3-1 Front Panel Layout



- Ⓐ Power On/Off button
  - Ⓑ Two-line status display
  - Ⓒ RF connector for *Bluetooth* connection to DUT
  - Ⓓ Left channel line input
  - Ⓔ Left channel microphone input
  - Ⓕ Left channel speaker outputs
  - Ⓖ Left channel line output
  - Ⓗ Right channel line output
  - Ⓘ Right channel speaker output
  - Ⓙ Right channel microphone input
  - Ⓚ Right channel line input
  - Ⓛ Headphone connector
  - Ⓜ LEDs indicating active connectors
- } Audio connectors

**Figure 3-1.** MT8855A Front Panel

## 3-2 Rear Panel Layout



- Ⓐ Mains power connection
- Ⓑ Cooling fan
- Ⓒ USB connection with the PC running BlueAudio
- Ⓓ Cable restrainer. Used to prevent the USB cable from being accidentally pulled out.
- Ⓔ Ground nut. Used if the MT8855A power cord does not have a built-in ground.

**Figure 3-2.** MT8855A Rear Panel

# Chapter 4 — Installation

## 4-1 Required Hardware and Operating Environment

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

- Intel-based PC with Pentium processor or equivalent.
- Microsoft Windows XP or Windows Vista (32-bit) operating systems.
- English, Chinese, or Japanese language environment.
- CD-ROM drive (if installing BlueAudio from the supplied CD).
- PC display resolution of 1024 x 768 or greater.

## 4-2 BlueAudio Installation

1. Insert the product CD into the drive on the PC. The [MT8855A Bluetooth Audio Test Set] window displays automatically.
2. Click “BlueAudio” in the contents list.
3. A check is made to verify whether .NET Framework 2.0 is already present on the PC. If detected, the BlueAudio installation begins as shown in step 4. If not detected, the .NET Framework license agreement displays. Read the license agreement and click “I Agree” to run the installation.
4. The BlueAudio setup wizard displays as shown below. Click [Next>].



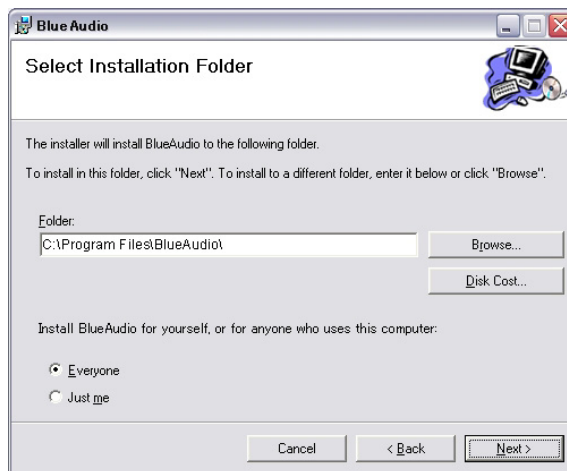
**Figure 4-1.** BlueAudio Setup Wizard

5. The “Licence Agreement” dialog displays. Read the agreement and if you agree to the conditions select “I Agree” and click [Next>].



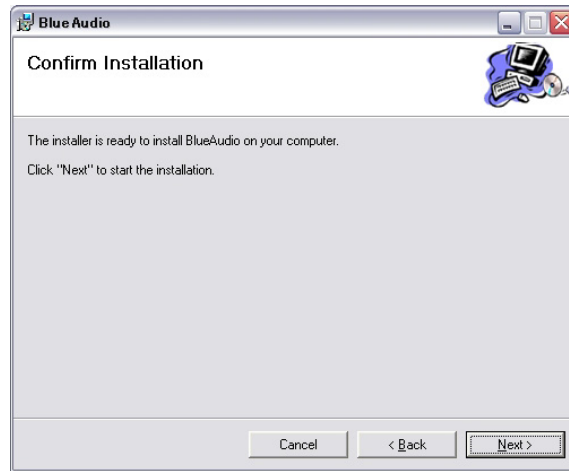
**Figure 4-2.** Licence Agreement

6. A dialog displays asking the user to specify the folder to which BlueAudio will be installed. By default, BlueAudio is installed to C:\Program Files\BlueAudio. Click [Next>] to install to the default directory, or click [Browse...] to specify a different location for installation.



**Figure 4-3.** Install Location

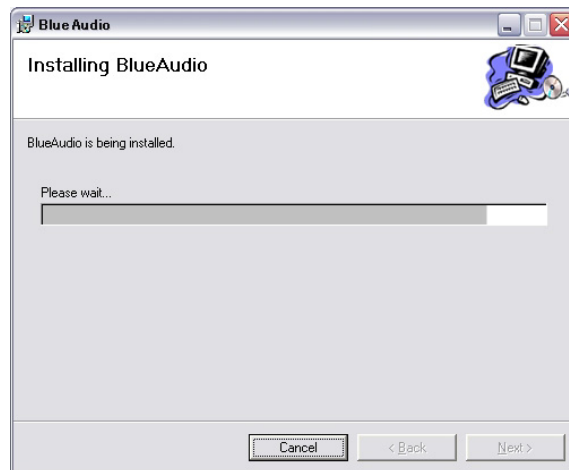
7. Click [Next>] at the “Confirm Installation” dialog to start the installation.
- 



**Figure 4-4.** Confirm Installation

---

8. The progress of the installation is shown in the dialog below.
- 



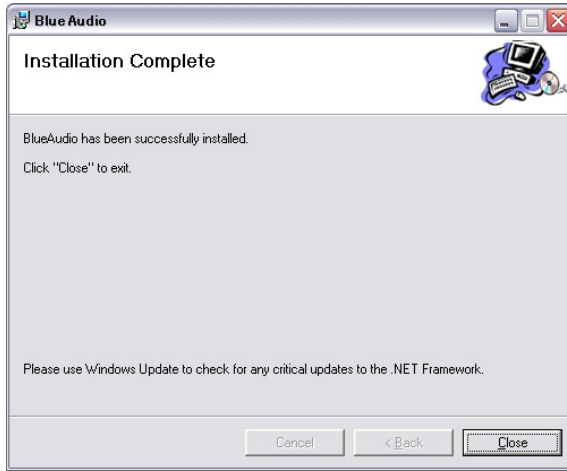
**Figure 4-5.** Installing BlueAudio

---



9. The dialog shown below displays when the installation is complete.

---



---

**Figure 4-6.** Installation Complete

## 4-3 USB Driver Installation

BlueAudio communicates with the MT8855A by means of a standard USB connection. The MT8855A USB driver must be installed on the PC to enable communication.

1. Install BlueAudio as detailed in section 4-2.
2. Insert one end of the USB cable into the connector on the rear of the MT8855A (connector C in figure 3-2).
3. Power on the MT8855A and insert the other end of the USB cable into the PC. Windows detects the connection and displays the New Hardware Wizard.
4. Click “Install from a list or specific location” and click [Next].
5. A dialog displays for selection of search and installation options. Browse to the location of the “MT8855A.inf” file generated during BlueAudio installation. By default this file is installed to C:\Program Files\BlueAudio\Driver. Click [Next].
6. The wizard locates the driver and begins the installation.
7. A Windows verification message displays. Click [Continue Anyway].
8. The USB driver is installed and a message displays when installation is complete.

**Note**

The USB driver installation is specific to the selected USB port on the PC. Users will need to repeat the driver installation if the MT8855A is subsequently connected to any other USB port on the PC.



# Chapter 5 — BlueAudio Overview

## 5-1 The Main Window

Start BlueAudio by double-clicking the “BlueAudio” icon generated on the desktop during installation, or by accessing the Windows programs directory and selecting [Anritsu] > [BlueAudio].

The main [Anritsu BlueAudio] window displays. The main window is split into a number of component areas labelled (A) to (G) in the figure below. Each area is described over the following pages.

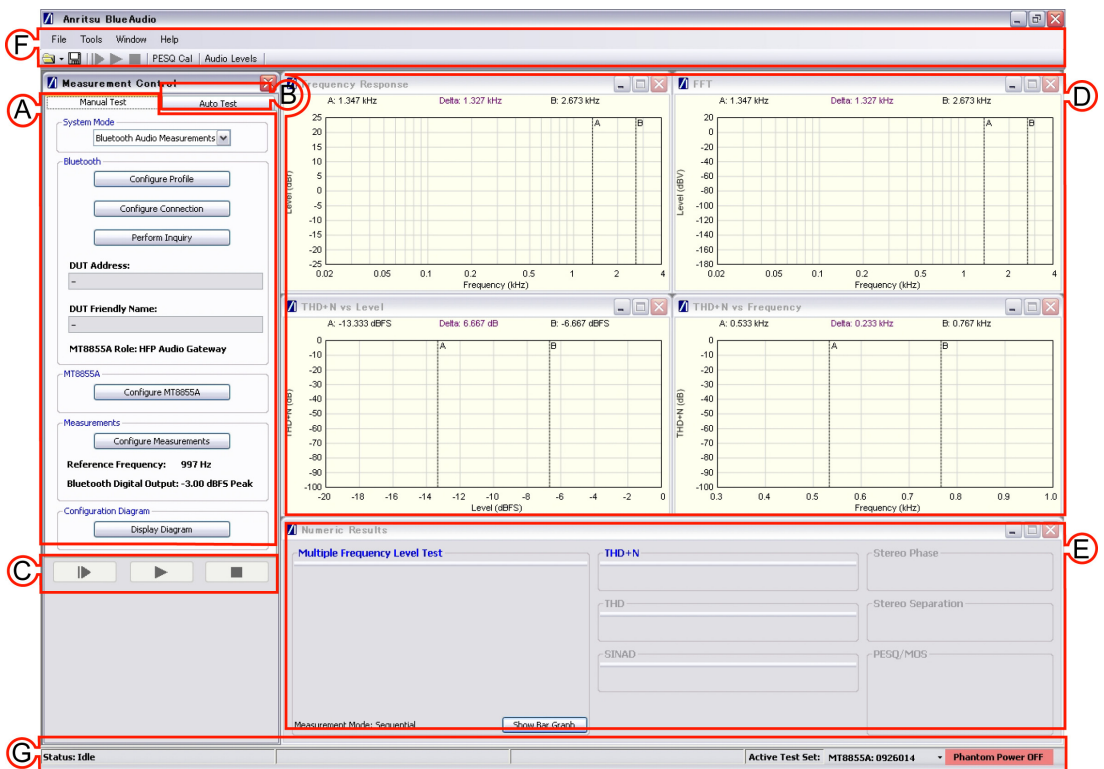


Figure 5-1. [Anritsu BlueAudio] Main Windows

## A: [Manual Test] Tabbed Page

The [Manual Test] tab is ideal for R&D testing during new product development. It allows the user to select the system mode and then define and execute any combination of measurements (six numeric measurements, three graphical measurements, and FFT) that share a common *Bluetooth* profile and MT8855A role setting. Measurements can be executed once or in a continuous loop.

The screenshot shows the [Manual Test] tabbed page interface. It is organized into several sections:

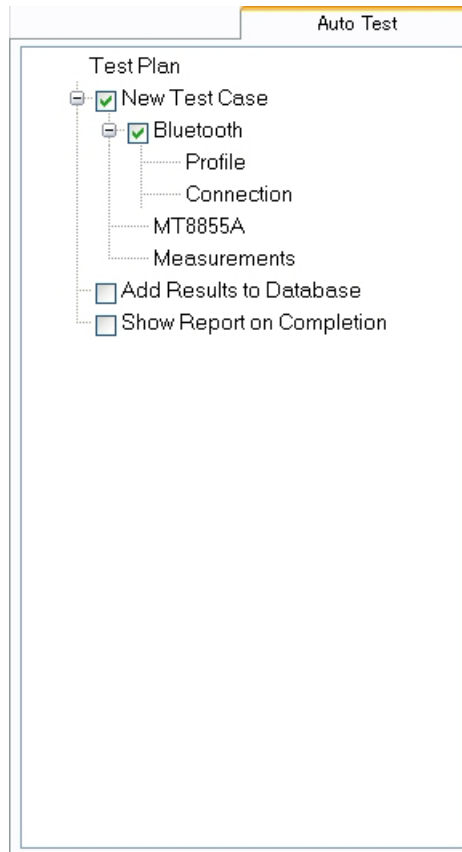
- System Mode:** A dropdown menu currently set to "Bluetooth Audio Measurements".
- Bluetooth:** Contains three buttons: "Configure Profile", "Configure Connection", and "Perform Inquiry". Below these are two text input fields: "DUT Address:" and "DUT Friendly Name:", both containing a hyphen (-). Below the fields is the text "MT8855A Role: HFP Audio Gateway".
- MT8855A:** Contains a button labeled "Configure MT8855A".
- Measurements:** Contains a button labeled "Configure Measurements". Below the button, it displays "Reference Frequency: 997 Hz" and "Bluetooth Digital Output: -3.00 dBFS Peak".
- Configuration Diagram:** Contains a button labeled "Display Diagram".

**Figure 5-2.** [Manual Test] Tabbed Page

Chapters 9 to 18 of this manual explain how to use [Manual Test] to perform measurements in a number of different test scenarios. Each chapter explains how to configure the equipment, how to run the tests, and how to interpret the results.

## B: [Auto Test] Tabbed Page

The [Auto Test] tab is primarily targeted at production testing. It is used to configure, save, and run a “test plan” of multiple groups of measurements known as “test cases”. Each component test case within the plan can be configured with any combination of up to six numeric measurements. The *Bluetooth* profile can be configured independently for each test case, allowing the user to run measurements while automatically switching profiles as required. Any of the component test cases or measurements within the test plan can be turned on or off as required before execution.



**Figure 5-3.** [Auto Test] Tabbed Page

A full explanation of how to configure and execute an auto test plan is provided in chapter 17.

## C: Control Buttons

BlueAudio provides two buttons that can be used to commence testing.



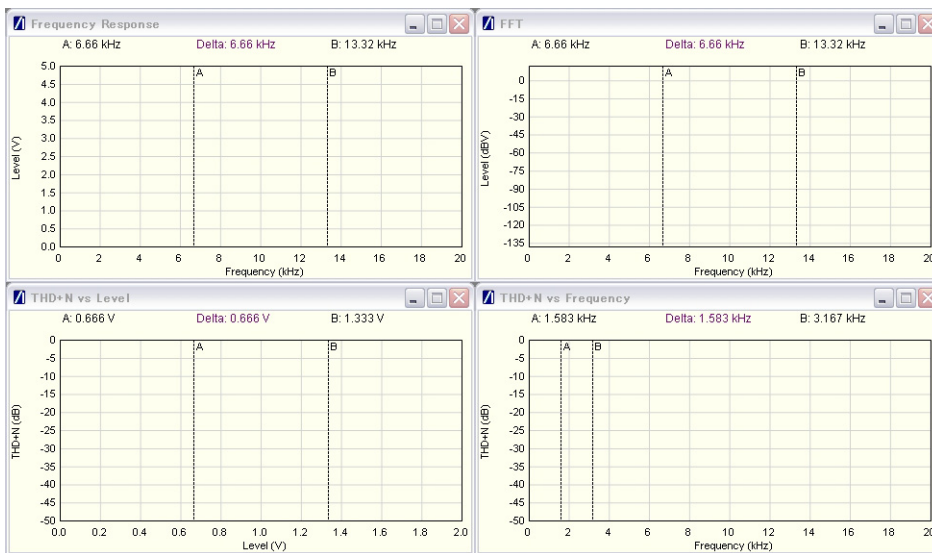
**Figure 5-4.** Control Buttons

The [Run Once] button runs the selected measurements once before stopping and displaying the results.

The [Run Continuous] button runs the selected measurements in a continuous loop until stopped when the user clicks [Stop].

## D: Graphical Results Display Area

The graphical results display area is used when graphical measurements are run from the [Manual Test] tab. The area houses four results traces, one for each of the three graphical measurements (Frequency response, THD+N vs Level, and THD+N vs Frequency), and one for FFT. When more than one trace is enabled, the traces are updated in turn.



**Figure 5-5.** Graphical Results Display Area

### Note

When the user clicks the [Auto Test] tab, the graphical measurements display area is replaced with the [Auto Test Output] window for the display of auto test status information. Refer to section 17-3 for further details.

### E: Numeric Results Display Area

The numeric measurements display area is used when measurements are initiated from the [Manual Test] tab. The area houses six display frames, one for each of the numeric measurements: Multiple Frequency Level Test, THD+N, THD, SINAD, Stereo Separation, and Stereo Phase.

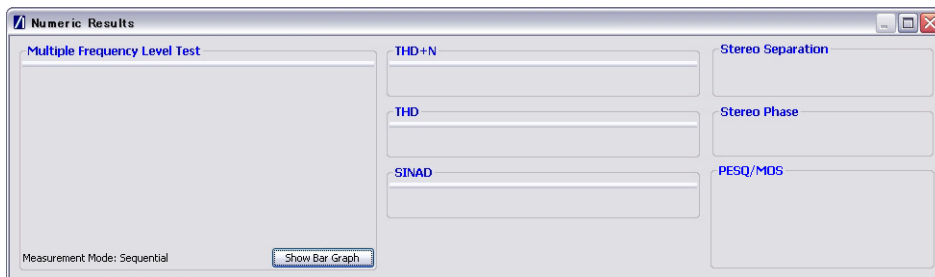


Figure 5-6. Numeric Results Display Area

**Note** When the user clicks the [Auto Test] tab, the numeric measurements display area is replaced with the [Auto Test Output] window for the display of auto test status information. Refer to section 17-3 for further details.

### F: Tool Bar

The tool bar at the top of the window provides easy access to some of the more frequently used menu commands.

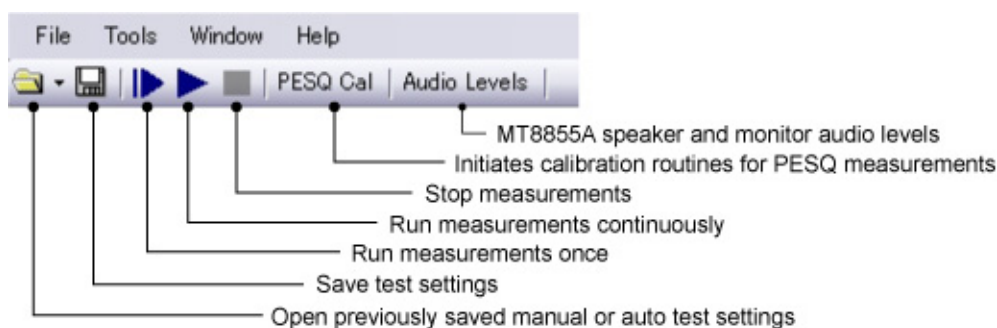
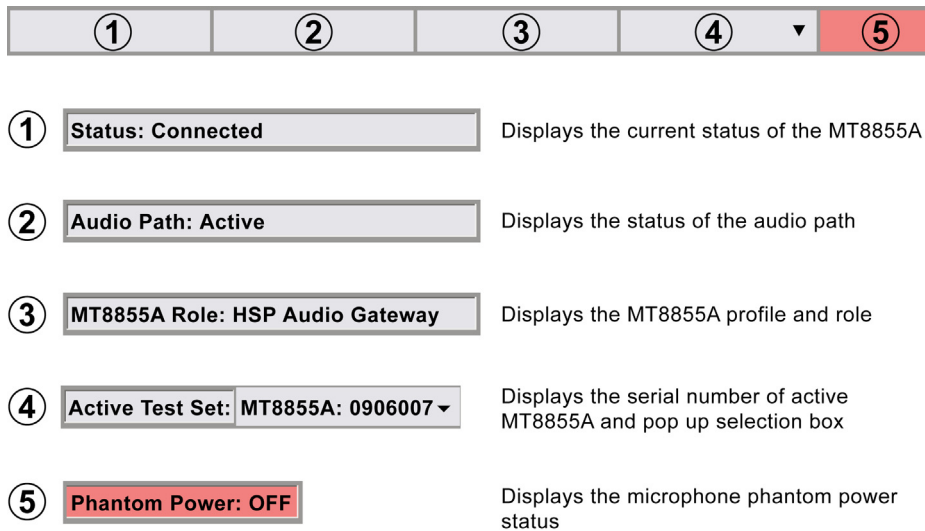


Figure 5-7. Tool Bar



## G: Status Bar

The status bar at the bottom of the main window provides information about the active test set and the current status of instrument and measurements. The status bar is split into five areas as shown in the representation below.



**Figure 5-8.** Status Bar

### Note

There are two “Audio Path” states: “None” and “Active”.

Audio Path “None” is used to show that a *Bluetooth* protocol connection has been established but that the audio path is not active. As an audio path is not active, measurements cannot be made in this state for profiles other than A2DP. If the profile is A2DP measurements can be made, as starting the measurement causes the audio path to become active.

Audio path “Active” is used to show that there is an active audio path. Audio measurements can be made in this state.

# Chapter 6 — System Modes

## 6-1 Understanding System Modes

The BlueAudio [Manual Test] tab, introduced briefly in chapter 5, allows the user to select from three different modes of operation: *Bluetooth* audio measurement mode, *Bluetooth* pass through mode, and analogue audio measurement mode. An overview of each mode is given below.



Figure 6-1. System Mode Selection

### Bluetooth Audio Measurements

The device is tested with a *Bluetooth* connection between the DUT and the MT8855A, and using the built-in audio generator and analyzer.

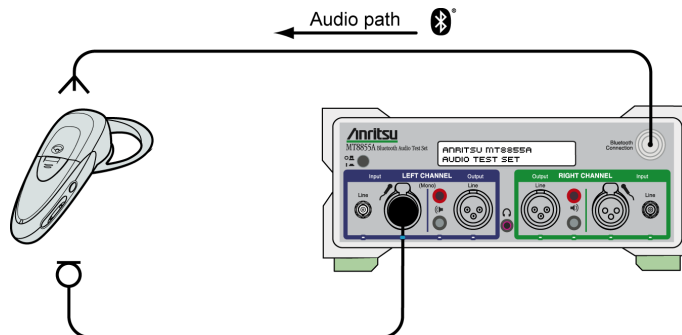
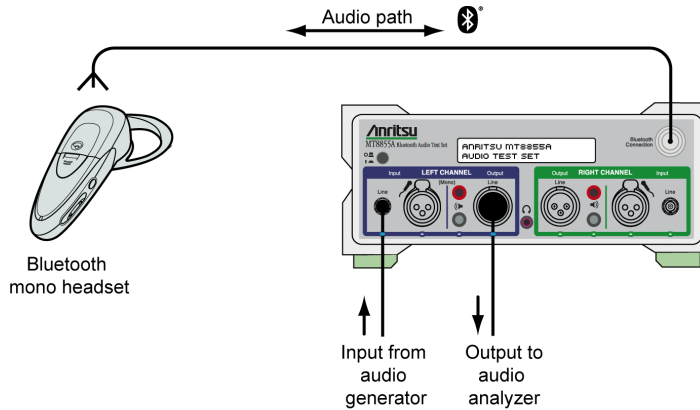


Figure 6-2. Bluetooth Audio Measurements

Using the MT8855A to make *Bluetooth* audio measurements is explained in detail in chapters 9 to 16 of this manual.

## Bluetooth Pass Through Measurements

In this mode, the MT8855A is used to establish a *Bluetooth* connection to the DUT, but an external analyzer and generator are used to supply the signal and measure the audio performance.

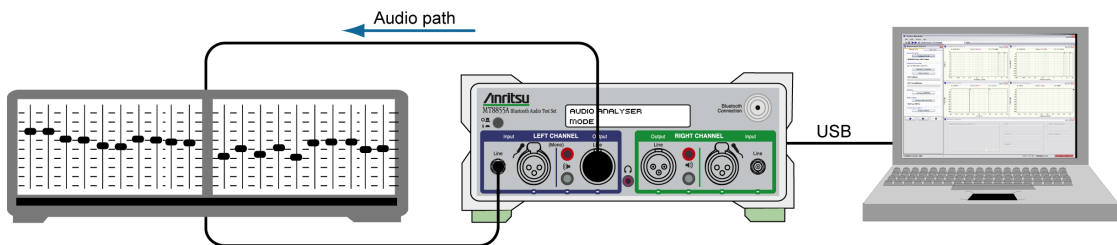


**Figure 6-3.** Bluetooth Pass Through Measurements

Using the MT8855A in pass through mode is explained in detail in chapter 17.

## Analogue Audio Measurements

In this mode, the MT8855A serves as a standard audio generator and analyzer with no *Bluetooth* connection to the DUT.



**Figure 6-4.** Analogue Audio Measurements

Using the MT8855A to make analogue audio measurements is explained in detail in chapter 18.

# Chapter 7 — *Bluetooth* Profiles and MT8855A Roles

## 7-1 Audio Testing Methodology

As explained briefly in chapter 5, *Bluetooth* audio tests can be configured and executed on the MT8855A in two ways:

- By using the settings on the BlueAudio [Manual Test] tab to define and execute measurements sharing a common *Bluetooth* profile and a common MT8855A role setting.
- By using the settings on the BlueAudio [Audio Test] tab to define and execute a “test plan” of one or multiple “test cases” that do not necessarily share a common *Bluetooth* profile or MT8855A role setting.

In both cases, the MT8855A is configured for measurements by selecting the *Bluetooth* profile and role to match the equipment configuration.

## 7-2 Understanding *Bluetooth* Profiles

A *Bluetooth* profile is an application layer specification defining a minimum set of requirements that a *Bluetooth* device must support in order to communicate with another *Bluetooth* device.

Numerous profiles have now been adopted by the *Bluetooth* Special Interest Group (SIG), each targeted at a specific product grouping or usage. To use a wireless headset, for example, requires a different profile to that used to transfer picture files or send data to a printer.

Any given *Bluetooth* product may support any number of *Bluetooth* profiles but, in order to connect to another *Bluetooth* product, both transmitting and receiving devices must use the same profile. A *Bluetooth* headset, for example, will only work with a *Bluetooth* enabled mobile phone if both phone and headset support either the Headset profile (HSP) or the Hands-Free profile (HFP).

Each *Bluetooth* profile also includes information on dependencies with other profiles, recommended user interface formats, and details of the particular parts of the *Bluetooth* protocol stack that it uses.

Three of the *Bluetooth* profiles deal specifically with the transfer of audio content (voice or music) over a *Bluetooth* connection; these profiles are explained below. In addition to the three profiles, testing can also be performed after establishing a basic SCO/eSCO connection.

### A2DP

A2DP, or Advanced Audio Distribution Profile, is used when streaming stereo-quality audio content from one device to another over a *Bluetooth* connection. A typical usage scenario is the streaming of music from a media player to a wireless headset.

|             |   |
|-------------|---|
| <b>Note</b> | The A2DP profile is not available when “System Mode” is set “ <i>Bluetooth</i> Pass Through”. |
|-------------|---|

## HSP

HSP, or Headset Profile, was designed to enable a *Bluetooth* headset to communicate with a PC or other *Bluetooth* enabled device such as a mobile phone. The Headset Profile supports simultaneous two-way (full-duplex) audio, but it does not support stereo audio.

## HFP

HFP, or Hands-Free Profile describes how a headset or two-way wireless speaker is used with a mobile phone. A common use of HFP is in car kits that allow the driver to accept a call via the audio system or installed speaker, without the need to touch the phone.

**Note**

The HSP and HFP profiles offer identical audio performance but differ slightly in functionality. HSP was introduced first but was superseded by HFP that offered greater functionality such as voice recognition and battery level monitoring. Most *Bluetooth* headsets now default to HFP and there would be no reason for users to run tests on both profiles unless HFP was not supported by the device in question.

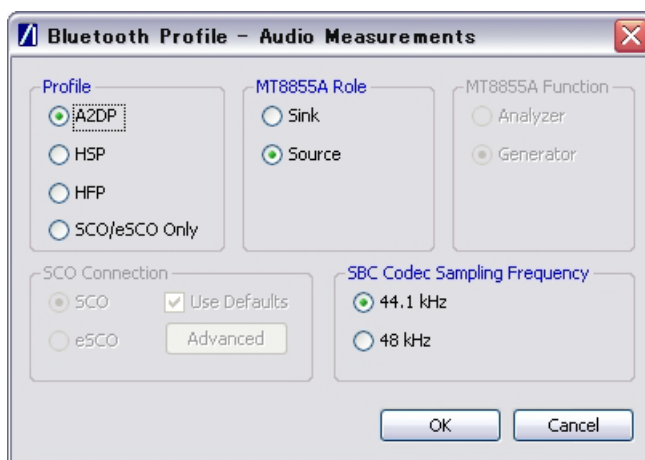
## SCO/eSCO Only

SCO/eSCO Only ((Extended) Synchronous Connection-Oriented links) is used to establish a *Bluetooth* connection to the DUT without establishing a connection at the profile level. No profile is used but a basic connection to the DUT is established up to the HCI level.

## 7-3 Bluetooth Profiles Within BlueAudio

The *Bluetooth* profile is selected in the BlueAudio [*Bluetooth Profile*] dialog. Full explanations of the settings required for each type of testing are provided in chapters 9 to 18. The purpose of the information provided in this section is to familiarize the user with the settings and their meanings.

1. Start BlueAudio by double-clicking the “BlueAudio” icon generated on the desktop during installation, or by accessing the Windows programs directory and selecting [Anritsu] > [BlueAudio].
2. Set “System Mode” to “*Bluetooth Audio Measurements*”.
3. Click [Configure Profile] on the [Manual Test] tab to display the [*Bluetooth Profile*] dialog shown below.



**Figure 7-1.** [*Bluetooth Profile*] Dialog

Selecting any of the *Bluetooth* profiles (A2DP, HSP, HFP, or SCO/eSCO Only) gives the user access to two “MT8855A Role” settings. The setting combinations are shown in the table below.

**Table 7-1.** *Bluetooth* Profiles and Associated MT8855A Roles

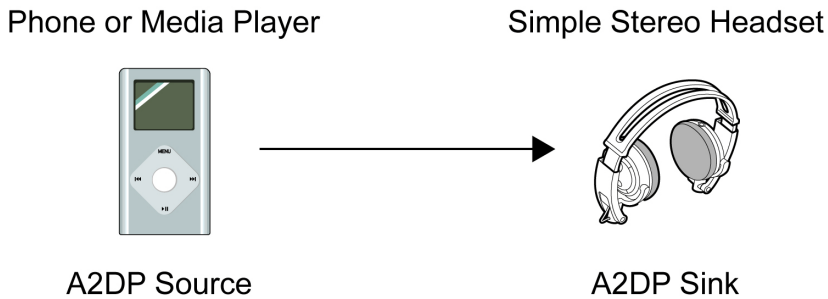
| <b>Bluetooth Profile</b> | <b>MT8855A Role</b>   |
|--------------------------|---|
| <b>A2DP</b>              | <ul style="list-style-type: none"> <li>• Sink</li> <li>• Source</li> </ul>          |
| <b>HSP and HFP</b>       | <ul style="list-style-type: none"> <li>• Device</li> <li>• Audio Gateway</li> </ul> |
| <b>SCO/eSCO Only</b>     | <ul style="list-style-type: none"> <li>• Analyzer</li> <li>• Generator</li> </ul>   |

Section 6.4 provides a number of examples to further explain each profile and its associated role settings.

## 7-4 Profile and Role Examples

### Example 1: A2DP

Example 1 represents music being streamed from a media player to a stereo *Bluetooth* headset. As the originator of the digital audio stream, the media player represents the “Source” (specified in the [*Bluetooth* Profile] dialog). As the recipient of the audio stream, the headset represents the “Sink”.

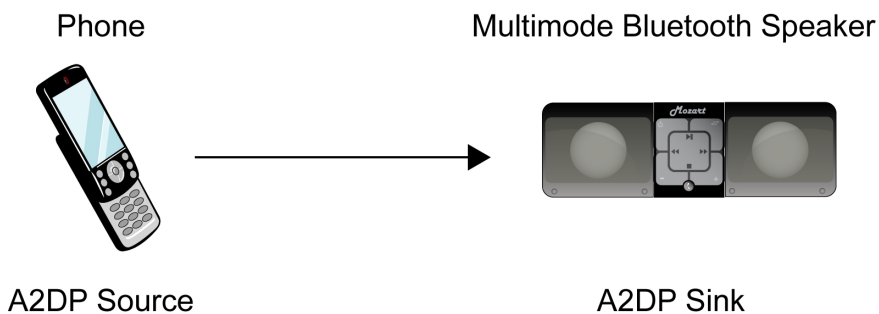


**Figure 7-2.** Example 1: A2DP Sink and Source

### Example 2: A2DP and HSP

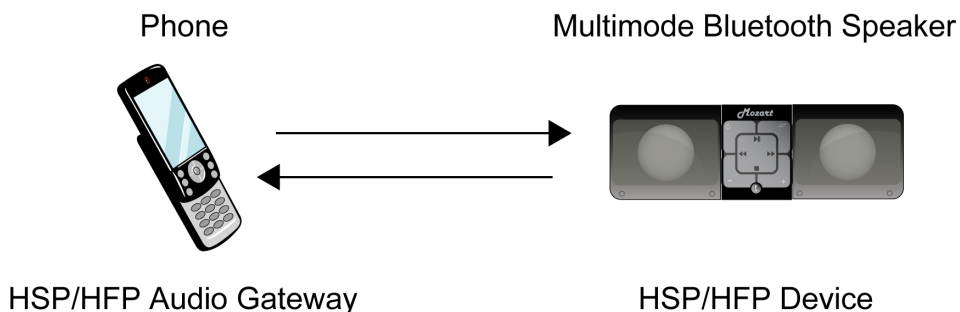
Example 2 shows a scenario with two *Bluetooth* enabled products supporting multiple profiles and able to switch between profiles as required.

In step 1, music is streamed from a phone to a multi-mode *Bluetooth* speaker. At this time, the phone is the originator of the audio stream and is therefore the “Source”. As the recipient of the audio stream, the speaker is the “Sink”. Data is being conveyed in only one direction at this time.



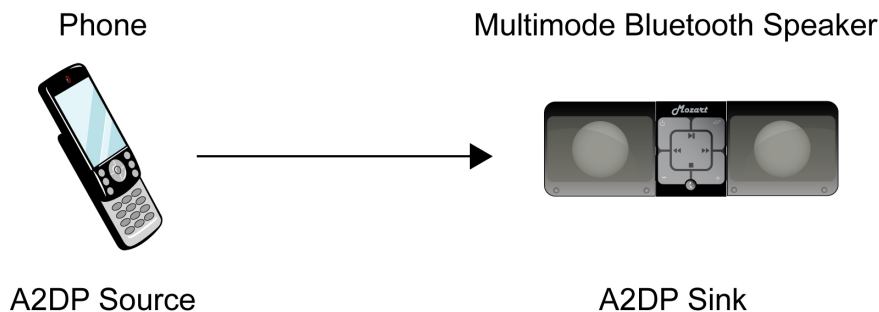
**Figure 7-3.** Example 2, Step 1: AD2P and HSP

In step 2, the user receives an incoming call and presses a button on the speaker to stop the music and accept the call. When the button is pressed, the *Bluetooth* profile changes to HFP or HSP for two-way (full-duplex) communication. The phone acts as the router relaying the incoming signal from the cellular network to the speaker and is therefore the “audio gateway”. Acting as the remote audio input (microphone) and output (speaker) mechanism for the audio gateway, the speaker serves as the “Device”.



**Figure 7-4.** Example 2, Step 2: AD2P and HSP

In step 3 below, the call ends and the user presses the button on the speaker again to complete the call. When the button is pressed, the *Bluetooth* profile reverts to A2DP and music is once again streamed in from the phone. As before, the phone, as the originator of the audio stream, represents the “Source”; the speaker, as the recipient of the audio stream, represents the “Sink”.



**Figure 7-5.** Example 2, Step 3: AD2P and HSP



### Example 3:HSP / HFP

In example 3, an audio signal is being channeled in both directions between a *Bluetooth* enabled phone and a simple mono headset. Both phone and headset would typically support the HSP and HFP profiles, although they would have to use the same profile to communicate. In this scenario, the phone serves as the audio gateway by relaying the incoming signal to the headset. Acting as the remote audio input and output mechanism for the audio Gateway, the headset serves as the “Device”.

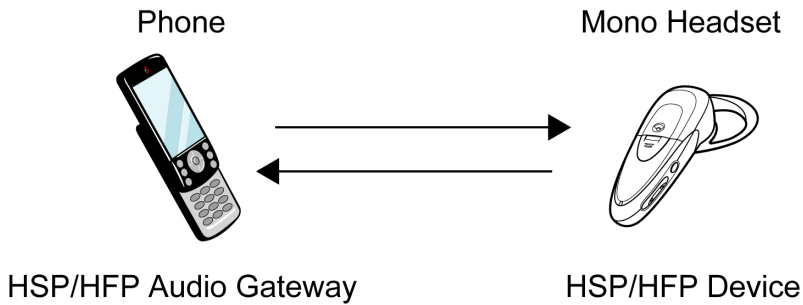


Figure 7-6. Example 3: HSP / HFP

### Example 4: SCO/eSCO Only

When testing using a basic SCO/eSCO connection, no profile is active. In this case the MT8855A is used to establish the SCO/eSCO connection to the DUT. The audio generator and analyzer can be used to transmit or receive audio over the *Bluetooth* connection.

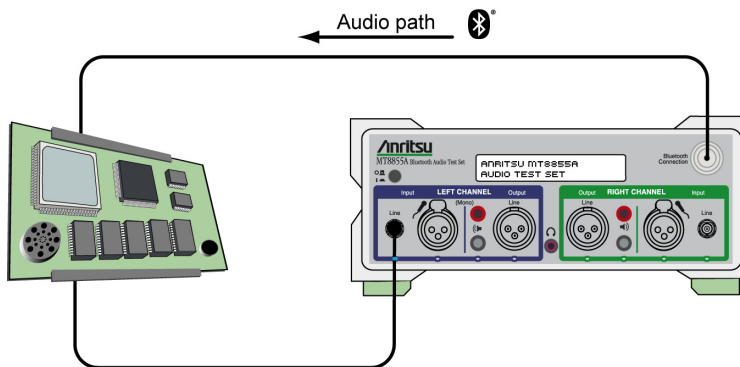


Figure 7-7. Example 4: SCO/eSCO Only

# Chapter 8 — Measurement Overview

The purpose of this chapter is to familiarize the user with the meaning and significance of the main audio measurements that can be performed using the MT8855A / BlueAudio.

## 8-1 Multiple Frequency Level Test

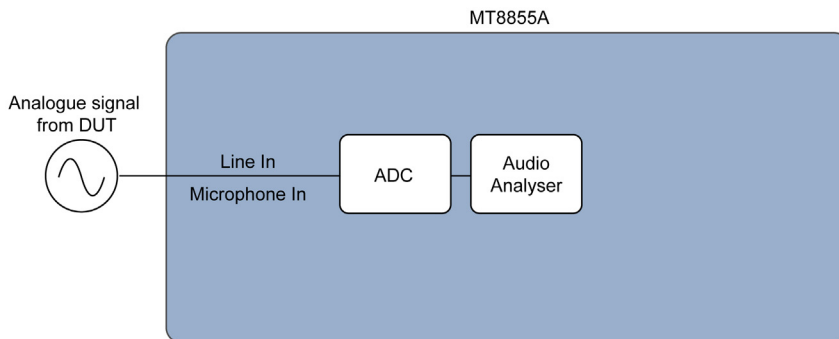
In the multiple frequency level test, the MT8855A measures the audio frequency response of the DUT. Measurements are made at five user-defined frequencies that can be played in sequence (“Sequential”) or simultaneously (“Multitone”).

**Note**

The “Multitone” setting has the advantage of being less susceptible to noise cancelling algorithms.

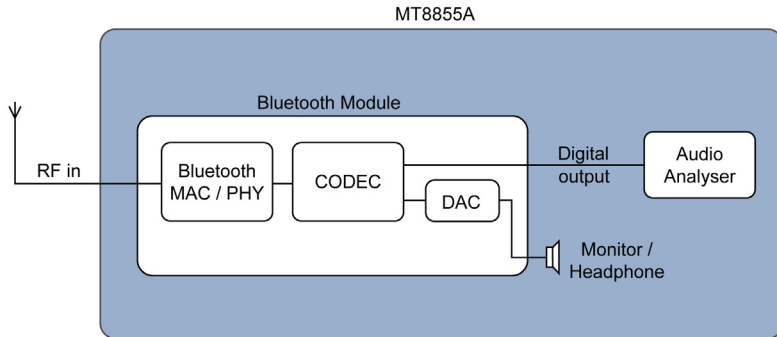
Due to the characteristics of the CVSD codec, the results for the Multitone measurement may differ from those of Sequential measurements.

If the audio is input through one of the front panel connectors (Line or Microphone), the signal is digitized by an ADC and fed to the audio signal analyzer. This is shown in the figure below.



**Figure 8-1.** Audio Measurement - Analogue

A single tone can be measured in Volts (typically millivolts) and one tone frequency defined as the reference level against which all other frequencies are measured. In this case, the reference tone has units of Volts (mV) and all other frequencies have levels with units of dB relative to the absolute value of the reference signal (dBr).



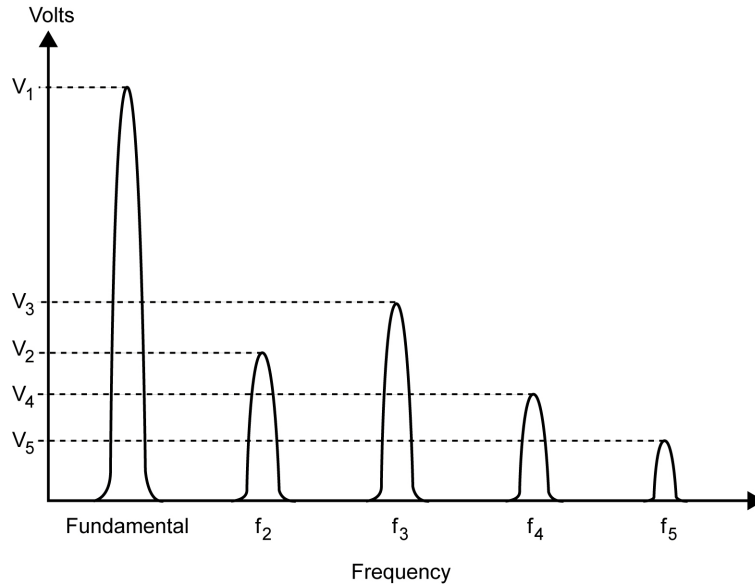
**Figure 8-2.** Audio Measurement - RF

If the audio signal is encoded onto the RF input (as shown in the figure above), it is not possible to measure the audio tone level in absolute terms

In this situation, the RF is decoded and the audio signal level is defined in terms of Full Scale Deflection (FSD) of the codec in the MT8855A *Bluetooth* module. As before, one frequency can be defined as the reference frequency and the signal level at all other frequencies measured against that frequency.

## 8-2 Total Harmonic Distortion (THD)

Total Harmonic Distortion is a measurement of additional, undesired signals with frequencies that are integer multiples (harmonics) of the input signal.



**Figure 8-3.** Total Harmonic Distortion

In the figure above, V1 represents the fundamental signal at 997 Hz. Undesired harmonics can be seen at subsequent multiples (f2 to f5).

Harmonics are introduced by non-linearities in the codec or audio circuitry, such as amplifiers and filters.

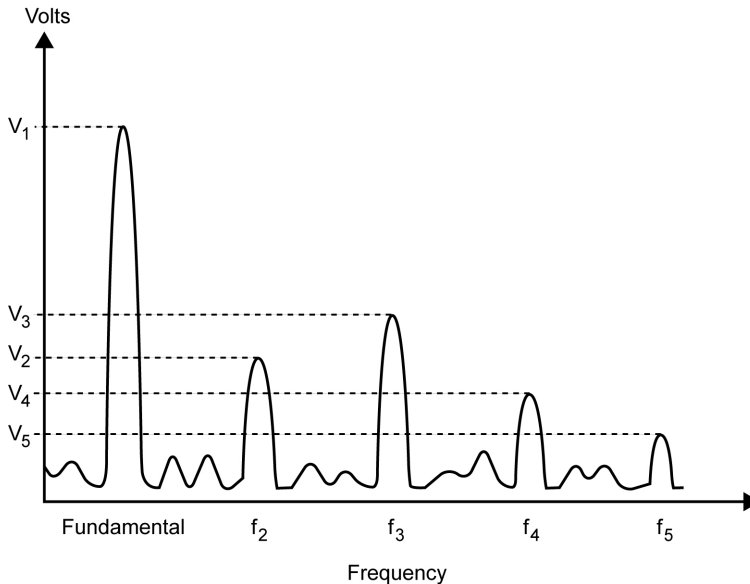
Total harmonic distortion is calculated by dividing the square root of the voltage squares of each harmonic (V2, V3, V4, V5) by the voltage at the fundamental (V1). This can be expressed using the formula below.

$$20 \log_{10} \left( \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + \dots + V_n^2}}{V_1} \right)$$

The number of harmonics sampled in the calculation can be set automatically within BlueAudio or can be specified as required by the user.

### 8-3 Total Harmonic Distortion Plus Noise (THD+N)

For devices with good distortion properties it may be desirable to add the effects of noise to the total harmonic distortion measurement to provide a single figure of merit. THD+N is commonly used for this purpose.



**Figure 8-4.** Total Harmonic Distortion Plus Noise

The THD+N measurement provides a means of ascertaining the combined effects of undesired harmonics and noise on the output signal. The measurement calculates the ratio between the output signal level and the input signal level. THD+N is calculated using the formula below. THD+N can also be expressed as a percentage.

$$10 \log_{10} \left( \frac{\sum \text{Harmonic Power} + \text{Noise Power}}{\text{Total Power}} \right)$$

## 8-4 Signal to Noise and Distortion (SINAD)

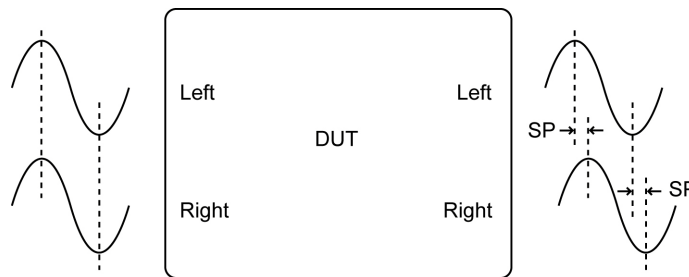
Signal to Noise and Distortion (SINAD) provides another means of comparing the ratio of the energy of the input signal to the sum of the energy found in noise and harmonic distortion. SINAD provides a convenient measure of the dominance of the desired signal as compared to the undesired noise and distortion. SINAD is calculated using the formula below.

$$10 \log_{10} \left( \frac{\text{Total Power}}{\sum \text{Harmonic Power} + \text{Noise Power}} \right)$$

For historical reasons different industry segments favour the use of the SINAD measurement while others may favour THD+N.

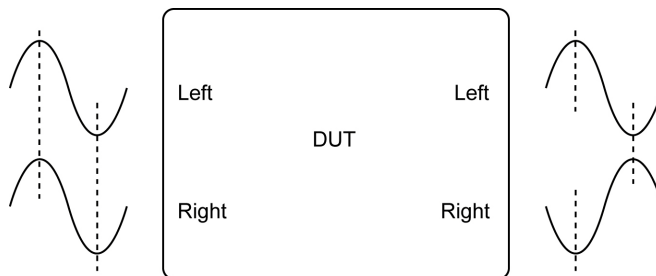
## 8-5 Stereo Phase

In the stereo phase measurement, a specific tone with equal phase is applied to the left and right channel of a DUT. The stereo phase is calculated by subtracting the phase of the left channel from the phase of the right channel. Stereo phase is shown in the figure below by the phase angle “SP”. A stereo phase shift of this nature is likely to be caused by filters in the audio path, or by physical differences of the length of the electrical path.



**Figure 8-5.** Stereo Phase

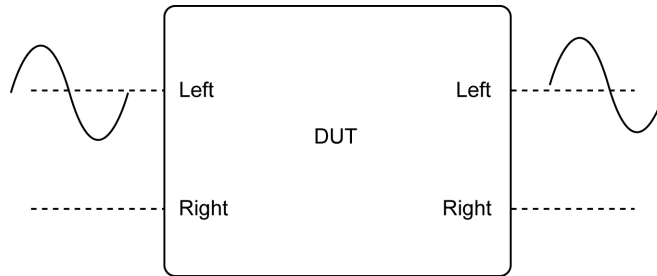
On other occasions the path may appear reflected through 180 degrees as shown in the figure below. This is likely to be caused by incorrect polarity of the audio connectors.



**Figure 8-6.** Stereo Phase Caused by Incorrect Connections

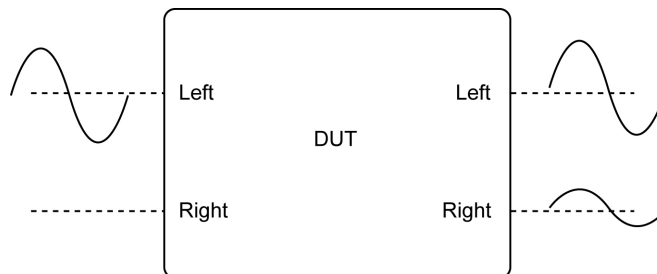
## 8-6 Stereo Separation

Stereo separation describes signal leakage from one channel to another. Under ideal circumstances, if a signal is fed through the DUT on one channel only, this would appear at the output from the DUT, as shown in the figure below.



**Figure 8-7.** No Stereo Separation Between Left and Right Channels

Occasionally, cross-talk (leakage) may result in a situation such as that shown below.



**Figure 8-8.** Stereo Separation from Left to Right Channel

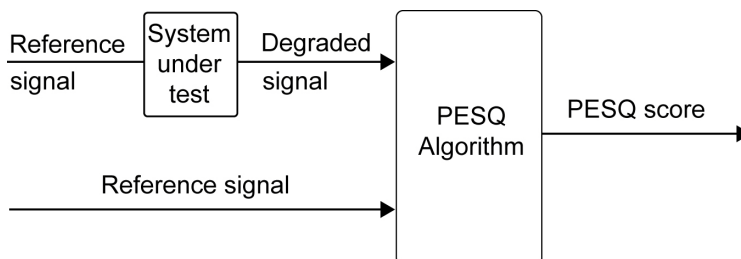
The amount of stereo separation is calculated using the formula shown below.

$$20 \log_{10} \left( \frac{\text{Tone Voltage (Selected channel)}}{\text{Tone Voltage (Non selected channel)}} \right)$$

## 8-7 PESQ

PESQ (Perceptual Evaluation of Speech Quality) is an automated method of performing an end-to-end speech quality assessment for a network. It is also an ITU recommendation: ITU P.862. A PESQ algorithm, developed by KPN of the Netherlands and British Telecommunications and now licensed by Psytechnics (UK) and OPTICOM (Germany), is used to compare a reference audio signal with the corresponding degraded signal. The resultant value (-0.5 to 4.5) provides an indication of audio quality as perceived by the user. Anritsu offers Artificial Speech-like Test Stimulus files (option MT8855A-033 ASTS audio files) that can be used as reference audio signals. Alternatively, the ITU offers freely downloadable files from their website, or users can create customized reference test files. The advantage of ASTS files is that they have been specially developed to include a full range of speech sounds (phonics) in a short period of time. This results in a test that completes in a short period with comprehensive coverage of common speech sounds.

The PESQ measurement is an automated and objective assessment of end-to-end speech clarity. The ITU provide an algorithm that converts a PESQ score into a Mean Opinion Score (MOS). The MOS score was often used before the development of the PESQ algorithm to indicate speech clarity. MOS scores are based on subjective results assessed by a group of people performing listening tests.



**Figure 8-9.** PESQ Measurement Algorithm

**Note** Refer to section 20-16 for details of how to perform PESQ measurements.

## 8-8 Frequency Response

The frequency response curve is generated by sweeping a CW tone between a lower and upper frequency limit. The resultant trace displays the amplitude level response of the system under test to the frequency range covered. Typically the level axis has units of dBr. The reference frequency level is defined as being 0 dBr and all other levels are displayed as gain or loss relative to the level at the reference frequency.

## 8-9 THD+N vs Level

THD+N is commonly used to measure the quality of audio systems. The THD+N Vs Level graph shows the variation of audio quality against the level of the input. In this graph, all measurements are made at the defined reference frequency. The level of the reference frequency is swept over a selected range and the THD+N is measured for each level.



## 8-10 THD+N vs Frequency

This graph shows the audio quality variations of the system at different frequencies. In this graph the tone frequency (at a given level) is swept across the specified frequency range and THD+N is measured for each frequency.

## 8-11 FFT

The FFT displays the audio spectrum of the received audio signal from the DUT. Harmonic and distortion components can be seen relative to the fundamental audio tone. The overall noise floor is also displayed.

FFT has three modes:

- **Both:** The FFT is updated for each frequency measured during frequency response, THD+N vs level, and THD+N vs frequency measurements. The FFT is also updated at the reference frequency during numeric measurements.
- **Numerical:** The FFT is only displayed for the frequency set as the numeric measurement reference frequency.
- **Graphical:** The FFT is updated for each frequency measured during graphical response measurements but not for numeric measurements.

Chapters 9 to 18 of this manual describe in detail how to configure and run measurements for a number of different purposes and DUTs.

# Chapter 9 — Testing a Mono Headset: Microphone Input

## 9-1 Test Overview

A mono headset is a full duplex device allowing audio to pass in both directions at the same time.

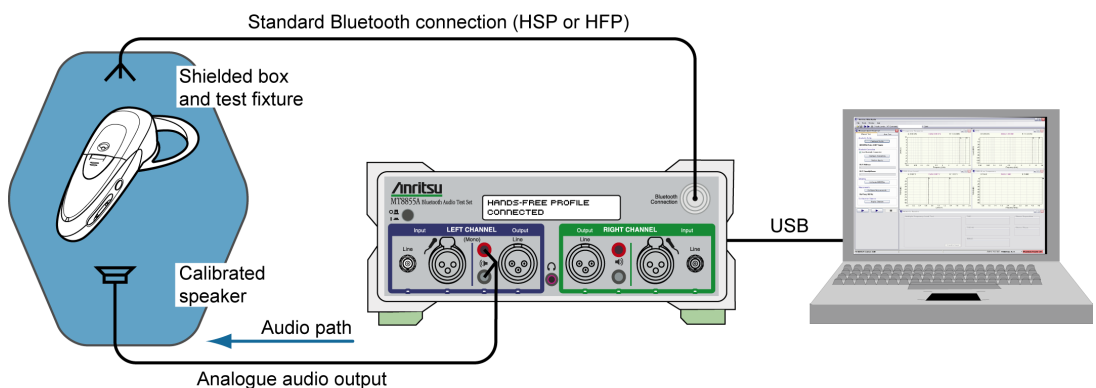
The test described in this chapter is used to confirm that an analogue signal can be sent to a mono headset, routed through the microphone and codec, and transmitted over an RF *Bluetooth* link (using either the Hands-free or Headset profile) to the MT8855A without distortion.

Refer to chapter 9 for details of testing in the opposite direction (audio path of a mono headset from RF input to analogue output).

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 9-2 Preparing to Test

1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.



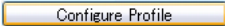
**Figure 9-1.** Testing a Mono Headset: Microphone Input

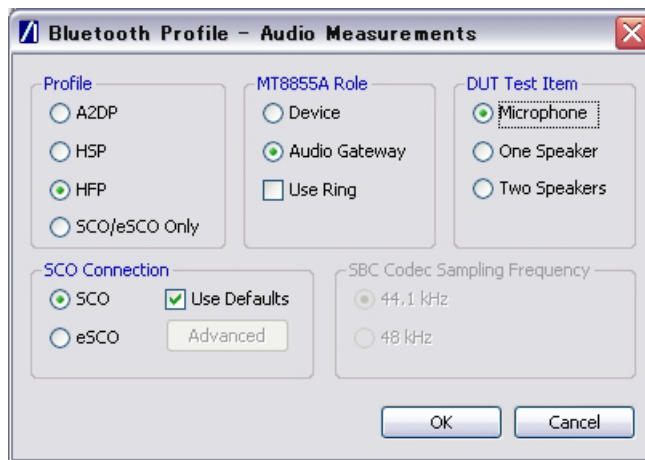
The following points should be observed to ensure that satisfactory measurement results are obtained:

**Note**

- The DUT should be positioned in a shielded acoustic box.
- The MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.


3. Configure the *Bluetooth* profile and MT8855A role.

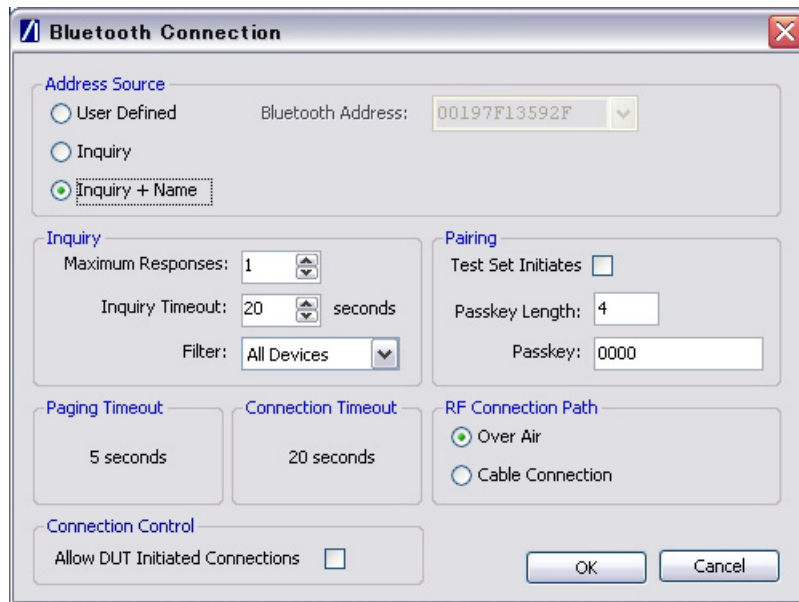
- Click the [Manual Test] tab.
- Set “System Mode” to “*Bluetooth* Audio Measurements”.
- Click  to open the [*Bluetooth* Profile] dialog.



**Figure 9-2.** [*Bluetooth* Profile] Dialog Configured for Mono Headset Microphone Testing

- Set “Profile” to “HFP”, or to “HSP” if “HFP” is not supported. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- Set “MT8855A Role” to “Audio Gateway”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- Select or clear the "Use Ring" check box as required. If the check box is cleared (the default setting), the incoming call is accepted automatically without the user needing to press the call accept button on the headset. If the check box is selected, the user will need to press the call accept button on the headset to accept the call. Selecting the check box would only be required by users specifically wishing to test the functionality of the button on the headset.
- Set “DUT Test Item” to “Microphone”. (As we are testing the analogue signal transmitted from the MT8855A to the headset microphone.)
- Select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.

- i. Click [OK] when complete.
4. Configure a *Bluetooth* connection between the MT8855A and the DUT.
    - a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the documentation supplied with the product.
    - b. Click  to open the dialog shown below.



**Figure 9-3.** [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**


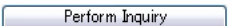
The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.

- d. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.

|             |  |
|-------------|--|
| <b>Note</b> | As the mono headset does not have an interface from which a <i>Bluetooth</i> connection can be established, the initial connection must always be made from the MT8855A. |
|-------------|--|

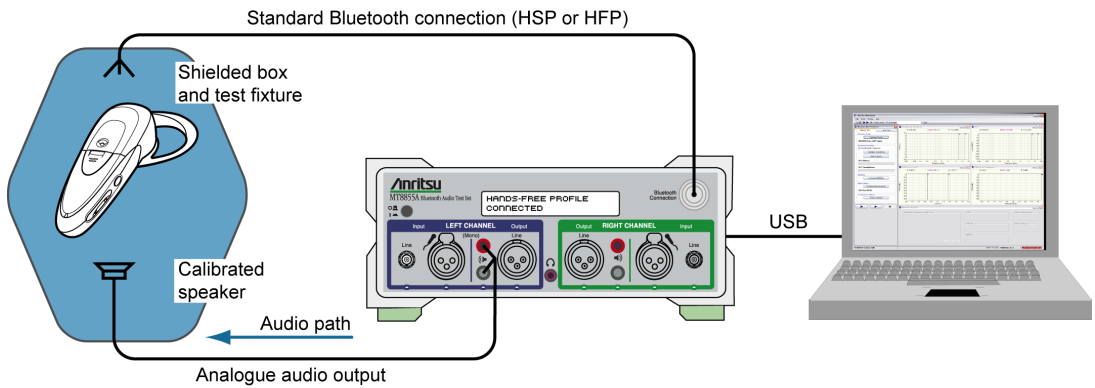
- e. Select or clear the "Test Set Initiates" check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the "Test Set Initiates" check box prevents the tester from initiating pairing.
- f. Enter the "Passkey". Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically "0000" but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.
- g. Set the "RF Connection Path" between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5dBm; for cable connections the output power is nominally -40 dBm.

|             |   |
|-------------|---|
| <b>Note</b> | For reliable air connections the DUT should be positioned within 5 meters of the MT8855A. |
|-------------|---|

- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
- If "Address Source" was set to a "User Defined" *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If "Address Source" was set to a "Inquiry" or "Inquiry + Name", the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

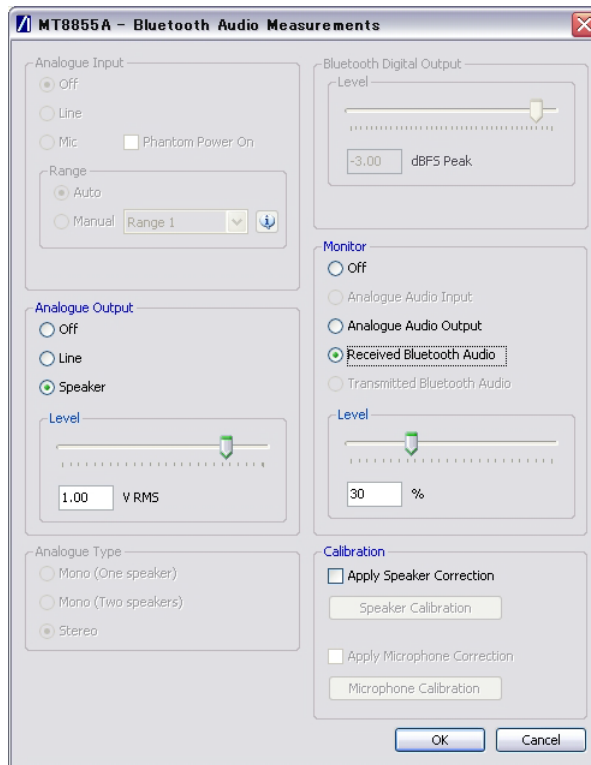
When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the "Status" field in the status bar changes to "Connected".

- Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.



**Figure 9-4.** Testing a Mono Headset: Microphone Input

- Click  on the [Manual Test] tab to open the [Configure MT8855A] dialog.



**Figure 9-5.** [MT8855A] Dialog for Mono Headset Microphone to Audio Gateway Testing

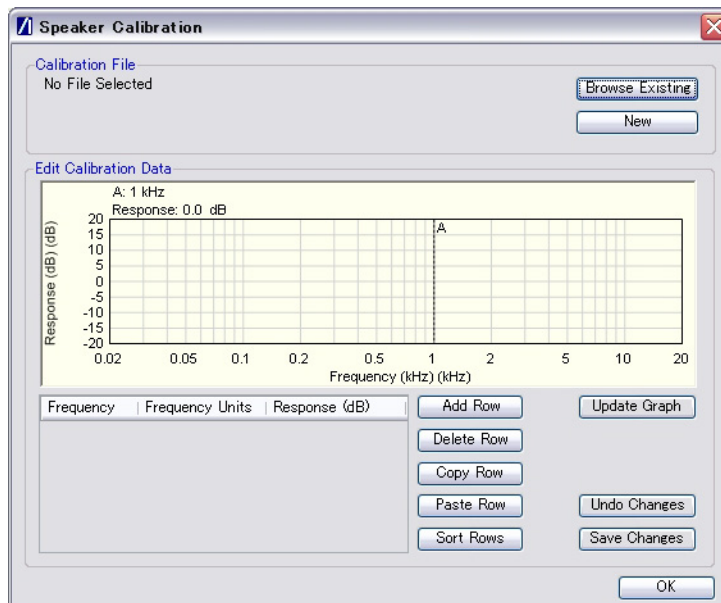
- b. Set “Analogue Output” to “Speaker”. (As seen in the configuration diagram, the left channel speaker output is in use.)
- c. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. Select “Received *Bluetooth* Audio” to hear the audio signal relayed over *Bluetooth* from the headset. Select “Analogue Audio Output” to hear the signal sent from the MT8855A to the DUT.
- d. Set the monitor “Level” setting to the required volume.

When monitoring the signal from a microphone, it may be better to use a headset to avoid audible feedback.

**Note**

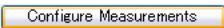
To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.

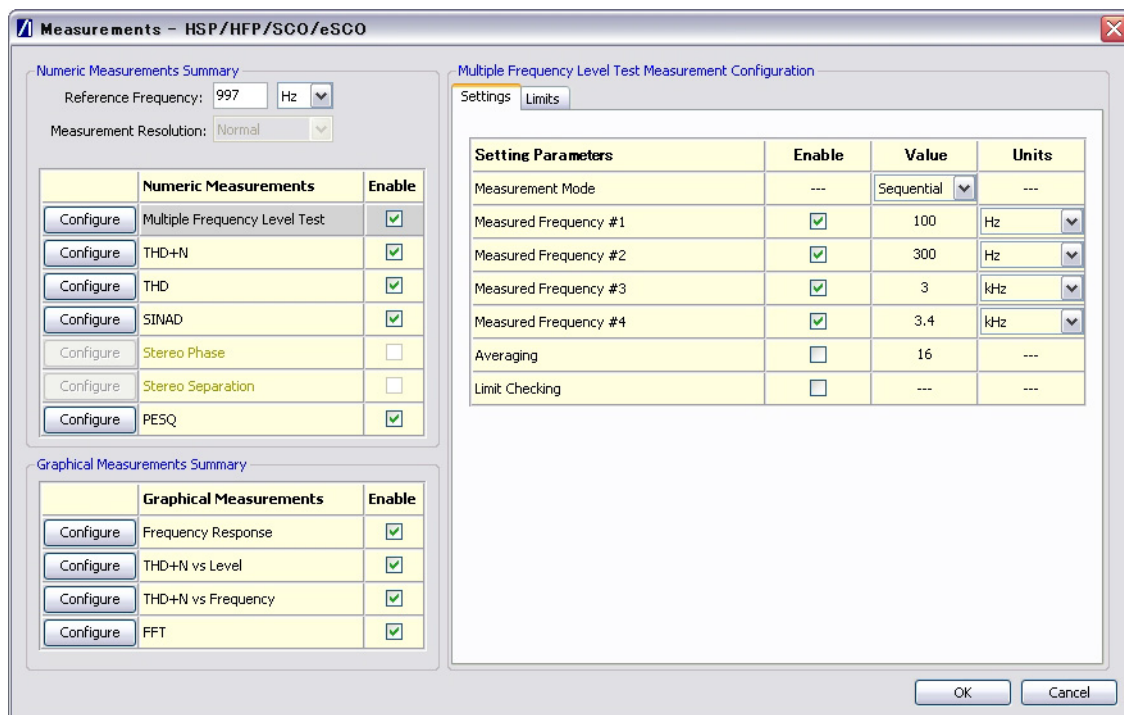
- e. Apply speaker correction if required by the speaker in use. Select “Apply Speaker Correction” and click [Speaker Calibration] to display the dialog below. Correction is used to compensate for the frequency response of the speaker, normalized to the reference frequency. The level result measurement accuracy will be improved if test speaker response calibration data is used. Refer to sections 20-10, 20-11, and 20-16 for details.



**Figure 9-6.** Speaker Calibration

- f. Browse to an existing calibration file or create a new table by adding rows and values as required.

- g. Click [OK] to close the [Speaker Calibration] dialog.
  - h. Click [OK] close the [MT8855A] dialog.
6. Configure measurements.
- a. Click  on the [Manual Test] tab to open the dialog shown below.



**Figure 9-7.** [Measurement] Dialog

- b. Specify the “Reference Frequency”.

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997 Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

- c. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.
- Four measurements display numeric results only, and three display graphical results.



When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.

- d. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- e. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.

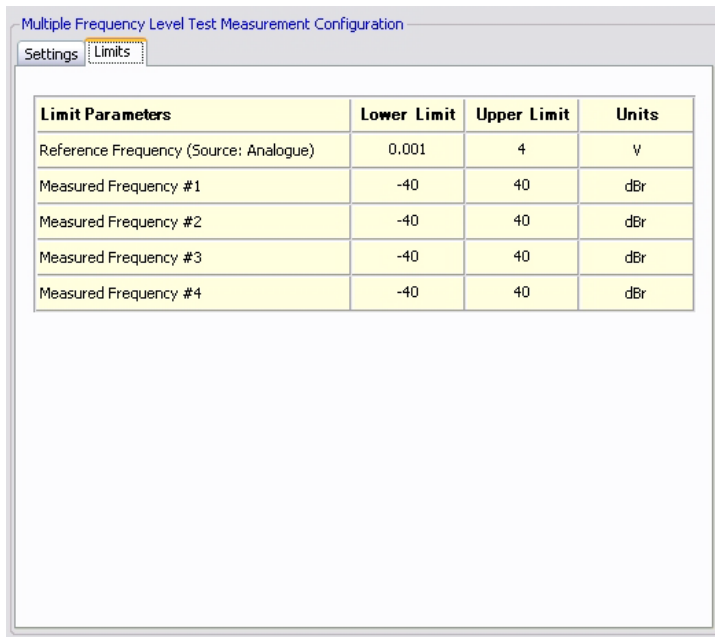





Figure 9-8. [Limits] Tab

- f. Repeat steps (d) to (e) for each measurement to be run.
  - g. Perform PESQ calibration if PESQ measurements are to be run. Refer to section 20-16 for details.
  - h. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click Display Diagram and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.

## 9-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

## 9-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

## 9-5 Understanding Test Results

### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for these tests. When using the Headset or Hands-free profile that mandates the CVSD codec, a typical device interfaced to the MT8855A Line audio connectors with cables, will show that other tones within the range 300 Hz to 3 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

### THD+N

For a standard reference tone of 997 Hz, this test will typically show a THD+N measurement of  $> -17$  dB when interfaced to the MT8855A Line audio connectors with cables. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical mono headset using the CVSD codec will be  $-10$  to  $-20$  dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

## THD

For a standard reference tone of 997 Hz, when interfaced to the MT8855A Line audio connectors with cables, this test will typically show a THD measurement result of 5 dB better than for THD+N. If the DUT is operating at close to maximum signal level for a CVSD codec, the CVSD codec exhibits non-linear behavior. Under these conditions THD+N and THD will give similar results because the 3rd harmonic distortion will dominate the measurement result. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices. The result is expected to be better than THD+N as noise is not included in the result. For this reason, use of the THD measurement alone should be treated with caution, as devices exhibiting good THD performance may still exhibit compromised audio performance if the noise performance is poor.

THD is degraded if the DUT has poor linearity. Noise can be added to the audio signal path through noisy amplifiers or poor schematic layout resulting in the pick up of unwanted signals on the audio paths.

When using a microphone and speaker in the test configuration, the THD performance of a typical mono headset using the CVSD codec will be 15 to 20 dB. Background noise in the test environment will not degrade the THD measurement result as significantly as is the case for the THD+N measurement.

## PESQ

PESQ scores lie in the range -0.5 (worst) to +4.5 (best).

When testing a device using cable connections (from RF test port to RF connector, and from the device to the test set audio line input and output), a typical PESQ score would be >4.0.

The score may be reduced if the digital signal level of the audio connection is set to 0 dBFS and the device is optimized for lower digital audio levels. In this case, reduce the digital signal level of the audio sent over the *Bluetooth* connection and repeat the test.

When testing a device using over-the-air connections (from the MT8855A to the device antenna, and acoustic coupling using accessory microphones and speakers to interface to a fully assembled headset), a typical PESQ score would be between 2.7 to 3.7.

The score may be reduced under any of the following conditions:

- If interference from other RF sources results in dropped packets in the *Bluetooth* connection.
- If background noise is picked up by the device or test system microphone.
- If there is frequency response and distortions introduced by the device and test system microphones and speakers.
- If the digital signal level is set above the level that the test device is optimized to receive.

## THD+N vs Level

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise, and for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

## THD+N vs Frequency

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 300 Hz to 1 kHz so that an acceptable number of harmonics can be measured. At 997 Hz, when testing a CVSD device, the number of harmonics measured is limited by the CVSD codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.



# Chapter 10 — Testing a Mono Headset: Headset Speaker Output

## 10-1 Test Overview

A mono headset is a full duplex device allowing audio to pass in both directions at the same time.

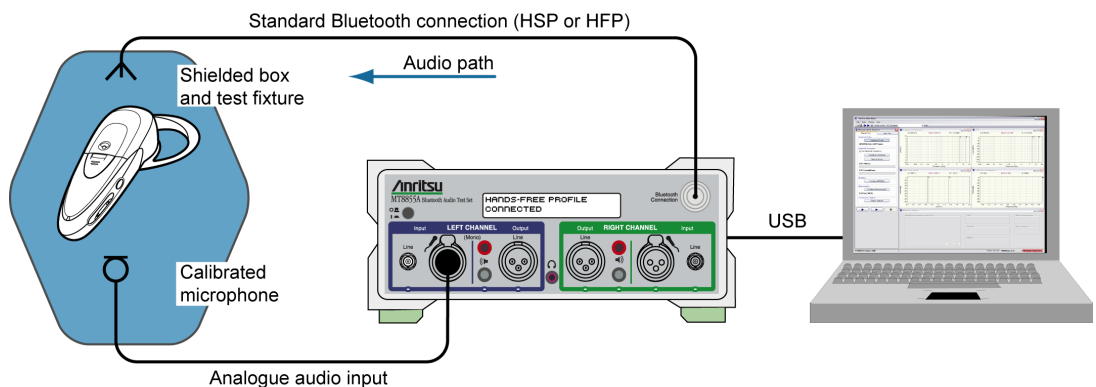
The test described in this chapter is used to confirm that an audio signal, transmitted by a MT8855A running the Hands-free or Headset profile, can be sent to a mono headset, routed through the codec and amplifier, and output from the speaker without distortion. The output audio tone is picked up by a calibrated microphone and fed back to the MT8855A audio analyzer.

Refer to chapter 8 for details of testing in the opposite direction (audio path of a mono headset microphone input through to the RF output).

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 10-2 Preparing to Test

1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.



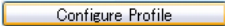
**Figure 10-1.** Testing a Mono Headset: Headset Speaker Output

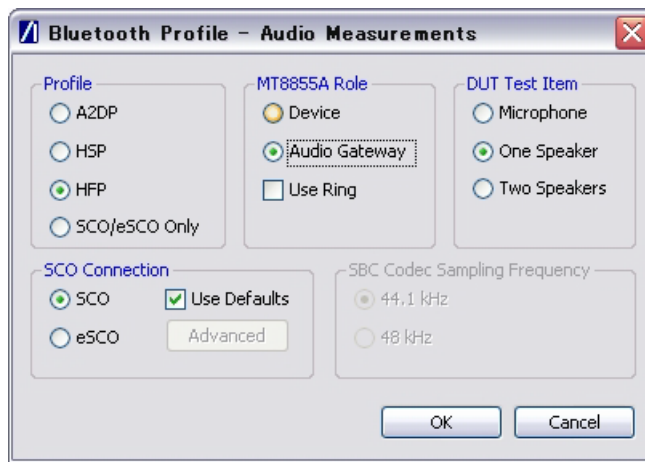
The following points should be observed to ensure that satisfactory measurement results are obtained:

**Note**

- The DUT should be positioned in a shielded acoustic box.
- The MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.

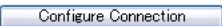
3. Configure the *Bluetooth* profile and MT8855A role.

- Click the [Manual Test] tab.
- Set “System Mode” to “*Bluetooth* Audio Measurements”.
- Click  to open the [*Bluetooth* Profile] dialog.



**Figure 10-2.** [*Bluetooth* Profile] Dialog for Mono Headset Speaker Testing

- Set “Profile” to “HFP”, or to “HSP” if “HFP” is not supported. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- Set “MT8855A Role” to “Audio Gateway”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- Select or clear the “Use Ring” check box as required. If the check box is cleared (the default setting), the incoming call is accepted automatically without the user needing to press the call accept button on the headset. If the check box is selected, the user will need to press the call accept button on the headset to accept the call. Selecting the check box would only be required by users specifically wishing to test the functionality of the button on the headset.
- Set “DUT Test Item” to “One Speaker”. (As we are testing a mono device, rather than A2DP headset, there is only one speaker.)
- Select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.

- i. Click [OK] when complete.
4. Configure a *Bluetooth* connection between the MT8855A and the DUT.
    - a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the documentation supplied with the product.
    - b. Click  to open the dialog shown below.



**Figure 10-3.** [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**

The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.


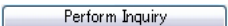


- d. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.

**Note** As the mono headset does not have an interface from which a *Bluetooth* connection can be established, the initial connection must always be made from the MT8855A.

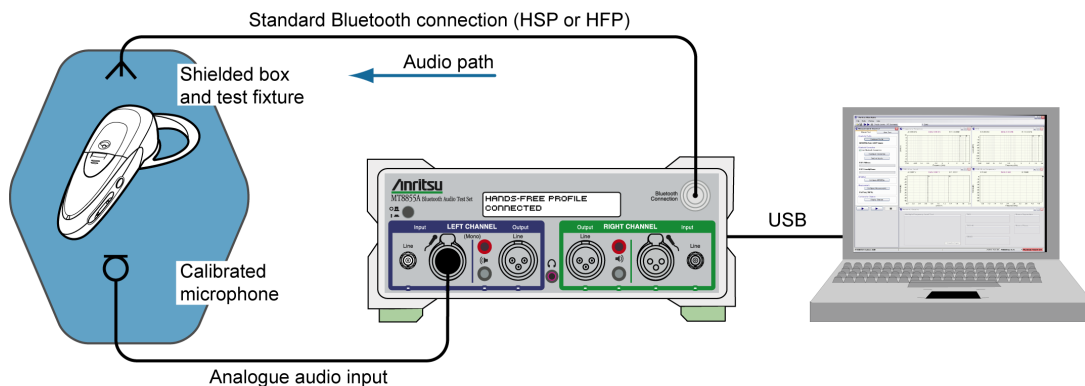
- e. Select or clear the "Test Set Initiates" check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the "Test Set Initiates" check box prevents the tester from initiating pairing.
- f. Enter the "Passkey". Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically "0000" but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.
- g. Set the "RF Connection Path" between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5 dBm; for cable connections the output power is nominally -40 dBm.

**Note** For reliable air connections the DUT should be positioned within 5 meters of the MT8855A.

- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
- If "Address Source" was set to a "User Defined" *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If "Address Source" was set to a "Inquiry" or "Inquiry + Name", the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

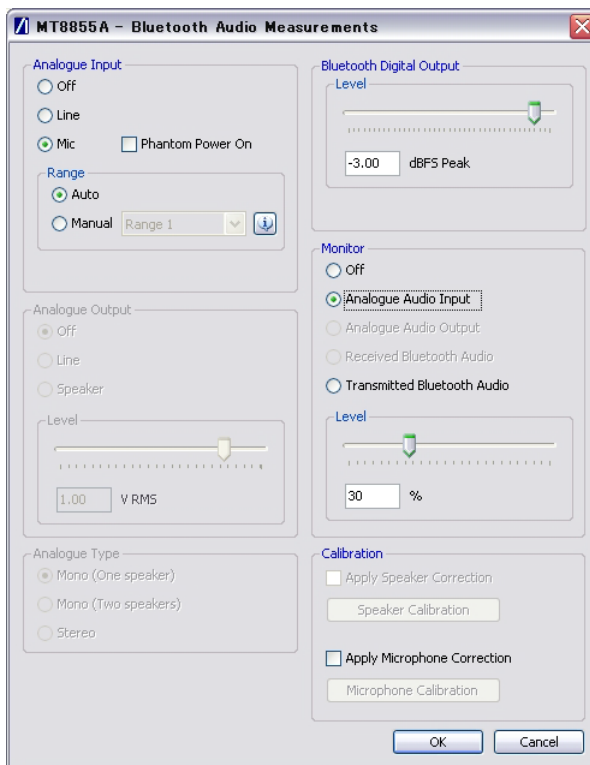
When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the "Status" field in the status bar changes to "Connected".

- Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.



**Figure 10-4.** Testing a Mono Headset: Headset Speaker Output

- Click  on the [Manual Test] tab to open the [Configure MT8855A] dialog.



**Figure 10-5.** [MT8855A] dialog for mono headset microphone testing

- b. Set “Analogue Input” to “Mic”. (As seen in the configuration diagram on the previous page, the microphone cable feeds into the left channel microphone input socket. The left channel is always used for testing mono devices.)
- c. Select “Phantom Power On” if required by the microphone in use. Phantom power is a 48 V DC supply used to power capacitor-based microphones. Select “Phantom Power On” whenever the external microphone connected to the microphone input of MT8855A requires DC power. If selected, the phantom power indicator on the BlueAudio status bar changes from red to green.

|             |   |
|-------------|---|
| <b>Note</b> | Both of the Anritsu microphones available as optional accessories (2000-1607-R and 2000-1608-R) require the use of phantom power. |
|-------------|---|

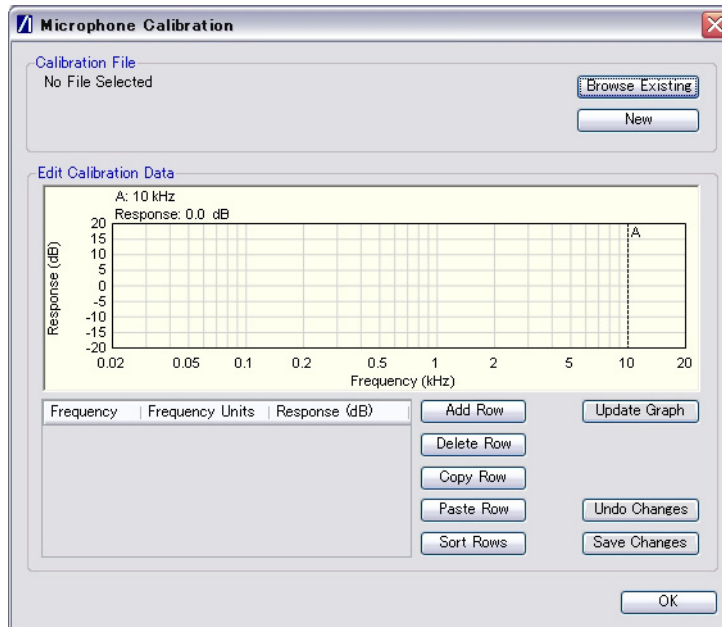
- d. Set “Range” to “Auto”.

The “Auto” setting is suitable for all normal signals under test. If the signal under test has excessive noise the auto range algorithm on the MT8855A may fail. In this case use of the manual range is required. Refer to section 18-13 for a list of the manual range settings.
- e. Set the “Bluetooth Digital Output”.

Use the slider to set the Bluetooth digital output to the maximum signal level that the device under test is designed to receive. This will typically be a value between -3 and -12 dBFS.
- f. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. Select “Analogue Audio Input” to hear the signal picked up by the microphone. Select “Transmitted *Bluetooth* Audio” to hear the signal relayed over the *Bluetooth* connection from the MT8855A to the DUT.
- g. Set the monitor “Level” setting to the required volume.

|             |   |
|-------------|---|
| <b>Note</b> | <p>When monitoring the signal from a microphone, it may be better to use a headset to avoid audible feedback.</p> <p>To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.</p> |
|-------------|---|

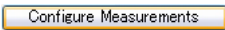
- h. Apply microphone correction if required by the microphone in use. Select “Apply Microphone Correction” and click [Microphone Calibration] to display the dialog below. Correction is used to compensate for the frequency response of the speaker, normalized to the reference frequency. Anritsu microphones are supplied with a calibration curve (see Table 1-2 on page 1-5 for details).



**Figure 10-6.** Microphone Calibration

- i. Browse to an existing calibration file or create a new table by adding rows and values as required.
- j. Click [OK] to close the [Microphone Calibration] dialog.
- k. Click [OK] close the [MT8855A] dialog.

6. Configure measurements.

- a. Click  on the [Manual Test] tab to open the dialog shown below.

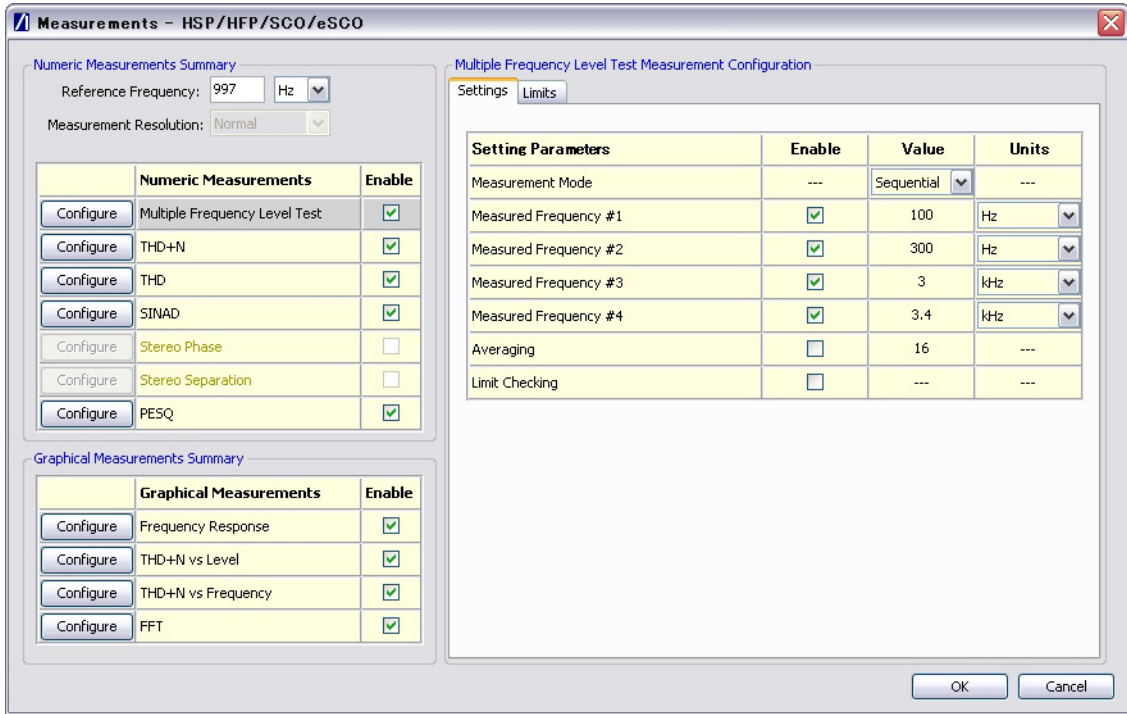


Figure 10-7. [Measurement] Dialog

- b. Specify the “Reference Frequency”.

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

- c. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

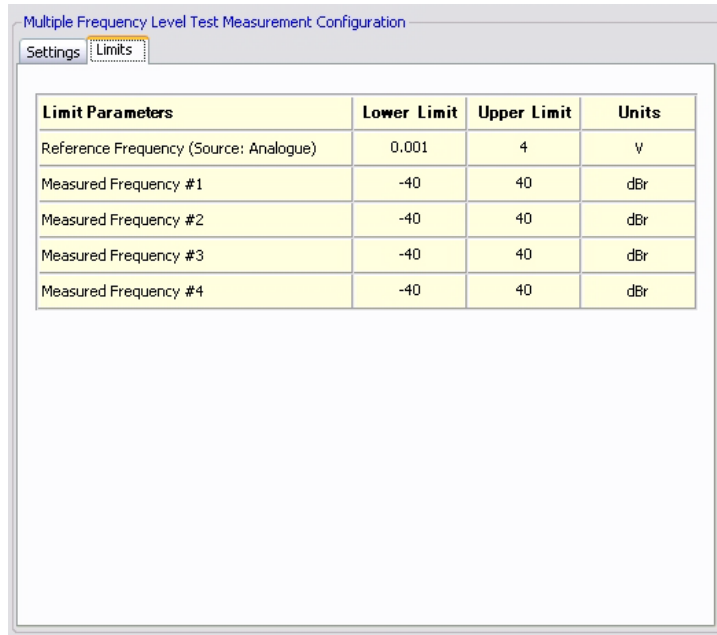
Four measurements display numeric results only, and three display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.

- d. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

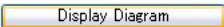
The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- e. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.




| Limit Parameters                       | Lower Limit | Upper Limit | Units |
|--|-------------|-------------|-------|
| Reference Frequency (Source: Analogue) | 0.001       | 4           | V     |
| Measured Frequency #1                  | -40         | 40          | dBr   |
| Measured Frequency #2                  | -40         | 40          | dBr   |
| Measured Frequency #3                  | -40         | 40          | dBr   |
| Measured Frequency #4                  | -40         | 40          | dBr   |



**Figure 10-8.** [Limits] Tab

- f. Repeat steps (d) to (e) for each of the measurements to be run.
- g. Perform PESQ calibration if PESQ measurements are to be run. Refer to section 20-16 for details.
- h. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.

## 10-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

## 10-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

## 10-5 Understanding Test Results

### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for these tests. When using the Headset or Hands-free profile that mandates the CVSD codec, a typical device interfaced to the MT8855A Line audio connectors with cables, will show that other tones within the range 300 Hz to 3 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

### THD+N

For a standard reference tone of 997 Hz, this test will typically show a THD+N measurement of  $> -17$  dB when interfaced to the MT8855A Line audio connectors with cables. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical mono headset using the CVSD codec will be  $-10$  to  $-20$  dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

## THD

For a standard reference tone of 997 Hz, when interfaced to the MT8855A Line audio connectors with cables, this test will typically show a THD measurement result of 5 dB better than for THD+N. If the DUT is operating at close to maximum signal level for a CVSD codec, the CVSD codec exhibits non-linear behaviour. Under these conditions THD+N and THD will give similar results because the 3rd harmonic distortion will dominate the measurement result. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices. The result is expected to be better than THD+N as noise is not included in the result. For this reason, use of the THD measurement alone should be treated with caution, as devices exhibiting good THD performance may still exhibit compromised audio performance if the noise performance is poor.

THD is degraded if the DUT has poor linearity. Noise can be added to the audio signal path through noisy amplifiers or poor schematic layout resulting in the pick up of unwanted signals on the audio paths.

When using a microphone and speaker in the test configuration, the THD performance of a typical mono headset using the CVSD codec will be 15 to 20 dB. Background noise in the test environment will not degrade the THD measurement result as significantly as is the case for the THD+N measurement.

## PESQ

PESQ scores lie in the range -0.5 (worst) to +4.5 (best).

When testing a device using cable connections (from RF test port to RF connector, and from the device to the test set audio line input and output), a typical PESQ score would be >4.0.

The score may be reduced if the digital signal level of the audio connection is set to 0 dBFS and the device is optimized for lower digital audio levels. In this case, reduce the digital signal level of the audio sent over the *Bluetooth* connection and repeat the test.

When testing a device using over-the-air connections (from the MT8855A to the device antenna, and acoustic coupling using accessory microphones and speakers to interface to a fully assembled headset), a typical PESQ score would be between 2.7 to 3.7.

The score may be reduced under any of the following conditions:

- If interference from other RF sources results in dropped packets in the *Bluetooth* connection.
- If background noise is picked up by the device or test system microphone.
- If there is frequency response and distortions introduced by the device and test system microphones and speakers.
- If the digital signal level is set above the level that the test device is optimized to receive.

## THD+N vs Level

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise, and for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.



## THD+N vs Frequency

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 300 Hz to 1 kHz so that an acceptable number of harmonics can be measured. At 997 Hz, when testing a CVSD device, the number of harmonics measured is limited by the CVSD codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

# Chapter 11 — Testing Audio Gateway: Audio Output

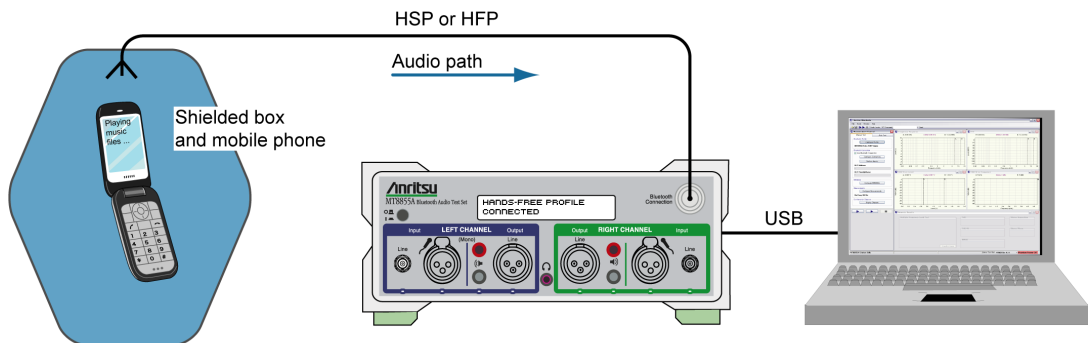
## 11-1 Test Overview

The test described in this chapter is used to confirm that an audio signal can be sent by an audio gateway to the MT8855A running the Hands-free or Headset profile without distortion.

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 11-2 Preparing to Test

1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.
  - c. Establish a connection with the phone from the cellular network from which audio will be routed.

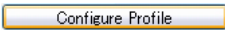


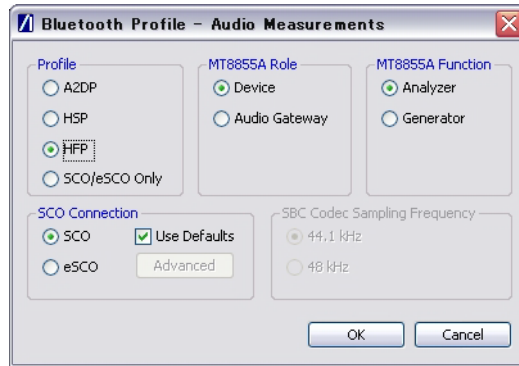
Note: Audio routed to phone from cellular network.

**Figure 11-1.** Testing Audio Gateway: Audio Output

**Note** To ensure that satisfactory measurement results are obtained, the MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.

3. Configure the *Bluetooth* profile and MT8855A role.

- a. Click the [Manual Test] tab.
- b. Set “System Mode” to “*Bluetooth* Audio Measurements”.
- c. Click  to open the [*Bluetooth* Profile] dialog.



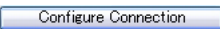
**Figure 11-2.** [*Bluetooth* Profile] Dialog for Mono Headset Microphone Testing

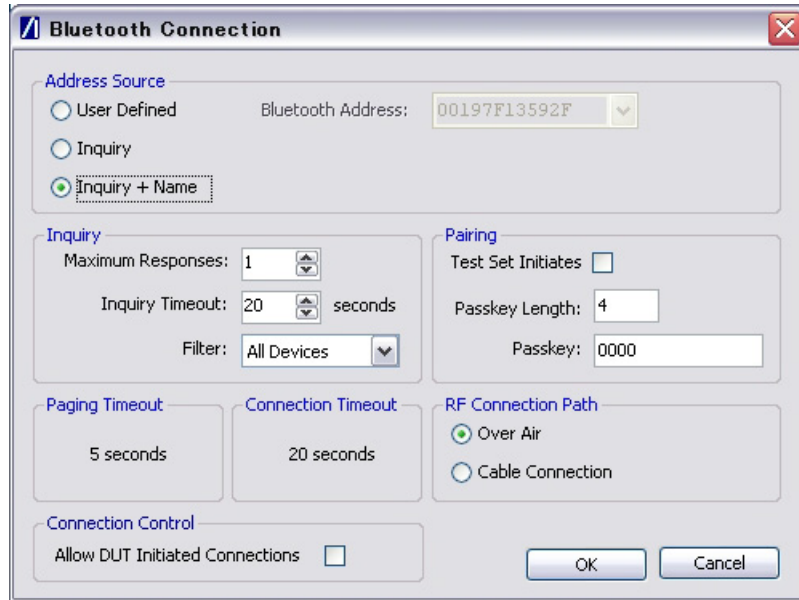
- d. Set “Profile” to “HFP”, or to “HSP” if “HFP” is not supported. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- e. Set “MT8855A Role” to “Device”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- f. Set “MT8855A Function” to “Analyzer”. (The MT8855A is being used to analyze the incoming *Bluetooth* signal.)
- g. Select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.
- h. Click [OK] when complete.

4. Configure a *Bluetooth* connection between the MT8855A and the DUT.

The connection can be initiated from the DUT or the MT8855A.

To initiate the connection from the DUT

- a. Click  to open the dialog shown below.



**Figure 11-3.** [Bluetooth Connection] Dialog


- b. At the DUT, set the passkey to match that specified in the dialog above.
- c. Select the “Allow DUT Initiated Connections” check box.

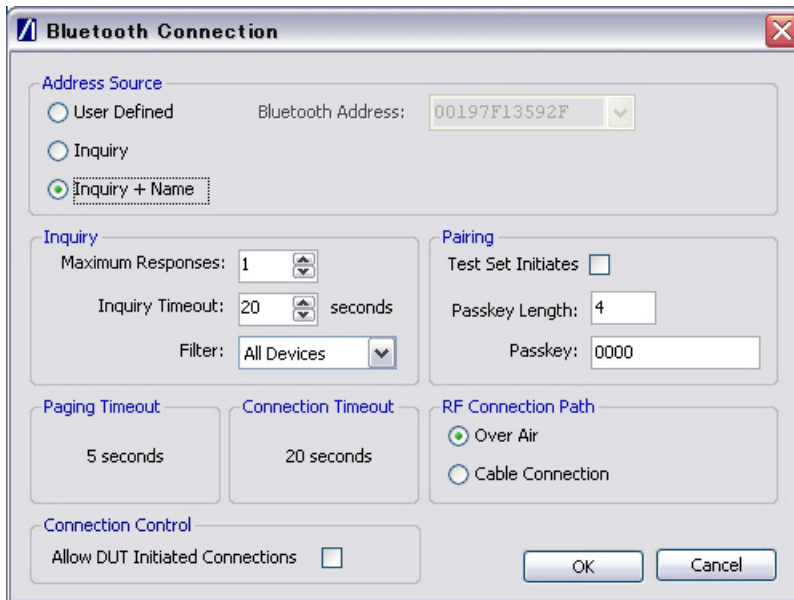
After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.

- d. Refer to the DUT manufacturer’s instructions for details of how to initiate a connection.

When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the “Status” field in the status bar changes to “Connected”.

To initiate the connection from the MT8855A.

- a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the DUT manufacturer's instructions for details.
- b. Click  to open the dialog shown below.



**Figure 11-4.** [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**

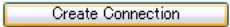

The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.

- d. Select or clear the "Test Set Initiates" check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the "Test Set Initiates" check box prevents the tester from initiating pairing.

- e. Enter the “Passkey” to match that of the DUT. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.
- f. Clear the "Allow DUT Initiated Connections" check box as required.
- g. Set the “RF Connection Path” between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5dBm; for cable connections the output power is nominally -40 dBm.

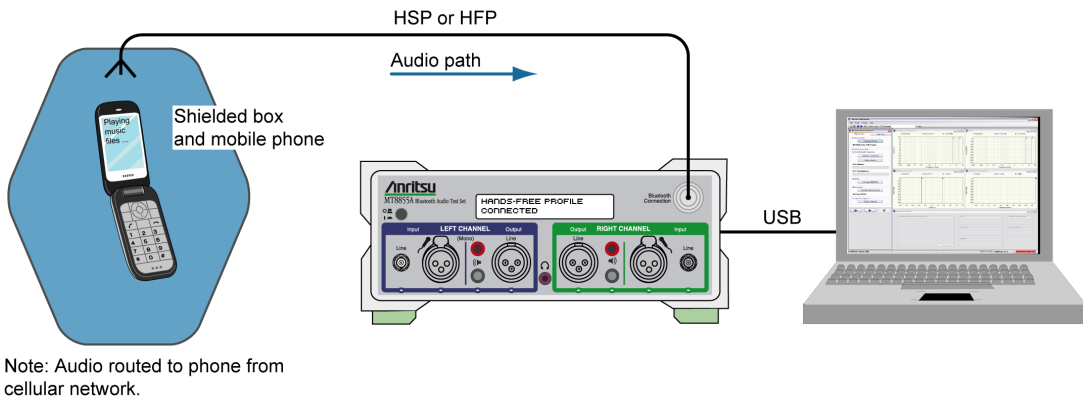
**Note**

For reliable air connections the DUT should be positioned within 5 meters of the MT8855A.

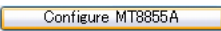
- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
  - If the “Address Source” was set to a “User Defined” *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If the “Address Source” was set to a “Inquiry” or “Inquiry + Name”, the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

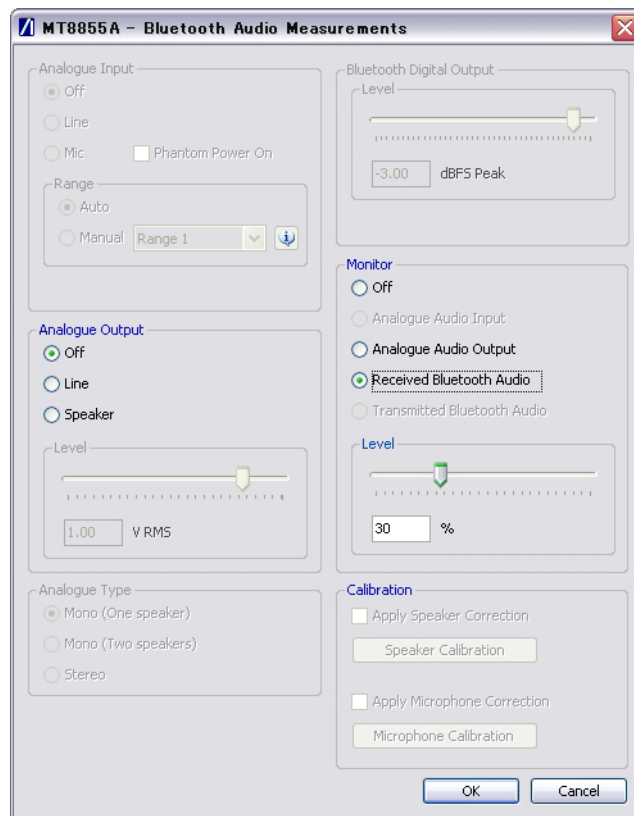
When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the “Status” field in the status bar changes to “Connected”.

- Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.



**Figure 11-5.** Testing Audio Gateway: Audio Output

- a. Click  on the [Manual Test] tab to open the [Configure MT8855A] dialog.



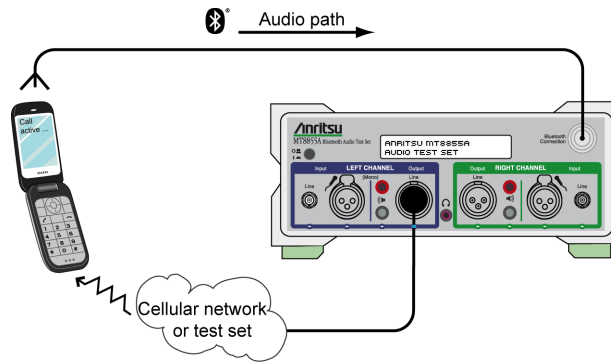
**Figure 11-6.** [MT8855A] Dialog for Audio Gateway Testing

- b. Set “Analogue Output” to “Off”. (As seen in the configuration diagram on the previous page, the audio signal is fed in from a cellular network or test set and there are no audio output feeds from the MT8855A.)

Two other “Analogue Output” settings can be used if outputting an audio test signal directly from the MT8855A:

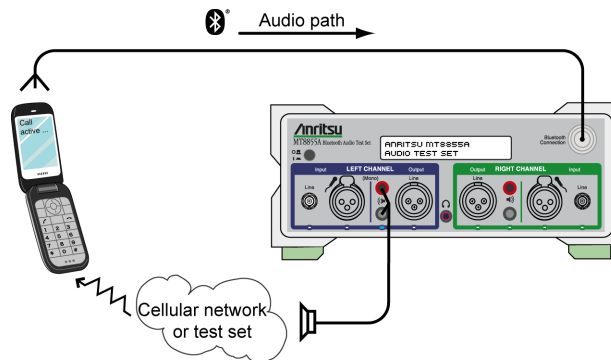


Set “Analogue Output” to “Line” if configuring to send an audio tone from the MT8855A to the handset that will be used to establish the cellular connection with the phone under test. This test scenario is illustrated in the figure below.



**Figure 11-7.** Analogue Output: Line

Set “Analogue Output” to “Speaker” if configuring to use a speaker to send an audio tone from the MT8855A to the microphone on the handset that will be used to establish the cellular connection with the phone under test. This test scenario is illustrated in the figure below.



**Figure 11-8.** Analogue Output: Speaker

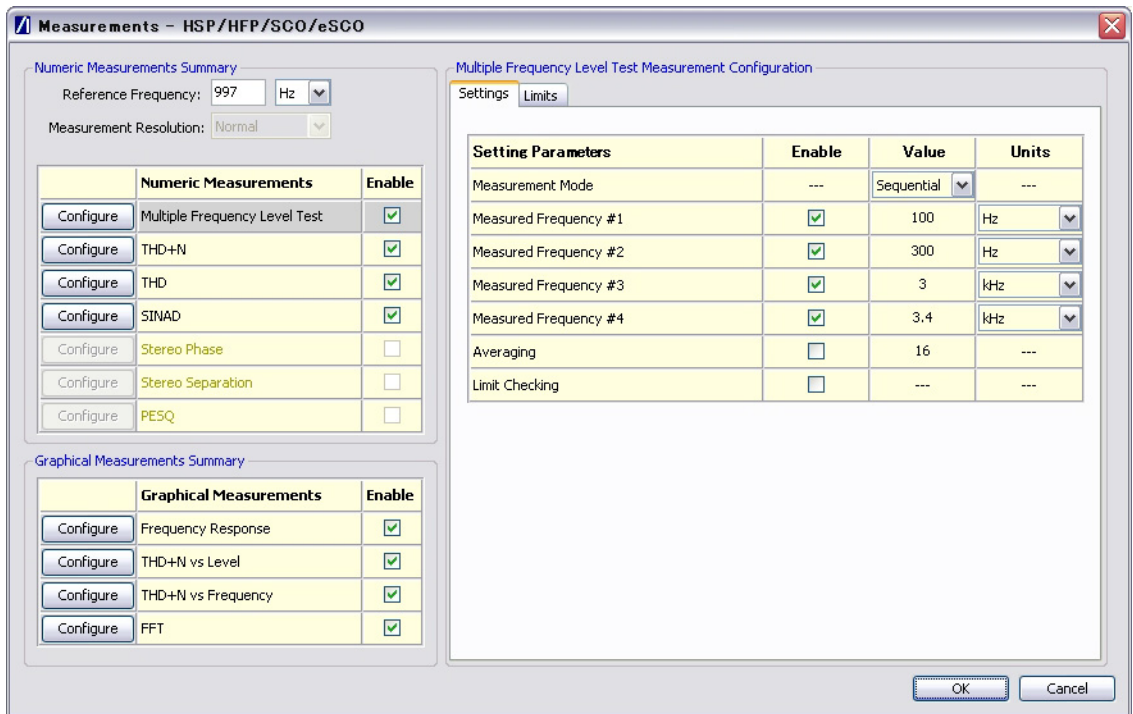
- c. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. Select “Received *Bluetooth* Audio” to hear the RF signal from the audio gateway. The other settings are not applicable to this test.

- d. Set the monitor “Level” setting to the required volume.

**Note** To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.

**6. Configure measurements.**

- a. Click Configure Measurements on the [Manual Test] tab to open the dialog shown below.



**Figure 11-9.** [Measurement] Dialog

- b. Specify the “Reference Frequency”.

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997 Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

- c. Set the “Measurement Resolution”.

"Measurement Resolution" refers to the resolution of the FFT. The “Normal” setting captures 4 kilobytes of data and the “High” setting captures 8kbytes of data. The extra resolution resulting from the “High” setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the “Normal” setting the lowest frequency these measurements can be made at is 300 Hz. The "Measurement Resolution" setting does not have any effect on the multiple frequency level test or the frequency response graph.

- d. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

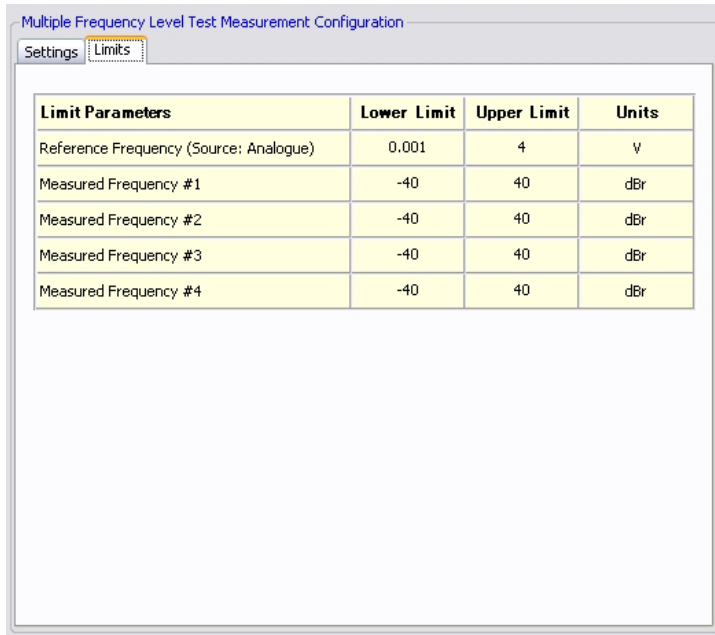
Six measurements display numeric results only, and three display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.

- e. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

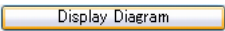
The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.




| Limit Parameters                       | Lower Limit | Upper Limit | Units |
|--|-------------|-------------|-------|
| Reference Frequency (Source: Analogue) | 0.001       | 4           | v     |
| Measured Frequency #1                  | -40         | 40          | dBr   |
| Measured Frequency #2                  | -40         | 40          | dBr   |
| Measured Frequency #3                  | -40         | 40          | dBr   |
| Measured Frequency #4                  | -40         | 40          | dBr   |



**Figure 11-10.** [Limits] Tab

- g. Repeat steps (d) to (f) for each measurement to be run.
- h. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.
8. Call the phone under test from the cellular network or GSM tester.

### 11-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

## 11-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and all numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

## 11-5 Understanding Test Results

### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for these tests. When using the Headset or Hands-free profile that mandates the CVSD codec, a typical device interfaced to the MT8855A Line audio connectors with cables, will show that other tones within the range 300 Hz to 3 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

### THD+N

For a standard reference tone of 997 Hz, this test will typically show a THD+N measurement of  $> -17$  dB when interfaced to the MT8855A Line audio connectors with cables. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical mono headset using the CVSD codec will be  $-10$  to  $-20$  dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

### THD

For a standard reference tone of 997 Hz, when interfaced to the MT8855A Line audio connectors with cables, this test will typically show a THD measurement result of 5 dB better than for THD+N. If the DUT is operating at close to maximum signal level for a CVSD codec, the CVSD codec exhibits non-linear behavior. Under these conditions THD+N and THD will give similar results because the 3rd harmonic distortion will dominate the measurement result. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices. The result is expected to be better than THD+N as noise is not included in the result. For this reason, use of the THD measurement alone should be treated with caution, as devices exhibiting good THD performance may still exhibit compromised audio performance if the noise performance is poor.

THD is degraded if the DUT has poor linearity. Noise can be added to the audio signal path through noisy amplifiers or poor schematic layout resulting in the pick up of unwanted signals on the audio paths.

When using a microphone and speaker in the test configuration, the THD performance of a typical mono headset using the CVSD codec will be 15 to 20 dB. Background noise in the test environment will not degrade the THD measurement result as significantly as is the case for the THD+N measurement.

### **THD+N vs Level**

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise, and for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

### **THD+N vs Frequency**

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 300 Hz to 1 kHz so that an acceptable number of harmonics can be measured. At 997 Hz, when testing a CVSD device, the number of harmonics measured is limited by the CVSD codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.



# Chapter 12 — Testing Audio Gateway: Audio Input

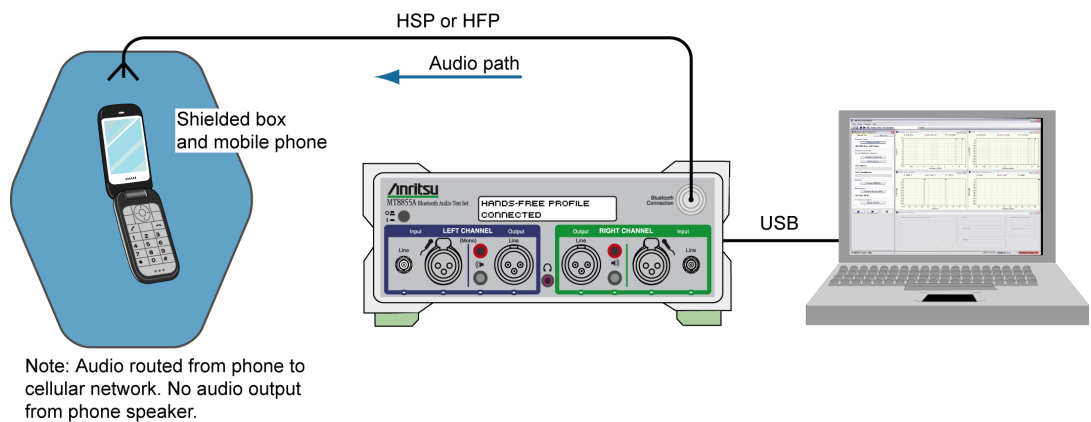
## 12-1 Test Overview

The test described in this chapter is used to confirm that an audio signal running the Hands-free or Headset profile can be sent from the MT8855A to an audio gateway without distortion.

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 12-2 Preparing to Test

1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.
  - c. Establish a connection from the phone to the cellular network to which audio will be routed.

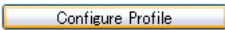


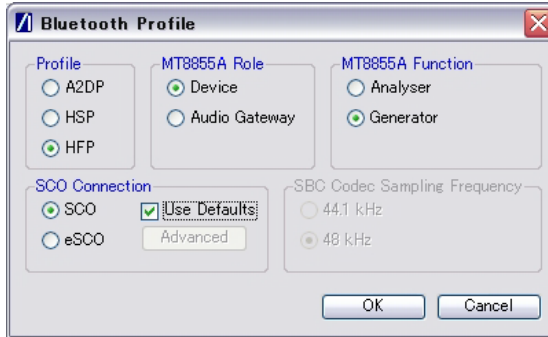
**Figure 12-1.** Testing Audio Gateway: Audio Input

**Note** To ensure that satisfactory measurement results are obtained, the MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.

3. Configure the *Bluetooth* profile and MT8855A role.



- a. Click the [Manual Test] tab.
- b. Set “System Mode” to “*Bluetooth* Audio Measurements”.
- c. Click  to open the [*Bluetooth* Profile] dialog.



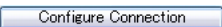
**Figure 12-2.** [*Bluetooth* Profile] Dialog for Audio Gateway Receiver Testing

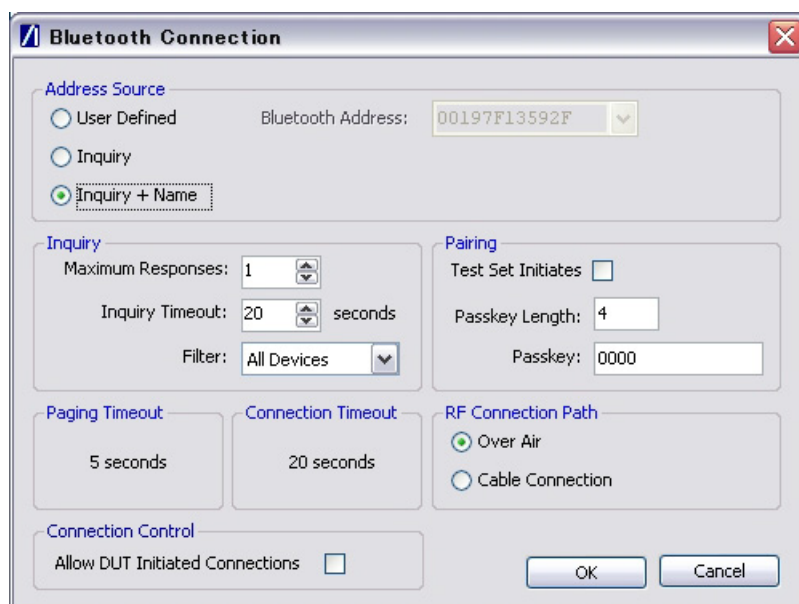
- d. Set “Profile” to “HFP”, or to “HSP” if “HFP” is not supported. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- e. Set “MT8855A Role” to “Device”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- f. Set “MT8855A Function” to “Generator”. (The MT8855A is being used to generate the *Bluetooth* signal being sent to the audio gateway.)
- g. Select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.
- h. Click [OK] when complete.

4. Configure a *Bluetooth* connection between the MT8855A and the DUT.

The connection can be initiated from either the DUT or the MT8855A.

To initiate the connection from the DUT.

- a. Click  to open the dialog shown below.




**Figure 12-3.** [Bluetooth Connection] Dialog

- b. At the DUT, set the passkey to match that specified in the dialog above.
- c. Select the “Allow DUT Initiated Connections” check box.
- d. Refer to the DUT manufacturer’s instructions for details of how to initiate a connection.

When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the “Status” field in the status bar changes to “Connected”.

To initiate the connection from the MT8855A.

- a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the DUT manufacturer's instructions for details.
- b. Click  to open the dialog shown below.

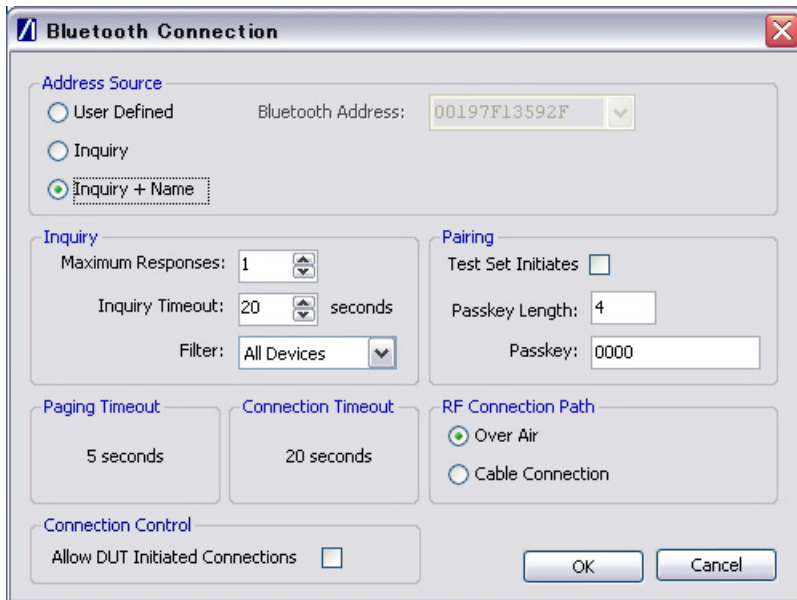


Figure 12-4. [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.


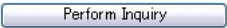
**Note**

The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.

- d. Select or clear the “Test Set Initiates” check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the “Test Set Initiates” check box prevents the tester from initiating pairing.
- e. Enter the “Passkey”. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.

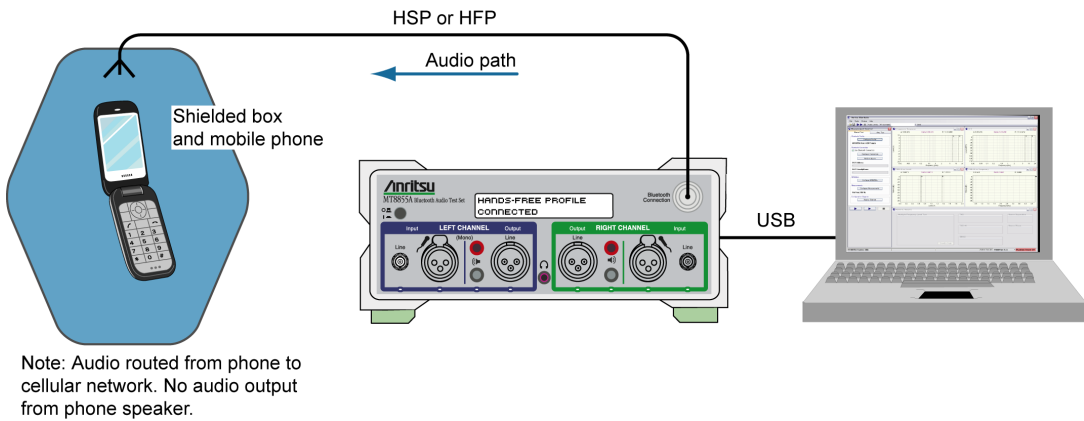
- f. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.
- g. Set the "RF Connection Path" between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5 dBm; for cable connections the output power is nominally -40 dBm.

|             |   |
|-------------|---|
| <b>Note</b> | For reliable air connections the DUT should be positioned within 5 meters of the MT8855A. |
|-------------|---|

- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
  - If "Address Source" was set to a "User Defined" *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If "Address Source" was set to a "Inquiry" or "Inquiry + Name", the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

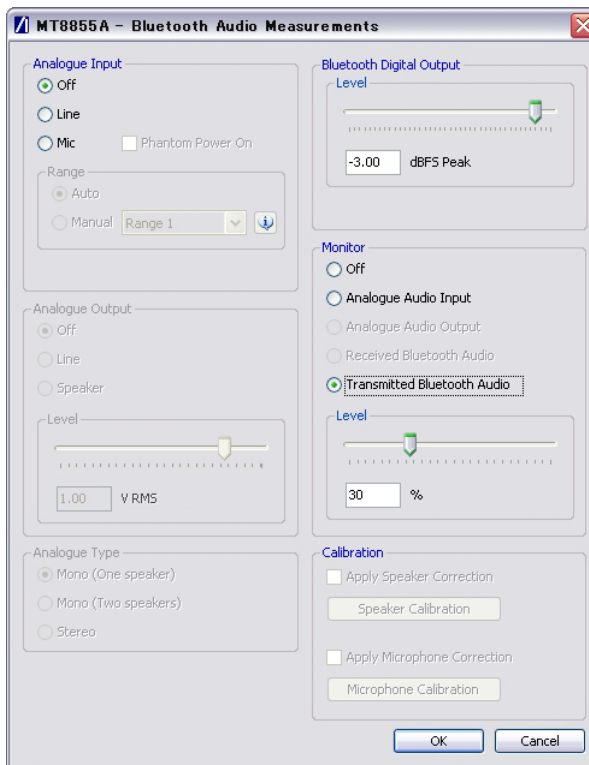
When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the "Status" field in the status bar changes to "Connected".

- Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.



**Figure 12-5.** Testing Audio Gateway: Audio Input

- Click Configure MT8855A on the [Manual Test] tab to open the [Configure MT8855A] dialog.

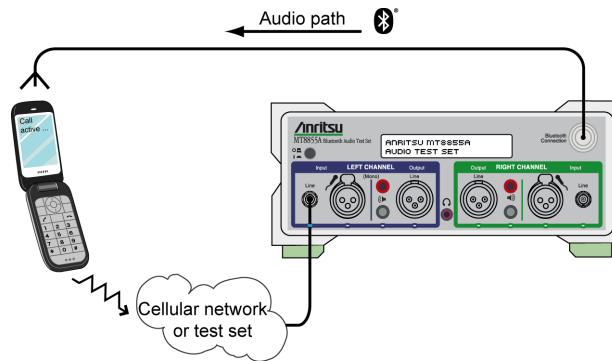


**Figure 12-6.** [MT8855A] Dialog for Audio Gateway Receiver Testing

- b. Set “Analogue Input” to “Off”. (As seen in the configuration diagram on the previous page, there are no analogue input feeds to the MT8855A.)

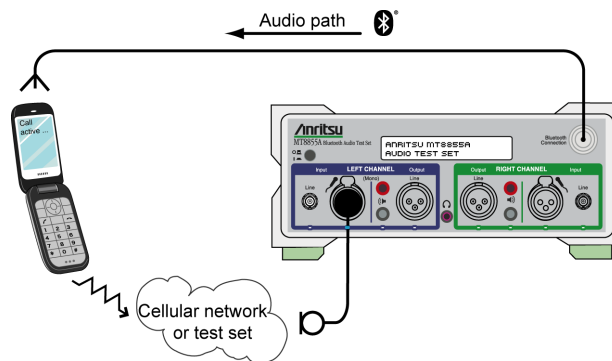
Two other “Analogue Input” settings can be used if outputting audio from the cellular network or test set directly to the MT8855A:

Set “Analogue Input” to “Line” if configuring to send an audio tone over the cellular network from the DUT to the handset and relayed back to the MT8855A. This test scenario is illustrated in the figure below.



**Figure 12-7.** Analogue Input: Line

Set “Analogue Input” to “Microphone” if configuring to use a microphone to pick up an audio tone sent over the cellular network from the DUT to the handset. This test scenario is illustrated in the figure below.



**Figure 12-8.** Analogue Input: Microphone

- c. Set “Range” to “Auto”.

The “Auto” setting is suitable for all normal signals under test. If the signal under test has excessive noise the auto range algorithm on the MT8855A may fail. In this case use of the manual range is required. Refer to section 18-13 for a list of the manual range settings.

- d. Set the "Bluetooth Digital Output".

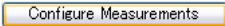
Use the slider to set the Bluetooth digital output to the maximum signal level that the device under test is designed to receive. This will typically be a value between -3 and -12 dBFS.

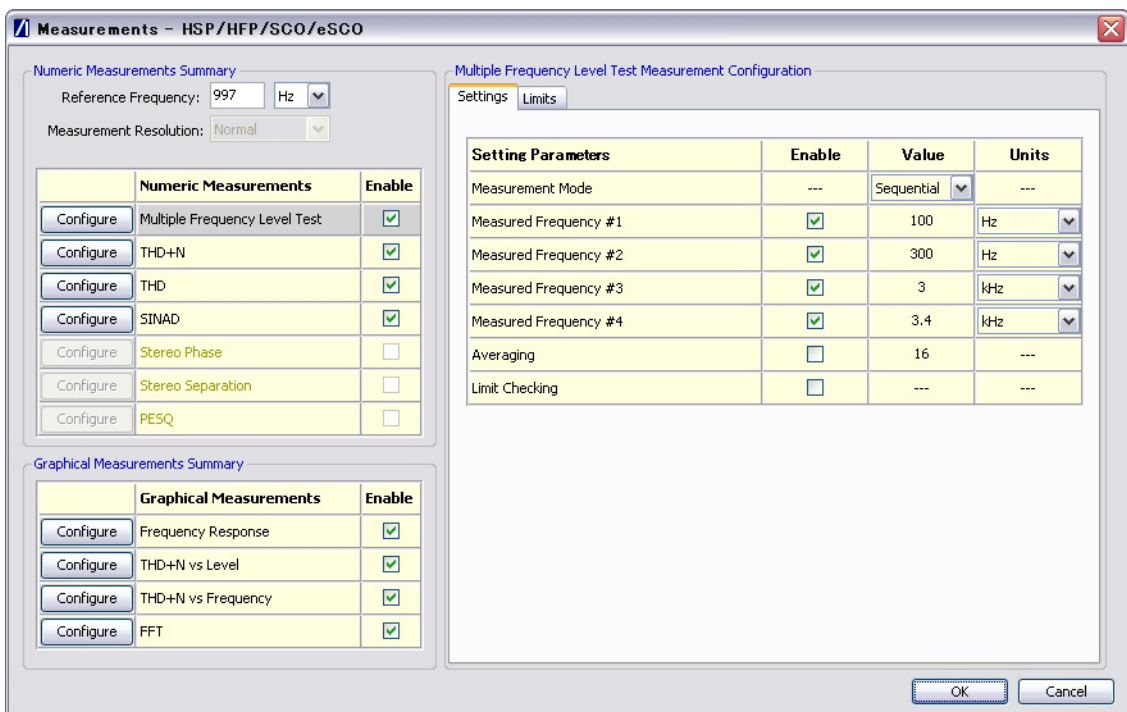
- e. Select the required "Monitor" setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. In this particular case, select "Transmitted *Bluetooth Audio*".
- f. Set the monitor "Level" setting to the required volume.

**Note**

To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.

**6. Configure measurements.**

- a. Click  on the [Manual Test] tab to open the dialog shown below.



**Figure 12-9.** [Measurement] Dialog

- b. Specify the "Reference Frequency".

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997Hz is selected in relation to the standard sampling frequencies of 44.1 kHz and 48 kHz of the SBC codec so that sampling in successive cycles occurs at different phases of the audio tone.

It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

- c. Set the "Measurement Resolution".

"Measurement Resolution" refers to the resolution of the FFT. The "Normal" setting captures 4kbytes of data and the "High" setting captures 8kbytes of data. The extra resolution resulting from the "High" setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the "Normal" setting the lowest frequency these measurements can be made at is 300 Hz. The "Measurement Resolution" setting does not have any effect on the multiple frequency level test or the frequency response graph.

- d. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

Six measurements display numeric results only, and three display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.

- e. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

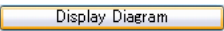
The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.



- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.


| Limit Parameters                       | Lower Limit | Upper Limit | Units |
|--|-------------|-------------|-------|
| Reference Frequency (Source: Analogue) | 0.001       | 4           | V     |
| Measured Frequency #1                  | -40         | 40          | dBr   |
| Measured Frequency #2                  | -40         | 40          | dBr   |
| Measured Frequency #3                  | -40         | 40          | dBr   |
| Measured Frequency #4                  | -40         | 40          | dBr   |



**Figure 12-10.**[Limits] Tab

- g. Repeat steps (d) to (f) for each of the measurements to be run.
- h. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.
8. Call the phone under test from the cellular network or GSM tester.

## 12-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

## 12-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and all numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

## 12-5 Understanding Test Results

### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for these tests. When using the Headset or Hands-free profile that mandates the CVSD codec, a typical device interfaced to the MT8855A Line audio connectors with cables, will show that other tones within the range 300 Hz to 3 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

### THD+N

For a standard reference tone of 997Hz, this test will typically show a THD+N measurement of  $> -17$  dB when interfaced to the MT8855A Line audio connectors with cables. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical mono headset using the CVSD codec will be  $-10$  to  $-20$  dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

### THD

For a standard reference tone of 997 Hz, when interfaced to the MT8855A Line audio connectors with cables, this test will typically show a THD measurement result of 5 dB better than for THD+N. If the DUT is operating at close to maximum signal level for a CVSD codec, the CVSD codec exhibits non-linear behaviour. Under these conditions THD+N and THD will give similar results because the 3rd harmonic distortion will dominate the measurement result. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices. The result is expected to be better than THD+N as noise is not included in the result. For this reason, use of the THD measurement alone should be treated with caution, as devices exhibiting good THD performance may still exhibit compromised audio performance if the noise performance is poor.

THD is degraded if the DUT has poor linearity. Noise can be added to the audio signal path through noisy amplifiers or poor schematic layout resulting in the pick up of unwanted signals on the audio paths.

When using a microphone and speaker in the test configuration, the THD performance of a typical mono headset using the CVSD codec will be 15 to 20 dB. Background noise in the test environment will not degrade the THD measurement result as significantly as is the case for the THD+N measurement.

### **THD+N vs Level**

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise, and for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

### **THD+N vs Frequency**

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 300 Hz to 1 kHz so that an acceptable number of harmonics can be measured. At 997 Hz, when testing a CVSD device, the number of harmonics measured is limited by the CVSD codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

# Chapter 13 — Testing an A2DP Sink

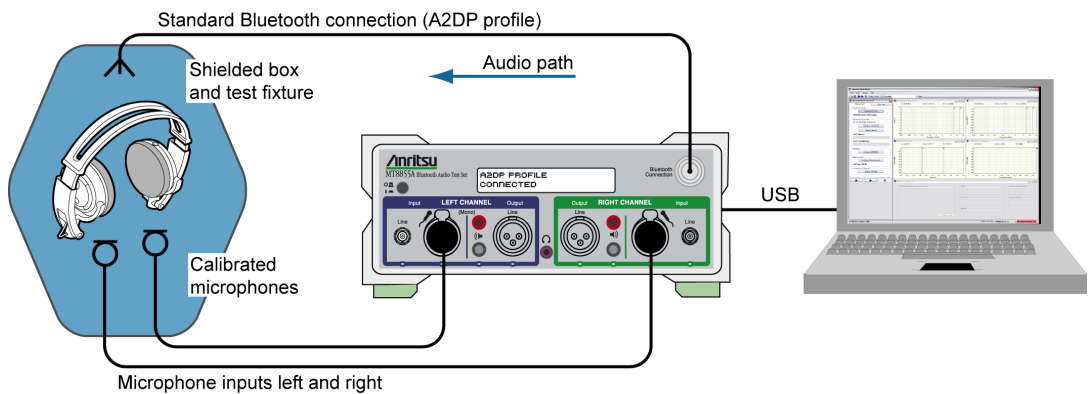
## 13-1 Test Overview

The test described in this chapter is used to confirm that an audio signal, transmitted by a MT8855A running the A2DP profile, can be sent to an A2DP sink and routed back to the MT8855A over an analogue connection without distortion.

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 13-2 Preparing to Test

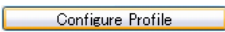
1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.

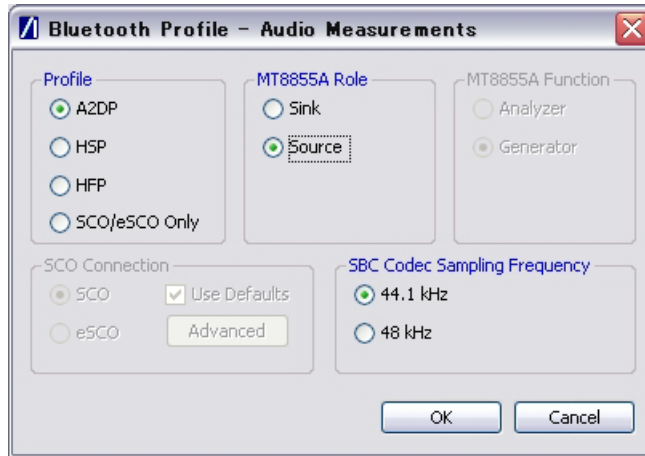


**Figure 13-1.** Testing an A2DP Sink

The following points should be observed to ensure that satisfactory measurement results are obtained:

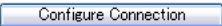
- Note**
- The DUT should be positioned in a shielded acoustic box.
  - The MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.

3. Configure the *Bluetooth* profile and MT8855A role.
  - a. Click the [Manual Test] tab.
  - b. Set “System Mode” to “*Bluetooth* Audio Measurements”.
  - c. Click  to open the [*Bluetooth* Profile] dialog.



**Figure 13-2.** [*Bluetooth* Profile] Dialog for A2DP Testing

- d. Set “Profile” to “A2DP”. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- e. Set “MT8855A Role” to “Source”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- f. Set the “SBC Codec Sampling Frequency” to a sampling rate supported by the DUT. The sampling frequency can be set by the A2DP source. The A2DP sink must align with the source setting. Most commercial A2DP products default to a 44.1 kHz sampling frequency.
- g. Click [OK] when complete.

4. Configure a *Bluetooth* connection between the MT8855A and the DUT.
  - a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the documentation supplied with the product.
  - b. Click  to open the dialog shown below.



**Figure 13-3.** [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**

The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.



- d. Select or clear the “Test Set Initiates” check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the “Test Set Initiates” check box prevents the tester from initiating pairing.
- e. Enter the “Passkey”. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.

- f. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.

**Note** As the A2DP sink (commonly a *Bluetooth* stereo headset, or multi-mode speaker) does not have an interface from which a *Bluetooth* connection can be established, the initial connection must always be made from the MT8855A.

- g. Set the "RF Connection Path" between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5dBm; for cable connections the output power is nominally -40dBm.

**Note** For reliable air connections the DUT should be positioned within 5 meters of the MT8855A.

- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
- If "Address Source" was set to a "User Defined" *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If "Address Source" was set to a "Inquiry" or "Inquiry + Name", the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the "Status" field in the status bar changes to "Connected".

- Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.

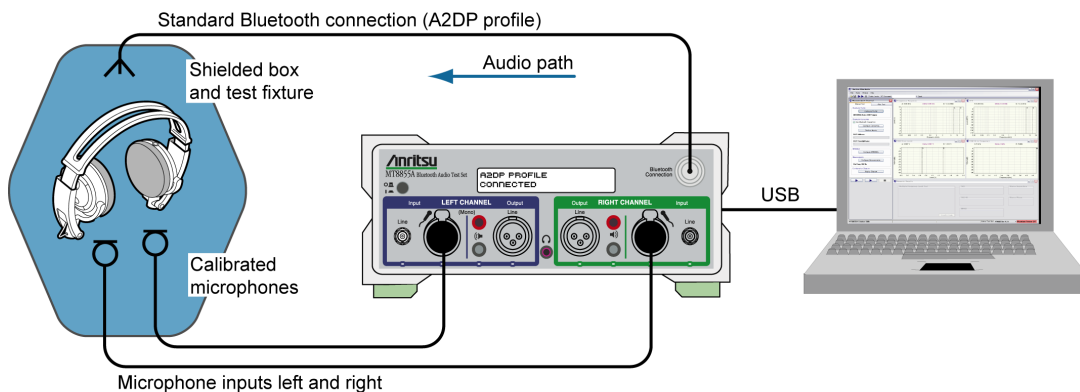


Figure 13-4. Testing an A2DP Sink

- Click Configure MT8855A on the [Manual Test] tab to open the [Configure MT8855A] dialog.

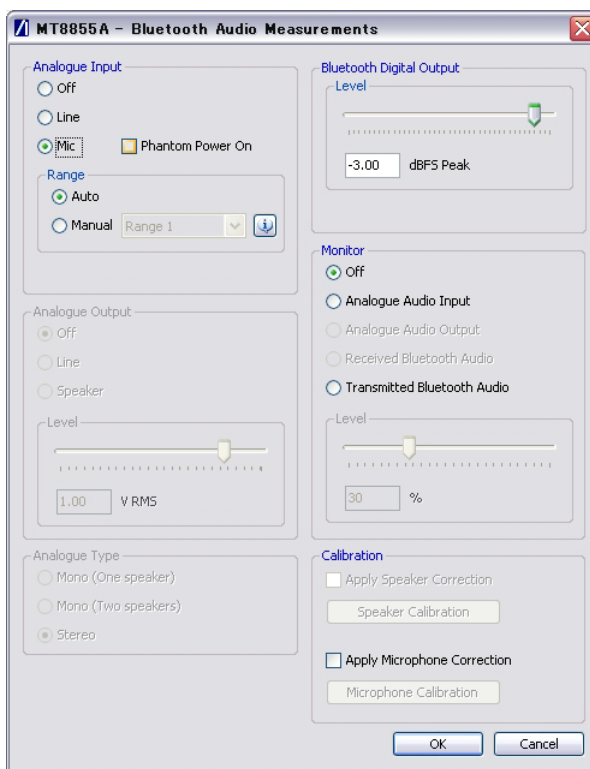


Figure 13-5. [MT8855A] dialog for A2DP Sink Testing



- b. Set “Analogue Input” to “Mic”. (As seen in the configuration diagram on the previous page, the microphone cables feed into the left and right channel microphone input socket.
- c. Select “Phantom Power On” if required by the microphone in use. Phantom power is a 48 V DC supply used to power capacitor-based microphones. Select “Phantom Power On” whenever the external microphone connected to the microphone input of MT8855A requires DC power. If selected, the phantom power indicator on the BlueAudio status bar changes from red to green.

|             |   |
|-------------|---|
| <b>Note</b> | Both of the Anritsu microphones available as optional accessories (2000-1607-R and 2000-1608-R) require the use of phantom power. |
|-------------|---|

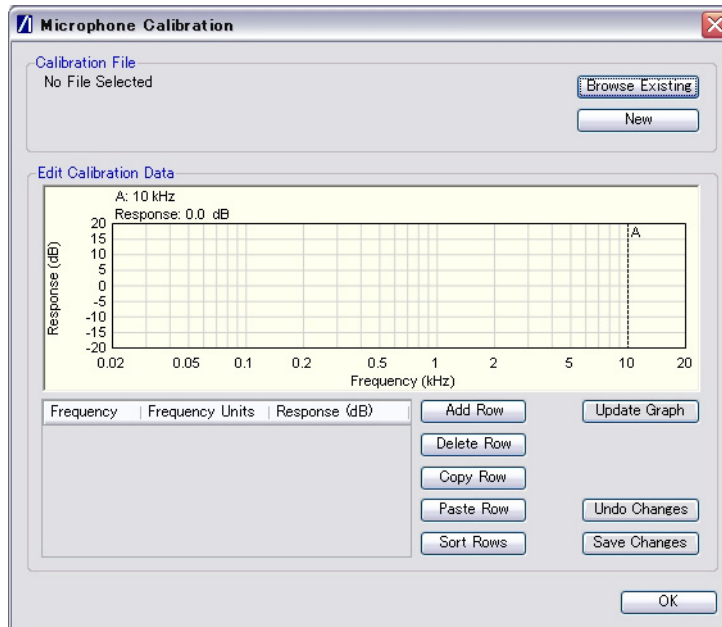
- d. Set “Range” to “Auto”.

The “Auto” setting is suitable for all normal signals under test. If the signal under test has excessive noise the auto range algorithm on the MT8855A may fail. In this case use of the manual range is required. Refer to section 18-13 for a list of the manual range settings.
- e. Set the "Bluetooth Digital Output".

Use the slider to set the Bluetooth digital output to the maximum signal level that the device under test is designed to receive. This will typically be a value between -3 and -12 dBFS.
- f. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. Select “Analogue Audio Input” to hear the signal picked up by the microphone. Select “Transmitted *Bluetooth* Audio” to hear the signal relayed over the *Bluetooth* connection from the MT8855A to the DUT.
- g. Set the monitor “Level” setting to the required volume.

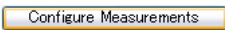
|             |   |
|-------------|---|
| <b>Note</b> | <p>When monitoring the signal from a microphone, it may be better to use a headset to avoid audible feedback.</p> <p>To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.</p> |
|-------------|---|

- h. Apply microphone correction if required by the microphone in use. Select “Apply Microphone Correction” and click [Microphone Calibration] to display the dialog below. Correction is used to compensate for the frequency response of the microphone, normalized to the reference frequency. Anritsu microphones are supplied with a calibration curve (see Table 1-2 on page 1-5 for details).



**Figure 13-6.** Microphone Calibration

- i. Browse to an existing calibration file or create a new table by adding rows and values as required.
- j. Click [OK] to close the [Microphone Calibration] dialog.
- k. Click [OK] close the [MT8855A] dialog.
6. Configure measurements.

- a. Click  on the [Manual Test] tab to open the dialog shown below.

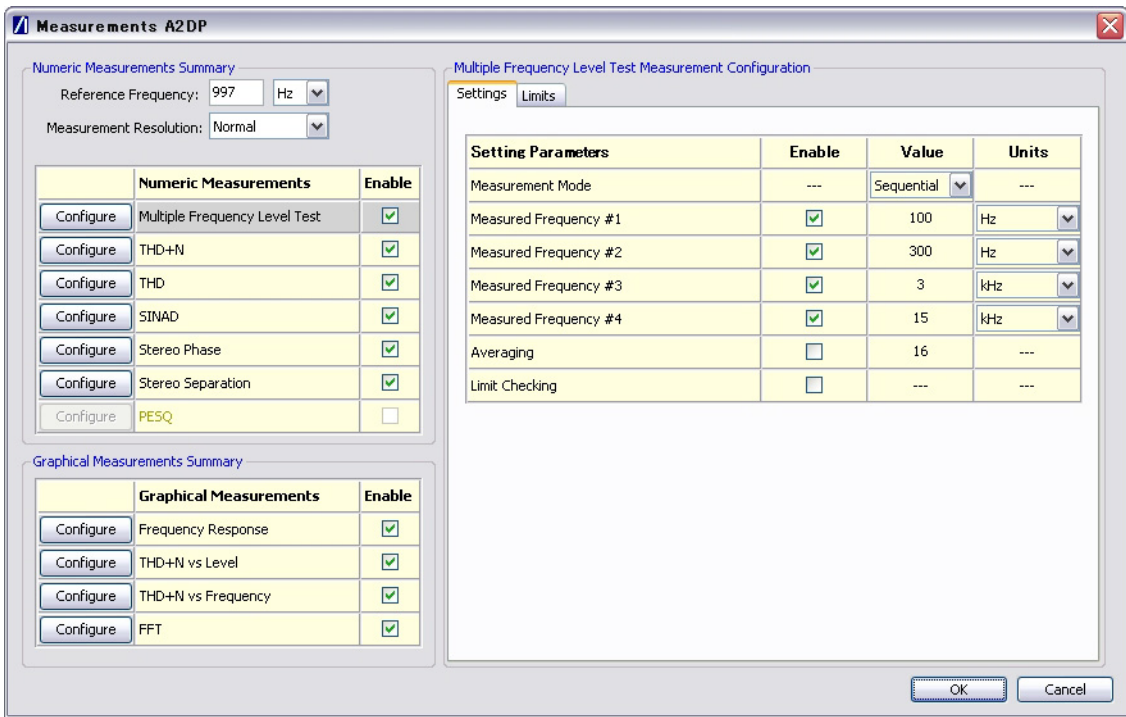


Figure 13-7. [Measurement] Dialog

- b. Specify the "Reference Frequency".

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997 Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

- c. Set the “Measurement Resolution”.

“Measurement Resolution” refers to the resolution of the FFT. The “Normal” setting captures 4kbytes of data and the “High” setting captures 8kbytes of data. The extra resolution resulting from the “High” setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the “Normal” setting the lowest frequency these measurements can be made at is 300 Hz. The “Measurement Resolution” setting does not have any effect on the multiple frequency level test or the frequency response graph.

- d. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

Six measurements display numeric results only, and three display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.


- e. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.


| Limit Parameters                       | Lower Limit | Upper Limit | Units |
|--|-------------|-------------|-------|
| Reference Frequency (Source: Analogue) | 0.001       | 4           | V     |
| Measured Frequency #1                  | -40         | 40          | dBr   |
| Measured Frequency #2                  | -40         | 40          | dBr   |
| Measured Frequency #3                  | -40         | 40          | dBr   |
| Measured Frequency #4                  | -40         | 40          | dBr   |



**Figure 13-8.** [Limits] Tab

- g. Repeat steps (d) to (f) for each of the measurements to be run.
  - h. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.

### 13-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

### 13-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and all numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

### 13-5 Understanding Test Results

#### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for this test. When using the A2DP profile the MT8855A uses the mandated SBC codec for all audio measurements. When interfaced to the MT8855A Line audio connectors with cables, this test will typically show that other tones within the range of 50 Hz to 15 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

#### THD+N

For a standard reference tone of 997 Hz, this test will typically show a THD+N measurement of  $> 60$  dB when interfaced to the MT8855A Line audio connectors with cables and using the SBC codec. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical stereo headset using the SBC codec will be >30 dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

## THD

For a standard reference tone of 997 Hz, when interfaced to the MT8855A Line audio connectors with cables, and using the SBC codec, this test will typically show a THD measurement result >60 dB. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD performance of a typical stereo headset using the SBC codec will be 30 to 40 dB. It is less important to shield the test microphone from background noise in the test environment as noise is not included in the THD measurement result.

## Stereo Separation

For a standard reference tone of 997 Hz, when interfaced to the MT8855A using Line audio connectors with cables, typical stereo separation results will be >50 dB.

If the measurement is performed on a stereo headset using two microphones to pick up the audio signal from the DUT speakers, typical results will be >20 dB. The actual measured value for this test is dependent on the quality of the test fixture and its ability to isolate the acoustic signal on the left channel from leaking onto the right channel (and visa versa).

## Stereo Phase

Results for the stereo phase test case should be similar regardless of whether performed using Line inputs or microphones and speakers.

The result of the stereo phase test case does not typically show variations between all products of the same design. The phase is determined by the schematic layout of the DUT's audio circuits and components. A good design will show that stereo phase between left and right channels is <10 degrees and typically around 5 degrees.

If the result is around 180 degrees, this indicates that one of the audio channels has been assembled with the cables reversed. As this is a common assembly mistake, the test is often performed in production specifically to identify this assembly error.

## THD+N vs Level

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise; for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance is dependent on each DUT design.

## THD+N vs Frequency

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 250 Hz to 5 kHz so that an acceptable number of harmonics can be measured. (Note the low frequency limit can be extended to 150 Hz if the FFT mode is set to "High".) At 5 kHz, when testing an A2DP device, the number of harmonics measured is limited by the SBC codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

# Chapter 14 — Testing an A2DP Source

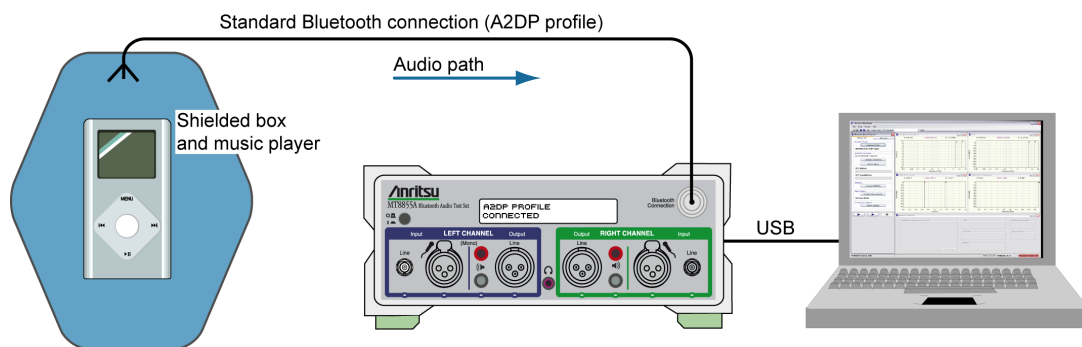
## 14-1 Test Overview

The test described in this chapter is used to confirm that an audio signal can be transmitted to the MT8855A from a device running the A2DP profile without distortion.

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 14-2 Preparing to Test

1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.



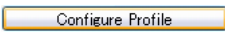
**Figure 14-1.** Testing an A2DP Source

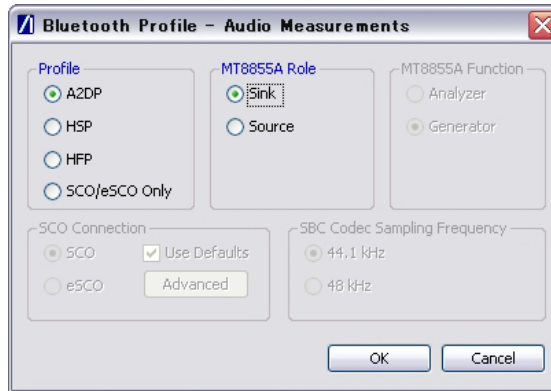
The following points should be observed to ensure that satisfactory measurement results are obtained:

- Note**
- The DUT should be positioned in a shielded acoustic box.
  - The MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.

3. Load the music player with the audio files that will be sent over *Bluetooth* to the MT8855A. The product CD shipped with the MT8855A includes a number of audio tone files that are ideal for this purpose.



4. Configure the *Bluetooth* profile and MT8855A role.
  - a. Click the [Manual Test] tab.
  - b. Set “System Mode” to “*Bluetooth* Audio Measurements”.
  - c. Click  to open the [*Bluetooth* Profile] dialog.



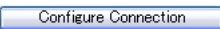
**Figure 14-2.** [*Bluetooth* Profile] Dialog for A2DP Source Testing

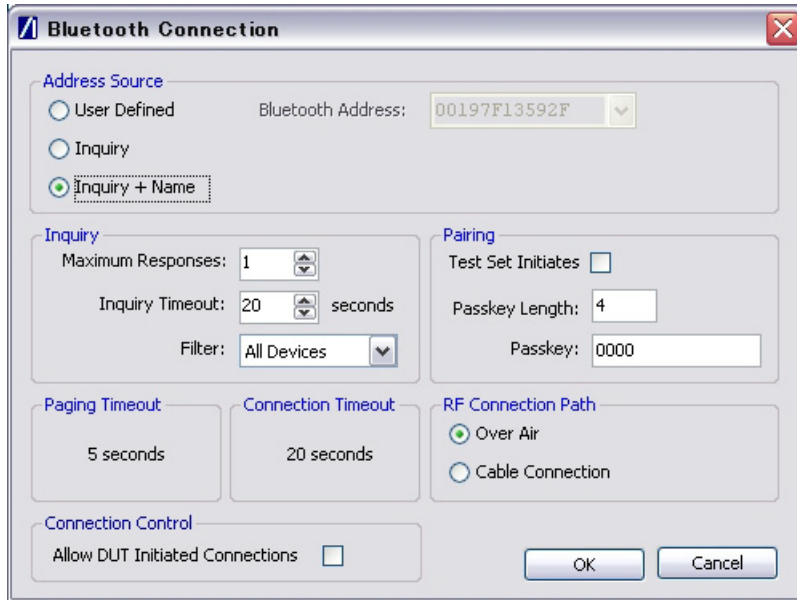
- d. Set “Profile” to “A2DP”. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- e. Set “MT8855A Role” to “Sink”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- f. Click [OK] when complete.

5. Configure a *Bluetooth* connection between the MT8855A and the DUT.

The connection can be initiated from either the DUT or the MT8855A.

To initiate the connection from the DUT

- a. Click  to open the dialog shown below.



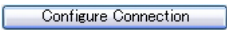
**Figure 14-3.** [Bluetooth Connection] Dialog

- b. At the DUT, set the passkey to match that specified in the dialog above.
- c. Select the “Allow DUT Initiated Connections” check box.
- d. Refer to the DUT manufacturer’s instructions for details of how to initiate a connection.

When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the “Status” field in the status bar changes to “Connected”.

To initiate the connection from the MT8855A.

- a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the DUT manufacturer’s instructions for details.
- b. Set “System Mode” to “*Bluetooth* Audio Measurements”.

- c. Click  to open the dialog shown below.

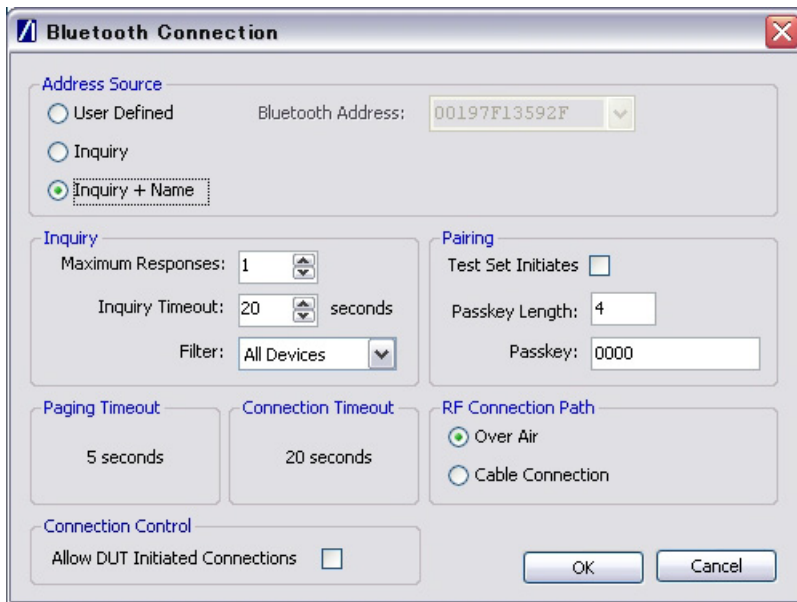


Figure 14-4. [Bluetooth Connection] Dialog

- d. Select the “Address Source” from the three options available.
- Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.


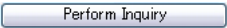
**Note**

The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.

- e. Select or clear the “Test Set Initiates” check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the “Test Set Initiates” check box prevents the tester from initiating pairing.
- f. Enter the “Passkey”. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.

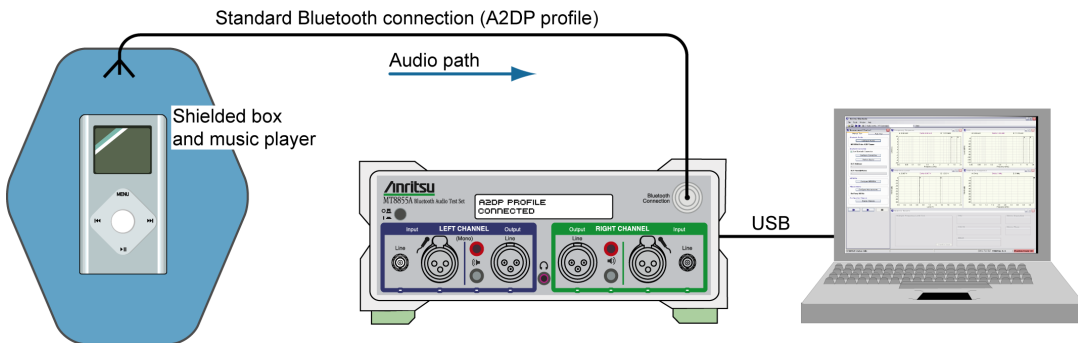
- g. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.
- h. Set the "RF Connection Path" between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5dBm; for cable connections the output power is nominally -40 dBm.

|             |   |
|-------------|---|
| <b>Note</b> | For reliable air connections the DUT should be positioned within 5 meters of the MT8855A. |
|-------------|---|

- i. Click [OK] to close the [Connection Setup] dialog.
- j. Establish the *Bluetooth* connection.
- If "Address Source" was set to a "User Defined" *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If "Address Source" was set to a "Inquiry" or "Inquiry + Name", the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

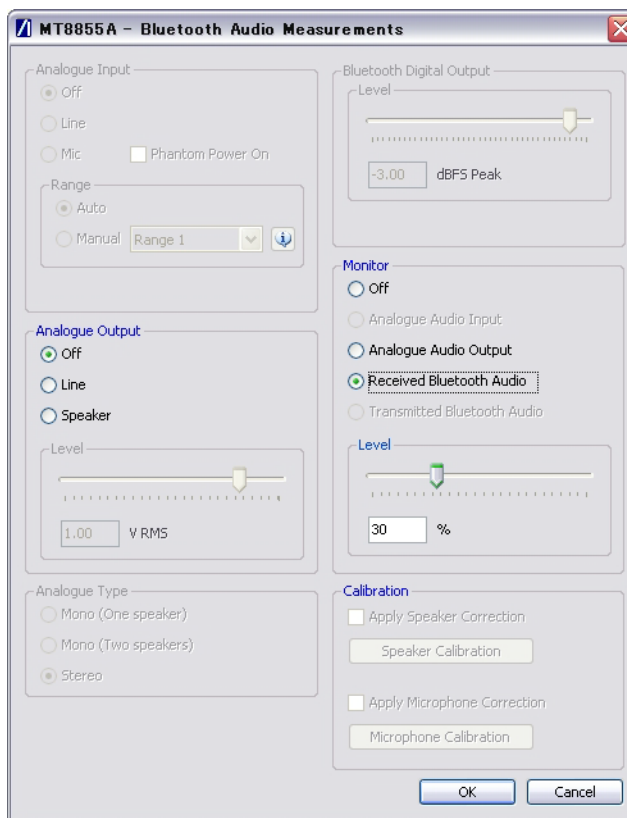
When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the "Status" field in the status bar changes to "Connected".

6. Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.



**Figure 14-5.** Testing an A2DP Source

- a. Click  on the [Manual Test] tab to open the [Configure MT8855A] dialog.



**Figure 14-6.** [MT8855A] Dialog for A2DP Source Testing

- b. Set “Analogue Output” to “Off”. (As seen in the configuration diagram on the previous page, there are no analogue output feeds from the MT8855A.)  
The CD supplied with the MT8855A includes a number of audio tones in MP3 format. These can be copied to the media player and used in testing.
- c. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. Select “Received *Bluetooth* Audio” to hear the RF signal from the music player. The other settings are not applicable to this test.
- d. Set the monitor “Level” setting to the required volume.

**Note** To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.

7. Configure measurements.

- a. Click Configure Measurements on the [Manual Test] tab to open the dialog shown below.

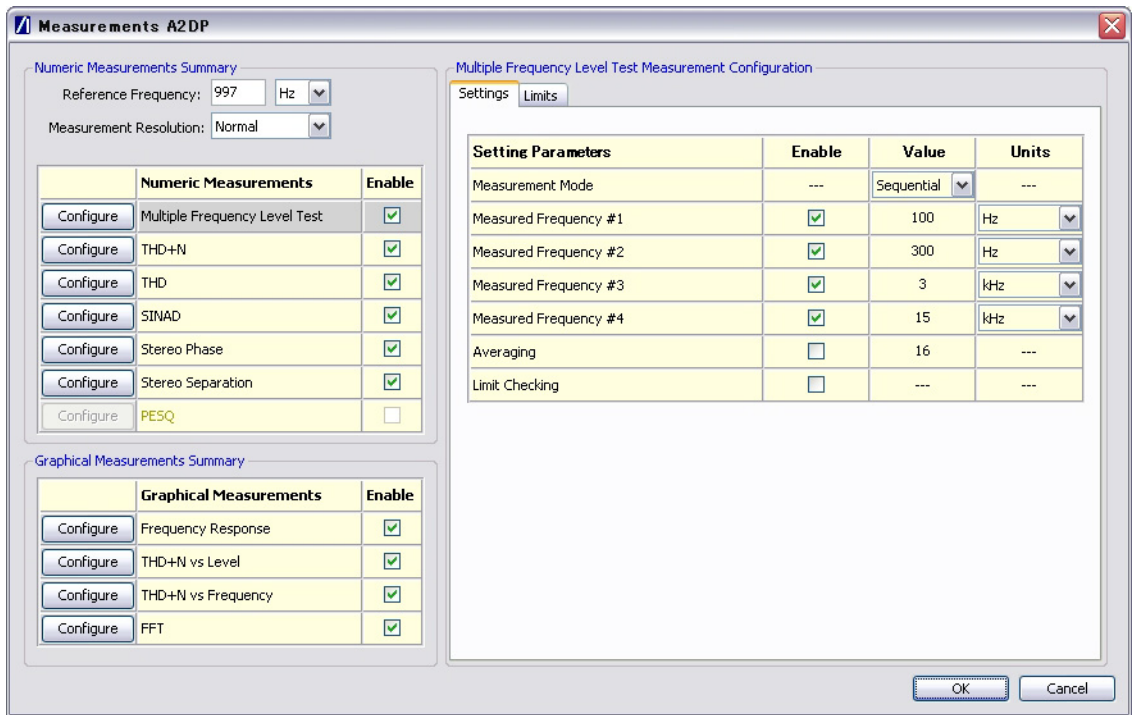


Figure 14-7. [Measurement] Dialog

**b.** Specify the “Reference Frequency”.

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

|             |   |
|-------------|---|
| <b>Note</b> | The multiple frequency level test cannot be performed if using the single-tone audio files supplied by Anritsu. |
|-------------|---|

**c.** Set the “Measurement Resolution”.

"Measurement Resolution" refers to the resolution of the FFT. The “Normal” setting captures 4kbytes of data and the “High” setting captures 8 kilobytes of data. The extra resolution resulting from the “High” setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the “Normal” setting the lowest frequency these measurements can be made at is 300 Hz. The "Measurement Resolution" setting does not have any effect on the multiple frequency level test or the frequency response graph.

**d.** Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

Six measurements display numeric results only, and three display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.

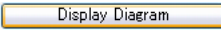
**e.** Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.


| Limit Parameters                        | Lower Limit | Upper Limit | Units |
|---|-------------|-------------|-------|
| Reference Frequency (Source: Bluetooth) | -40         | 0           | dBfs  |
| Measured Frequency #1                   | -40         | 40          | dB    |
| Measured Frequency #2                   | -40         | 40          | dB    |
| Measured Frequency #3                   | -40         | 40          | dB    |
| Measured Frequency #4                   | -40         | 40          | dB    |



**Figure 14-8.** [Limits] Tab

- g. Repeat steps (d) to (f) for each of the measurements to be run.
- h. Click [OK] when complete to close the [Configure Measurements] dialog.
8. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.
9. Use the controls on the music player to play selected audio files.

### 14-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .



## 14-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and all numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

## 14-5 Understanding Test Results

### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for this test. When using the A2DP profile the MT8855A uses the mandated SBC codec for all audio measurements. When interfaced to the MT8855A Line audio connectors with cables, this test will typically show that other tones within the range of 50 Hz to 15 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

### THD+N

For a standard reference tone of 997 Hz, this test will typically show a THD+N measurement of  $> 60$  dB when interfaced to the MT8855A Line audio connectors with cables and using the SBC codec. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical stereo headset using the SBC codec will be  $>30$ dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

### THD

For a standard reference tone of 997 Hz, when interfaced to the MT8855A Line audio connectors with cables, and using the SBC codec, this test will typically show a THD measurement result  $>60$  dB. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD performance of a typical stereo headset using the SBC codec will be 30 to 40 dB. It is less important to shield the test microphone from background noise in the test environment as noise is not included in the THD measurement result.

## Stereo Separation

For a standard reference tone of 997 Hz, when interfaced to the MT8855A using Line audio connectors with cables, typical stereo separation results will be >50 dB.

If the measurement is performed on a stereo headset using two microphones to pick up the audio signal from the DUT speakers, typical results will be >20 dB. The actual measured value for this test is dependent on the quality of the test fixture and its ability to isolate the acoustic signal on the left channel from leaking onto the right channel (and visa versa).

## Stereo Phase

Results for the stereo phase test case should be similar regardless of whether performed using Line inputs or microphones and speakers.

The result of the stereo phase test case does not typically show variations between all products of the same design. The phase is determined by the schematic layout of the DUT's audio circuits and components. A good design will show that stereo phase between left and right channels is <10 degrees and typically around 5 degrees.

If the result is around 180 degrees, this indicates that one of the audio channels has been assembled with the cables reversed. As this is a common assembly mistake, the test is often performed in production specifically to identify this assembly error.

## THD+N vs Level

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise; for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance is dependent on each DUT design.

## THD+N vs Frequency

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 250 Hz to 5 kHz so that an acceptable number of harmonics can be measured. (Note the low frequency limit can be extended to 150Hz if the FFT mode is set to "High".) At 5 kHz, when testing an A2DP device, the number of harmonics measured is limited by the SBC codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.



# Chapter 15 — Testing a *Bluetooth* Stereo Headset: Microphone Input

## 15-1 Test Overview

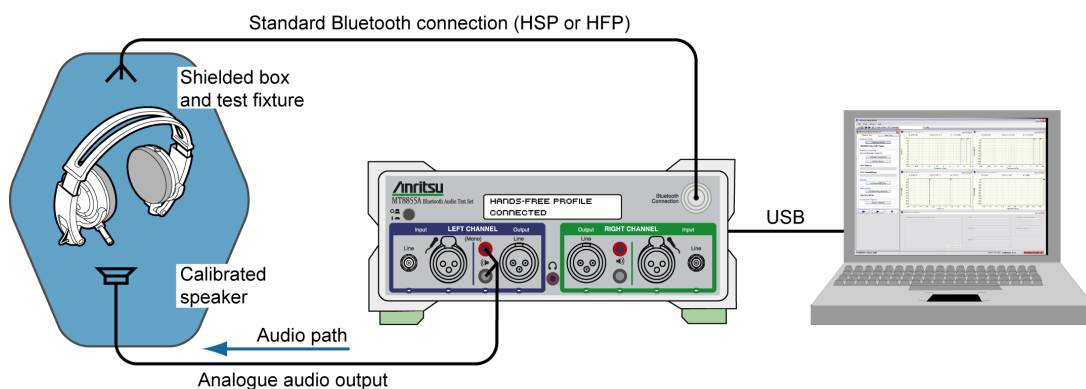
A *Bluetooth* stereo headset is the generic name given to a *Bluetooth* headset capable of automatically switching between A2DP and HSP/HFP profiles for seamless handling of music streams and incoming calls.

The test described in this chapter is used to confirm that an analogue signal can be sent to a the headset, routed through the microphone, codec, and RF, and transmitted over the Hands-free to the MT8855A without distortion.

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 15-2 Preparing to Test

1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.

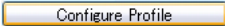


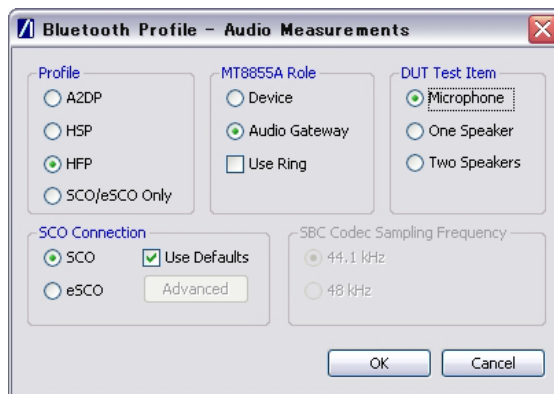
**Figure 15-1.** Testing a *Bluetooth* Stereo Headset: Microphone Input

The following points should be observed to ensure that satisfactory measurement results are obtained:

- Note**
- The DUT should be positioned in a shielded acoustic box.
  - The MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.

3. Configure the *Bluetooth* profile and MT8855A role.

- Click the [Manual Test] tab.
- Set “System Mode” to “*Bluetooth* Audio Measurements”.
- Click  to open the [*Bluetooth* Profile] dialog.



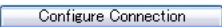
**Figure 15-2.** [*Bluetooth* Profile] Dialog for Ultimate Headset Microphone Testing

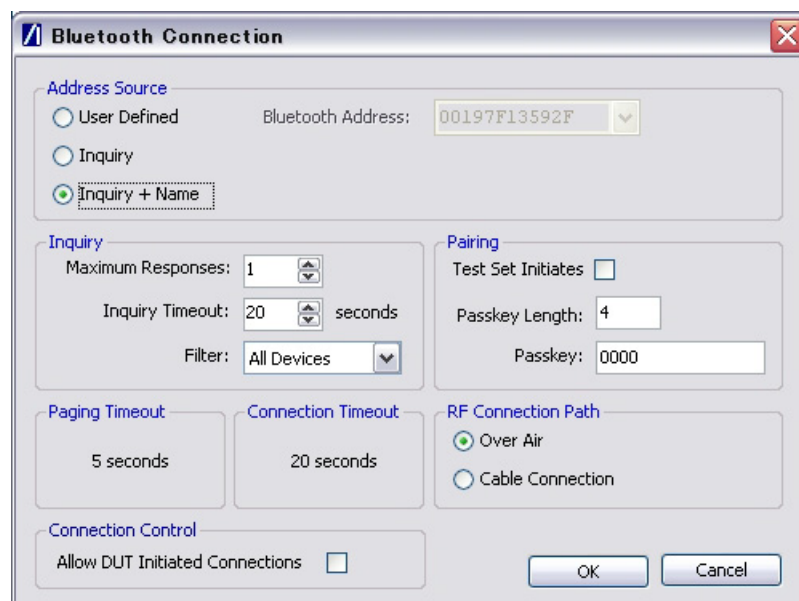
- Set “Profile” to “HFP”. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- Set “MT8855A Role” to “Audio Gateway”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- Select or clear the “Use Ring” check box as required. If the check box is cleared (the default setting), the incoming call is accepted automatically without the user needing to press the call accept button on the headset. If the check box is selected, the user will need to press the call accept button on the headset to accept the call. Selecting the check box would only be required by users specifically wishing to test the functionality of the button on the headset.
- Set “DUT Test Item” to “Microphone”. (As we are testing the analogue signal transmitted from the MT8855A to the headset microphone.)
- Select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.
- Click [OK] when complete.

4. Configure a *Bluetooth* connection between the MT8855A and the DUT.**Note**

After an initial connection has been made, many headsets attempt to reconnect to the same address whenever powered on. The MT8855A is maintained in a permanently discoverable state to allow such connections to succeed.

When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the “Status” field in the status bar changes to “Connected”.

- a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the documentation supplied with the product.
- b. Click  to open the dialog shown below.



**Figure 15-3.** [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.

- Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**

The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.

- d. Select or clear the "Test Set Initiates" check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the "Test Set Initiates" check box prevents the tester from initiating pairing.
- e. Enter the “Passkey”. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.
- f. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.


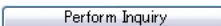
**Note**

As the headset does not have an interface from which a *Bluetooth* connection can be established, the initial connection must always be made from the MT8855A.

- g. Set the “RF Connection Path” between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5 dBm; for cable connections the output power is nominally -40 dBm.

**Note**

For reliable air connections the DUT should be positioned within 5 meters of the MT8855A.

- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
  - If “Address Source” was set to a “User Defined” *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If “Address Source” was set to a “Inquiry” or “Inquiry + Name”, the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the “Status” field in the status bar changes to “Connected”.

5. Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.

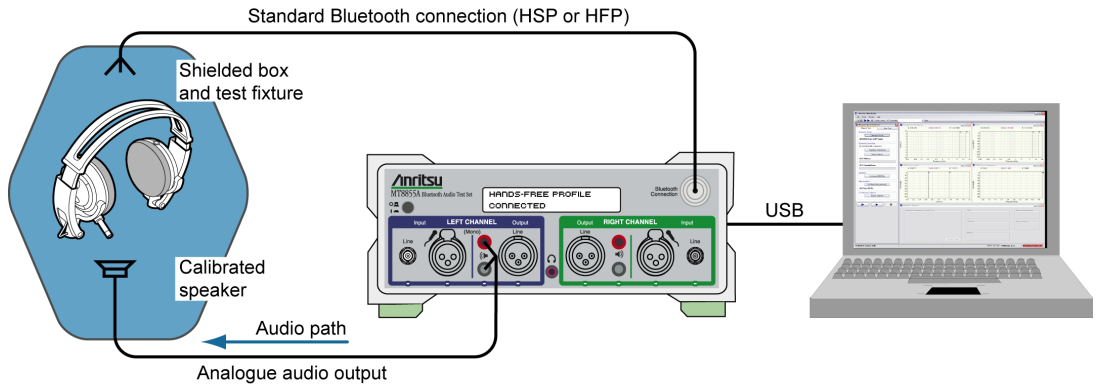


Figure 15-4. Testing a *Bluetooth* Stereo Headset: Microphone Input

- a. Click Configure MT8855A on the [Manual Test] tab to open the [Configure MT8855A] dialog.

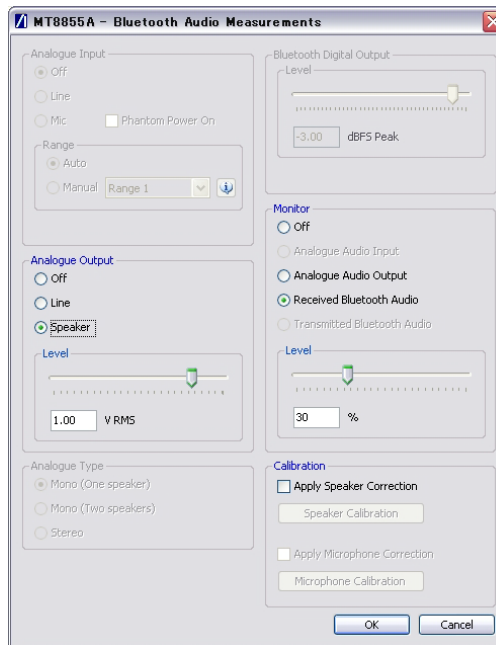


Figure 15-5. [MT8855A] Dialog for Ultimate Headset Microphone to Audio Gateway Testing



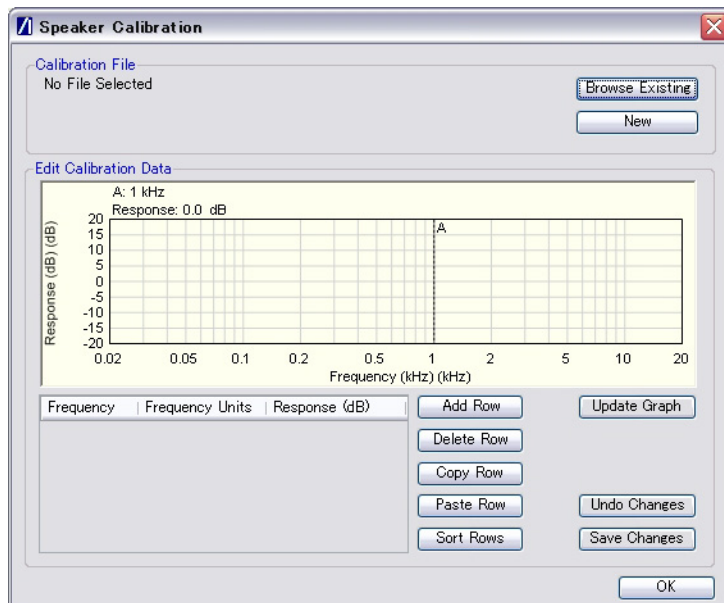
- b. Set “Analogue Output” to “Speaker”. (As seen in the configuration diagram, the left channel speaker output is in use.)
- c. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. Select “Received *Bluetooth* Audio” to hear the RF signal from the headset. Select “Analogue Audio Output” to hear the signal sent from the MT8855A to the DUT.
- d. Set the monitor “Level” setting to the required volume.

When monitoring the signal from a microphone, it may be better to use a headset to avoid audible feedback.

**Note**

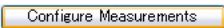
To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.

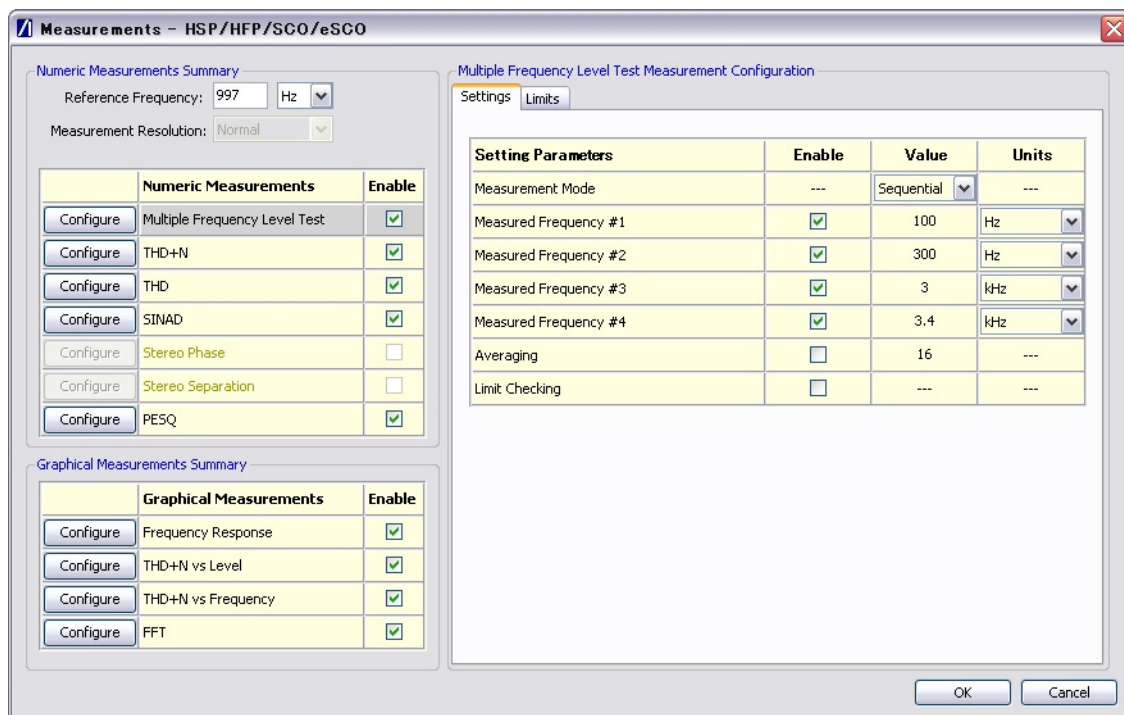
- e. Apply speaker correction if required by the speaker in use. Select “Apply Speaker Correction” and click [Speaker Calibration] to display the dialog below. Correction is used to compensate for the frequency response of the speaker, normalized to the reference frequency. The level result measurement accuracy will be improved if test speaker response calibration data is used. Refer to sections 20-10, 20-11, and 20-16 for details.



**Figure 15-6.** Speaker Calibration

- f. Browse to an existing calibration file or create a new table by adding rows and values as required.

- g. Click [OK] to close the [Speaker Calibration] dialog.
  - h. Click [OK] close the [MT8855A] dialog.
6. Configure measurements.
- a. Click  on the [Manual Test] tab to open the dialog shown below.



**Figure 15-7.** [Measurement] Dialog

- b. Specify the “Reference Frequency”.

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997 Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

- c. Set the “Measurement Resolution”.

"Measurement Resolution" refers to the resolution of the FFT. The “Normal” setting captures 4kbytes of data and the “High” setting captures 8kbytes of data. The extra resolution resulting from the “High” setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the “Normal” setting the lowest frequency these measurements can be made at is 300 Hz. The "Measurement Resolution" setting does not have any effect on the multiple frequency level test or the frequency response graph.

- d. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

Six measurements display numeric results only, and four display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.

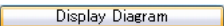
- e. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.


| Limit Parameters                        | Lower Limit | Upper Limit | Units |
|---|-------------|-------------|-------|
| Reference Frequency (Source: Bluetooth) | -40         | 0           | dBFs  |
| Measured Frequency #1                   | -40         | 40          | dBBr  |
| Measured Frequency #2                   | -40         | 40          | dBBr  |
| Measured Frequency #3                   | -40         | 40          | dBBr  |
| Measured Frequency #4                   | -40         | 40          | dBBr  |



Figure 15-8. [Limits] Tab

- g. Repeat steps (d) to (f) for each of the measurements to be run.
  - h. Perform PESQ calibration if PESQ measurements are to be run. Refer to section 20-16 for details.
  - i. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click  to open the [Configuration Diagram] window.
  8. Select “Display Stereo Headset” from the drop-down list in the top left on the window and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.

## 15-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

## 15-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and all numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

## 15-5 Understanding Test Results

### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for these tests. When using the Headset or Hands-free profile that mandates the CVSD codec, a typical device interfaced to the MT8855A Line audio connectors with cables, will show that other tones within the range 300 Hz to 3 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

## THD+N

For a standard reference tone of 997 Hz, this test will typically show a THD+N measurement of > -17 dB when interfaced to the MT8855A Line audio connectors with cables. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical mono headset using the CVSD codec will be -10 to -20 dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

## THD

For a standard reference tone of 997 Hz, when interfaced to the MT8855A Line audio connectors with cables, this test will typically show a THD measurement result of 5 dB better than for THD+N. If the DUT is operating at close to maximum signal level for a CVSD codec, the CVSD codec exhibits non-linear behaviour. Under these conditions THD+N and THD will give similar results because the 3rd harmonic distortion will dominate the measurement result. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices. The result is expected to be better than THD+N as noise is not included in the result. For this reason, use of the THD measurement alone should be treated with caution, as devices exhibiting good THD performance may still exhibit compromised audio performance if the noise performance is poor.

THD is degraded if the DUT has poor linearity. Noise can be added to the audio signal path through noisy amplifiers or poor schematic layout resulting in the pick up of unwanted signals on the audio paths.

When using a microphone and speaker in the test configuration, the THD performance of a typical mono headset using the CVSD codec will be 15 to 20 dB. Background noise in the test environment will not degrade the THD measurement result as significantly as is the case for the THD+N measurement.

## Stereo Separation

This measurement does not apply to measurements made on mono headsets.

## Stereo Phase

This measurement does not apply to measurements made on mono headsets.

## PESQ

PESQ scores lie in the range -0.5 (worst) to +4.5 (best).

When testing a device using cable connections (from RF test port to RF connector, and from the device to the test set audio line input and output), a typical PESQ score would be >4.0.

The score may be reduced if the digital signal level of the audio connection is set to 0 dBFS and the device is optimized for lower digital audio levels. In this case, reduce the digital signal level of the audio sent over the *Bluetooth* connection and repeat the test.

When testing a device using over-the-air connections (from the MT8855A to the device antenna, and acoustic coupling using accessory microphones and speakers to interface to a fully assembled headset), a typical PESQ score would be between 2.7 to 3.7.

The score may be reduced under any of the following conditions:

- If interference from other RF sources results in dropped packets in the *Bluetooth* connection.
- If background noise is picked up by the device or test system microphone.
- If there is frequency response and distortions introduced by the device and test system microphones and speakers.
- If the digital signal level is set above the level that the test device is optimized to receive.

### **THD+N vs Level**

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise, and for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

### **THD+N vs Frequency**

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 300 Hz to 1 kHz so that an acceptable number of harmonics can be measured. At 997 Hz, when testing a CVSD device, the number of harmonics measured is limited by the CVSD codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.



# Chapter 16 — Testing a *Bluetooth* Stereo Headset: Speaker Output

## 16-1 Test Overview

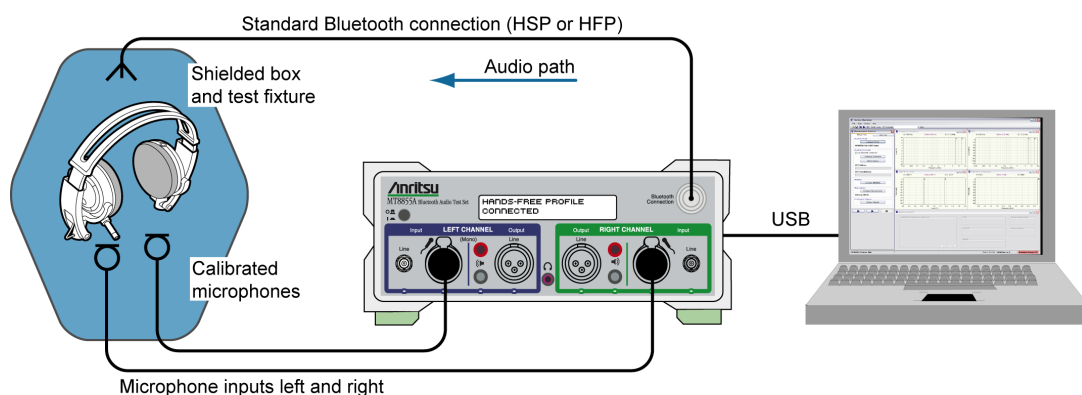
A *Bluetooth* stereo headset is the generic name given to a *Bluetooth* headset capable of automatically switching between A2DP and HSP/HFP profiles for seamless handling of music streams and incoming calls.

The test described in this chapter is used to confirm that an audio signal, transmitted by a MT8855A running the Hands-free or Headset profile, can be sent to a stereo headset, routed through the RF, codec, and amplifier, and output from the speakers without distortion. The output audio tone is picked up by two calibrated microphones and fed back to the MT8855A audio analyzer.

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 17.

## 16-2 Preparing to Test

1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.



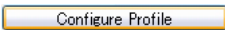
**Figure 16-1.** Testing a *Bluetooth* Stereo Headset: Speaker Output

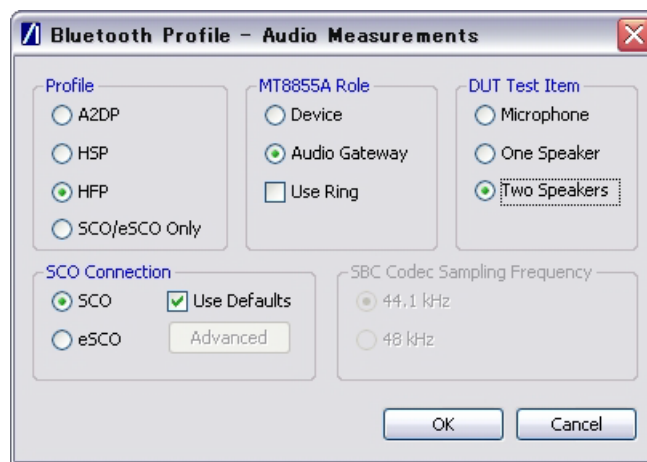


The following points should be observed to ensure that satisfactory measurement results are obtained:

- Note**
- The DUT should be positioned in a shielded acoustic box.
  - The MT8855A should be positioned away from sources of strong magnetic fields, power supplies, and CRT displays.

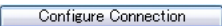
3. Configure the *Bluetooth* profile and MT8855A role.

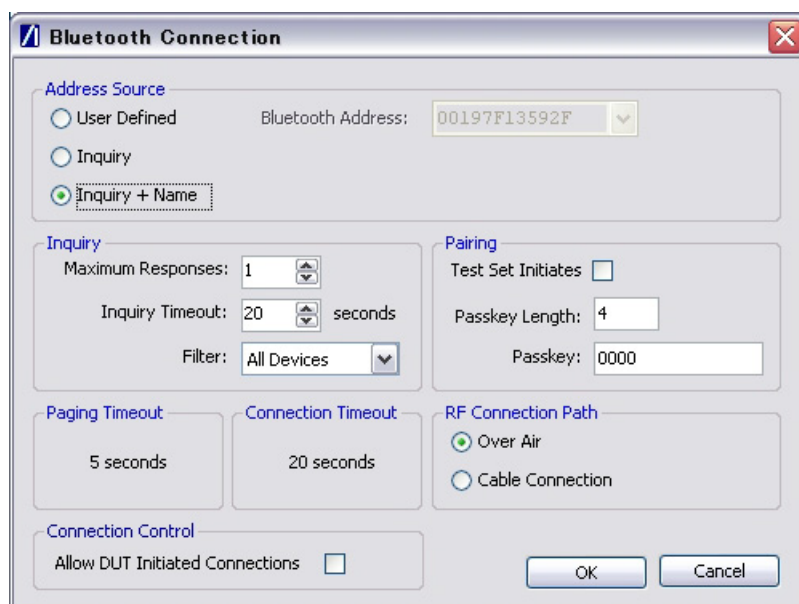
- Click the [Manual Test] tab.
- Set “System Mode” to “*Bluetooth* Audio Measurements”.
- Click  to open the [*Bluetooth* Profile] dialog.



**Figure 16-2.** [*Bluetooth* Profile] Dialog for Ultimate Headset Speaker Testing

- Set “Profile” to “HFP”. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- Set “MT8855A Role” to “Audio Gateway”. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- Select or clear the "Use Ring" check box as required. If the check box is cleared (the default setting), the incoming call is accepted automatically without the user needing to press the call accept button on the headset. If the check box is selected, the user will need to press the call accept button on the headset to accept the call. Selecting the check box would only be required by users specifically wishing to test the functionality of the button on the headset.
- Set “DUT Test Item” to “Two Speakers”. (As we are testing both right and left side speakers.)
- Select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.

- i. Click [OK] when complete.
4. Configure a *Bluetooth* connection between the MT8855A and the DUT.
    - a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the documentation supplied with the product.
    - b. Click  to open the dialog shown below.



**Figure 16-3.** [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**

The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.



- d. Select or clear the "Test Set Initiates" check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the "Test Set Initiates" check box prevents the tester from initiating pairing.

- e. Enter the “Passkey”. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.
- f. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.

**Note** As the headset does not have an interface from which a *Bluetooth* connection can be established, the initial connection must always be made from the MT8855A.

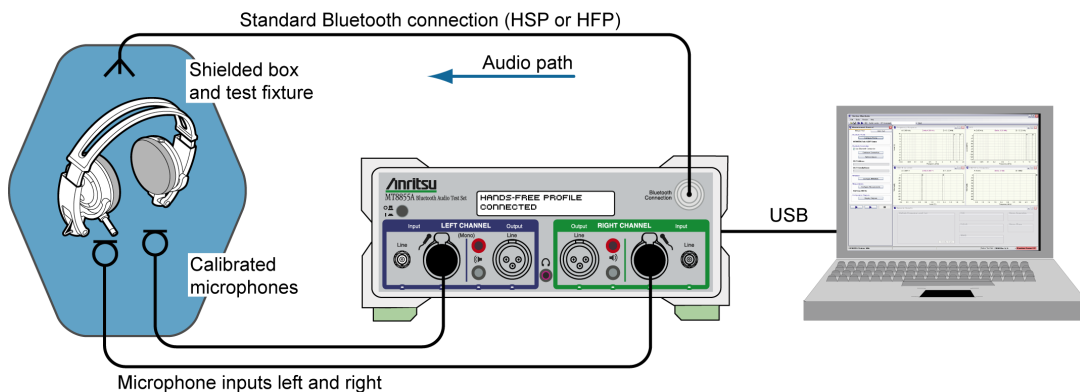
- g. Set the “RF Connection Path” between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5dBm; for cable connections the output power is nominally -40 dBm.

**Note** For reliable air connections the DUT should be positioned within 5 meters of the MT8855A.

- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
  - If “Address Source” was set to a “User Defined” *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If “Address Source” was set to a “Inquiry” or “Inquiry + Name”, the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

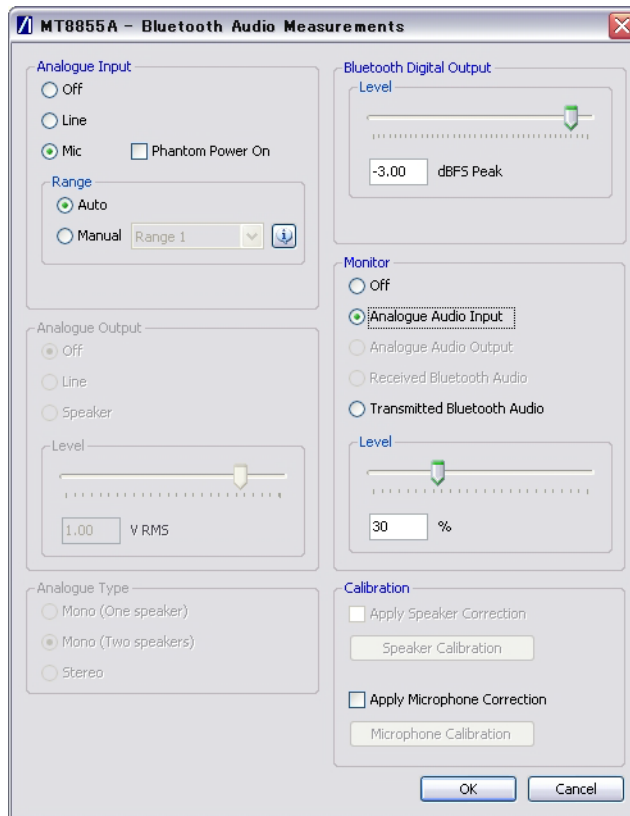
When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the “Status” field in the status bar changes to “Connected”.

5. Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.



**Figure 16-4.** Testing a *Bluetooth* Stereo Headset: Speaker Output

- a. Click  on the [Manual Test] tab to open the [Configure MT8855A] dialog.



**Figure 16-5.** [MT8855A] Dialog for *Bluetooth* Stereo Headset Speaker Testing

- b. Set “Analogue Input” to “Mic”. (As seen in the configuration diagram on the previous page, the microphone cables feed into the left and right channel microphone input socket.)
- c. Select “Phantom Power On” if required by the microphone in use. Phantom power is a 48 V DC supply used to power capacitor-based microphones. Select “Phantom Power On” whenever the external microphone connected to the microphone input of MT8855A requires DC power. If selected, the phantom power indicator on the BlueAudio status bar changes from red to green.

**Note**

Both of the Anritsu microphones available as optional accessories (2000-1607-R and 2000-1608-R) require the use of phantom power.

- d. Set “Range” to “Auto”.

The “Auto” setting is suitable for all normal signals under test. If the signal under test has excessive noise the auto range algorithm on the MT8855A may fail. In this case use of the manual range is required. Refer to section 18-13 for a list of the manual range settings.

- e. Set the "Bluetooth Digital Output".

Use the slider to set the Bluetooth digital output to the maximum signal level that the device under test is designed to receive. This will typically be a value between -3 and -12 dBFS.

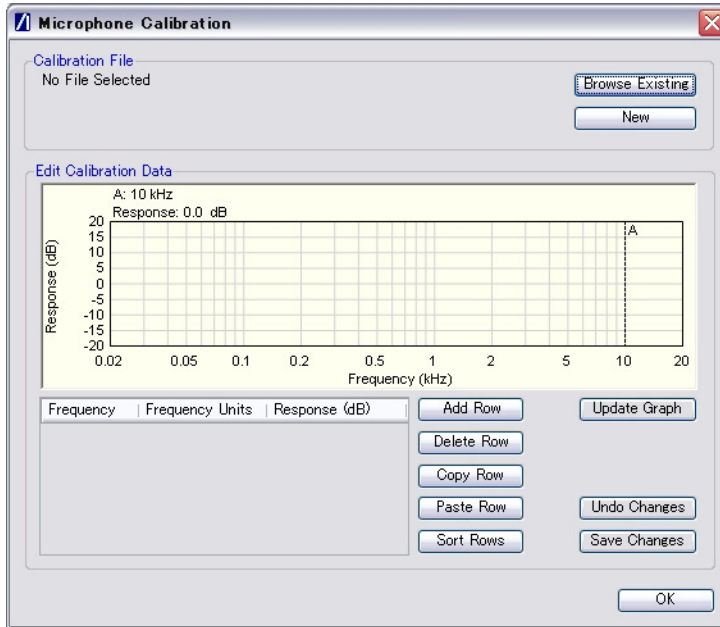
- f. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. Select “Analogue Audio Input” to hear the signal picked up by the microphone. Select “Transmitted *Bluetooth* Audio” to hear the signal relayed over the *Bluetooth* connection from the MT8855A to the DUT.
- g. Set the monitor “Level” setting to the required volume.

When monitoring the signal from a microphone, it may be better to use a headset to avoid audible feedback.

**Note**

To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.


- h. Apply microphone correction if required by the microphone in use. Select “Apply Microphone Correction” and click [Microphone Calibration] to display the dialog below. Correction is used to compensate for the frequency response of the microphone, normalized to the reference frequency. Anritsu microphones are supplied with a calibration curve (see Table 1-2 on page 1-5 for details).



**Figure 16-6.** Microphone Calibration

- i. Browse to an existing calibration file or create a new table by adding rows and values as required.
- j. Click [OK] to close the [Microphone Calibration] dialog.
- k. Click [OK] close the [MT8855A] dialog.

## 6. Configure measurements.

- a. Click  on the [Manual Test] tab to open the dialog shown below.

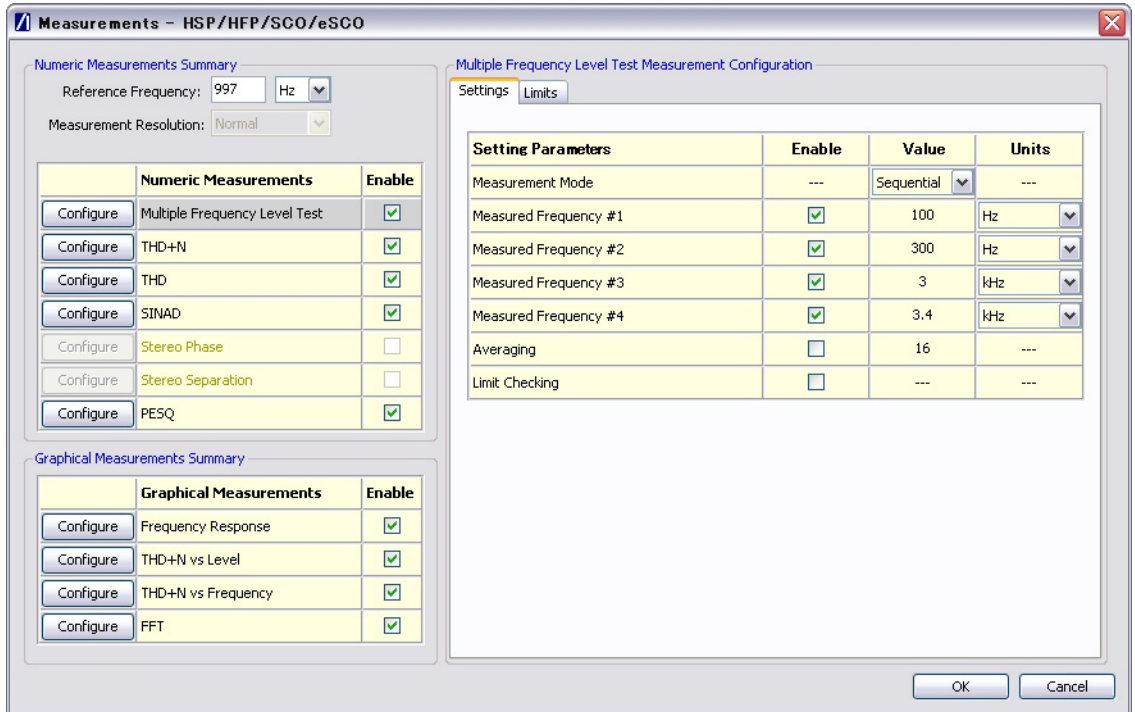


Figure 16-7. [Measurement] Dialog

- b. Specify the "Reference Frequency".

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997 Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.



- c. Set the “Measurement Resolution”.

"Measurement Resolution" refers to the resolution of the FFT. The “Normal” setting captures 4kbytes of data and the “High” setting captures 8kbytes of data. The extra resolution resulting from the “High” setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the “Normal” setting the lowest frequency these measurements can be made at is 300 Hz. The "Measurement Resolution" setting does not have any effect on the multiple frequency level test or the frequency response graph.

- d. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

Six measurements display numeric results only, and three display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.


- e. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.


| Limit Parameters                       | Lower Limit | Upper Limit | Units |
|--|-------------|-------------|-------|
| Reference Frequency (Source: Analogue) | 0.001       | 4           | V     |
| Measured Frequency #1                  | -40         | 40          | dBr   |
| Measured Frequency #2                  | -40         | 40          | dBr   |
| Measured Frequency #3                  | -40         | 40          | dBr   |
| Measured Frequency #4                  | -40         | 40          | dBr   |



Figure 16-8. [Limits] Tab

- g. Repeat steps (d) to (f) for each of the measurements to be run.
  - h. Perform PESQ calibration if PESQ measurements are to be run. Refer to section 20-16 for details.
  - i. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.

## 16-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

## 16-4 Viewing Test Results

Measurement results display at the right side of the BlueAudio interface. Graphical measurements display at the top and all numeric results display in the [Numeric Results] window.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|

## 16-5 Understanding Test Results

### Frequency Response and Multiple Frequency Level Test.

It is standard practice to set the reference frequency to 997 Hz for these tests. When using the Headset or Hands-free profile that mandates the CVSD codec, a typical device interfaced to the MT8855A Line audio connectors with cables, will show that other tones within the range 300 Hz to 3 kHz are  $\pm 3$  dB of the reference tone.

When performing this test using test microphones and speakers, the low frequency response is likely to be limited to  $>500$  Hz by the small physical size of the speaker. This frequency response will also be affected by the mechanical coupling between the speaker and the microphone. For the best low frequency response, the headset speaker should be acoustically coupled with the microphone directly opposite using a custom test fixture. If the speaker is radiating into open space, low frequency response will be lost. It is common to see large variations in the multiple frequency level test or frequency response curves when using microphones and speakers in the test setup. The flatness of the response can be modified by adjusting the distance between the speaker and microphone and by the mechanics of the test fixture used to couple the sound between speaker and microphone.

## THD+N

For a standard reference tone of 997 Hz, this test will typically show a THD+N measurement of > -17 dB when interfaced to the MT8855A Line audio connectors with cables. Actual performance depends on the performance of the audio signal path, amplifiers, and ADC/DAC devices.

When using a microphone and speaker in the test configuration, the THD+N performance of a typical mono headset using the CVSD codec will be -10 to -20 dB. It is important to shield the test microphone from background noise in the test environment as this will significantly degrade the THD+N measurement result.

## THD

For a standard reference tone of 997Hz, when interfaced to the MT8855A Line audio connectors with cables, this test will typically show a THD measurement result of 5 dB better than for THD+N. If the DUT is operating at close to maximum signal level for a CVSD codec, the CVSD codec exhibits non-linear behaviour. Under these conditions THD+N and THD will give similar results because the 3rd harmonic distortion will dominate the measurement result. Actual performance depends on the performance of the audio signal path including amplifiers, and ADC/DAC devices. The result is expected to be better than THD+N as noise is not included in the result. For this reason, use of the THD measurement alone should be treated with caution, as devices exhibiting good THD performance may still exhibit compromised audio performance if the noise performance is poor.

THD is degraded if the DUT has poor linearity. Noise can be added to the audio signal path through noisy amplifiers or poor schematic layout resulting in the pick up of unwanted signals on the audio paths.

When using a microphone and speaker in the test configuration, the THD performance of a typical mono headset using the CVSD codec will be 15 to 20 dB. Background noise in the test environment will not degrade the THD measurement result as significantly as is the case for the THD+N measurement.

## Stereo Separation

This measurement does not apply to measurements made on mono headsets.

## Stereo Phase

Results for the stereo phase test case should be similar regardless of whether performed using Line inputs or microphones and speakers.

The result of the stereo phase test case does not typically show variations between all products of the same design. The phase is determined by the schematic layout of the DUT's audio circuits and components. A good design will show that stereo phase between left and right channels is <10 degrees and typically around 5 degrees.

If the result is around 180 degrees, this indicates that one of the audio channels has been assembled with the cables reversed. As this is a common assembly mistake, the test is often performed in production specifically to identify this assembly error.

## PESQ

PESQ scores lie in the range -0.5 (worst) to +4.5 (best).

When testing a device using cable connections (from RF test port to RF connector, and from the device to the test set audio line input and output), a typical PESQ score would be >4.0.

The score may be reduced if the digital signal level of the audio connection is set to 0 dBFS and the device is optimized for lower digital audio levels. In this case, reduce the digital signal level of the audio sent over the *Bluetooth* connection and repeat the test.

When testing a device using over-the-air connections (from the MT8855A to the device antenna, and acoustic coupling using accessory microphones and speakers to interface to a fully assembled headset), a typical PESQ score would be between 2.7 to 3.7.

The score may be reduced under any of the following conditions:

- If interference from other RF sources results in dropped packets in the *Bluetooth* connection.
- If background noise is picked up by the device or test system microphone.
- If there is frequency response and distortions introduced by the device and test system microphones and speakers.
- If the digital signal level is set above the level that the test device is optimized to receive.

### THD+N vs Level

This test is designed for use during product design evaluation. It graphically displays the usable signal level range of a DUT. For small signal levels, the THD+N will be limited by system noise, and for large signal levels the result will be limited by saturation of the DUT input stages.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.

### THD+N vs Frequency

This test is designed for use during product design evaluation. It graphically displays the distortion within the DUT across a range of audio frequencies. The frequency range is limited to 300 Hz to 1 kHz so that an acceptable number of harmonics can be measured. At 997Hz, when testing a CVSD device, the number of harmonics measured is limited by the CVSD codec to 3.

The actual levels over which a device shows acceptable performance are dependent on each DUT design.



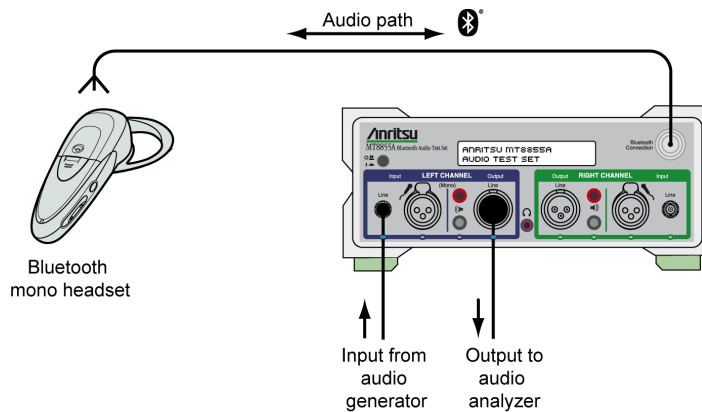
# Chapter 17 — Testing *Bluetooth* Audio Using Pass Through Mode

## 17-1 Test Overview

In pass through mode, the MT8855A acts as a *Bluetooth* transmitter / receiver and all MT8855A audio measurements are turned off. Externally generated analogue signals are supplied through the line input and transmitted over *Bluetooth* to the DUT. Audio transmitted over *Bluetooth* from the DUT to the MT8855A is fed through the line output to an external audio analyzer.

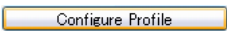
## 17-2 Preparing to Test

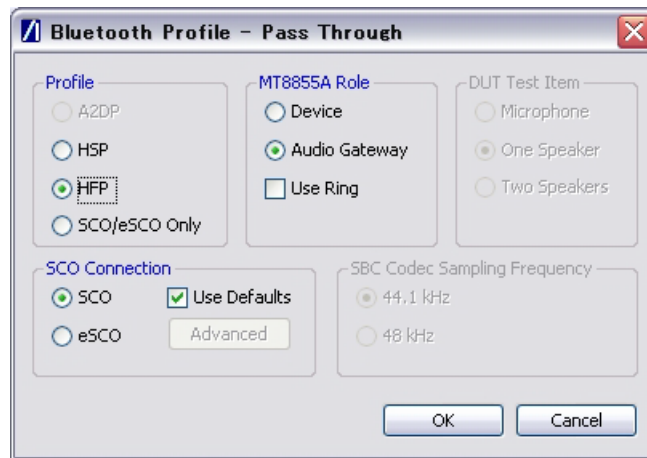
1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.



**Figure 17-1.** *Bluetooth* Pass Through Measurements

3. Configure the *Bluetooth* profile and MT8855A role.
  - a. Click the [Manual Test] tab.
  - b. Set “System Mode” to “*Bluetooth* Pass Through”.

- c. Click  to open the [Bluetooth Profile] dialog.

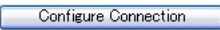


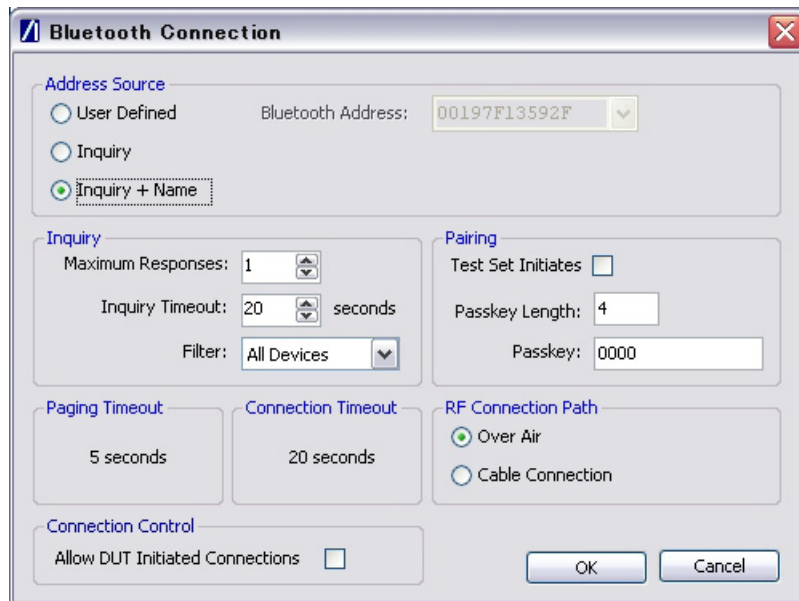
**Figure 17-2.** [Bluetooth Profile] Dialog for Pass Through Mode

- d. Set “Profile” as required. (Refer to chapter 7 for an explanation of the *Bluetooth* profiles.)
- If “Profile” is set to “HSP” or “HFP”, follow steps [e] and [f] below.
  - If “Profile is set to “SCO/eSCO”, jump to step [g] below.
- e. Set “MT8855A Role” to “Audio Gateway” or “Device” as required. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- f. Select or clear the "Use Ring" check box as required. If the check box is cleared (the default setting), the incoming call is accepted automatically without the user needing to press the call accept button on the headset. If the check box is selected, the user will need to press the call accept button on the headset to accept the call. Selecting the check box would only be required by users specifically wishing to test the functionality of the button on the headset.
- g. Select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.

**Note** The “SCO Connection” setting is not applicable if “Profile” is set to “HSP”.

- h. Click [OK] when complete.
4. Configure a *Bluetooth* connection between the MT8855A and the DUT.
- a. Configure the DUT to enable pairing (discoverable mode). The procedure to enable pairing differs depending on the DUT in question. Refer to the documentation supplied with the product.

- b. Click  to open the dialog shown below.



**Figure 17-3.** [Bluetooth Connection] Dialog

- c. Select the “Address Source” from the three options available.
- Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**



The “Maximum Responses”, “Inquiry Timeout”, and “Filter” settings can be used to control the length and extent of the inquiry to match the test environment.

- d. Select or clear the "Test Set Initiates" check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the "Test Set Initiates" check box prevents the tester from initiating pairing.
- e. Enter the “Passkey”. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.



- f. Select or clear the "Allow DUT Initiated Connections" check box as required. After an initial connection, certain DUTs may automatically attempt to re-establish a previous *Bluetooth* connection whenever powered on. Users performing measurements on the same DUT over an extended period may opt to select the "Allow DUT Initiated Connections" check box, allowing the DUT to reconnect in this manner. Alternatively, users performing tests on a number of varying DUTs may find it useful to clear the "Allow DUT Initiated Connections" check box, preventing unwanted connections from DUTs that have previously been connected to the test set.
- g. Set the "RF Connection Path" between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5dBm; for cable connections the output power is nominally -40 dBm.

|             |   |
|-------------|---|
| <b>Note</b> | For reliable air connections the DUT should be positioned within 5 meters of the MT8855A. |
|-------------|---|

- h. Click [OK] to close the [Connection Setup] dialog.
- i. Establish the *Bluetooth* connection.
- If "Address Source" was set to a "User Defined" *Bluetooth* address, the button beneath [Configure Connection] displays as . Click this button to establish a *Bluetooth* link with the specified DUT.
  - If "Address Source" was set to a "Inquiry" or "Inquiry + Name", the button beneath [Configure Connection] displays as . Click this button to display an [Inquiry Results] dialog, select the required DUT and click [Connect].

When a *Bluetooth* connection is successfully established, the DUT address and user friendly name display on the [Manual Test] tab, and the "Status" field in the status bar changes to "Connected".

- Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown again in the figure below.

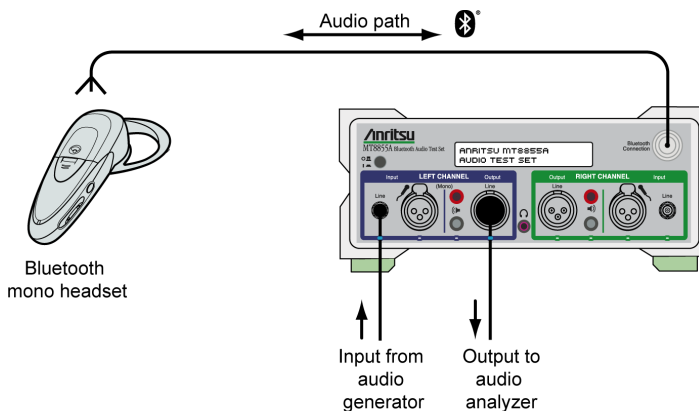


Figure 17-4. Bluetooth Pass Through Measurements

- Click  on the [Manual Test] tab to open the [Configure MT8855A] dialog.

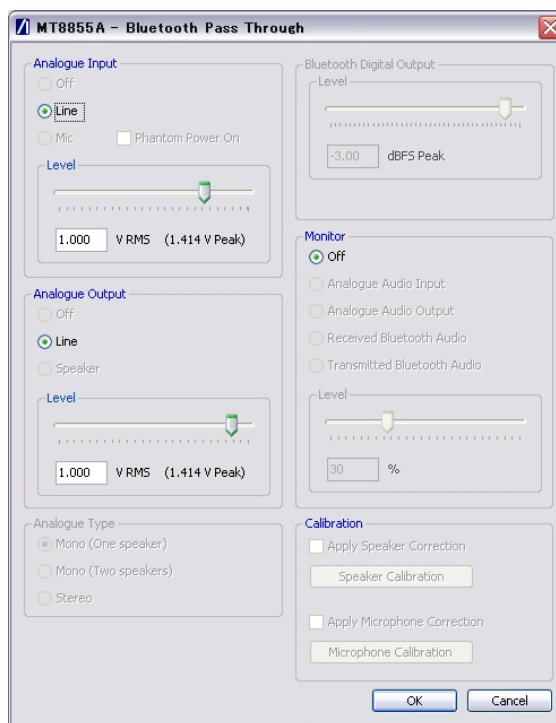
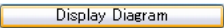



Figure 17-5. [MT8855A] Dialog for Pass Through Testing

- b. In the “Analogue Input” frame select the “Line” input. The “Level” control is used to set the RMS (and peak) voltage that will generate 0 dBFS on the transmitted *Bluetooth* signal from the MT8855A to the DUT.
- c. In the “Analogue Output” frame set the “Line” output level to the RMS (and peak) voltage that will result from a 0 dBFS signal being received over *Bluetooth* from the DUT.

**Note** The voltage set in (c) above is only valid following the calibration procedure described below.

- d. Click [OK] close the [MT8855A] dialog.
6. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.
7. Connect the audio analyzer to the line output of the MT8855A.
8. Click [Calibrate] to adjust the Analogue Output “Level” to match that specified in the “Analogue Output” of the [MT8855A] dialog. The output level must be calibrated before the run button becomes available. If the output level is changed it is necessary to repeat the calibration process.

### 17-3 Preparing for Measurements

Click  to configure the instrument as set in the procedure above. Measurements must be made using external instruments.

# Chapter 18 — Testing Analogue Audio

## 18-1 Test Overview

In addition to its roles as a *Bluetooth* audio test set, the MT8855A can also be used as a stand-alone audio signal generator and analyzer.

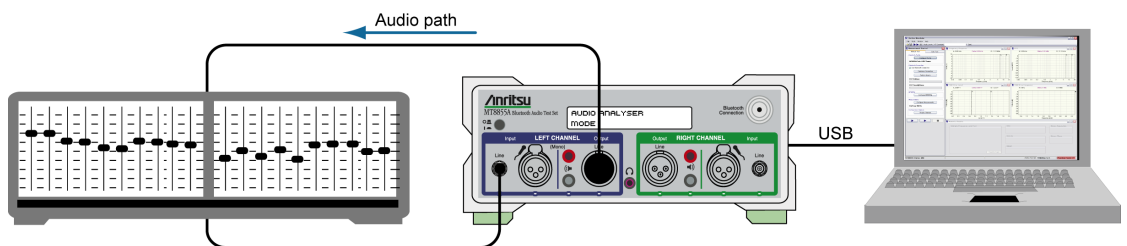
There are a number of configurations that could be used when making measurements on a non-*Bluetooth* signal. A signal could be output from the MT8855A to a calibrated speaker, or a signal input for measurement by means of a line or calibrated microphone.

This chapter describes the procedure for routing a non-*Bluetooth* audio signal through a graphic equalizer and back to the MT8855A for audio analysis.

**Note** This chapter describes the procedures that the user must follow to perform this test from the BlueAudio [Manual Test] tab. Testing can also be performed from the [Auto Test] tab as explained in chapter 19.

## 18-2 Preparing to Test

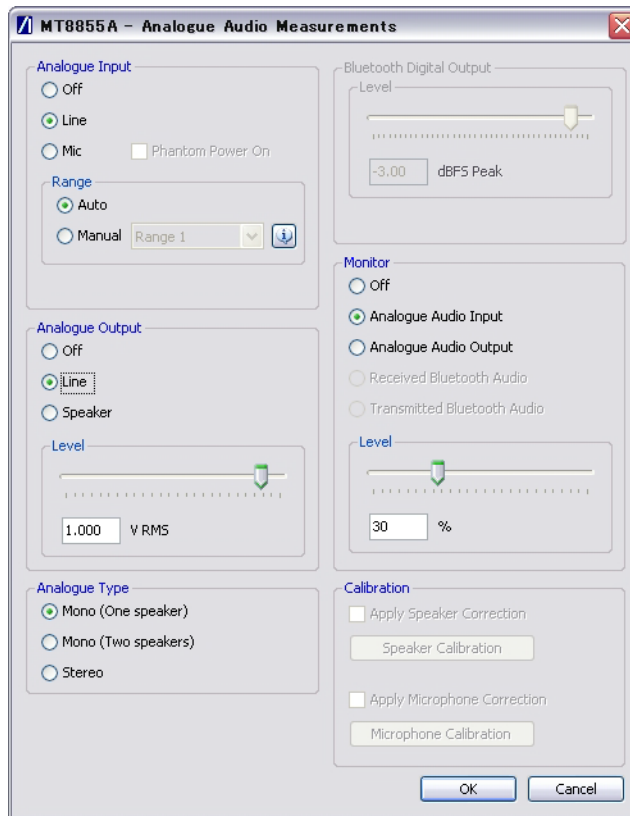
1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment as shown in the example below.
  - a. Set up the equipment as shown in the figure below.
  - b. Turn on all equipment and start BlueAudio.



**Figure 18-1.** Testing Audio without *Bluetooth*

3. Click the [Manual Test] tab.
4. Set “System Mode” to “Analogue Audio Measurements”.
5. Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT as shown on the previous page.

- a. Click  on the [Manual Test] tab to open the [Configure MT8855A] dialog.



**Figure 18-2.** [MT8855A] Dialog for Testing Audio without *Bluetooth*


- b. Set “Analogue Input” to “Line”. (As seen in the configuration diagram on the previous page, the audio signal is fed back to the MT8855A through the left channel line connector.)
- c. Set “Range” to “Auto”.
- d. Set “Analogue Output” to “Line”. (As seen in the configuration diagram, the left channel line out socket is occupied.)
- e. Set “Analogue Type” to “Mono (One speaker)”.
- f. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select whether the output heard from the internal speaker or headset during testing is relayed from the input to, or output from, the MT8855A. In this particular case, select “Analogue Audio Output” to hear the signal from the MT8855A, or select “Analogue Audio Input” to hear the signal from the graphic equalizer.

- g. Set the monitor “Level” setting to the required volume.

**Note** To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.

- h. Click [OK] close the [MT8855A] dialog.

6. Configure measurements.

- a. Click  on the [Manual Test] tab to open the dialog shown below.

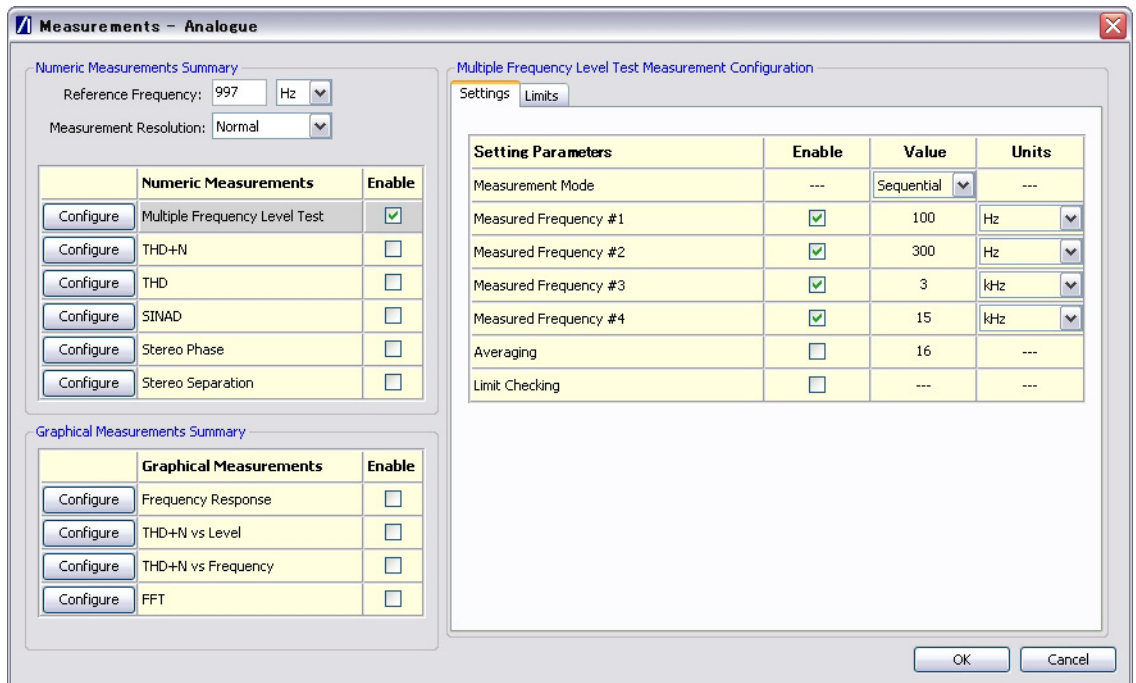


Figure 18-3. [Measurement] Dialog

- b. Specify the “Reference Frequency”.

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997 Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

- c. Set the “Measurement Resolution”.

"Measurement Resolution" refers to the resolution of the FFT. The “Normal” setting captures 4 kilobytes of data and the “High” setting captures 8 kilobytes of data. The extra resolution resulting from the “High” setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the “Normal” setting the lowest frequency these measurements can be made at is 300 Hz. The "Measurement Resolution" setting does not have any effect on the multiple frequency level test or the frequency response graph.

- d. Select the first measurement to be run by clicking the enable check box to the right of the measurement name.

Six measurements display numeric results only, and three display graphical results.

When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.


- e. Configure the measurement as required by enabling and entering values on the [Settings] tabbed page.

The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.


| Limit Parameters                       | Lower Limit | Upper Limit | Units |
|--|-------------|-------------|-------|
| Reference Frequency (Source: Analogue) | 0.001       | 4           | V     |
| Measured Frequency #1                  | -40         | 40          | dBr   |
| Measured Frequency #2                  | -40         | 40          | dBr   |
| Measured Frequency #3                  | -40         | 40          | dBr   |
| Measured Frequency #4                  | -40         | 40          | dBr   |



Figure 18-4. [Limits] Tab

- g. Click [OK] when complete to close the [Configure Measurements] dialog.
7. Click  and check that the actual configuration of the equipment matches the configuration shown in the figure. If the configurations do not match, check that the MT8855A role and configuration settings are correct for the required application.

### 18-3 Running Tests

Click either of the run buttons to commence measurement.

Click  to execute the specified measurements once.

Click  to execute the specified measurements in a continuous loop until the stopped by clicking .

### 18-4 Viewing Test Results

The audio signal looped back from the graphic equalizer displays in the [Frequency Response] window. Changes made to the controls on the graphic equalizer are immediately plotted on the frequency response trace.

|   |
|---|
| <b>Note</b> Refer to chapter 20 for details of saving, printing, and manipulating data. |
|---|





# Chapter 19 — Auto Testing

## 19-1 Auto Testing Overview

**Note**

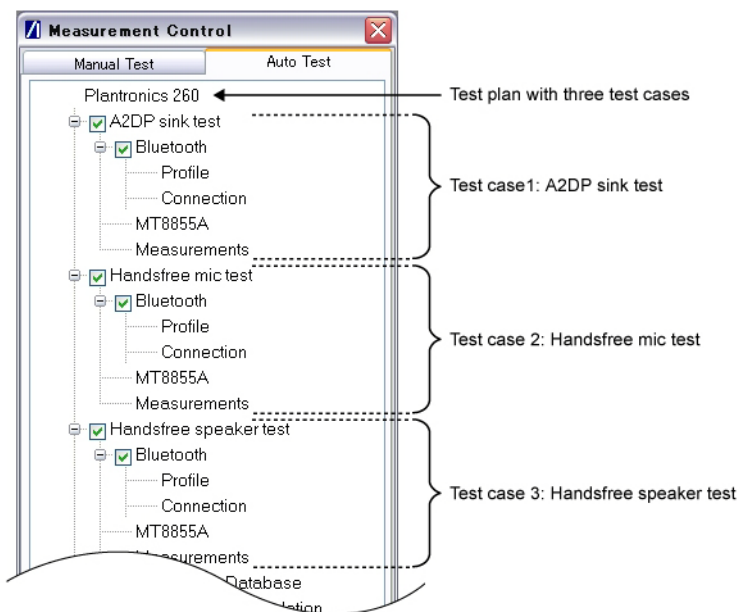
Auto Testing is not available if the “System Mode” setting on the [Manual Test] tab is set to “Bluetooth Pass Through”.

In addition to configuring measurements from the [Manual Test] tab, BlueAudio also provides an [Auto Test] tab from which the user can define and save a “Test Plan” of multiple measurements groupings.

Each test plan comprises multiple component sections known as “Test Cases”. Each test case comprises between one and six audio measurements. Once defined, test plans can be saved, recalled, and modified whenever required.

The *Bluetooth* profile, the MT8855A configuration, and the measurements to be executed can be defined independently within each of the component test cases. Once configured, the entire test plan, or any of the component parts, can then be executed with no further interaction from the user.

If, for example, the user were testing a multi-profile headset, a test plan could be created with three component test cases: a first to test the A2DP sink, a second to test the microphone after switching to Handsfree profile, and a third to test the headset speaker. This structure is shown in the figure below.



**Figure 19-1.** Test Plan With Three Test Cases

## 19-2 Creating a Test Plan

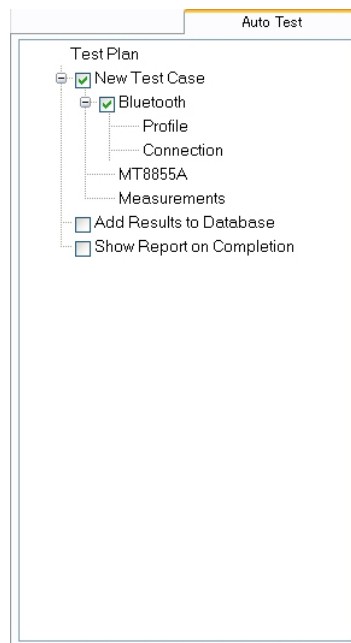
1. Install BlueAudio and the associated USB driver as detailed in chapter 4.
2. Configure the equipment as required.

**Note**

If, as in the figure on the previous page, the test plan includes test cases to measure the performance of differing aspects of the DUT, the user must ensure that the MT8855A and the DUT are preconfigured to enable all measurements. In the example of a multi-profile stereo headset, this would necessitate setting up audio inputs for the microphone, and an audio outputs for the speaker. Failure to have the equipment preconfigured in this manner will result in incomplete or erroneous results for the test case in question.

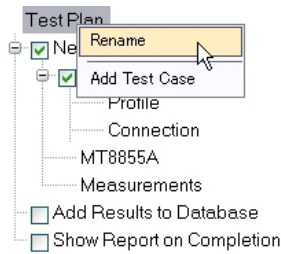
Full details of the configurations required for each specific type of audio testing are provided in chapters 9 to 18.

3. Turn on the PC, MT8855A, and the DUT.
4. Start BlueAudio by double-clicking the “BlueAudio” icon generated on the desktop during installation, or by accessing the Windows programs directory and selecting [Anritsu] > [BlueAudio].
5. If multiple MT8855A test sets are connected to the PC running BlueAudio, select the test set from the status bar on the main [Anritsu BlueAudio] window. Refer to page 20-1, “*Active Test Set - Selecting*” for further details.
6. Click the [Auto Test] tab. The [Auto Test] tabbed page displays as shown in the figure below.



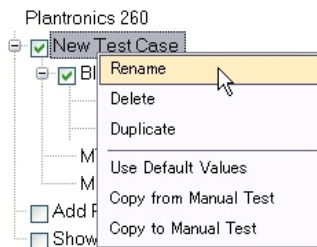
**Figure 19-2.** [Auto Test] Tab

7. Right-click “Test Plan”, select [Rename] from the pop-up menu, and assign an appropriate name.



**Figure 19-3.** Rename Test Plan

8. Right-click “New Test Case”, select [Rename] from the pop-up menu, and assign an appropriate name.



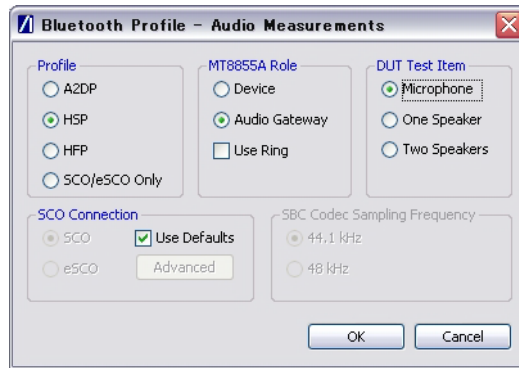
**Figure 19-4.** Rename Test Case

9. Configure the test case as required. This can be performed in two ways:
  - Manually, by following steps 10 to 14 below.
  - Automatically, by right-clicking the test case name and selecting [Copy from Manual Test] from the pop-up menu. The test case is populated with the settings configured at the time on the [Manual Test] tab. Jump to step 15 in this procedure.
10. Select or clear the “Bluetooth” check box as required. A check mark (✓) displays in the box to indicate that *Bluetooth* is selected for use.

|             |  |
|-------------|--|
| <b>Note</b> | Removing the check mark is required only if wanting to define a test case within which the audio generator and analyzer are used to make measurements on a non- <i>Bluetooth</i> audio signal. |
|-------------|--|

11. Configure the *Bluetooth* profile for the new test case.

- a. Double click [Profile] in the test plan tree to open the [*Bluetooth* Profile] dialog shown below. This dialog can also be opened by right-clicking [Profile] and selecting [Configure] from the pop-up menu.



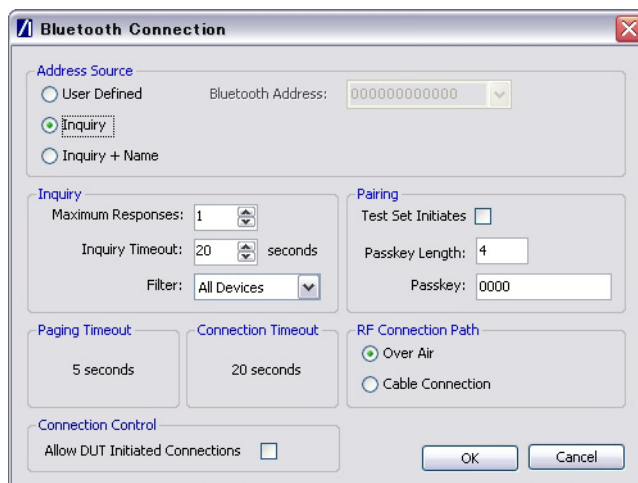
**Figure 19-5.** [*Bluetooth* Profile] Dialog

- b. Set the “Profile” as required. (Refer to chapter 6 for an explanation of the *Bluetooth* profiles.)
- c. Set the “MT8855A Role” as required. (Refer to chapter 6 for an explanation of the MT8855A role settings.)
- d. If applicable, set “DUT Test Item“ (or “MT8855A Function”) as required.
- e. For HFP or HSP profiles, select the required “SCO Connection”. The MT8855A defaults to SCO using HV3 packets. The packet type can be changed by clearing the “Use Defaults” check box, clicking [Advanced] and selecting a different setting. All SCO packet types are defined in Appendix D.
- f. Click [OK] when complete.

**Note**

Refer to chapters 9 to 18 for details of the configurations required for each specific type of audio testing.

12. Configure a *Bluetooth* connection between the MT8855A and the DUT.
- Double click [Connection] in the test plan tree to open the [Connection Setup] dialog shown below. This dialog can also be opened by right-clicking [Connection] and selecting [Configure] from the pop-up menu.



**Figure 19-6.** [Bluetooth Connection] Dialog

- Select the “Address Source” from the three options available.
  - Select “User Defined” to enter a known *Bluetooth* address directly into the entry field, or select a previously used address from the drop-down list.
  - Select “Inquiry” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices.
  - Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available.

**Note**

When testing in Auto Test mode, the "Address Source" should be set only after giving careful consideration to the following points:

Selecting "User Defined" will necessitate that the user change the *Bluetooth* address each time that the test case is run on a different DUT. This will be time-consuming when using the test case on multiple, differing products.

The "Inquiry" or "Inquiry + Name" settings are more suitable for Auto Mode, but, as "Maximum Responses" is limited to 1 in Auto Mode, these should only be used if the user is confident that the first device to respond will be the device upon which tests are to be conducted. This will not be a problem if using a cable connection or positioning the DUT in a shielded enclosure.

- Select or clear the "Test Set Initiates" check box as required. Some devices operate smoothly only if they initiate the pairing process. Clearing the "Test Set Initiates" check box prevents the tester from initiating pairing.

- d. Enter the “Passkey” to match that of the DUT. Connection with the DUT will be rejected unless the correct passkey specified. The passkey is typically “0000” but this may differ depending on the DUT in question. Refer to the documentation supplied with the product.
- e. Clear the “Allow DUT Initiated Connections” check box.

**Note** Auto Test does not support DUT initiated connections.

- f. Set the “RF Connection Path” between the MT8855A and the DUT. Select either a cable or air connection to match the instrument configuration. For air connections, connect a suitable antenna to the MT8855A *Bluetooth* connector port. Anritsu provide a 2.4 GHz antenna and adaptor as an optional accessory (option number 2000-1613-R). For air connections, the output power of the MT8855A transmitter is nominally -5dBm; for cable connections the output power is nominally -40dBm.

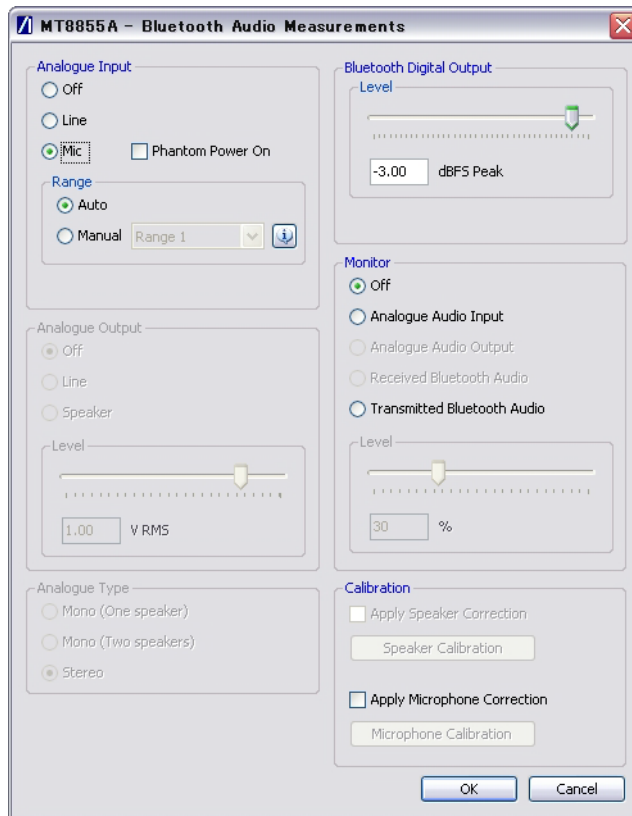
**Note** For reliable air connections the DUT should be positioned within 5 meters of the MT8855A.

- g. Click [OK] to close the [Connection Setup] dialog.

13. Configure the MT8855A settings within BlueAudio to match the physical configuration of the MT8855A and DUT.

**Note** Refer to chapters 9 to 18 for details of the configurations required for each specific type of audio testing

- a. Double click [MT8855A] in the test plan tree to open the [MT8855A] dialog shown below. This dialog can also be opened by right-clicking [MT8855A] and selecting [Configure] from the pop-up menu



**Figure 19-7.** [Configure MT8855A] Dialog.

- b. Set “Analogue Input” as required to match the feeds into the MT8855A for the test in question.
- c. Select “Phantom Power On” if required by the microphone in use. Phantom power is a 48 V DC supply used to power capacitor-based microphones. Select “Phantom Power On” whenever the external microphone connected to the microphone input of MT8855A requires DC power. If selected, the phantom power indicator on the BlueAudio status bar changes from red to green.

**Note**

Both of the Anritsu microphones available as optional accessories (2000-1607-R and 2000-1608-R) require the use of phantom power.

- d. Set “Range” to “Auto”.



The “Auto” setting is suitable for all normal signals under test. If the signal under test has excessive noise the auto range algorithm on the MT8855A may fail. In this case use of the manual range is required. Refer to section 18-13 for a list of the manual range settings.

- e. Set “Analogue Output” as required to match the feeds out of the MT8855A for the test in question.
- f. Set the "Bluetooth Digital Output".  
Use the slider to set the Bluetooth digital output to the maximum signal level that the device under test is designed to receive. This will typically be a value between -3 and -12 dBFS.
- g. Select the required “Monitor” setting. The monitor setting does not affect the outcome of the selected measurements. It allows the user to select what, if anything, is heard from the internal speaker or headset during testing.
- h. Set the monitor “Level” setting to the required volume.

When monitoring the signal from a microphone, it may be better to use a headset to avoid audible feedback.

**Note**

To avoid hearing damage, care should be taken if using a headset to listen to the monitored signal. Set the monitor level to a low value before adjusting to a comfortable level for the headset in use.

- i. Apply speaker or microphone correction if required. Correction is used to compensate for gain or loss relative to the ideal reference.
  - j. Click [OK] close the [MT8855A] dialog.
14. Select and configure the measurements to be included in the test case.

- a. Double click [Measurements] in the test plan tree to open the [Measurements] dialog shown below. This dialog can also be opened by right-clicking [Measurements] and selecting [Configure] from the pop-up menu.

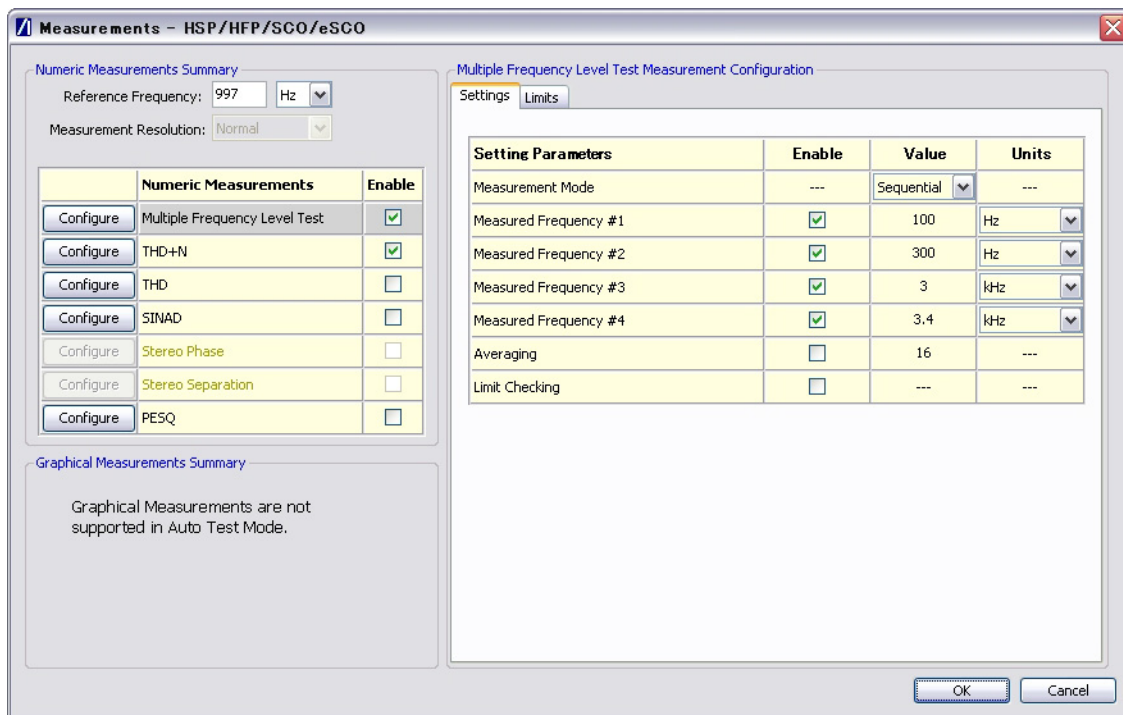


Figure 19-8. [Measurement] Dialog

**b.** Specify the “Reference Frequency”.

The "Reference Frequency" is the frequency at which all the measurements are made. It is also the reference frequency used for the multiple frequency level test and frequency response graph. The default value is set as 997 Hz. This is the frequency specified by the Audio Engineering Society in their standard AES17 for test instruments. 997 Hz is selected in relation to the standard sampling frequencies (8kHz for CVSD, 44.1 kHz and 48 kHz for the SBC codec) so that sampling in successive cycles occurs at different phases of the audio tone. It ensures that an ADC or DAC is fully exercised because it is not harmonically related to the sampling rates. If, for example, a 1 kHz sine wave is sampled at 48 kHz it will be sampled at the same 48 phases of the sine wave in each cycle.

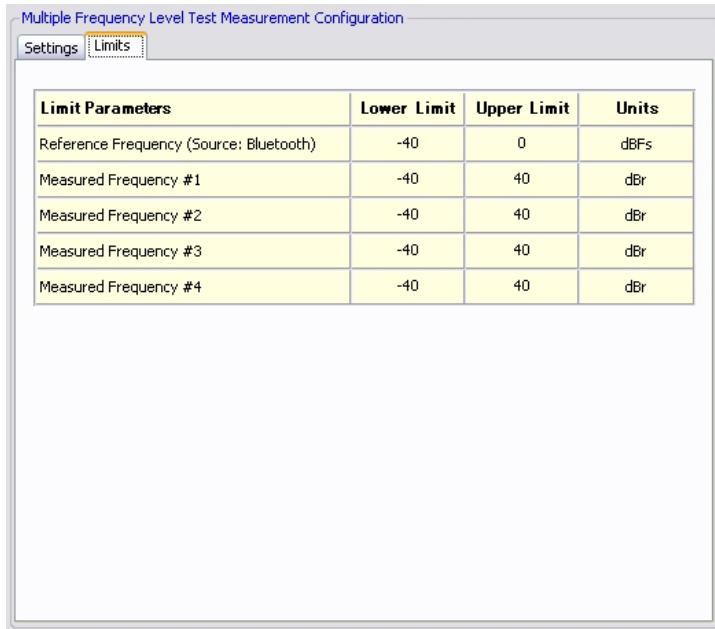
**c.** Set the “Measurement Resolution”.

"Measurement Resolution" refers to the resolution of the FFT. The “Normal” setting captures 4kbytes of data and the “High” setting captures 8kbytes of data. The extra resolution resulting from the “High” setting enables THD+N, THD, SINAD, stereo separation, and stereo phase measurements to be made from 150 Hz to 20 kHz. At the “Normal” setting the lowest frequency these measurements can be made at is 300 Hz. The "Measurement Resolution" setting does not have any effect on the multiple frequency level test or the frequency response graph.

**d.** Select the first measurement to be run by clicking the enable check box to the right of the measurement name. When the check box is selected a check mark (✓) appears within the box to denote that it has been selected.**e.** Configure the measurement as required by entering values on the [Settings] tabbed page.

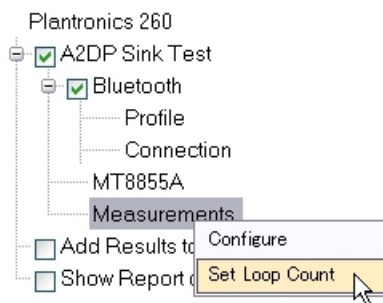
The settings for the measurement in question display automatically when a measurement is selected. They can also be displayed by clicking the [Configure] button to the left of each measurement.

- f. Click the [Limits] tab and specify the associated limits as required by the measurement. The specified limits are checked when the “Limit Checking” item on the [Settings] tab is selected.



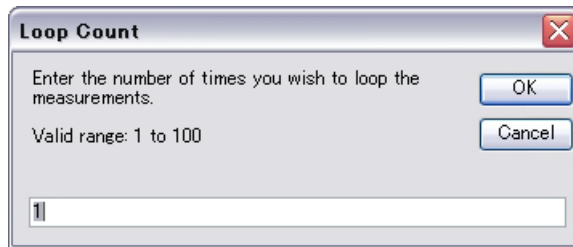
**Figure 19-9.** [Limits] Tab

- g. Repeat steps (d) to (f) for each of the measurements to be run.
- h. Perform PESQ calibration if PESQ measurements are to be run. Refer to section 20-16 for details.
- i. Click [OK] when complete to close the [Configure Measurements] dialog.
- j. If wishing to perform each of the measurements more than once, right-click “Measurements” and select [Set Loop Count] from the pop-up menu.



**Figure 19-10.** Set Loop Count

- k. The [Loop Count] dialog allows the user to specify the number of times that the measurements selected in the [Measurements] dialog will be performed on the current DUT.

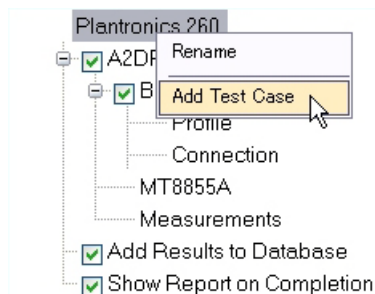


**Figure 19-11.** [Loop Count] Dialog

15. Add additional test cases to the test plan as required. Any number of test cases can be added and, presuming that the instrumentation is configured accordingly, each can be configured with differing profile, configuration, and measurement settings. Additional test cases can be added using either of the methods outline below.

Method 1:

- a. Right-click the test plan name and select [Add Test Case] from the pop-up menu. A second test case, titled “New Test Case, is added to the test plan.

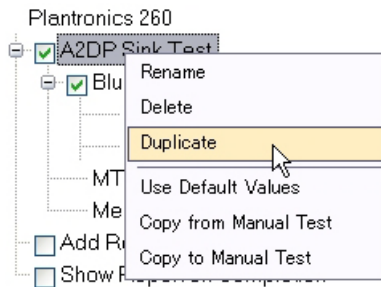


**Figure 19-12.** Add Test Case

- b. Rename the new test case as explained earlier in this procedure.

Method 2:

- a. Right-click the existing test case and select [Duplicate] from the pop-up menu. A duplicate of the original test case is generated in the test plan tree with an incremented number in parenthesis after the test case name.



**Figure 19-13.** Duplicate a Test Case

- b. Rename the new test plan as explained earlier in this procedure
- 16.** Configure the new test case(s) as required. This can be performed in three ways:
- By manually specifying or editing the settings as explained previously in steps 9 to 14.
  - By right-clicking the test case name and selecting [Copy from Manual Test] from the pop-up menu. The test case is populated with the settings configured on the [Manual Test] tab.

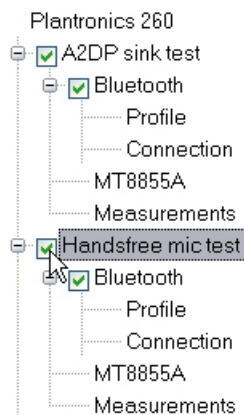
- By right-clicking the test case name and selecting [Use Default Values] from the pop-up menu. The test case is populated with the default values as defined in Appendix B of this manual.

The following points should be noted when configuring subsequent test cases within the test plan:

**Note**

- The “Bluetooth” check box can be selected or cleared for each test case independently.
- The “Connection” branch within any of the test cases can be double-clicked to open the [Bluetooth Connection] dialog. Unlike the other branches of the test case, the Bluetooth Connection settings cannot be configured independently for each test case. The most recently made settings are applied automatically to all test cases in the test plan.
- To ensure that the status of the DUT is always clearly defined, the Bluetooth connection is always broken and then re-established between consecutive (Bluetooth configured) test cases in the test plan.
- The settings within the [MT8855A] dialog can be configured independently for each test case within the test plan. It should however be noted that these settings must reflect the physical setup (audio inputs and outputs) of the MT8855A and the DUT. When executing a test plan comprising of multiple test cases with different settings, the MT8855A and DUT must be configured to meet the requirements of each test case before executing the test plan. Failure to have the equipment pre-configured in this manner will result in erroneous results for the test case in question.

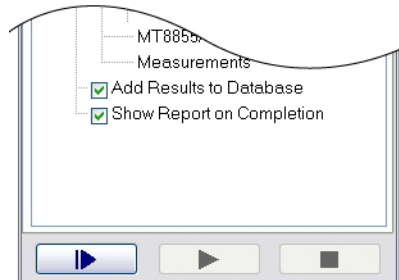
17. Select all test cases to be executed when the test plan is run. The main branch of each test case carries a check box that must be selected as shown in the figure below. Only the selected test cases are included in the test plan.



**Figure 19-14.** Select Test Cases

18. Select or clear the “Add Results To Database” check box as required. If the check box is selected (as shown in Figure 17-15), a report of the test plan results is added to the database. The results database can be viewed at any time by selecting [Report Database...] from the [Tools] menu. An explanation of how to use the database to filter and view the reports is provided in chapter 18.

19. Select or clear the “Show Report On Completion” check box as required. If the check box is selected (as shown in Figure 17-15), the report displays automatically when the test plan is complete.




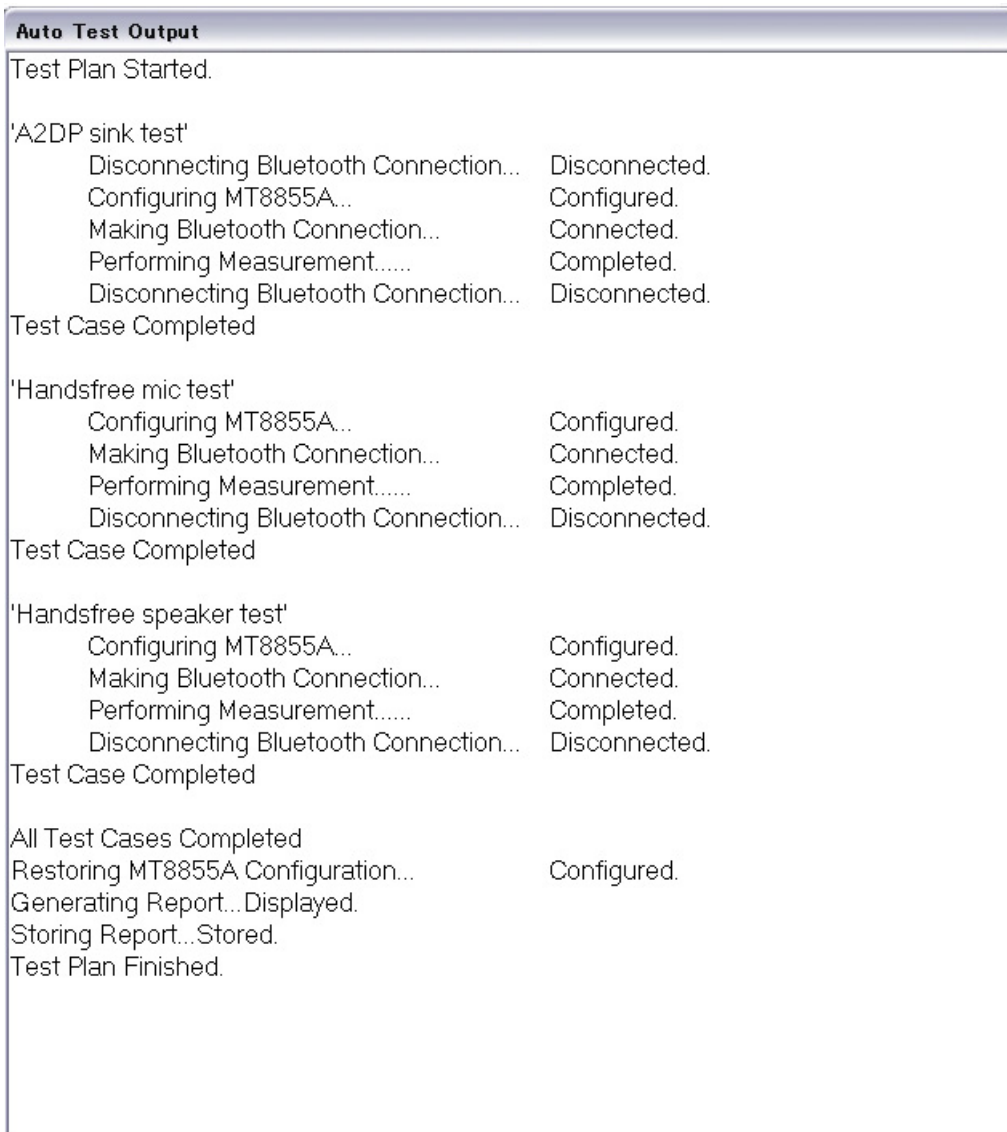
**Figure 19-15.**Auto Test Results and Report Options

20. If required, save the test plan for future use. To do this, select [Save As...] from the [File] menu and specify a name and location to which the test plan will be saved. Saved test plans can be imported into BlueAudio by selecting [Open Manual Test...] or [Open Auto Test...] from the [File] menu. (Refer to chapter 20 for further details of saving and loading test settings.)



## 19-3 Running a Test Plan

1. Check that the DUT is powered on and ready to accept a connection from the MT8855A.
2. Click  to execute the test plan.
3. Status information displays in the [Auto Test Output] window as each stage of the test plan is commenced and completed.



**Figure 19-16.** [Auto Test Output]

4. If the “Show Report On Completion” check box was selected, a test report displays automatically when the test plan is complete.

**Anritsu BlueAudio**

**Test Report**

**Test Plan:** Test Plan      **Date:** 05 May 2010  
**Start Time:** 10:36:57      **BlueAudio Version:** 1.30.0.0  
**Stop Time:** 10:38:04  
**Elapsed Time:** 1 Minute, 6 Seconds

**DUT**      **MT8855A**  
**Bluetooth Address:** 00197F1358A5      **Bluetooth Address:** 00066E19298D  
**Friendly Name:** 260Plantronics      **Serial Number:** P018  
**Firmware Version:** 1.30

***Test Case: A2DP Sink Test***

**Multiple Frequency Level Test**  
Measurement Mode: Sequential

**Reference**

| Frequency (Hz) | Left Result (V) | Right Result (V) |
|----------------|-----------------|------------------|
| 997            | 0.6250          | 0.6210           |

**Result**

| Frequency (Hz) | Left Result (dBr) | Right Result (dBr) |
|----------------|-------------------|--------------------|
| 100            | -0.55             | -0.57              |
| 300            | -0.07             | -0.07              |
| 3000           | 0.01              | 0.01               |

**Figure 19-17.** Test Report

If the “Show Report On Completion” check box was not selected, a test report can be viewed by selecting [Report Database...] from the [Tools] menu. An explanation of how to use the database to filter and view the reports is provided in chapter 18.



# Chapter 20 — 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.

## 20-1 Active Test Set - Selecting

Multiple MT8855A units can be connected over the USB to the PC running BlueAudio. Each connected test set is configured individually, the active test set being displayed in the status bar of the main [Anritsu BlueAudio] window.

To change the active test set, click the status bar button as shown in the figure below and select the required test set from the pop-up menu.

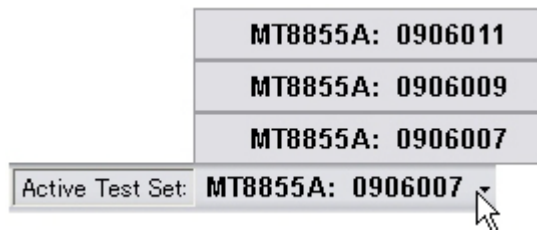


Figure 20-1. Active Test Set Selection

## 20-2 Audio Levels - Adjusting

1. Click [Audio Levels] on the toolbar of the main [Anritsu Blue Audio] window.
2. The [Audio Levels] dialog opens as shown below.

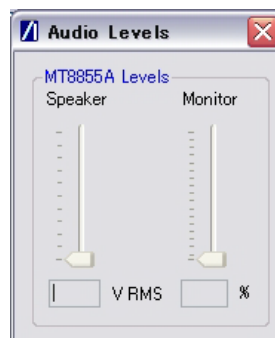


Figure 20-2. [Audio Levels]

3. Adjust the MT8855A speaker and monitor levels as required and close the dialog.

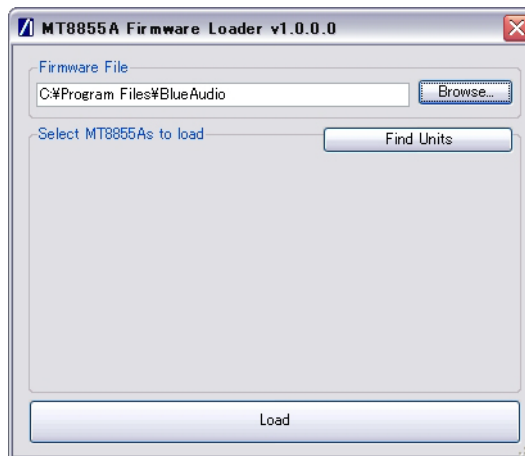
## 20-3 Autoscaling

1. Right-click any of the graphical trace windows and select [Y Axis Scale ] > [AutoScale] from the pop-up menu.
2. The Y-axis scaling is automatically adjusted so that the whole of the trace is displayed within the graph area.

## 20-4 Firmware - Updating

New versions of the MT8855A firmware can be downloaded from the Anritsu website as they become available.

1. Download the latest firmware from the Anritsu website (<http://www.anritsu.com/downloads/>).
2. Turn on the MT8855A and start BlueAudio.
3. Connect the MT8855A to the PC using the USB cable provided.
4. Select [Firmware Update...] from the [Tools] menu to display the dialog below.



**Figure 20-3.** [MT8855A Firmware Loader] Window

5. Click [Browse...] to locate the firmware file downloaded to the PC.
6. Click [Find Units] to display a list of all MT8855A units connected to the PC through the USB connection.
7. Select the check box next to the unit(s) to be upgraded.
8. Click [Load]. The current firmware is deleted and the new version installed.

**Note** Do not turn the MT8855A off or remove the USB cable until the update is complete.

- Click [Help] > [About BlueAudio] to confirm that the new firmware version is displayed.

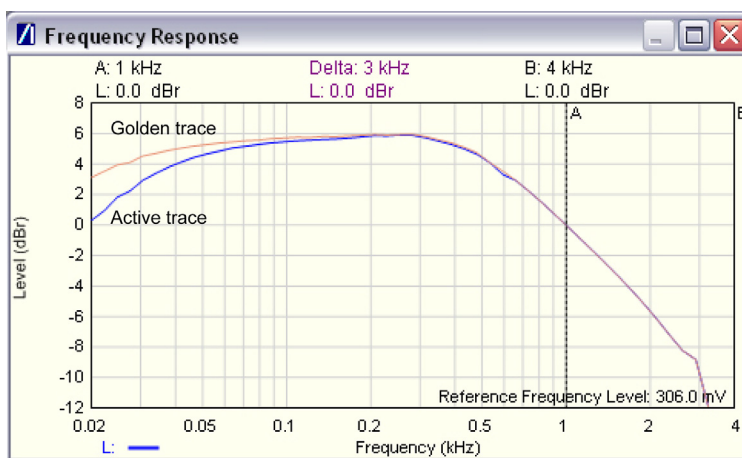
**Note**

To receive automatic notification of software releases, send a blank e-mail with the subject heading of "MT8855A Software Notification Request" to bluetooth.support@anritsu.com. You will receive an e-mail when new software is available to download.

## 20-5 Golden Trace - Displaying

Frequency response traces for the right or left channel can be saved and then superimposed in the [Frequency Response] window as required. These saved traces are known as 'golden' traces and are useful when verifying performance against an acceptable standard or when monitoring the effect of modifications in the test conditions.

- Generate a frequency response trace that is suitable to save as a golden trace for the right or left channel.
- Right-click the [Frequency Response] window and select [Golden Trace] > [Save As (Left Channel)...] or [Save As (Right Channel)...] from the pop-up menu. The trace data is saved as a .gtd file at the specified location.
- Right-click the [Frequency Response] window and select [Golden Trace] > [Open...].
- Navigate to the golden trace saved in step 2 and click [Open].
- Right-click the [Frequency Response] window and select [Golden Trace] > [Display].
- Make further measurements to generate a new frequency response trace.
- The golden trace and the active trace both display in the [Frequency Response] window and a comparison between the traces can be made with ease.



**Figure 20-4.** Golden Trace

**Note**

Only one golden trace (for either the left or right channel) can be displayed at any one time.

## 20-6 Log Data - Outputting

The BlueAudio log capture tool can be used to generate a log of messages transmitted between the MT8855A and the DUT. This log data can be analyzed by Anritsu support personnel if *Bluetooth* interoperability or connectivity difficulties are experienced with the DUT.

1. Select [Tools] > [Log Control..] to display the [MT8855A Internal Log Capture] dialog..



**Figure 20-5.** [MT8855A Internal Log Capture] Dialog

2. Select “Enable Logging” to enable the capture of log data during *Bluetooth* communication.
3. Click [Clear Log] to clear any previously generated log content before saving a new log.
4. Click [OK] to close the dialog.
5. Replicate the events that resulted in the error.
6. When the error has been replicated, display the [MT8855A Internal Log Capture] dialog again and click [Save Log] to save the log data as a text file.
7. Send the file to Anritsu in line with the instructions given in chapter 19.

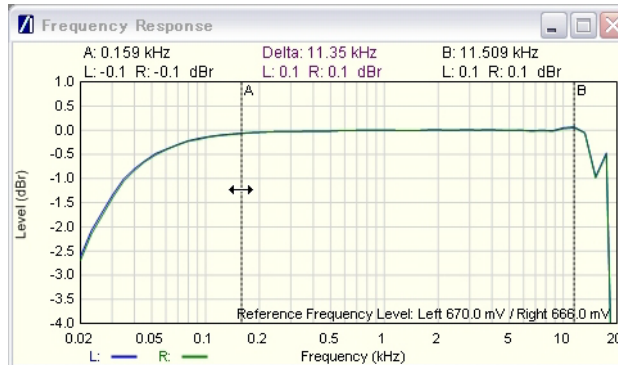
**Note**

If submitting multiple error occurrences to Anritsu, users should always use [Clear Log] at the end of each error capture sequence.

The generated log data (.adl) file is not intended for analysis by the user. Users should send the file to Anritsu and not try to open it.

## 20-7 Markers - Positioning By Drag and Drop

1. Position the mouse pointer directly above the marker to be moved. The pointer changes to a double headed arrow as shown below.



**Figure 20-6.** Dragging Markers

2. Drag the marker to the required position. The marker positions (A, B, and Delta) display in the area of the window immediately above the trace itself.

## 20-8 Markers - Positioning by Numeric Input

1. Right-click any of the graphical trace windows and select [Configure Markers] from the pop-up menu to display the dialog below.



**Figure 20-7.**

2. Select the “Enable Markers” check box.
3. Enter positions for the markers as required.
4. Click [OK] to close the dialog and display the markers at the specified position.



## 20-9 Measurement Results - Exporting to XML

1. Select [Export to XML] from the [File] menu or right-click any of the four graphical results windows and select [Export Data As...] from the pop-up menu.
2. Specify a file name and location in the normal manner and click [Save].
3. Start Microsoft Excel and select [File] > [Open...] to import the .xml file generated above.
4. Select "Use the XML Source task pane" in the [Open XML] dialog that displays.
5. A second dialog displays stating that the specified XML source does not refer to a schema. Click [OK].
6. Drag and drop the required measurement files from the tree on the right to the blank Excel sheet.

|             |  |
|-------------|--|
| <b>Note</b> | Do not drop the files in the top row of the Excel sheet as this will not allow room for the associated headings. |
|-------------|--|

7. When the files are dropped, a drop-down menu is accessible from the cell furthest to the right. Open the drop-down menu and select "Place XML Heading Above". The headings appear in the row directly above.
8. Right-click any of the cells within the row and select [XML] > [Refresh XML Data] from the pop-up menu. The cells are now populated with the appropriate data.

## 20-10 Microphone or Speaker Calibration Data - Creating

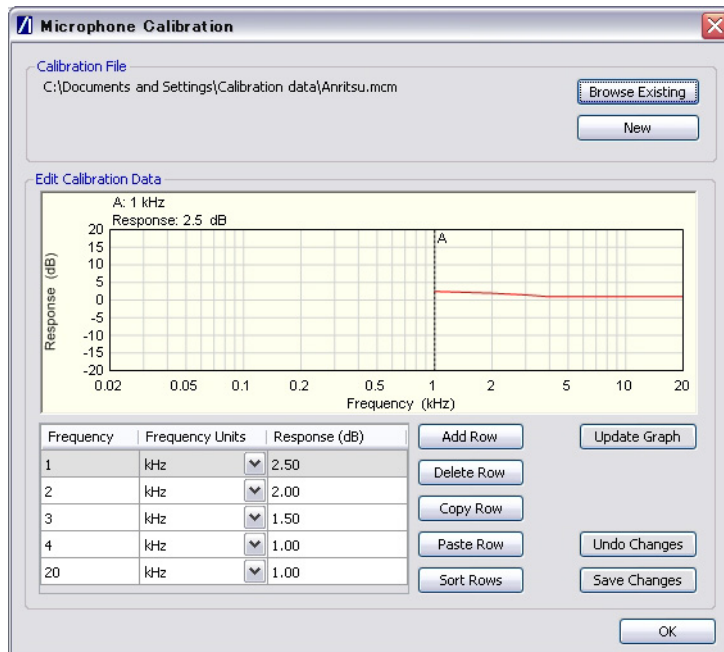
The steps below explain how to create microphone or speaker calibration data. Calibration is used to compensate for gain or loss introduced by the speaker or microphone relative to the ideal reference.

1. Click [Configure MT8855A] to open the [MT8855A] dialog.
2. Select the appropriate calibration setting.
  - To create microphone calibration data, select "Apply Microphone Correction" and click [Microphone Calibration] to open the [Microphone Calibration] dialog.
  - To create speaker calibration data, select "Apply Speaker Correction" and click [Speaker Calibration] to open the [Speaker Calibration] dialog.

|             |   |
|-------------|---|
| <b>Note</b> | The "Apply Microphone Correction" selection box is not available unless "Analogue Input" is set to "Mic".<br>The "Apply Speaker Correction" selection box is not available unless "Analogue Output" is set to "Speaker" |
|-------------|---|

3. Click [Add Row] to create a line in the frequency table to the right.
4. Click in the "Frequency" cell and enter an appropriate frequency value.
5. Select the required units of frequency.
6. Click in the "Response" cell and enter an appropriate response.

7. Add additional lines to the table as required and click [Update Graph] when complete. The data entered into the table appears in the graph as shown in the example below.



**Figure 20-8.** Microphone Calibration

8. Once created, the calibration data can be saved for use again in the future. Click [New] and browse to a location to which the data will be saved. The file path displays in the "Calibration File" frame.
9. Click [Save Changes] to save the calibration data to the specified location. Once saved, the calibration data can be imported at any time as explained in the procedure below.
10. Click [OK] to close the calibration dialog.

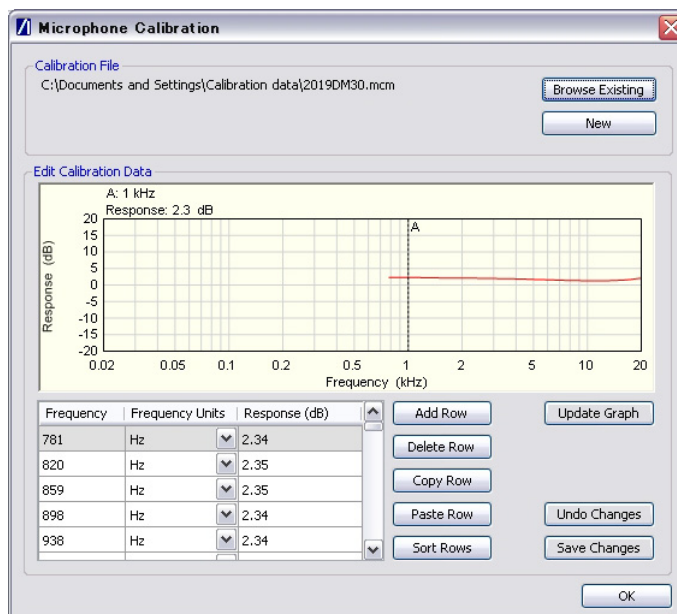
## 20-11 Microphone or Speaker Calibration Data - Importing

The steps below explain how to import microphone or speaker calibration data. Calibration is used to compensate for gain or loss introduced by the speaker or microphone relative to the ideal reference.

1. Click [Configure MT8855A] to open the [MT8855A] dialog.
2. Select the appropriate calibration setting.
  - To import microphone calibration data, select “Apply Microphone Correction” and click [Microphone Calibration] to open the [Microphone Calibration] dialog.
  - To import speaker calibration data, select “Apply Speaker Correction” and click [Speaker Calibration] to open the [Speaker Calibration] dialog.

**Note** The “Apply Microphone Correction” selection box is not available unless “Analogue Input” is set to “Mic”. The “Apply Speaker Correction” selection box is not available unless “Analogue Output” is set to “Speaker”

3. Click [Browse Existing], navigate to the calibration data file, and click [Open]. Refer to section 20-16 for details. The data is imported to the table and graph as shown in the example below.

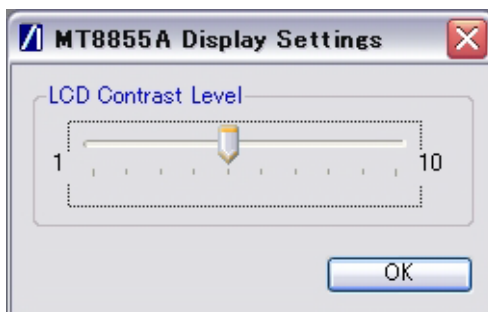


**Figure 20-9.** Microphone Calibration

4. Once imported, the data can be used as is, or can be edited as required by simply changing the frequency or response values, or by using the buttons to the right of the table. Click [Update Graph] to reflect the changes in the graph.
5. Click [OK] to close the calibration dialog.

## 20-12 MT8855A Display Contrast - Adjusting

1. Select [MT8855A LCD Settings] from the [Tools] menu to display the dialog below.



**Figure 20-10.** [MT8855A Display Settings] Dialog

2. Use the slider to adjust the contrast level as required and click [OK]. As the slider is moved, the text on the MT8855A display changes to match the setting.

## 20-13 MT8855A - Presetting

An instrument preset can be performed to return all settings for the selected instrument to their default settings.

1. Select the unit to be preset from the pop-up menu on the BlueAudio status bar (as shown in figure 18-1).
2. Select [Tools] > [Preset Instrument].

|             |   |
|-------------|---|
| <b>Note</b> | Presetting the instrument terminates all measurements being executed and drops the <i>Bluetooth</i> connection. |
|-------------|---|

## 20-14 Multitone Measurement Mode - Using

In the multiple frequency level test, the MT8855A measures the relative audio level of the DUT at five user-defined frequencies. Follow the procedure below to have these tones played simultaneously.

1. Click [Configure Measurements] to open the [Measurements] dialog.
2. Click “Multiple Frequency Level Test” to display the settings on the right side of the dialog.
3. Select “Multitone” from the drop-down selection box that displays in the uppermost cell of the “Value” column.

|             |  |
|-------------|--|
| <b>Note</b> | If multitone frequency mode is selected, the maximum tone value is reduced from 1 V to $1V / \text{number of tones}$ . |
|-------------|--|

## 20-15 Options - Enabling

1. Select [Tools] > [Options] > [Enable Option...].
2. Enter the two-digit option number and the supplied enable code. For options 332 and 333, enter option numbers 32 and 33 respectively.
3. Click [Enable].
4. Click [Close] to close the dialog.

## 20-16 PESQ Measurements

PESQ (Perceptual Evaluation of Speech Quality) is an automated method of performing an end-to-end speech quality assessment for a network. Follow the procedure below to perform PESQ measurements.

1. Click [Configure Profile] and check that BlueAudio is correctly configured to enable PESQ measurements. The settings must match one of the following combinations:
  - Profile = HSP, MT8855A Role = Audio Gateway
  - Profile = HFP, MT8855A Role = Audio Gateway
  - Profile = SCO/eSCO Only, MT8855A Role = Analyzer or Generator

|             |   |
|-------------|---|
| <b>Note</b> | PESQ measurements cannot be performed on Audio Gateways as it would not be possible to isolate the <i>Bluetooth</i> connection from the performance of the gateway's cellular network and the codecs. |
|-------------|---|

2. Establish a *Bluetooth* connection with the EUT. A *Bluetooth* connection is required in order to perform automatic calibration as detailed in step 7.
3. Click [Configure MT8855A] and select the appropriate "Analogue Input" or "Analogue Output" settings to match the configuration. PESQ measurements are not available if "Analogue Input" or "Analogue Output" is set to "Off".
4. Check that the line input and output cables are correctly connected.
5. Click [Configure Measurements] and select the PESQ "Enable" check box.

6. Click [PESQ Calibration] to display the dialog below.



**Figure 20-11.** PESQ Calibration

Calibration must be performed before a PESQ measurement can be made. Calibration optimizes the audio signal path gain such that the level of the recovered signal is similar to that of the original. The PESQ cal dialogue can also be accessed at any time by clicking [PESQ Cal] on the toolbar.



7. Select the appropriate mode.

- The "Automatic" calibration mode is recommended. Automatic mode is available only when the DUT is in a *Bluetooth* connection with the MT8855A.
- "Manual" calibration can be used if a *Bluetooth* connection is not available but the required signal level (into the DUT microphone input or test speaker input, or the DUT output) is known.

If the MT8855A is configured for line out or speaker, manual calibration adjusts the output of the MT8855A such that the signal level is set to the value specified in the "Full Scale Voltage" field, regardless of the impedance of the EUT connection.

If the MT8855A is configured for line in or microphone, manual calibration selects the appropriate input range for the value set at "Full Scale Voltage".

8. Click [Run] to calibrate the analog signal range to minimize digital loss.
9. Click [Save] and specify a file name and location in the normal manner.
10. Click [Exit] to close the [PESQ Calibration] dialog. It is not necessary to repeat PESQ calibrations unless the test system configuration is changed.
11. Click [Reference File] and select the reference test signal from one of the three default folders: ASTS, USER and ITU. The PESQ algorithm compares the reference signal to the degraded signal and outputs a PESQ score of between -0.5 and 4.5.
12. Click [Calibration File] and select the calibration file saved earlier.

13. Click [OK] to close the [Measurements] dialog. If PESQ measurements are selected, the [Measurements] dialogue cannot be closed unless a Reference File and Calibration File are selected.
14. Click  to run measurements once, or click  to run measurements in a continuous loop.

**Note**

If making PESQ and non-PESQ measurements together, consideration should always be given to the monitor volume setting. Users may find it necessary to raise the monitor volume for the PESQ audio signals, but this higher setting may make non-PESQ tones uncomfortably loud especially when using headphones.

## 20-17 Range Input - Using Manual Range

Follow the procedure below if excessive noise necessitates the use of a manual input range for microphone or line.

1. Click [Configure MT8855A] to open the [MT8855A] dialog.
2. Set the “Range” field to “Manual” and select the appropriate range from the drop-down list. The ranges are detailed in the table below.

Users should select the lowest range that adequately covers the expected voltage of the test signal. If, for example, the expected line input test signal was 1000 mV, it would be necessary to select input Range 3 (1024 mV).

**Table 20-1.** Line Input Ranges

| Range   | Maximum Input |
|---------|---------------|
| Range 1 | 4096 mV       |
| Range 2 | 1880 mV       |
| Range 3 | 1024 mV       |
| Range 4 | 512 mV        |
| Range 5 | 256 mV        |
| Range 6 | 128 mV        |
| Range 7 | 64 mV         |
| Range 8 | 32 mV         |
| Range 9 | 16 mV         |

**Table 20-2.** Mic Input Ranges

| Range   | Maximum Input |
|---------|---------------|
| Range 1 | 200 mV        |
| Range 2 | 93 mV         |
| Range 3 | 50 mV         |
| Range 4 | 25 mV         |
| Range 5 | 12.5 mV       |

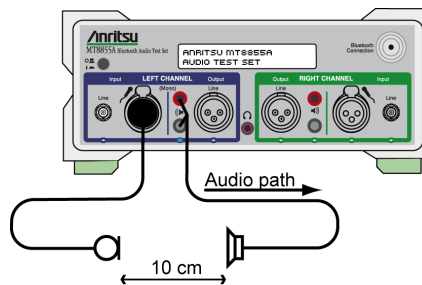
**Table 20-2.** Mic Input Ranges

| Range   | Maximum Input |
|---------|---------------|
| Range 6 | 6.25 mV       |
| Range 7 | 3.13 mV       |
| Range 8 | 1.56 mV       |


## 20-18 Speaker Calibration Data - Saving from Trace

A speaker calibration data file can be saved from the frequency response and imported as described in procedure 20-11.

1. Configure the equipment as shown in the figure below. The distance between the speaker and the microphone should match the actual distance between the speaker and the DUT, typically around 10 cm.



**Figure 20-12.** Configuration for Acquiring Speaker Calibration Data File

2. Start BlueAudio and set “System Mode” to “Analogue Audio Measurement”.
3. Click [Configure MT8855A].
4. Set “Analogue Input” to “Mic”, select “Phantom Power On”, and set “Analogue Output” to “Speaker”.
5. Click [Configure Measurements] and select the “Frequency Response” measurement.
6. On the [Settings] tab for the “Frequency Response” measurement, set “Start Frequency” and “Stop Frequency” as required. Typically this is from 100 Hz to 4 kHz for HSP, HFP, SCO/eSCO applications. When using speakers such as the accessory Anritsu speaker, the small cone size means that the speaker cannot function efficiently below around 100 Hz.
7. Click [OK] to close the [Configure Measurements] dialog.
8. Click  to execute the specified measurements once.
9. When the measurements are complete, right-click anywhere within the [Frequency Response] window and select [Speaker Calibration] > [Save As (Left Channel)..].
10. Specify a name and location for file and click [Save].
11. The calibration data file generated above can be imported for use when making *Bluetooth* audio measurements. Refer to section 20-11 for details.



## 20-19 Test Case - Adding

1. Click the [Auto Test] tab.
2. Right-click the test plan name in the test plan tree and select [Add Test Case] from the pop-up menu.

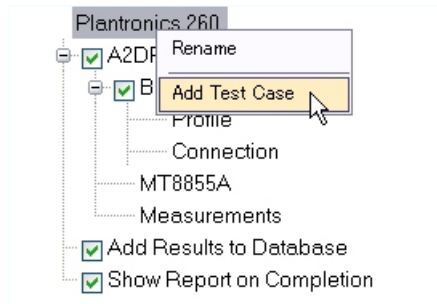


Figure 20-13.[Add Test Case]

3. The test case displays in the test plan tree as shown below.

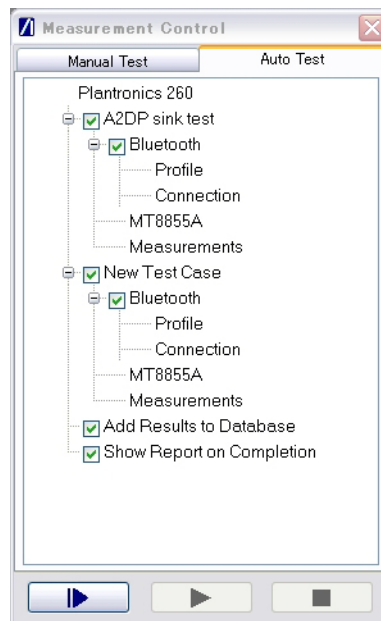
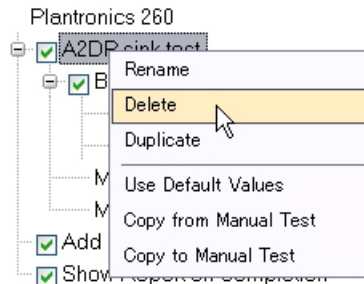


Figure 20-14. Test Plan with New Test Case

## 20-20 Test Case - Deleting

1. Click the [Auto Test] tab.
2. Right-click the test case to be deleted and select [Delete] from the pop-up menu.



**Figure 20-15.** Delete Test Case

## 20-21 Test Case - Duplicating

1. Click the [Auto Test] tab.
2. Right-click the test case to be duplicated.
3. Select [Duplicate] from the pop-up menu.

## 20-22 Test Case - Renaming

1. Click the [Auto Test] tab.
2. Right-click the test case to be renamed.
3. Select [Rename] and enter a new name.

## 20-23 Test Case Settings - Copying from Manual Test

Test cases on the [Auto Test] tab can be populated automatically by copying configuration and measurement settings from the [Manual Test] tab.

1. Click the [Auto Test] tab and add a new test case to the test plan.
2. Right-click the test case name and select [Copy from Manual Test] from the pop-up menu.

## 20-24 Test Case Settings - Copying To Manual Test

The setting dialogs on the [Manual Test] tab can be populated automatically by copying test case settings from the [Auto Test] tab.

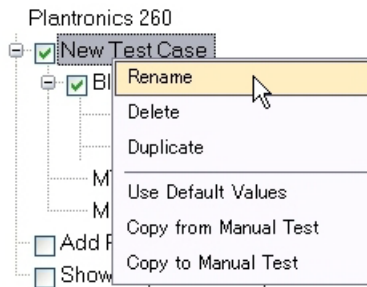
1. Click the [Auto Test] tab.
2. Right-click the test case name from which settings will be copied and select [Copy to Manual Test] from the pop-up menu.

## 20-25 Test Case Settings - Setting to Default

1. Click the [Auto Test] tab.
2. Right-click the name of the test case.
3. Select [Use Default Values] from the pop-up menu. All settings for the test case in question revert to the default settings.

## 20-26 Test Plan - Renaming

1. Click the [Auto Test] tab.
2. Right-click “New Test Plan” to display a pop-up dialog.



**Figure 20-16.** Rename Test Plan

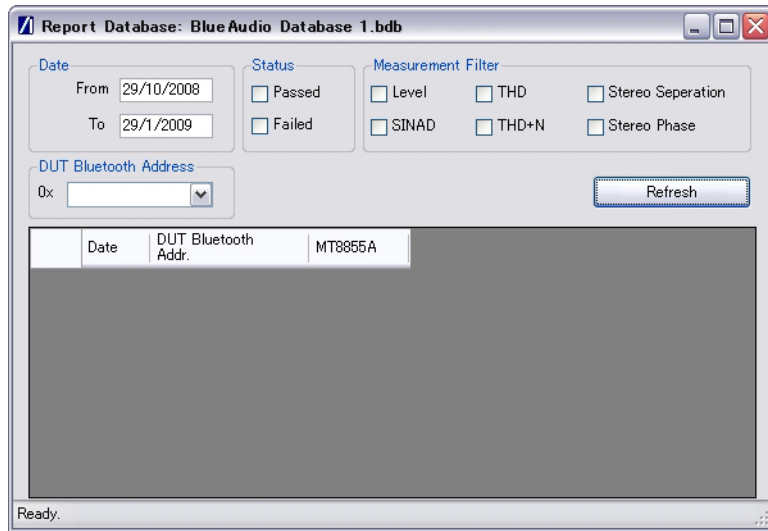
3. Select [Rename] and rename the test plan as required.

## 20-27 Test Plan Reports - Viewing

Test plan results display automatically if “Show Report On Completion” is selected when the test plan is executed.

If “Add Results to Database” is selected, a test plan report is added to the reports database. The reports within the database can be filtered and displayed as outline below.

1. Select [Tools] > [Report Database] to open the window below.



**Figure 20-17.** [Report Database] Window

2. Enter the “From” and “To” dates within which the reports in the database will be filtered.
3. Use the “Status” and “Measurement Filter” check boxes to filter the displayed results as required.
4. If required, filter the displayed results to those of a specific device by selecting or entering the associated *Bluetooth* address in “DUT *Bluetooth* Address” entry field. If the address entry field is left blank, all results that match the filtering requirements are displayed regardless of device type.
5. Click [Refresh] to display the filtered results.
6. Double click any of the rows within the results table to display the associated report.

## 20-28 Test Plan Report Database - Changing

By default, test plan results are written to the “BlueAudio Database 1.bdb” file whenever “Add Results To Database” is selected on the [Auto Test] tab. This file can be duplicated, deleted, or moved as required to meet needs for separation of measurement results by product type. Follow the procedure below to create and specify use of a new database file.

1. Select [File] > [Database...] to open the [Select or create a database file] dialog.
2. Specify a name for the new database in “File name” and click [Open].  
The new file is created at the same location as the original and immediately adopted as the selected database.
3. Select [Tools] > [Report Database] to display the [Report Database] dialog. The name of the newly generated database file is shown in the title bar.

## 20-29 Test Settings - Loading

BlueAudio settings saved using the [Save As...] command can be loaded at any time.

1. Select [Open Manual Test...] or [Open Auto Test...] from the [File] menu.
2. Select the .sfm or .tpm file and click [Open] to populate the configuration dialogs with the settings from the selected file.

## 20-30 Test Settings - Saving

1. Select [Save As...] from the [File] menu.
2. Specify a file name and location in the normal manner and click [Save].

## 20-31 Traces - Printing

1. Right-click the required trace window and select [Print] from the pop-up menu.
2. Click [OK].

## 20-32 Trace Image - Saving as Image File

1. Right-click the required trace window and select [Save Image As...] from the pop-up menu.
2. Specify a file name and location in the normal manner and click [Save].

## 20-33 Version Information - Viewing

1. Select [About BlueAudio...] from the [Help] menu on the toolbar of the main [Anritsu Blue Audio] window
2. The [About BlueAudio] dialog opens displaying the version information for application, user interface, class library, and USB driver.



Figure 20-18. [About BlueAudio] Dialog

## 20-34 X-axis Scale - Changing

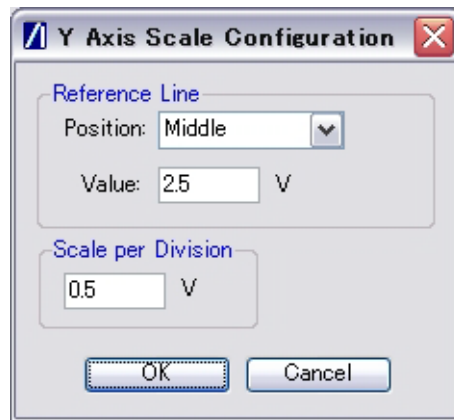
1. Right-click any of the four trace windows.
2. Select [X Axis Scale] from the pop-up menu.
3. Select either [Linear] or [Logarithmic].

## 20-35 Y-axis Scale - Auto-scaling

1. Right-click any of the four trace windows.
2. Select [Y Axis Scale] from the pop-up menu.
3. Select [Autoscale].

## 20-36 Y-axis Scale - Configuring

1. Right-click any of the four trace windows.
2. Select [Y Axis Scale] from the pop-up menu.
3. Select [Configure] to display the dialog shown below.



**Figure 20-19.**[Y Axis Scale Configuration]

# Chapter 21 — Technical Assistance

## 21-1 Troubleshooting

This chapter provides a list of problems that may be experienced during testing. If operational difficulties are experienced, check the listed items and suggested actions before contacting Anritsu for technical assistance.

### 1. I cannot establish a *Bluetooth* connection between the DUT and the MT8855A.

- Check whether the correct *Bluetooth* profile has been selected. (Anritsu BlueAudio > [Manual Test] > [Configure Profile])
- Check whether the correct *Bluetooth* address has been selected. (Anritsu BlueAudio > [Manual Test] > [Configure Connection])
- Check whether pairing is enabled. (Anritsu BlueAudio > [Manual Test] > [Configure Connection])
- Check whether the correct RF connection path is selected. (Anritsu BlueAudio > [Manual Test] > [Configure Connection])
- Check whether the connection must be initiated from the DUT.
- Check whether the DUT is in a discoverable state. (Refer to the manufacturer's documentation for details of how to enable pairing.)
- Check whether authentication is required and/or set.
- Check whether the DUT is positioned too far away from the MT8855A.
- Check whether the DUT is already paired to another device.

### 2. The frequency response of my A2DP DUT is very poor and/or has resonances when using microphones / speakers

- Check whether microphone/speaker frequency response has been calibrated out.
- Check the coupling between test microphone/speaker and the DUT microphone/speaker.
- Use an shielded enclosure to remove resonances.

### 3. The THD+N measurement is unstable

- Use an shielded enclosure to remove resonances.
- Check whether there are other sources of RF that may be causing instability.

### 4. There are clicks in the recovered audio

- The RF link quality may be poor.
- Check whether there are other sources of RF that may be causing instability.
- Use the Anritsu MT8852B to confirm radio BER/FER.



**5. The audio tone is not stable (wow or flutter)**

- The DUT may take time to stabilize the audio when profiles are changed.

**6. The FFT shows different response for left and right channels even with cable / line audio connections.**

- This is quite possible due to internal architecture or layout of DUT.

**7. The BlueAudio interface shows that I have established a connection, but I am not getting any audio measurement results**

- Check that the MT8855A and DUT inputs/outputs are correctly configured.
- Check that the audio levels are set appropriately. (Anritsu BlueAudio > Tool Bar > [Audio Levels])
- Check that the required measurements are selected in the [Measurements] dialog.
- Check the volume control settings on the DUT.

**8. I cannot hear the audio tone on the MT8855A monitor speakers.**

- Check whether the correct audio source has been selected for the MT8855A monitor speakers.
- Check that the audio levels are set appropriately. (Anritsu BlueAudio > Tool Bar > [Audio Levels])

**9. I want to use the audio generator or analyzer without making a *Bluetooth* connection.**

- Set “System Mode” to “Analogue Audio Measurements”. (Anritsu BlueAudio > [Manual Test] tab > “System Mode” = “Analogue Audio Measurements”)

**10. When I do an inquiry, I get lots of responses and don't know which to connect to.**

- Use a shielded acoustic box.
- Select “Inquiry + Name” to run an inquiry and select the DUT from a list of discovered *Bluetooth* devices that may include user-friendly names when available. (Anritsu BlueAudio > [Manual Test] tab > [Configure Connection])

**11. I am unable to initiate a *Bluetooth* connection with the MT8855A from the DUT.**

- Check whether the passkey specified at the DUT matches that within BlueAudio. (Anritsu BlueAudio > [Manual Test] tab > [Configure Connection])
- Check that the “Allow DUT Initiated Connections” check box is selected. (Anritsu BlueAudio > [Manual Test] tab > [Configure Connection])

## 12. I get spikes in my frequency response, THD+N vs level, or THD+N vs frequency traces.

- Audio distortion may be experienced if testing in an environment with other transmissions on 2.4 GHz (e.g., wireless LAN or other *Bluetooth* devices).
- Use a shielded acoustic box to remove resonances.
- Turn off potential sources of interference.
- If testing over-air, move the DUT as close to the antenna as possible.

## 21-2 Contacting Anritsu for Technical Assistance

If you have read the troubleshooting information above and still require technical support, send an e-mail with the information listed below to our technical support team at [bluetooth.support@anritsu.com](mailto:bluetooth.support@anritsu.com).

- A debug log (refer to the procedure below)
- MT8855A serial number
- BlueAudio version
- Description of the problem
- List of error messages displayed (BlueAudio and/or MT8855A)
- Description of procedure required to replicate the problem
- Details of steps already taken to correct the problem

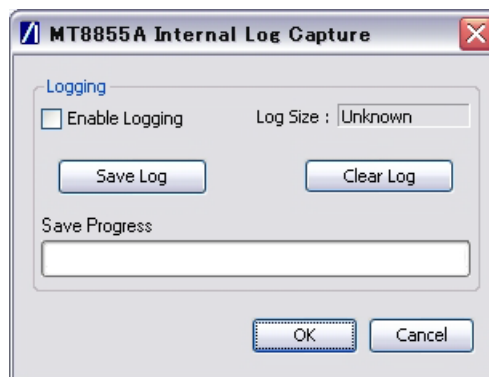
Every effort will be made to investigate the problem and reply within one working day.

Full details of Anritsu contact information can be accessed at [www.anritsu.com/Contact.asp](http://www.anritsu.com/Contact.asp)

## 21-3 Outputting Log Data

The BlueAudio log capture tool can be used to generate a log of messages transmitted between the MT8855A and the DUT. This log data can be analysed by Anritsu support personnel if *Bluetooth* interoperability or connectivity difficulties are experienced with the DUT.

1. Select [Tools] > [Log Control..] to display the [MT8855A Internal Log Capture] dialog..



**Figure 21-1.** [MT8855A Internal Log Capture] Dialog

2. Select “Enable Logging” to enable the capture of log data during *Bluetooth* communication.
3. Click [Clear Log] to clear any previously generated log content before saving a new log.
4. Click [OK] to close the dialog.
5. Replicate the events that resulted in the error.
6. When the error has been replicated, display the [MT8855A Internal Log Capture] dialog again and click [Save Log] to save the log data as a text file.
7. Send the file to Anritsu in line with the instructions given in chapter 19.

**Notes**

If submitting multiple error occurrences to Anritsu, users should always use [Clear Log] at the end of each error capture sequence.

The generated log data (.adl) file is not intended for analysis by the user. Users should send the file to Anritsu and not try to open it.

The user is required to re-pair with the DUT if the state of “Enable Logging” is changed or if the log is saved.

# Chapter 22 — BlueStart

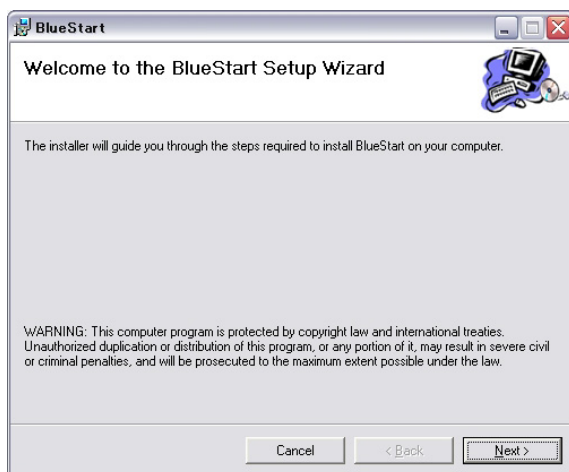
## 22-1 What is BlueStart?

BlueStart is a simple application designed to help familiarize developers with the use of the MT8855 class library.

This chapter describes the installation process and explains how to prepare the Visual Studio project installed with the source files so that BlueStart can be compiled successfully.

## 22-2 Installing BlueStart

1. Insert the product CD into the drive on the PC. The [MT8855A *Bluetooth* Audio Test Set] window displays automatically.
2. Click "BlueStart" in the contents list.
3. The BlueStart setup wizard displays as shown below. Click [Next>].



**Figure 22-1.** BlueStart Setup Wizard

---

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

---

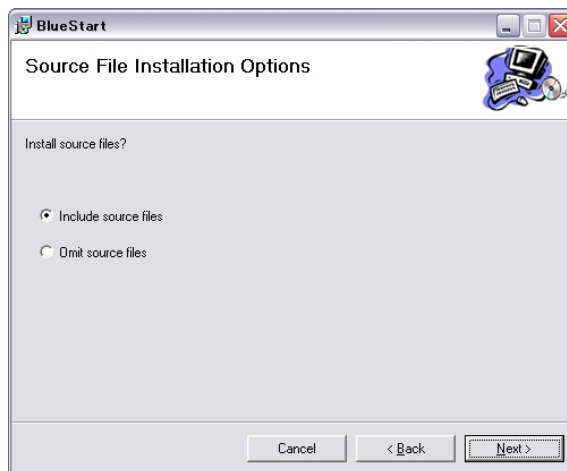


**Figure 22-2.** License Agreement

---

A dialog displays asking the user to select whether to install the source files. Click "Include source files" and click [Next>].

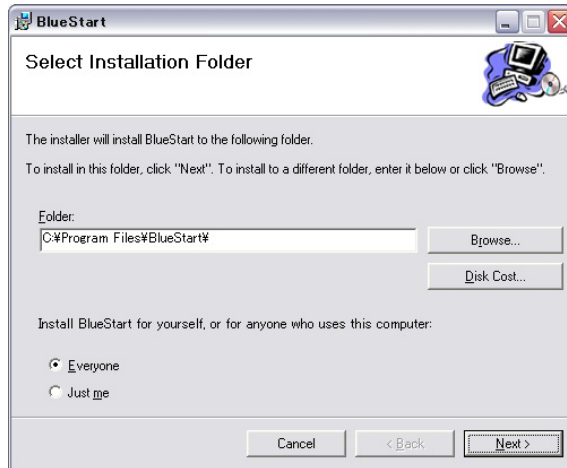
---



**Figure 22-3.** Source File Installation Options

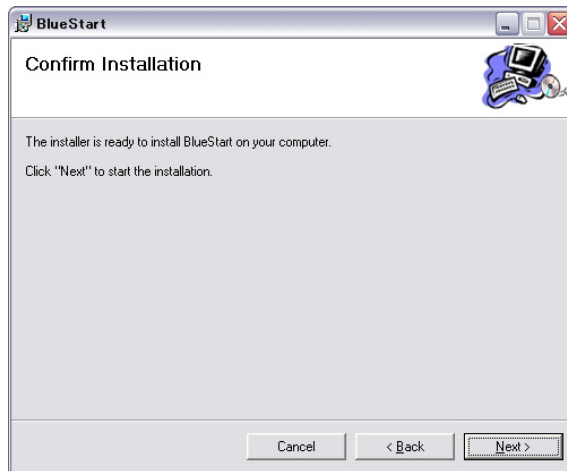
---

A dialog displays asking the user to specify the folder to which BlueStart will be installed. By default, BlueStart is installed to C:\Program Files\BlueStart. Click [Next>] to install to the default directory, or click [Browse...] to specify a different location for installation.



**Figure 22-4.** Select Installation Folder

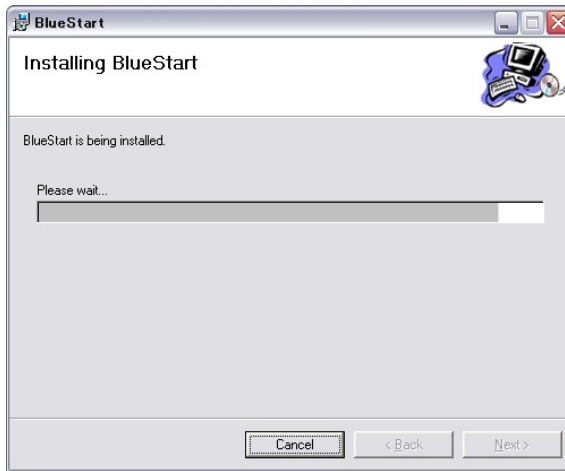
Click [Next>] at the "Confirm Installation" dialog to start the installation.



**Figure 22-5.** Confirm Installation

The progress of the installation is shown in the dialog below.

---

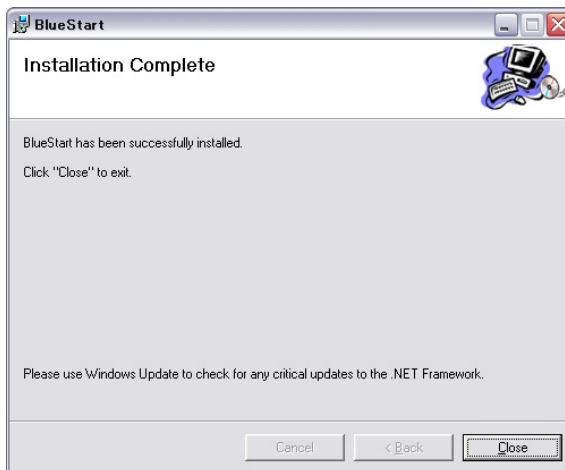


**Figure 22-6.** Installing BlueStart

---

The dialog shown below displays when the installation is complete.

---



**Figure 22-7.** Installation Complete

---

Before running BlueStart:

**Note**

- Connect the MT8855A to a USB port on the PC.
- Turn on the MT8855A.
- Connect an A2DP headset, or similar device, to the line-in sockets on the MT8855A.
- Configure the headset to be discoverable by a *Bluetooth* inquiry.

The operation of BlueStart is intended to be self-explanatory. There is a description of how it was put together in the MT8855 class library help file which can be accessed by double-clicking the icon on the desktop.

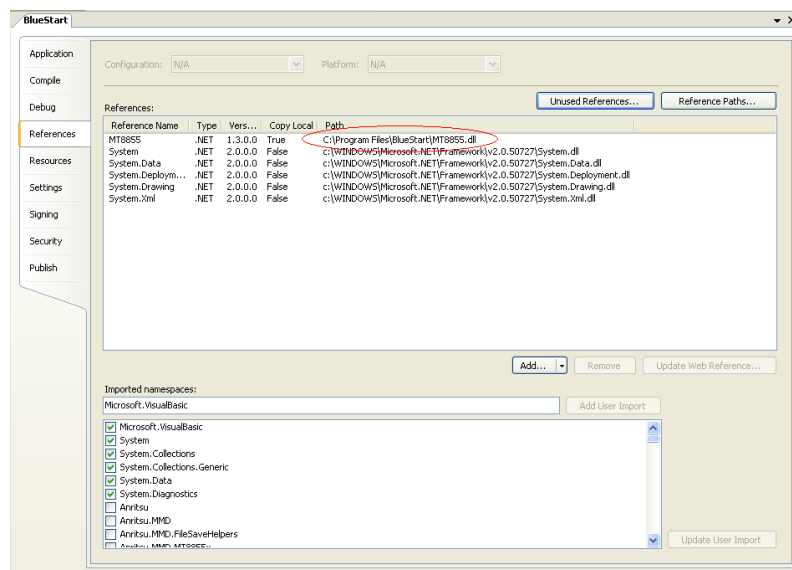
## 22-3 Using the BlueStart Source Files

The following sections of the document explain how to use the source files to adapt and rebuild BlueStart as required.

**Note** It is assumed that the user has a copy of Visual Studio 2005 (or later) installed.

The BlueStart source files are installed to [c:\Program Files\BlueStart\BlueStart Source Files].

1. Open [c:\Program Files\BlueStart\BlueStart Source Files].
2. Double-click “BlueStart.vbproj” to open the project in Visual Studio.
3. Double-click “My Project” in the Solution Explorer and select the “References” tab.
4. Locate the “MT8855” reference in [c:\Program Files\BlueStart].



**Figure 22-8.** Reference File



**Note**

If BlueStart was installed to a location other than [c:\Program Files], the reference to the class library will not be valid and there will be errors in the error list. In this case, remove the reference to MT8855, click “Add...” and create a reference to the correct location.

5. Assuming that BlueStart will initially be run with the Visual Studio debugger, ensure that Debug mode is selected.
6. Build and execute the project.

```
*****
* BlueStart V1.0.1.0 *
*****
An example program in Visual Basic 2005 for use with the
Anritsu MT8855A Audio Test Set

Establishing USB connection to test set:
Number of test sets found: 0
msg: Unable to load DLL 'UsbDriver.dll': The specified module could not be found
. <Exception from HRESULT: 0x8007007E>
Reported status: NoTestSetConnected
Press Return key to exit program.
-
```

**Figure 22-9.** Missing Module

The project will not execute correctly (as shown above) because an essential file, “UsbDriver.dll”, is not handled automatically by Visual Studio. This file must now be copied into the project manually.

7. Copy the “UsbDriver.dll” from [c:\Program Files\BlueStart] to [c:\Program Files\BlueStart\BlueStart Source Files\bin\Debug].

**Note**

If the project is subsequently built in “Release” mode, a release folder is created in BlueStart Source Files\bin. “UsbDriver.dll” must also be copied to that folder.

8. Check that the equipment is correctly configured:
  - Connect the MT8855A to a USB port on the PC.
  - Turn on the MT8855A.
  - Connect an A2DP headset, or similar device, to the line-in sockets on the MT8855A.
  - Configure the headset to be discoverable by a *Bluetooth* inquiry.
9. Build and run the project.

When the program is built and executed, it connects to the MT8855A, establishes a *Bluetooth* connection to the DUT and performs measurements. Typical output is shown below.

```
*****
* BlueStart V1.0.1.0 *
*****
An example program in Visual Basic 2005 for use with the
Anritsu MT8855A Audio Test Set

Establishing USB connection to test set:
Number of test sets found: 1
Connecting to test set:
Model: MT8855A, Serial Number: P003
Current test set state: Idle

Do you wish to monitor test set events (Y or N)?
y
Bluetooth inquiry in progress .
>>> EVENT <<< - Bluetooth inquiry status has changed: InquiryUpdated
>>> EVENT <<< - Bluetooth inquiry status has changed: InquiryComplete

Connecting to DUT: 001D82049204
Connecting ...
>>> EVENT <<< - Bluetooth connection state has changed: PairingComplete
..
```

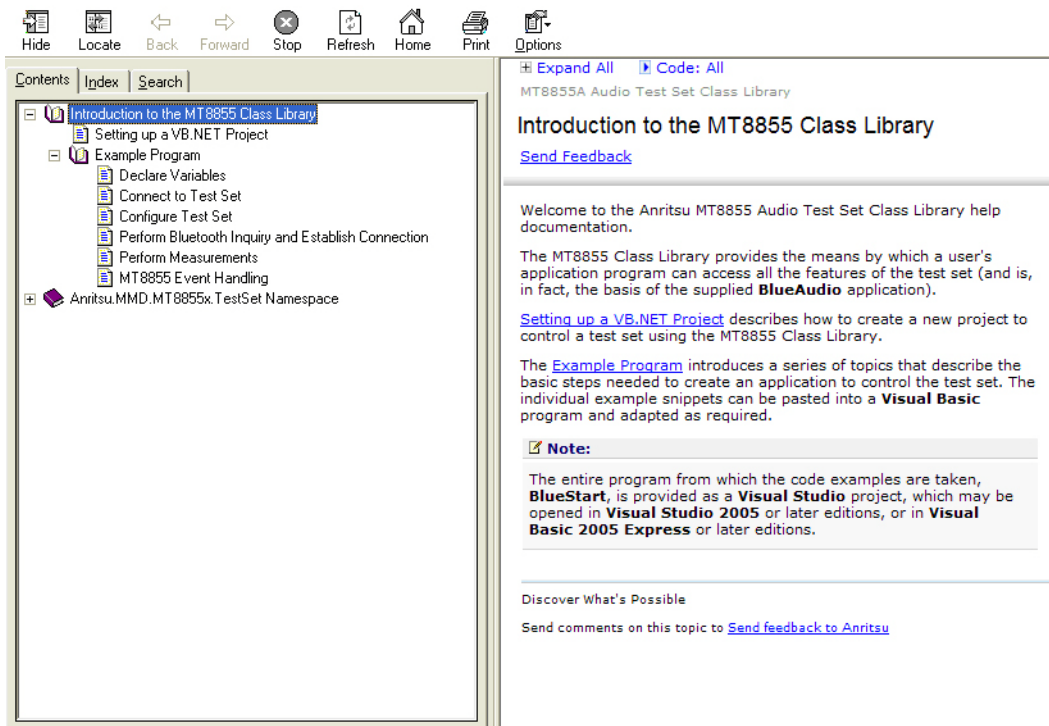
Figure 22-10. BlueStart Output

**Note**

Further information on using the MT8855 class library to control the MT8855A can be found in the Help file.

## 22-4 Viewing the Help File

The help file, “MT8855A Class Library Help.chm”, is installed in the BlueStart folder. It can be opened by double-clicking the desktop icon or selecting Start > Anritsu > MT8855A Class Library Help.



**Figure 22-11.** Class Library Help

When viewed on the “Contents” tab, the Help is divided into two sections:

- “Introduction to the MT8855 Class Library”.  
The section is a basic introduction to controlling the test set using the class library. It includes BlueStart programming examples.
- “Anritsu.MMD.MT8855x.TestSet Namespace”.  
This section contains detailed information on the class library.

## 22-5 Help File Troubleshooting

If the right-side Help frame states that “Navigation to the website was canceled”, the Help file content is being blocked. The most likely reason for this is that the help file was opened from a network drive.

Following a security update by Microsoft in 2005 it may not be possible to view the content of CHM help files from a network drive.

# Appendix A — Specifications

## A-1 MT8855A Specification

| Parameter                           | Specification  |
|-------------------------------------|--|
| <b>RF</b>                           |  |
| RF connections                      | Type N (f), Impedance 50 Ohms  |
| RF level                            | Support for both cable connections and over-air connections.<br>Setting 1: Nominally -5 dBm for over-air connections<br>Setting 2: Nominally -40 dBm for cable connections                             |
| Radio RF performance                | Compliant with requirements of core specification 1.2, 2.0, 2.1 +EDR for initial frequency, modulation, drift, and sensitivity test cases.   |
| <b>System Modes</b>                 |  |
| <i>Bluetooth</i> Audio Measurements | Creates a <i>Bluetooth</i> connection to DUT and uses internal audio generator and analyzer for measurements   |
| <i>Bluetooth</i> Pass Through       | Creates a <i>Bluetooth</i> connection to the DUT, external audio source and analyzer routed through instrument line input and output.  |
| Analogue Audio Measurements         | Audio measurements using internal audio generator and analyzer with no <i>Bluetooth</i> connection.  |
| <b>Profiles</b>                     |  |
| Profiles                            | Headset, Hands-Free (Gateway and Device), A2DP (sink and source), AVRCP<br><br>For DUTs that do not support HSP, HFP, A2DP profiles, a basic SCO/eSCO connection can be established for audio testing. |
| Supported codecs                    | CVSD, SBC, $\mu$ -Law, A-Law   |
| <b>Audio Generators</b>             |  |
| Audio generators                    | 2 linked for left and right channels   |
| Freq range                          | 20 Hz to 20 kHz  |
| Freq resolution                     | 1 Hz   |
| Freq accuracy                       | 0.1 Hz at 997 Hz. 100 ppm across full frequency range  |
| <b>Line Output</b>                  |  |
| Line output connectors              | XLR, one each for left and right (usable for both balanced and unbalanced)   |

## MT8855A Specification

|                            |  |
|----------------------------|--|
| Line output level          | Voltage range: 1 mV to 2V RMS into 600 Ohms or greater<br>Plus tone off mode   |
| Line output resolution     | 1mV  |
| Line output level accuracy | $\pm 0.1$ dB at 997 Hz into 600 Ohms or greater for voltage range 100 mV to 2V<br>$\pm 0.5$ dB at 997 Hz into 600 Ohms or greater for voltages <100 mV       |
| Line output flatness       | $\pm 0.5$ dB at 20 Hz to 20 kHz relative to 997 Hz for voltage range 100 mV to 2V<br>$\pm 1$ dB from 20 Hz to 20 kHz relative to 997 Hz for voltages <100 mV |
| Line output distortion     | $\leq -87$ dB THD+N at 997 Hz at 200 mV to 2V output into 600 Ohm load   |
| Output impedance           | Impedance: <120 Ohm  |

### Speaker Output

|                           |  |
|---------------------------|--|
| Speaker output connector  | 4 mm socket left and right outputs   |
| Speaker output level      | 2 x 1 Watt into 8 Ohm<br>Suitable for speakers with impedance in range 4 Ohm to 32 Ohm |
| Speaker output resolution | 10 mV  |
| Speaker output accuracy   | $\pm 0.2$ dB at 997 Hz into 8 Ohms, 100 uW to 1 W                                      |
| Speaker output flatness   | $\pm 1.0$ dB from 20 Hz to 20 kHz at 100 mW relative to 997 Hz                         |
| Speaker output distortion | <-50 dB THD+N at 997 Hz at 100 mW  |
| Speaker output impedance  | <1 Ohm (nominal value 0.1 Ohm at room temperature)                                     |

### Audio Analyzer

|                |                             |
|----------------|-----------------------------|
| Audio analyzer | For left and right channels |
| Freq range     | 20 Hz to 20 kHz             |

### Line Input

|                       |  |
|-----------------------|--|
| Line input connection | BNC<br>Impedance: 100k Ohms<br>Input level: 10 mV to 4 V<br>Measurement resolution: 1 mV |
|-----------------------|--|

|                                    |  |
|------------------------------------|--|
| <p>Measurements for line input</p> | <p>Level:</p> <p>Input levels 20 mV to 4 V:<br/> <math>\pm 0.5</math> dB over 20 Hz to 20 kHz<br/> <math>\pm 0.1</math> dB at 997 Hz</p> <p>Input levels 10 mV to 19 mV:<br/> <math>\pm 1</math> dB over 20 Hz to 20 kHz<br/> <math>\pm 0.2</math> dB at 997 Hz</p> <p>THD+N:</p> <p>Input level 1 V at 997 Hz:<br/> <math>\pm 0.5</math> dB over range -80 dB to -20 dB</p> <p>Input levels 100 mV to 4 V at 997 Hz:<br/> <math>\pm 1.0</math> dB over range -80 dB to -20 dB</p> <p>THD:</p> <p>Input levels 100 mV to 4 V at 997 Hz:<br/> <math>\pm 0.5</math> dB over range -80 dB to -20 dB</p> <p>Stereo Separation:</p> <p><math>\pm 1.0</math> dB at input level 1 V at 997 Hz over dynamic range of 80 dB</p> <p>Stereo Phase:</p> <p>Mic input -90 to +270 <math>\pm 1</math> degree <math>\pm 1</math> sample at 997 Hz for input of 10 mV or greater, with signal to noise ratio of 30 dB or greater</p> |
| <p><b>Microphone Input</b></p>     |  |
| <p>Microphone input connection</p> | <p>XLR</p> <p>Impedance: 2k Ohms nominal</p> <p>Input level: 1 mV to 200 mV</p> <p>Measurement resolution: 0.1 mV</p> <p>Balanced</p> <p>Internal 48 V phantom power supply for accessory microphone.</p> <p>Compliant with EN61938: 1997.</p>   |

|  |   |
|--|---|
| <p>Measurements for microphone input</p> | <p>Level accuracy:</p> <p>Input levels 10 mV to 200 mV:</p> <ul style="list-style-type: none"> <li>±0.2dB at 997 Hz</li> <li>±0.5 dB, 100 Hz to 20 kHz</li> <li>-3 dB at 20 Hz</li> </ul> <p>Level accuracy:</p> <p>Input levels 2mV to 9.9 mV:</p> <ul style="list-style-type: none"> <li>±0.5 dB at 997 Hz</li> <li>±1 dB, 100 Hz to 20 kHz</li> <li>-3 dB at 20 Hz</li> </ul> <p>THD+N:</p> <p>For input levels 10 mV to 100 mV:</p> <ul style="list-style-type: none"> <li>±0.5 dB, -65 dB to -20 dB</li> </ul> <p>THD:</p> <p>For input levels 10 mV to 100 mV:</p> <ul style="list-style-type: none"> <li>±0.5 dB, -65 dB to -20 dB</li> </ul> <p>Stereo Separation:</p> <p>Accuracy: ±1 dB at input level 10 mV at 997 Hz and 20 kHz over dynamic range of 60 dB</p> <p>Stereo Phase:</p> <p>Mic input -90 to +270 ±1 degree ±1 sample at 997 Hz for input of 10 mV or greater, having signal to noise ratio of 30 dB or greater</p> |
|--|---|

**Other Audio Outputs**

|                            |   |
|----------------------------|---|
| <p>Built-in speakers</p>   | <p>2 integrated speakers</p>  |
| <p>Headphone connector</p> | <p>3.5 mm stereo output for connection of standard headphones.<br/>Connection of a headset automatically mutes the internal speakers.</p> |

**Bluetooth Digital Output Level**

|  |                           |
|--|---------------------------|
| <p>Level of sinusoidal test signal relative to maximum peak sinusoid</p> | <p>0 dBFS to -40 dBFS</p> |
|--|---------------------------|

| BlueAudio PC Application  |  |
|---------------------------|--|
| BlueAudio software        | <p>PC GUI application in VB.NET.</p> <p>Configures MT8855A hardware and displays results graphically and numerically.</p> <p>BlueAudio contains a Manual Mode in which individual tests are configured and run, and an Auto Test mode in which a test plan is generated and executed, with results automatically displayed in a report and saved to a database.</p>  |
| BlueAudio display windows | <p>Measurement control:</p> <ul style="list-style-type: none"> <li><i>Bluetooth</i> profile</li> <li><i>Bluetooth</i> connection</li> <li>Input/Output configuration</li> <li>Measurement configuration</li> </ul> <p>Results:</p> <p>Left / Right channel results displayed simultaneously.</p> <p>Numeric</p> <ul style="list-style-type: none"> <li>Level (5 frequency level measurements)</li> <li>THD+N</li> <li>THD (up to max 20 harmonics for 1 kHz tone, or less)</li> <li>SINAD</li> <li>Stereo separation</li> <li>Stereo phase</li> <li>PESQ/MOS (requires option)</li> </ul> <p>Graphical</p> <ul style="list-style-type: none"> <li>Freq response</li> <li>FFT</li> <li>THD+N vs level</li> <li>THD+N vs Freq</li> </ul> |
| PC requirements           | <p>The BlueAudio application runs on Windows XP and Vista operating systems. The application supports English, Chinese, Japanese operating systems.</p> <p>BlueAudio runs through a USB connection to the MT8855A.</p>   |



**PESQ and MOS option**

|  |  |
|--|--|
| Option -032<br>PESQ/MOS                        | <p>Performs PESQ (Perceptual Evaluation of Speech Quality) and MOS (Mean Opinion Score) measurements on reference audio signals.</p> <p>Reference audio signals can be user created, downloaded from the ITU website, or MT8855A-033 ASTS files.</p> <p>PESQ/MOS measurements are supported on HSP/HFP and SCO/eSCO connections.</p> <p>Anritsu license the PESQ measurement algorithm from Psytechnics Limited. The PESQ measurement is fully compliant with ITU-T P.862.</p> |
| Option -033<br>ASTS reference<br>audio signals | <p>Artificial Speech-like Test Signal (ASTS) are audio files that have been specially formulated for use in PESQ measurements. They contain a full range of British English and American English phonetic sounds in ten second files. Male and female voices supplied.</p>   |

**User programming interface**

|  |   |
|--|---|
| API interface to<br>MT8855A class<br>library | <p>Documentation and programming examples that explain how to use the MT8855A Class Library to create user test programs.</p> |
| BlueStart                                    | <p>A sample open source program developed in Visual Basic 2005 with comprehensive comments.</p>                               |

**General**

|         |  |
|---------|--|
| General | <p>Power supply: 85 to 264 V AC</p> <p>Frequency: 47 to 63 Hz</p> <p>Power: 50 Watt max, 25 Watt typical</p> <p>Dimensions: W:230 mm, H:110 mm, D:387 mm</p> <p>Weight: 3.5 Kg</p> <p>Operating temperature range: +5° C to +40° C</p> <p>Operating humidity: &lt;75% non condensing</p> <p>Safety: Complies with BS EN 61010-1 (Equivalent to IEC 61010-1).</p> <p>EMC: Conforms to the protection requirements of EEC Council Directive EN61326: 2006.</p> |
|---------|--|

# Appendix B — Default Values

## B-1 MT8855A Default Values

**Table B-1.** Audio Test Set Status Monitoring

| DESCRIPTION                                  | RANGE                       | DEFAULT    |
|--|-----------------------------|------------|
| Analogue Audio Input Type                    | Microphone   Line In        | Microphone |
| Phantom Power Supply State                   | On   Off                    | Off        |
| Analogue Audio Input Ranging Type            | Auto   Manual               | Auto       |
| Analogue Audio Input Range                   | 1 to 8                      | 8          |
| Analogue Audio Output Type                   | Speaker   Line out   Off    | Speaker    |
| 'Line out' Output Level                      | 1 mV to 2 V RMS             | 1 V        |
| Tx <i>Bluetooth</i> Signal Level             | Over air   Cable connection | Over air   |
| Internal Monitor Volume (Audio Input)        | 0 to 100                    | 30         |
| Internal Monitor Volume (Audio Output)       | 0 to 100                    | 30         |
| Internal Monitor Volume ( <i>Bluetooth</i> ) | 0 to 100                    | 30         |
| Audio Test Set LCD Contrast                  | 1 to 10                     | 5          |

**Table B-2.** *Bluetooth* Protocol and DUT Configuration

| DESCRIPTION            | RANGE                             | DEFAULT       |
|------------------------|-----------------------------------|---------------|
| DUT Address Source     | Manual   Inquiry   Inquiry + name | Inquiry       |
| Max. Inquiry Responses | 1 to 10                           | 1             |
| Inquiry Timeout        | 5 to 60 seconds                   | 20 seconds    |
| Inquiry Filter         | All   Audio / Video   Telephony   | All           |
| Profile                | A2DP   HSP   HFP                  | A2DP          |
| A2DP Role              | Source   Sink                     | Source        |
| A2DP Sample Rate       | 48 kHz   44.1 kHz                 | 44.1 kHz      |
| HSP/HFP Role           | Audio gateway   Hands-Free Unit   | Audio gateway |
| Use Default SCO Values | Yes   No                          | Yes           |
| SCO Connection Type    | SCO   eSCO                        | SCO           |

## MT8855A Default Values

**Table B-2.** *Bluetooth* Protocol and DUT Configuration

| DESCRIPTION             | RANGE   | DEFAULT    |
|-------------------------|---|------------|
| Packet Type             | HV1   HV2   HV3   EV3   EV4   EV5   2EV3   2EV5   3EV3   3EV5 | HV3        |
| Voice Setting           | CVSD   $\mu$ -Law   A-Law                                     | CVSD       |
| DUT Test Item           | Microphone   Speaker  | Speaker    |
| Audio Test Set Function | Generator   Analyser  | Generator  |
| Pairing PIN Length      | 1 to 16   | 4          |
| Pairing PIN             | [0-9][A-Z] for each character                                 | 0000       |
| Pairing State           | Paired   Unpaired   | Unpaired   |
| Paging Timeout          | Default values used   | 5 seconds  |
| Connection Timeout      | Default values used   | 20 seconds |
| Test Set Initiates      | Yes   No  | No         |

**Table B-3.** Exporting Results

| DESCRIPTION  | RANGE                          | DEFAULT                |
|--|--------------------------------|------------------------|
| Export Format  | CSV   XML                      | CSV                    |
| Date Filter State                                    | On   Off                       | Off                    |
| Start Date   | 01/01/08 to current date       | Start of current month |
| End Date   | 01/01/08 to current date       | Current date           |
| DUT <i>Bluetooth</i> Address Filter State            | On   Off                       | Off                    |
| DUT <i>Bluetooth</i> Address                         | Valid <i>Bluetooth</i> address | 0x000000000000         |
| Audio Test Set <i>Bluetooth</i> Address Filter State | On   Off                       | Off                    |
| Audio Test Set <i>Bluetooth</i> Address              | Valid <i>Bluetooth</i> address | 0x000000000000         |
| Audio Test Set Serial Number Filter State            | On   Off                       | Off                    |
| Pass/Fail Filter State                               | On   Off                       | Off                    |
| Pass/Fail Value                                      | Pass   Fail                    | Fail                   |

**Table B-4.** Test Set Configuration

| DESCRIPTION               | RANGE                | DEFAULT    |
|---------------------------|----------------------|------------|
| Analogue Audio Input Type | Microphone   Line In | Microphone |

**Table B-4.** Test Set Configuration

| DESCRIPTION                       | RANGE  | DEFAULT                |
|-----------------------------------|--|------------------------|
| Phantom Power Supply State        | On   Off   | Off                    |
| System Mode                       | <i>Bluetooth</i> audio   Pass Through   Analogue audio                 | <i>Bluetooth</i> audio |
| Analogue Audio Input Ranging Type | Auto   Manual  | Auto                   |
| Analogue Audio Input Range        | 1 to 9   | 9                      |
| Analogue Audio Output Type        | Speaker   Line out   | Speaker                |
| 'Speaker' Output Level            | 0 to 2.83 V  | 1 V                    |
| 'Line out' Output Level           | 1 mV to 2 V RMS  | 1 V                    |
| Tx <i>Bluetooth</i> Signal Level  | Over air   Cable connection  | Over air               |
| Internal Monitor Source           | Off   Audio In   Audio Out   Rx <i>Bluetooth</i>   Tx <i>Bluetooth</i> | Off                    |
| LCD Contrast                      | 1 to 10  | 5                      |

**Table B-5.** *Bluetooth* System

| DESCRIPTION                    | RANGE                          | DEFAULT        |
|--------------------------------|--------------------------------|----------------|
| Connected Device Address       | Valid <i>Bluetooth</i> address | 0x000000000000 |
| Connected Device Friendly Name | 20 characters                  | N/A            |
| Inquiry Address 'n'            |                                |                |
| (n = 1 to 10)                  | Valid <i>Bluetooth</i> address | N/A            |
| Inquiry Friendly Name 'n'      |                                |                |
| (n = 1 to 10)                  | 20 characters                  | N/A            |
| Inquiry Filter                 | All   Audio & Telephony        | All            |
| Pairing PIN                    | [0-9][A-Z] for each character  | 0000           |
| Connection Timeout             | 2 to 30 seconds                | 20 seconds     |
| A2DP Profile Supported         | Yes   No                       | Yes            |
| HSP Profile Supported          | Yes   No                       | Yes            |
| HFP Profile Supported          | Yes   No                       | Yes            |
| Profile                        | A2DP   HSP   HFP               | A2DP           |
| A2DP Role                      | Source   Sink                  | Source         |
| A2DP Sample Rate               | 48 kHz   44.1 kHz              | 44.1 kHz       |
| HSP/HFP Role                   | Audio gateway   Device         | Audio gateway  |
| SCO Connection Type            | SCO   eSCO   Any               | Any            |
| DUT Test Item                  | Microphone   Speaker           | Speaker        |



# Appendix C — MT8855A LCD Messages

## C-1 MT8855A Messages

Table C-1. LCD Messages

| LCD Message                                   | Description   |
|---|---|
| <b>Analogue Audio</b>                         | Displayed when “System Mode” is set to “Analogue Audio”.  |
| <b>Anritsu MT8855A Audio Test Set</b>         | Displayed when the MT8855A does not have a USB connection to a PC.  |
| <b>Anritsu MT8855A M.mm</b>                   | Displayed after self test message. Indicates the version of the firmware installed in the MT8855A.  |
| <b>Answer The Call</b>                        | The MT8855A has sent a RING command to the DUT. The call must be answered on the DUT.   |
| <b>Bluetooth Audio</b>                        | Displayed when “System Mode” is set to “Bluetooth Audio”.   |
| <b>Bluetooth Pass Through</b>                 | Displayed when “System Mode” is set to “Bluetooth Pass Through”.  |
| <b>Call Answered</b>                          | The DUT has answered the call from the MT8855A.   |
| <b>Connected</b>                              | The MT8855A has successfully connected to the DUT.  |
| <b>Connecting</b>                             | The MT8855A is currently trying to connect to the DUT.  |
| <b>Connection Failed Authentication</b>       | The attempt to connect to the DUT failed due to an authentication error. Confirm that the Passkey Length and Passkey are set correctly in BlueAudio.  |
| <b>Connection Failed Page Timeout</b>         | The attempt to connect to the DUT failed due to a page timeout. Confirm that the DUT is in range, confirm that it is configured to accept connections, and confirm that the MT8855A RF connection path is set to Cable Connection or Over Air as appropriate for the test method. |
| <b>Connection Failed Unsupported Air Code</b> | The attempt to connect to the DUT failed due to the DUT not supporting the air code being used by the MT8855A. If using the HSP or HFP, check that the Voice Settings selected in [Bluetooth Profile] > [Advanced Configuration] match the requirements of the DUT.               |
| <b>Connection Failed Unsupported Pkt Type</b> | The attempt to connect to the DUT failed due to the DUT not supporting the packet type being used by the MT8855A. If using the HSP or HFP, check that the settings in the [Bluetooth Profile], “SCO Connections” frame are supported by the DUT.                                  |
| <b>Connection Failed Unsupported Profile</b>  | The attempt to connect to the DUT failed due to the DUT not supporting the profile being used by the MT8855A. Check that the Profile and MT8855A Role are set correctly.  |

## MT8855A Messages

Table C-1. LCD Messages

| LCD Message                         | Description  |
|-------------------------------------|--|
| <b>Connection Timeout</b>           | The <i>Bluetooth</i> connection has been lost as no communication has been received from the DUT within the timeout period.  |
| <b>Disconnected</b>                 | The disconnection attempt has been successfully completed.   |
| <b>Disconnecting</b>                | The MT8855A is attempting to break the <i>Bluetooth</i> connection with the DUT.   |
| <b>Disconnection Failed Timeout</b> | The disconnection attempt did not succeed within the specified time.   |
| <b>Encryption Not Accepted</b>      | The encryption request from the MT8855A was rejected by the DUT.   |
| <b>Host Timeout</b>                 | The DUT has not responded to a connection request.   |
| <b>Inquiry Cancelled</b>            | The <i>Bluetooth</i> inquiry was cancelled by the user.  |
| <b>Inquiry Complete</b>             | The MT8855A has completed the <i>Bluetooth</i> inquiry.  |
| <b>Inquiry in Progress</b>          | The MT8855A is performing a <i>Bluetooth</i> inquiry.  |
| <b>Inquiry Timeout</b>              | The <i>Bluetooth</i> inquiry timed out without finding a device.   |
| <b>Measuring</b>                    | The MT8855A is currently performing measurements.  |
| <b>Name Discovery Complete</b>      | The MT8855A has finished retrieving the <i>Bluetooth</i> friendly names.   |
| <b>Name Discovery In Progress</b>   | The MT8855A is retrieving the friendly names of the devices found during the <i>Bluetooth</i> inquiry.   |
| <b>Output Load Low</b>              | The device attached to the MT8855A's line output has an impedance of less than 600 Ohms.   |
| <b>Output Unlevelled</b>            | The signal being output from the MT8855A's line or speaker outputs is unlevelled.  |
| <b>Self Test – Fail XXXXXXXX</b>    | <p>Initial message displayed after power on, indicating that the MT8855A has failed one or more of the power on self tests. 'X' can either be 'P' – pass, or 'F' – fail.</p> <p>The order of the tests are (from left to right):</p> <ul style="list-style-type: none"><li>Checksum not set in the flash memory</li><li>Main application code cannot be found</li><li>Flash memory failed its checksum test</li><li>RAM read/write failure</li><li>RAM read/write failure</li><li>LCD read/write failure</li><li>LCD read/write failure.</li></ul> |
| <b>Self Test – Pass</b>             | Initial message displayed after power on, indicating that the MT8855A has passed the power on self tests.  |
| <b>Unsupported Features</b>         | The MT8855A has attempted to use a feature that the DUT cannot support.  |

**Table C-1.** LCD Messages

| <b>LCD Message</b>                             | <b>Description</b>   |
|--|--|
| <b>Update Complete<br/>Restarting Test Set</b> | The MT8855A's firmware has been successfully updated and the MT8855A is about to restart itself. |
| <b>Updating Firmware</b>                       | The MT8855A's firmware is currently being updated.   |
| <b>USB Connected</b>                           | The MT8855A has been connected to a PC via the USB.  |
| <b>USB Disconnected</b>                        | The USB connection to the PC has been removed.   |
| <b>USB Error Command Rx</b>                    | An error was detected in the data received from the PC.  |
| <b>USB Error Command Tx</b>                    | An error was detected when attempting to send data to the PC.                                    |
| <b>USB Error Event Tx</b>                      | An error was detected when attempting to send data to the PC.                                    |





# Appendix D — Packet Types

Table D-1. Packet Type Definitions

|             | User payload (bytes) | FEC | CRC | SCO / eSCO | EDR compatible |
|-------------|----------------------|-----|-----|------------|----------------|
| <b>HV1</b>  | 10                   | 1/3 | No  | SCO        | NO             |
| <b>HV2</b>  | 20                   | 2/3 | No  | SCO        | NO             |
| <b>HV3</b>  | 30                   | No  | No  | SCO        | NO             |
| <b>EV3</b>  | 1-30                 | No  | Yes | eSCO       | NO             |
| <b>EV4</b>  | 1-120                | 2/3 | Yes | eSCO       | NO             |
| <b>EV5</b>  | 1-180                | No  | Yes | eSCO       | NO             |
| <b>2EV3</b> | 1-60                 | No  | Yes | eSCO       | YES            |
| <b>3EV3</b> | 1-90                 | No  | Yes | eSCO       | YES            |
| <b>2EV5</b> | 1-360                | No  | Yes | eSCO       | YES            |
| <b>3EV5</b> | 1-540                | No  | Yes | eSCO       | YES            |

The achievable audio performance of the device is not affected by the packet type. The selection between different packet types, and between SCO and eSCO, is determined by the link Master and based upon the capabilities of the device and upon the demands on the *Bluetooth* piconet for data bandwidth. For example, a PC may be connected to a *Bluetooth* headset, phone, and printer at the same time. The bandwidth available for a Handsfree connection to the headset may be limited if the PC is also sending a large file to the printer at the same time. A simple SCO connection does not implement retries if a packet is lost or not Acknowledged. An eSCO connection does attempt retries if a packet is lost, and this can result in better audio quality, typically audible as fewer "clicks".

Where the RF link quality is good between two *Bluetooth* devices, and the FER is zero or close to zero, the audio performance is determined by other aspects of the *Bluetooth* specification such as codec selection and sampling rates.



# Appendix E — Rack Mounting

The MT8855A can be ordered with rack mounting hardware that allows it to be mounted into a standard 48 cm equipment rack. There are two rack mount option kits available:

The MT8855A-001 Rack Mount option allows the installation of a single MT8855A in either the left or right side rack position.

The MT8855A-003 Rack Mount option allows side-by-side mounting of two MT8855A test sets.

## E-1 Single Unit Rack Mounting (Option MT8855A-001)

This section describes the assembly procedure for fitting a single MT8855A into an instrument rack. The MT8855A universal top and bottom covers have removable feet to allow the rack mount kit to be fitted. The procedure involves fitting a support bracket, front plate, base panel, and a rear support bracket to the MT8855A. The MT8855A can then be loaded and secured in the rack position.

**Table E-1.** Parts List

| Anritsu No. | Description                       | Quantity |
|-------------|-----------------------------------|----------|
| 50077       | Front face plate                  | 1        |
| 900-848     | M4, kep nut                       | 2        |
| 790-319     | Speed nut                         | 4        |
| 900-821     | Decorative screw                  | 4        |
| 3-788-575   | Snap rivet, plastic               | 6        |
| C37276      | Rack mount, side, bracket         | 1        |
| C41449      | Rear support, bracket, rack mount | 1        |
| D41473      | Rack mount, support bracket       | 1        |
| 49361       | Bracket support, base panel       | 1        |
| 1-2796931   | Screw, 4NPS18S7 + SW+ WB          | 8        |

### Tools Required

- 1 small Phillips screwdriver
- 1 large Phillips screwdriver
- 1 small Phillips torque screwdriver 10 cNm to 120 cNm.
- 1 torque socket driver 6 cNm to 406 cNm.

### Assembly Procedure

1. Remove the four plastic feet from the front of the MT8855A.
2. Remove the four plastic feet from the rear of the MT8855A. When the feet have been removed, re-insert the four screws removed from the rear panel and torque them to 8

## Single Unit Rack Mounting (Option MT8855A-001)

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in-lbs (90 cNm). Refitting the rear panel screws in this manner provides extra strength to the outer casing.

3. Lay the large support bracket D41473 next to the MT8855A as per the assembly drawing. If the MT8855A is to be mounted on the left side of the rack, lay the bracket on the MT8855A's right side to show a mirror image of the assembly drawing.
4. Install the support bracket onto the MT8855A with 4 screws 1-2796931. Leave the two rear screws loose to allow alignment and securing of the 6 base plate snap rivets 3-788-575. Torque the two front screws to 4in-lbs (45cNm).
5. Install the front rack mounting bracket C37276 at the front of the MT8855A on the other side of the large support bracket with two screws 1-2796931. Torque the screws to 4in-lbs (45cNm).
6. Install the rear rack bracket C41449 at the back of the MT8855A on the other side to the large support bracket with two screws 1-2796931. Torque the screws to 4in-lbs (45cNm).
7. Install the front face plate 50077 with 2 kep nuts 900-848. Torque the nuts to 14in-lbs (158cNm).
8. Position the base panel 49361 as shown in the drawing, and secure with 6 snap rivets 3-788-575.
9. Torque the two rear screws installed in step 3 to 4in-lbs (45cNm).
10. Install the four speed nuts 790-319 to the rack in the correct place to allow mounting of the MT8855A into the rack.
11. Slide the MT8855A into the rack and secure with 4 decorative screws 900-821.

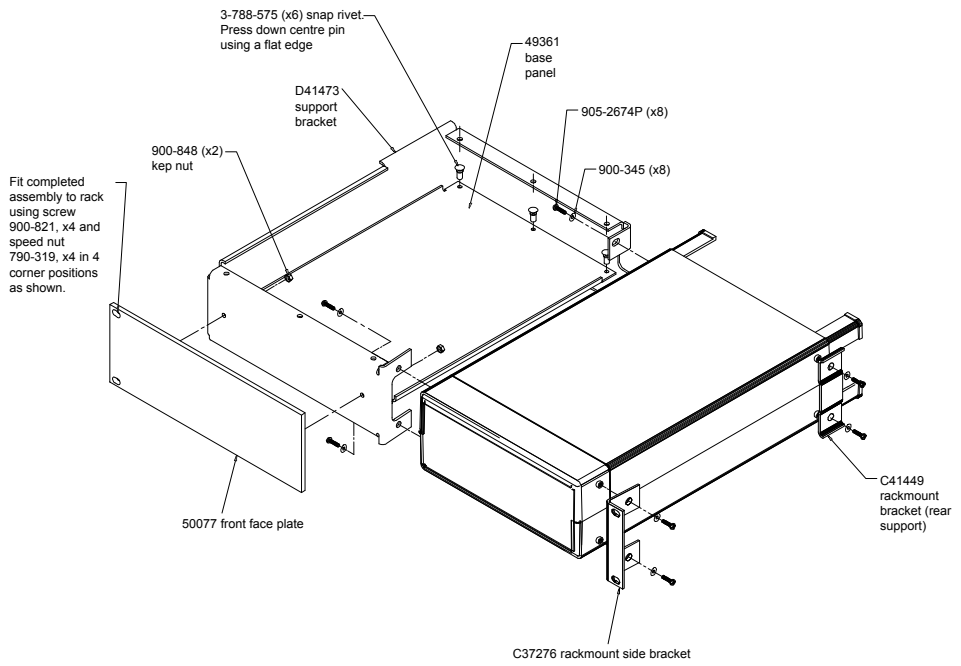


Figure E-1. Single Unit Rack Mounting

## E-2 Side-by-Side Rack Mounting (Option MT8855A-003)

This section describes the assembly procedure for fitting two MT8855A units into a instrument rack. The universal top and bottom covers have removable feet to allow the rack mount kit to be fitted. The procedure involves fitting support brackets and two rear support brackets, one on each unit. Once locked together, the two MT8855As can then be loaded and secured into the rack.

**Table E-2.** Parts List

| <b>Anritsu No</b> | <b>Description</b>                                 | <b>Quantity</b> |
|-------------------|--|-----------------|
| 790-319           | Speed nut  | 4               |
| 1-2796931         | Screw, 4NPS18S7 + SW + WB                          | 16              |
| 900-821           | Decorative screw                                   | 4               |
| 3-905-2640P       | M3X6, POS, SST, Patchlock, screw, metric, FLT HD   | 4               |
| 49415             | Rack mount side bracket                            | 1               |
| 49413             | Rack mount center rear bracket                     | 1               |
| C37275            | Rack mount center, front bracket                   | 1               |
| C37276            | Rack mount side bracket                            | 1               |
| C37277            | Rack mount center, bracket                         | 1               |
| C37279            | Rack mount center, bracket                         | 1               |
| C41449            | Rear support, bracket rackmount                    | 2               |
| 50210             | Foot removal tool                                  | 1               |
| 3-905-2674P       | M3 X 8, POS, SST, patchlock, screw, metric, PAN HD | 8               |
| 900-345           | Washer, 6-32UNC, oversize                          | 8               |

### Tools Required

- 1 small Phillips screwdriver
- 1 large Phillips screwdriver
- 1 small Phillips torque screwdriver 10 cNm to 120 cNm.
- 1 foot removal tool (supplied).

### Assembly Procedure

1. Remove the four plastic feet from the front of both units.
2. Remove the four plastic feet from the rear of both units. When the feet have been removed, re-insert the screws removed from the rear panel (four on each unit) and

torque them to 8 in-lbs (90 cNm). Refitting the rear panel screws in this manner provides extra strength to the outer casing.

3. On the two sides of the MT8855A to be joined together, fit the two rear brackets 49413, C37279, and two front brackets C37275, C37277 using 8 screws 1-2796931. Torque the screws to 4in-lbs (45cNm).
4. Slide the two MT8855As together and secure using 4 counter sink screws 3-905-2640P.
5. Install the two front rack brackets C37276 and 49415 at the front of each of MT8855A, one on each side with four screws 1-2796931. Torque the screws to 4in-lbs (45cNm).
6. Install the two rear rack brackets C41449 at the back of each MT8855A, one on each side with four screws 1-2796931. Torque the screws to 4in-lbs (45cNm).
7. Fit the four speed nuts 790-319 to the rack in the correct place to allow mounting of the two MT8855As in the rack.
8. Slide the two MT8855As into the rack and secure with 4 decorative screws 900-821.

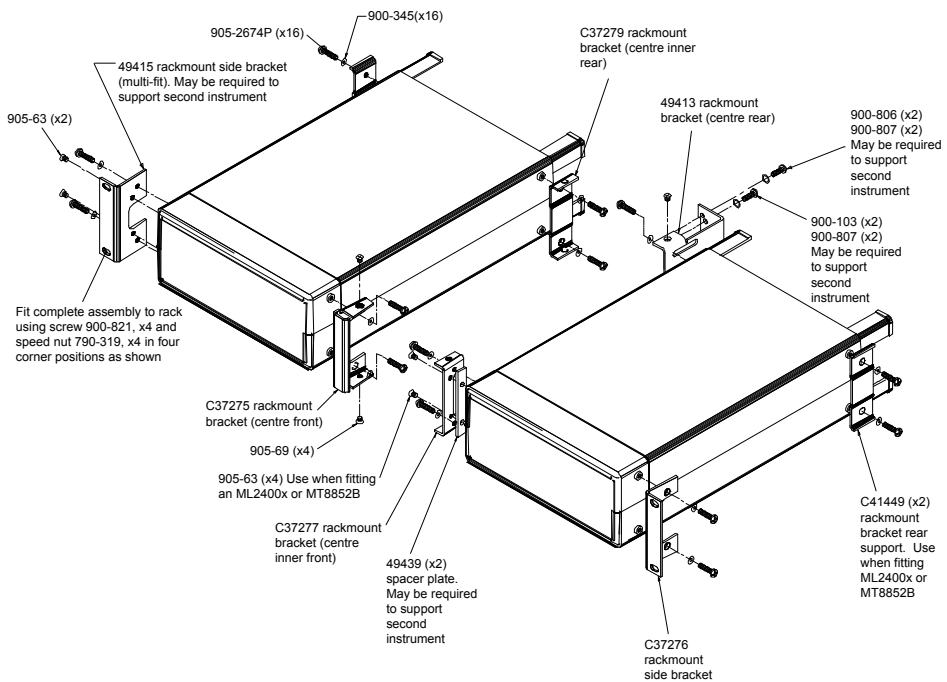


Figure E-2. Side by Side Rack Mounting





# Appendix F — Terminology Glossary

**Table F-1.** Commonly Used Acronyms and Terminology

| <b>Term</b> | <b>Meaning</b>  |
|-------------|---|
| A2DP        | Advanced Audio Distribution Profile   |
| API         | Application Programming Interface   |
| AVRCP       | Audio Visual Remote Control Profile   |
| BlueAudio   | PC application providing the user interface for Mozart                        |
| CRC         | Cyclical Redundancy Check   |
| CSV         | Comma Separated Variables   |
| dBFS        | dB Full Scale   |
| DUT         | Device Under Test   |
| eSCO        | <i>Bluetooth</i> extended Synchronous Connection Oriented (logical transport) |
| FEC         | Forward Error Correction  |
| FFT         | Fast Fourier Transform  |
| HFP         | <i>Bluetooth</i> Hands-Free profile   |
| HSP         | <i>Bluetooth</i> Headset profile  |
| HTML        | Hyper Text Mark-up Language   |
| MOS         | Mean Opinion Score  |
| PESQ        | Perceptual Evaluation of Speech Quality                                       |
| PIN         | Personal Identification Number  |
| RMS         | Root Mean Square  |
| SCO         | <i>Bluetooth</i> Synchronous Connection Oriented (logical transport)          |
| SIG         | <i>Bluetooth</i> Special Interest Group                                       |
| SINAD       | Signal-to-Noise and Distortion  |
| THD         | Total Harmonic Distortion   |
| THD+N       | Total Harmonic Distortion plus Noise  |
| XML         | Extensible Mark-up Language   |



# Appendix G — 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.

## G-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).

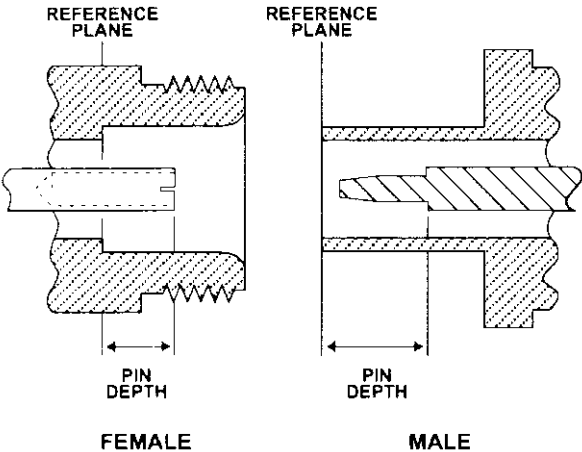
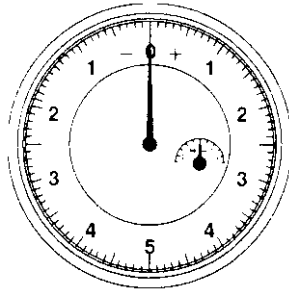


Figure G-1. N Connector Pin Depth Definition

## Torquing Connectors

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 Gauge equivalent can be used for this purpose.



**Figure G-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        | 01-162                    | -0.000             | Same as pin depth       |
| WSMA - Female      |                           | -0.010             |                         |
| 3.5 mm - Female    |                           |                    |                         |

## G-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.*

## G-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.

## G-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 H — PC Regional Settings

The BlueAudio 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 BlueAudio 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 (.).

## H-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.

## H-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.





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