

# **FONIX® 8000**

## **Hearing Aid Test System**

### **Operator's Manual**

Version 3.00



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## Basic Test Functions

### The basic 8000 can perform the following coupler tests:

- Pure-tone signal measurements
- Composite and Digital Speech signal measurements
- ISTS: International Speech Test Signal according to IEC 60118-15
- Phase measures for binaural hearing aid pairs
- Group delay (processing delay) measurement of digital hearing aids
- Battery Current as a function of amplitude and frequency
- I/O Curves
- Attack and Release
- Choice of IEC 60118-7:1994/2005, ANSI S3.22-2009/03/96/87/92/14, JIS, or Profiler automated test sequences

An additional function that comes standard with the 8000 is RS232 communication with an external personal computer. This allows remote operation of the analyzer from the computer, and lets you save test results onto your computer's hard drive. Firmware upgrades to the 8000 Test System can also be performed through the computer.

## Accessories

The following are accessories that are standard and optional on your FONIX 8000 hearing aid analyzer.

### Standard Accessories



#### **HA-2, 2-cc Coupler**

Dimensions per ANSI S3.7 for testing behind-the-ear aids, eyeglass aids, and body aids. When the FONIX 8000 is ordered with the 8120 Polar Plot Sound Chamber, this coupler has a magnetic strip. (p/n 044-1029-xx)



#### **HA-1 2-cc Coupler**

Dimensions per ANSI S3.7 for testing in-the-ear aids, canal aids, and aids fitted with earmolds. When the FONIX 8000 is ordered with the 8120 Polar Plot Sound Chamber, this coupler has a magnetic strip. (p/n 044-1031-xx)



#### **Microphone Adapter**

14 mm to 1" (25.4) mm adapter for coupling the M1950E microphone and reference microphone to a 1-inch device such as a sound level calibrator. (p/n 044-1006-01)



#### **CIC Coupler**

Non-standard (0.4 cc) coupler used for realistic testing of CIC hearing aids. This coupler is always used in conjunction with the CIC software correction factors. (p/n 044-1027-xx)



#### **6-cc Coupler**

Enables checking the response of standard audiometer headphones. It is designed around the NBS 9A coupler specifications. (p/n 044-1004-03)



#### **Chamber Remote Module**

It is used with either the 8060, 8070, or TBS25 chambers. (p/n REMOTE)



**Coupler Microphone - M3058E**

18 in. cable. (This Mic can be selected to use with the 8050 and the 8120 sound chamber for additional cost.)



**Coupler Microphone - M2050E**

6 ft. cable. (This Mic can be used with the 8060, the 8070 and the TBS25 sound chamber)



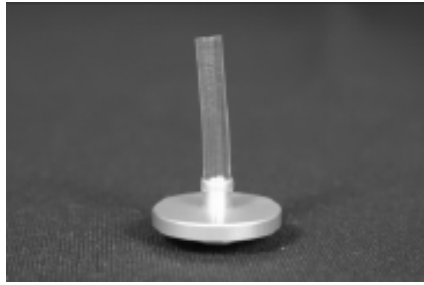
**8050 Sound Chamber**

This sound chamber can be used with the M1958E and the M2058E microphones. (p/n FC8050-1)



**Sound Level Calibrator**

A portable, self-contained, field-type calibrator for calibrating the micro-phone amplifier. It operates on one nine-volt transistor battery. Use with 14 mm-to-1" adapter. Calibration is traceable to the U.S. National Institute of Standards and Technology. Conforms to ANSI @1.40-2006 and IEC 942: 2003. (p/n 030-0004-01)



**Ear-Level Adapter (BTE)**

Snaps into the 1/4" (6.35 mm) diameter cavity of the HA-2 and MZ-2 couplers for testing BTE hearing aids. (p/n 044-1003-00)



**FPI Cable**

Used to connect the 8000 to sound chamber. Part number: 119-0282-00



**Auto-Detect Battery Substitution**

**Pills** - Used to power hearing aids, measure battery drain, and estimate battery life. Standard sizes:

675/76

13

312

10A/230



**Clamp Assembly BTE**

Attached to the BTE Rotator post and used to position the BTE hearing aid for Polar Plot testing. (p/n 034-1974-00)



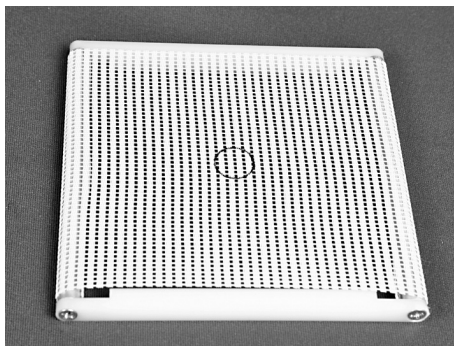
**Magnetic HA-1 Coupler**

This coupler is included with the 8000 in place of the standard HA-1 coupler when the 8120 Polar Plot sound chamber is ordered. It has a square magnetic surface attached to the coupler for easy positioning on the ITE Rotator Post for directional testing. (p/n 044-5031-01)

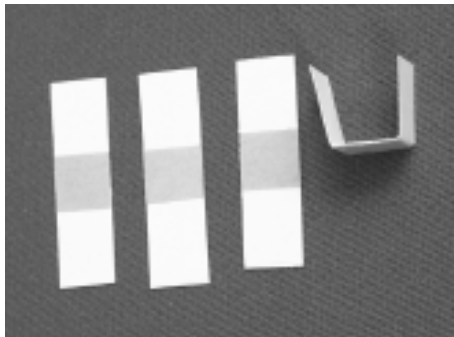


**Magnetic HA-2 Coupler**

This coupler is included with the 8000 in place of the standard HA-2 coupler when the 8120 Polar Plot sound chamber is ordered. It has a magnetic surface attached to the coupler for easy positioning on the BTE Rotator Post for directional testing. (p/n 044-5029-01)



**8120 Removable Test Surface** Placed over the 8120 cavity for non-directional hearing aid testing (p/n 053-1014-00)



**Paper shims**

Paper shims (or "gaskets") are provided for use inside the BTE Clamp Assembly to prevent scratches to the hearing aid. (p/n 011-0001-00)



**Probe Microphone Adapter**

This adapter is used to calibrate the probe microphone and for performing the RECD measurement. Part number (p/n 044-0025-01)



**Reference Microphone Calibrator Adapter**

This adapter is used to calibrate the reference microphone. Part number: 044-0208-00



**Monitor Headset**

For listening to the probe tube during real-ear measurements. Includes adapter. Part number: 015-1214-00



**BTE Rotator Post**

Used for mounting BTE hearing aids in the 8120 Polar Plot sound chamber (p/n 053-1013-00)



**ITE Rotator Post**

Used for mounting canal hearing aids to the 8120 Polar Plot sound chamber for directional testing. (p/n 053-1012-00)

## Layout, Controls, and Safety

This section describes the basic layout of the front and rear panel of the 8000 test system, and special information pertaining to safety regulations.

### Front Panel Layout

The front panel of the 8000 test system consists of 8 function keys, 4 arrow keys, and 9 other keys with varying operations. See Figure 1.5.1. Together, all of these keys are used to control all the operations of the 8000 test system. A wide internal thermal printer is located to the right of the front panel. The FONIX 8000 keyboard can also be controlled remotely from an Android tablet running the FONIX key-board app. See Appendix H for details.

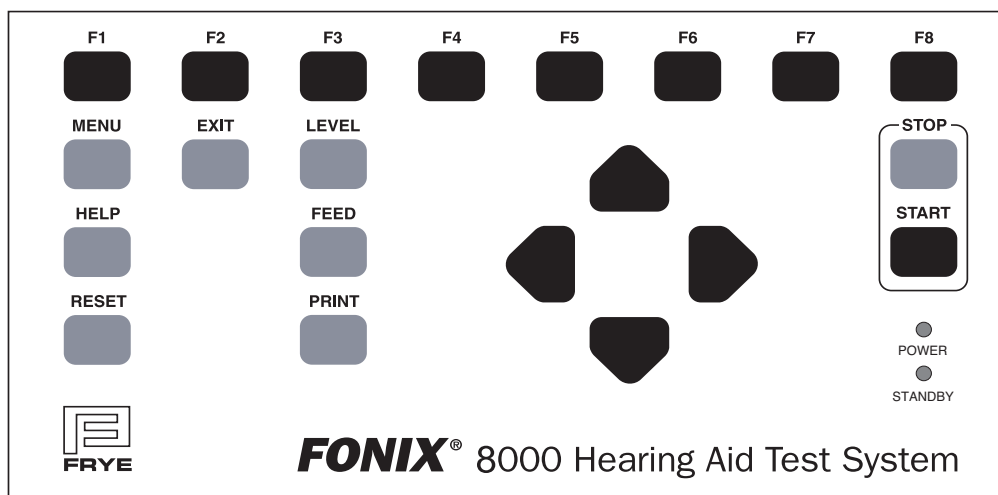


Figure 1.5.1—Front panel

#### FUNCTION KEYS:

The top row of buttons on the 8000 front panel consists of “function keys” labeled [F1] through [F8]. The function of these keys change from screen to screen, according to the operation displayed on the screen. There are three basic uses of the function keys:

- To navigate from screen to screen
- To toggle a selection
- To pop-up up a selection menu



<b>RESET:</b>	Resets the analyzer and returns you to the opening screen. Many settings, measurements, and test conditions are erased or returned to their default conditions with the push of this button. Use [EXIT] instead of [RESET] to avoid the loss of data.
<b>HELP:</b>	Displays a pop-up help window, which tells you what functions can be performed in the current screen.
<b>MENU:</b>	Opens a local menu, or the Default Settings menu.
<b>EXIT:</b>	Exits from the current screen, leaving all settings, measurements, and test conditions as is.
<b>LEVEL:</b>	Levels the sound chamber or sound field speaker.
<b>FEED:</b>	Advances the internal thermal paper feed.
<b>PRIN]:</b>	Prints current screen.
<b>STOP:</b>	Stops testing.
<b>START:</b>	Starts testing.

**ARROW KEYS:** The arrow keys perform different functions depending upon

the screen and previous buttons pushed. In a test situation, they adjust the source amplitude and frequency. If you press one of the function buttons to bring up a pop-up menu, they are used to scroll through the available options and make selections.

**LEDs:**

Power: When green, this LED indicates that the 8000 Test System is powered on.

Standby: When green, this LED indicates that the screensaver mode is engaged (screensaver not available at this time)

**For a more complete description of the operation of the function keys, see *Chapter 2 - Using the function keys*.**

## Rear Panel Layout

The rear panel of the 8000 test system contains the external connections for the analyzer. See Figure 1.5.2 for a diagram of the back panel.

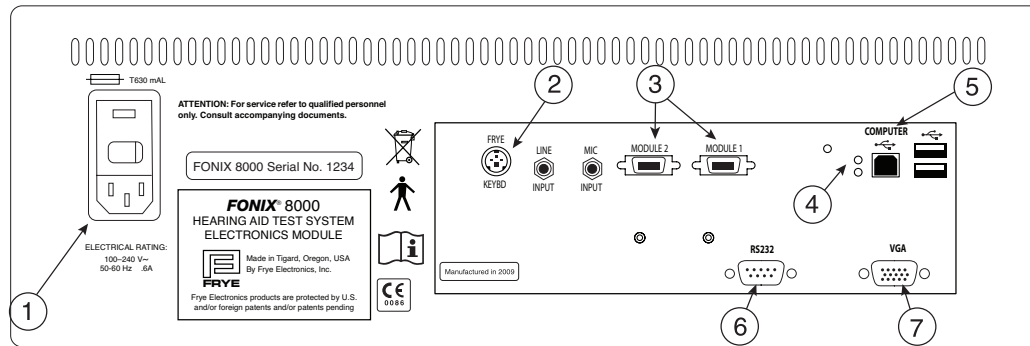


Figure 1.5.2—Back panel

1. **POWER:** Connects to the power cord and houses fuses.
2. **KEYBOARD:** Connects to Frye external keyboard.
3. **MODULE 1&2** Connects to Frye peripheral devices — 8050, 8060 & 8120 Sound Chambers, Chamber Remote Module and/or Probe Remote Module. Only one sound chamber can be con-nected at a time.
4. **RS232 LEDs:** The red LED indicates the analyzer is sending a poll. This will flash whether or not a computer is connected. The green LED indicates the analyzer is receiving a command from a connected computer.
5. **USB (Type B):** Connects to an external computer. You may need to make a BIOS setting to use this connector. This is the default com-puter communication connection. This connection is used for software upgrades, FONIX software programs like WinCHAP, FONIX NOAH Module or your own custom programs. Connect only to a standard USB port, 5 Volts maximum.
6. **RS232:** Connects to an external computer. You may need to make a BIOS setting to use this connector. This connector is disabled when shipped from the factory. The USB connection on No.5 above is the preferred method of communication.
7. **VGA:** See the maintenance manual if you must use this legacy 9 pin connector. Connect only to a standard RS232 port, 15

Volts Maximum. Connects to a video monitor.

The coupler microphone is plugged into the inside of the sound chamber. The connectors not labeled in Figure 1.5.2 are not currently active but will have functions in future software versions.

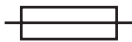
The following safety symbols can be found on the back of the 8000 hearing aid analyzer:



Type B Equipment. The probe microphone and insert earphone are type B applied parts, according to IEC 60601-1.



Read the accompanying documents. Please read this manual before operating the 8000 test system. A separate maintenance manual exists for the 8000 test system. If you wish to obtain a maintenance manual, please contact Frye Electronics, Inc. or your Frye representative.



Replace fuses only with the same type and rating.



The 8000 and some of its accessories contain lead. At the end of its useful life, please recycle or dispose of the 8000 according to local regulations.

## Safety

Safety Classification for IEC 60601-1

Type of protection against electric shock: Class I

Degree of protection against electric shock: Type B

Protection against harmful ingress of water: Ordinary

Mode of operation: Continuous

The 8000 does not require sterilization or disinfection.

Warning: This equipment is not suitable for use in the presence of flammable anaesthetic mixture with air or with oxygen or nitrous oxide.

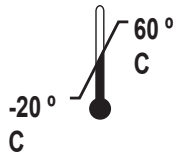
Warning: To avoid the risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

## Shipping

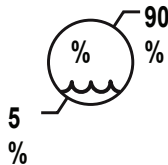
The following symbols are included on the electronic module shipping box:



Keep dry. The 8000 Hearing Aid Test System should not be exposed to water or other fluids. Failure to comply could lead to damage to the equipment or even electric shock in some cases.



The shipping/storage temperature of the 8000 is -20 to 60 degrees Celsius (-4 to 140 degrees Fahrenheit)



The shipping/storage Humidity of the 8000 is 5 to 90 percent relative humidity (non-condensing)

**Warning: Do not touch the contacts of connectors and the patient simultaneously.**

**Connection of peripheral equipment to the 8000**

**Compliance with IEC 60601-1: 2005 Safety requirements for medical electrical systems must be determined on a case-by-case basis.**

**All electrical equipment attached to the 8000, such as video monitors, computer equipment, etc. must, at a minimum, meet one of the following conditions:**

- a. The equipment complies with IEC 60601-1
- b. The equipment complies with relevant IEC and ISO safety standards and is supplied from a medical grade isolation transformer.
- c. The equipment complies with relevant IEC and ISO safety standards and is kept at least 1.5 meters from the patient.

The allowable leakage currents of IEC 60601-1: 2005 must not be exceeded. IEC 60601-1: 2005 should be consulted when assembling such a system. Failure to comply with these instructions could lead to interference with nearby medical equipment.

### **Electromagnetic compatibility**

The 8000 complies with IEC 60601-1-2.

The 8000 generates and uses radio frequency energy. In some cases the 8000 could cause interference to radio or television reception. You can determine if the 8000 is the source of such interference by turning the unit off and on.

If you are experiencing interference caused by the 8000, you may be able to correct it by one or more of the following measures:

1. Relocate or reorient the receiving antenna.
2. Increase the distance between the 8000 and the receiver.
3. Connect the 8000 to a different outlet than the receiver.

In some cases radio transmitting devices, such as cellular telephones, may cause interference to the 8000. In this case try increasing the distance between the transmitter and the 8000.

### **Disposal of the 8000 and accessories**

The 8000 and some of its accessories contain lead. At the end of its useful life, please recycle or dispose of the 8000 according to local regulations.

If you are located in the European Union, please report all safety-related concerns to our authorized representative:



Sivantos Ltd.  
Platinum House  
Sussex Manor Business Park  
Gatwick Road  
Crawley RH10 9NH  
ENGLAND

Otherwise, please report all safety related concerns to the Frye factory:



Frye Electronics, Inc. 8279 SW Cirrus Drive Beaverton, OR 97008  
Ph: (503) 620-2722 Fax: (503) 639-0128  
Email: support@frye.com sales@frye.com

## Setup

This section describes the unpacking and setup of the 8000 test system. A description of the front and back panels is also included.

### Unpacking the FONIX 8000

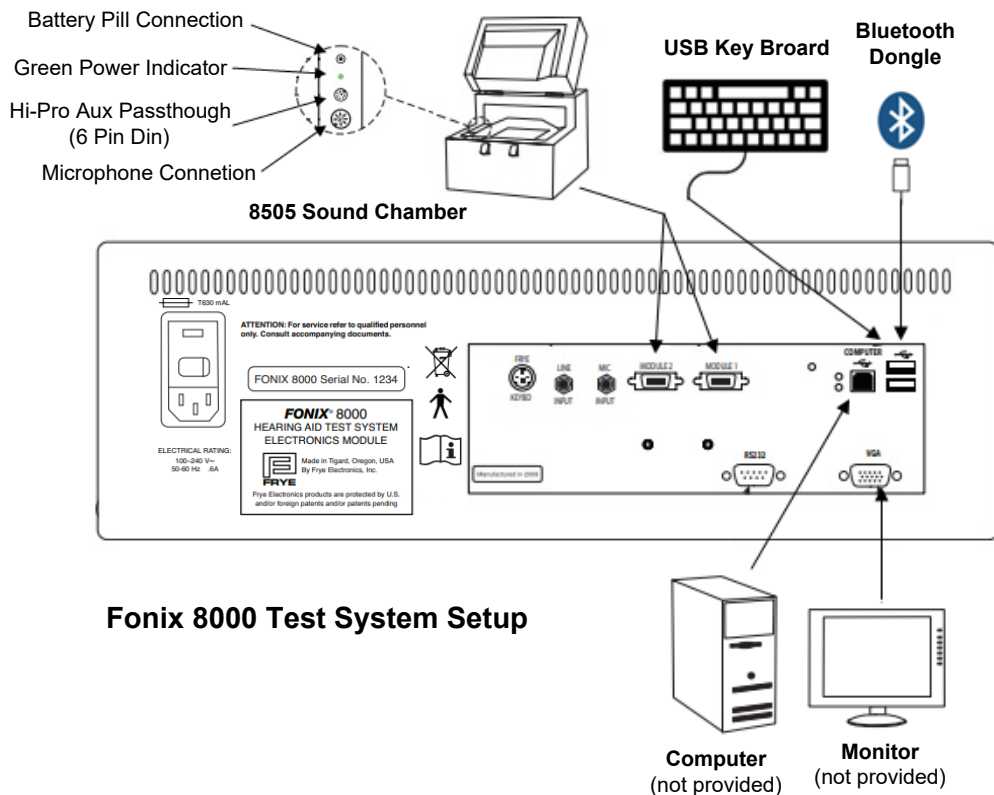
Remove the FONIX 8000 test system from the shipping cartons. Store the shipping cartons in a dry place so that they can be used again in the event that the unit must be returned to the factory for repair or upgrade.

**Main Module  
Fonix 8000**



**8050 Sound Chamber**





**Fonix 8000 Test System Setup**

### Locating and arranging the 8000 test system

Locate the 8000 test system in a moderately quiet area, such as a private office or laboratory. In order for test results to reliably conform to specifications, the ambient noise, mechanical vibrations, electrical or magnetic fields must not affect test results by more than 0.5 dB (ANSI S3.22). Low-noise acoustic conditions, as found in sound treated rooms and booths, are recommended but not necessary.

Locate the main module near the sound chamber. The video monitor may be placed on top of the main module.

### Connecting the Main Module & Components

Connect the main module to the system components as follows (see Figure 1.6.3):

1. Connect the video monitor to the jack marked "VGA" on the back of the main module. Tighten the screws on the connector to secure the connection.
2. Plug the M1958E microphone into the connector marked "MIC" located inside the sound chamber.

3. Plug the sound chamber cable into the connector marked "Module 1" on the back of the 8000 unit. Plug the other end of the cable into the back of the sound chamber. This cable provides all the connections necessary for operating the microphone, internal loudspeaker, telecoil, and battery voltage supply of the sound chamber.
4. Plug the power cord into the three-pronged jack on the rear panel of the 8000. Plug the power cords of both the 8000 and the video monitor into an AC outlet. We recommend using a switchable multiple outlet power strip with surge protection. Any voltage between 100 and 240 VAC is acceptable, 50 or 60 Hz line frequency.

### Powering up the 8000 test system

1. Turn on the 8000 system by reaching back on the right side of the main module (while you are facing the front of the unit), and pressing the POWER switch. The green LED on the front panel, above the words "POWER", will turn on after a couple seconds.
2. Turn on the video monitor. (Refer to the monitor's manual for instructions, if necessary.)

The Opening screen of the 8000 test system will be displayed. It contains the FONIX logo, along with the software version, the serial number, and the available options. This information is important in identifying your equipment when you communicate with the company about your FONIX 8000 test system.

Note: Do not disconnect or connect the sound chamber or probe module when the analyzer is turned on. This will not damage the analyzer but it may have trouble detecting the chamber without a power cycle.

### Maintenance

In order to ensure accurate testing, we recommend yearly calibrations of your coupler microphone. These calibrations can be performed by any Frye distributor or by yourself with the aid of a sound level calibrator, such as a Quest QC-10. Please see Appendix B for calibration instructions.

### Cleaning

For your safety, disconnect the 8000 from electrical power while cleaning. Wipe the 8000 with a moist cloth. Use plain water or water with mild dish washing detergent. Wipe away any detergent residue with a clear moist cloth. Finally, use a soft dry cloth to eliminate any lingering moisture.

Never allow fluid to enter the 8000:



- enclosure
- power switch
- power connector
- electrical connectors
- front panel buttons

The 8000 microphones should be wiped with a dry cloth. Excess moisture may damage the microphones.

Solvents and abrasives will cause permanent damage to the 8000.

### Care & Maintenance of your M1958E Coupler Microphone

Microphones are perhaps the most delicate of FONIX products. They require care and caution when handled. At the risk of sounding negative, the following is a list of the five microphone DON'Ts.

1. **Don't bend the microphone cord at the connection of the cord and the body!**  
This is perhaps the most common cause of microphone damage. The place where the cord and the body of the microphone meet is the most fragile part of their connection. The less strain you put on this area, the longer your microphone will last.
2. **Don't hit the microphone against the sound chamber or any other object!**  
The microphone head is delicate and easily damaged. Hitting the microphone against anything will do it no good and potentially much harm. Similarly, be careful not to drop the microphone on the floor.
3. **Don't pull the microphone from the coupler by the cord!**  
When removing the microphone from the coupler, grip the microphone body, not the cord. Pulling on the cord damages the connection.
4. **Don't get adhesive putty on the grill of the microphone!**  
Adhesive putty that accumulates on the grill will fall into the microphone body and onto the diaphragm which will damage the microphone.
5. **Don't touch the diaphragm of the microphone!**  
The diaphragm is located inside the grill of the microphone and is extremely sensitive. If you need to take the grill off the microphone, please do so with extreme care, and be especially careful not to touch the diaphragm, as this can cause permanent damage!

Overall, just be aware that your coupler microphone is a delicate device that needs to be treated with care and respect. If you do so, you will find it can provide years of reliable and accurate results.

## Locating the serial number and software version

When contacting the factory, it is very useful to have your serial number and software version handy. This information will help us assist you regarding repair, upgrade, and technical questions.

The serial number of your 8000 test system can be found on the back of the main module, just to the right of the power switch. See Figure 1.7.3A. It can also be found on the Opening screen of the 8000 test system.

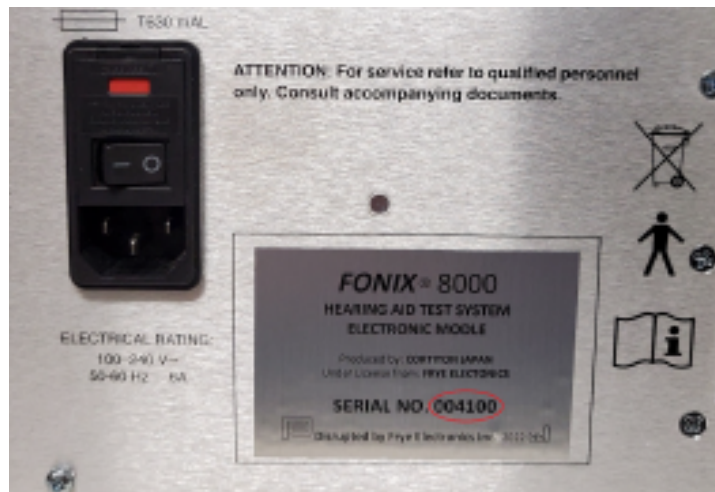


Figure 1.7.3A—Serial number location

The software version of your 8000 test system can be found on the Opening screen. See Figure 1.7.3B.

Press [HELP] to open a help window with more detailed service information. This data may be requested if you call in with a repair-related question. Press [HELP] again to close the help window.

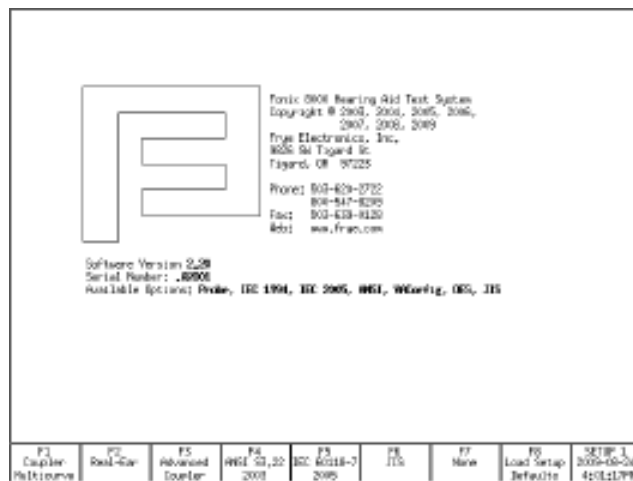


Figure 1.7.3B—Software version location

### Powering up the 8000 test system

1. Turn on the 8000 system by reaching back on the right side of the main module (while you are facing the front of the unit), and pressing the POWER switch. The green LED on the front panel, above the words "POWER", will turn on after a couple seconds.
2. Turn on the video monitor. (Refer to the monitor's manual for instructions, if necessary.)

The Opening screen of the 8000 test system will be displayed. It contains the FONIX logo, along with the software version, the serial number, and the available options. This information is important in identifying your equipment when you communicate with the company about your FONIX 8000 test system.

Note: Do not disconnect or connect the sound chamber or probe module when the analyzer is turned on. This will not damage the analyzer but it may have trouble detecting the chamber without a power cycle.

### Contacting the Factory

If you have any questions regarding your instrument, have your serial number and software version ready (see Section 1.7.3), and contact us at:

**Mailing address:**

Frye Electronics, Inc  
P.O. Box  
1712Beaverton OR  
97075 USA

Phone: (503) 620-2722

Fax: (503) 639-0128

**Shipping address:**

Frye Electronics, Inc.  
8279 SW Cirrus Drive  
Beaverton, OR 97008  
USA

Email: [sales@frye.com](mailto:sales@frye.com) (sales questions)

[Support@frye.com](mailto:Support@frye.com) (technical questions)

[Service@frye.com](mailto:Service@frye.com) (repair questions)

### Warranty

The 8000 test system and its accessories are guaranteed to be free of manufacturing defects that would prevent the product from meeting its specifications (given in Appendix A of this manual) for a period of one year from the date of purchase.

## Chapter 2

# General Operation

This chapter describes the general operation of the FONIX 8000 Test System, including basic operation of the buttons, screen navigation, default settings, source types, printing and other information.

## Operation of buttons

The general operation of the various buttons on the FONIX 8000 Test System are described in this section. This includes a description of the function buttons, the arrow buttons, and the Menu, Help, Reset, Exit, Level, Feed, Print, Stop and Start buttons.

### Using the function keys

The top row of buttons on the FONIX 8000 Test System front panel consists of “function keys” labeled [F1] through [F8]. The function of these keys changes from screen to screen, according to the need of the screen. The screen itself always shows the function of each of these buttons in a row of boxes along the bottom of the display. This row is meant to represent the physical buttons on the front panel. See Figure 2.1.

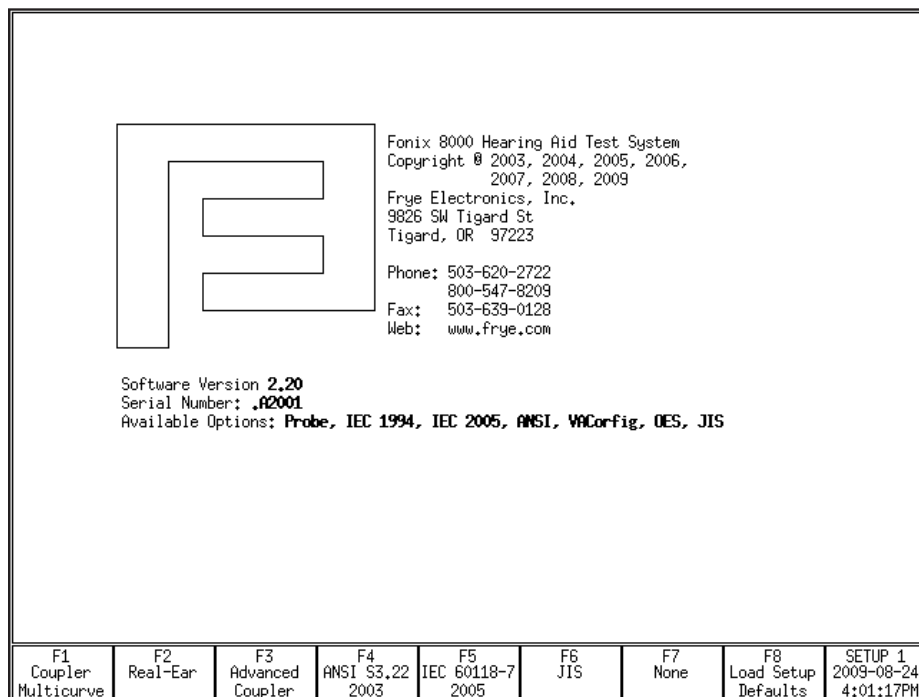


Figure 2.1—Function key display

There are three basic uses of the function keys:

- To navigate from screen to screen
- To toggle a selection
- To pop-up a selection menu

### **Navigation**

In the Opening screen, the function keys are used to navigate between the various measurement screens. For example, pushing [F1] in the Opening screen will take you to the Coupler Multicurve screen.

### **Toggle**

In a measurement screen, when a selection for a function key has only two possible options, pressing the function key will toggle between those options. For example, a function key setting the ear being tested will toggle between “left” and “right.” A red box will appear briefly around the function key box on the display. This red highlight means that the selection is in the process of being toggled.

### **Pop-up Menu**

In a measurement screen, when there are several possible selections to be made with a function key, pressing the function key will display a pop-up menu. When this happens, use the [▲ , ▼] keys to select the desired setting, and then use [▶] to perform the actual selection.

For example, in the Coupler screen, pressing [F5] will display a selection of source types. To select the desired source, you would use [▲ , ▼]. To complete the selection, you would press [▶].

## **Navigating through the screens**

The function keys are used to move from screen to screen. Here is a flow chart of all the available screens and the buttons used to open each screen. Some of the screens will only be available to you if you’ve ordered a certain option.

The F4-F7 keys are user configurable and may vary according to the analyzer’s default setup.

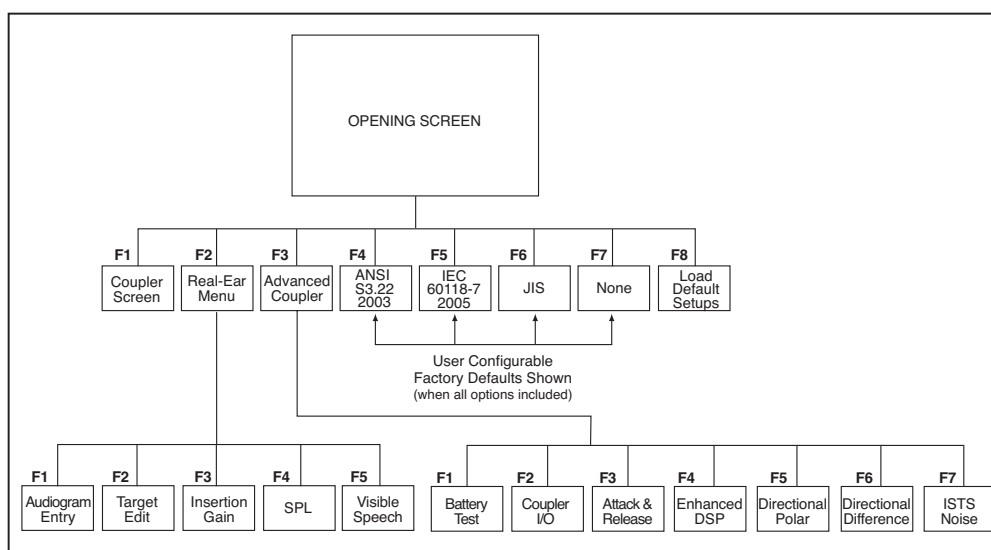


Figure 2.1.2—Navigation Flow Chart

### 2.1.3 Using the pop-up help windows

Each operational screen on the FONIX 8000 Test System has a local help win-dow designed to give you a basic operational overview of the current screen. In general, these help windows tell you what each button does in the current screen. See Figure 2.1.3 for an example.

In some help windows, you will be able to use the [▲, ▼] keys to display additional help text. This will be noted in the help window.

To close the help window, press [HELP] again or the [EXIT] button.

**Help Window**

Standard Usage in manual mode:  
 Select ear with F1.  
 Select curve with F2.  
 Change source type with F5.  
 Change source level with Up/Down buttons.  
 Press Start to measure the curve.  
 Press Stop to end the test.

Source Type Abbreviations:  
 First characters are: P-Puretone, C-Composite, or D-Digital Speech.  
 If the first character is P:  
   Second characters are: N-Normal, F-Fast, S-Short, or L-Long sweep.  
 If the first character is C or D:  
   Second characters are: F-Flat weighted, W-Speech weighted,  
   or S-Spectrum.  
 Third characters are: P-Power or SPL, and G-Gain.

FONIX 8000 TEST SYSTEM  
Coupler      Left Ear

Curve Characteristics					
Curv	←Source→	RMS	Cor	NR	
Name	Type	Trans	App	Out	
CL1	DWG	Chamb	60		4X
CL2	DWG	Chamb	60		4X
CL3	DWG	Chamb	60		4X
CL4	DWG	Chamb	60		4X
CL5	DWG	Chamb	60		4X
CL6	DWG	Chamb	60		4X
CL7	DWG	Chamb	60		4X
CL8	DWG	Chamb	60		4X
CL9	DWG	Chamb	60		4X
CLX	DWG	Chamb	60		4X

Source: DigSpeech, ANSI Weighted  
 Chamber, Levelled  
 Bias Tone: OFF  
 Projected Noise Reduction: 4X  
 Smoothing: Off  
 Battery Current:      mA  
 Size: Zn-Air Custom

60  
50

.25 .5 1 (kHz) 2 4 8

Source 60 dB SPL

Press HELP to close the HELP window.

F1 Left Ear Select	F2 1 Crv Select	F3	F4	F5 DigSpeech Src Select	F6 Off Auto Test	F7 Display Gain	F8 Off/Prev Source	SETUP 1 2012-01-04 2:59:48PM
--------------------------	-----------------------	----	----	-------------------------------	------------------------	-----------------------	--------------------------	------------------------------------

Figure 2.1.3—Pop-up help window

## Using the local menus

Pressing the [MENU] button will pop up a local menu that, like the help win-dow, will be overlaid on your current screen. Each local menu contains selections specific to your current screen. For instance, when you are in the Coupler screen, the local menu will contain only selections specific to coupler measurements. See Figure 2.1.4 for an example of a local menu.

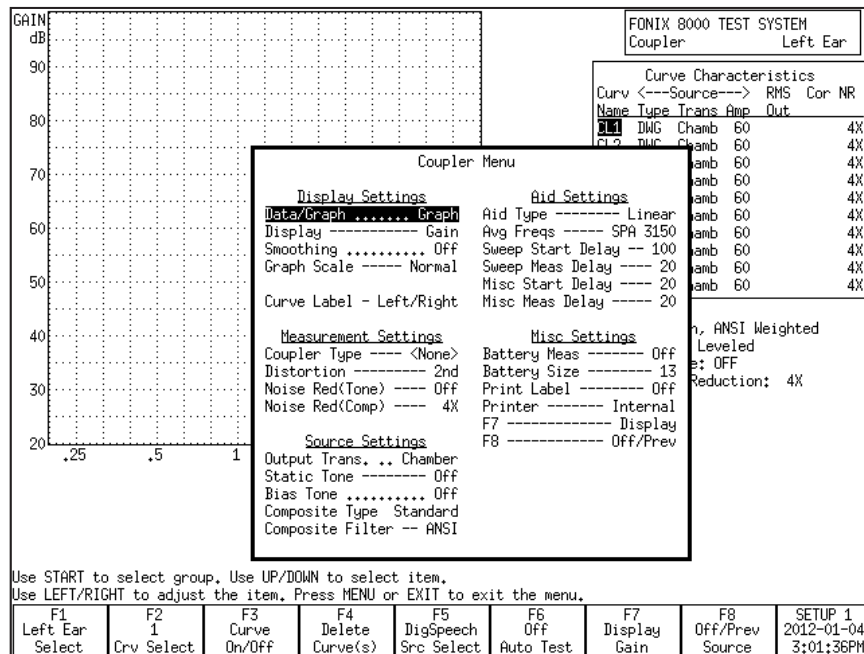


Figure 2.1.4—Local menu

Some local menu selections are common across screens. When this is the case, selections made in one local menu will usually carry across to any other local menu containing that selection. For instance, AID TYPE is a common selection in the local menus of the Coupler and Insertion Gain screens. If you were to set the AID TYPE to AGC in the local menu of the Coupler screen, it will automatically be set in local menu of the Insertion Gain screen.

**HINT:** Located between each option and its selection in the local menu is a series of dots or dashes. For instance, there are a series of dashes between AID TYPE and AGC in the local menu of the Coupler screen. Dashes indicate the selection can be saved as a default setting in the Default Settings screen. Dots indicate that the selection cannot be saved as a default selection. See Section 2.2 for details.

### Using the EXIT and RESET buttons

The [EXIT] and [RESET] buttons can be used to exit from any screen, menu or window.

The [RESET] button resets the analyzer, returns all settings to their default conditions, erases all measurements, and returns it to the start screen. By default, this start screen is the Opening screen with the Frye logo. However, the user can change the start screen to a variety of choices: Opening, Coupler Multicurve, ANSI S3.22-1987, ANSI S3.22-1996, ANSI S3.22-2003, ANSI 3.22-2009, ANSI S3.42, IEC 60118-7 1994, IEC 60118-7 2005, JIS, Profiler, and Coupler Directional (these selections will vary depending upon the options ordered with your analyzer). See Section 2.2.1 for more details.

It is recommended to use [EXIT] instead of [RESET] when moving between screens to avoid the loss of data.

The [EXIT] button closes a popup or local menu. When all such menus are closed, the [EXIT] button exits the current screen without altering the settings, measurements, and test conditions of the analyzer.

### Using the remaining buttons

Here is a description of the remaining buttons on the front panel of the analyzer and their use.

**[LEVEL]:** Levels the sound chamber or sound field speaker. See Sections 3.2 and 6.2.4 for details.

**[FEED]:** Advances the internal thermal printer paper.

**[PRINT]:** Prints the current screen. See Section 2.4 for details.

**[STOP]:** Stops a currently running test.

**[START]:** Starts a test.

**ARROW KEYS:** The arrow keys perform different functions depending upon the screen and previous buttons pushed. In a test situation, they adjust the source amplitude and frequency. If you press one of the function buttons to bring up a popup menu, they are used to scroll through the available options and make selections.



## Setup Menu

The Setup menu contains a number of different functions that set up your analyzer for testing. These functions include saving and loading default settings, setting the date and time, setting the user mode and performing calibration functions. This section contains instructions for several of these functions. For calibration instructions, see Appendix B. For instructions on leveling and saving leveling, see Section 3.2.

To open the Setup menu, press [MENU] from the Opening screen.

### Saving and loading default settings

All of the settings in the General and Coupler, Default Settings windows (described in Section 2.2.4) can be saved as default settings. There are five possible setups, so you can have five different configurations saved into the analyzer's permanent memory. You can also load (but not alter) the factory default configuration.

#### To save a user configuration:

1. Open the Setup menu by pressing [MENU] from the Opening screen.
2. Set up the General Default Settings as desired. See Section 2.2.4 for an explanation of all the default settings.
3. Use F1 to select the Coupler Default Settings Menu and change the settings as desired.
4. Press [F8] to open the Save Setup Defaults pop-up menu.
5. Use [▲, ▼] to select the desired setup number. If you are only going to use one saved configuration, use Setup 1.
6. Use [►] to complete the selection and close the pop-up menu. This will save all settings in the General and Coupler Default Settings windows. It will take a few seconds for the FONIX 8000 Test System to save the configuration. The saved setup number will automatically be selected as the current user.

#### To load a setup configuration:

1. Press [F8] in the Opening screen to open the Load Setup Defaults pop-up menu.
2. Use [▲, ▼] to select the desired setup number.
3. Use [►] to complete the selection and close the pop-up menu. This will load the selected setup. Whenever a user configuration is saved or loaded, that user will also be automatically saved as the new default user.

This function can also be performed in the Setup menu.

### Setting the date and time

The date and time displayed on every measurement screen can be changed in the Setup menu.

1. Open the Setup menu by pressing [MENU] from the Opening screen.
2. Press [F3] to open the Set Time/Date window.
3. Use the arrow keys to change the Year, Month, Day, Hour, and Minute. The  $\Rightarrow$ ,  $\blacktriangle$  keys choose the category and the  $\blacktriangleright$ ,  $\blacktriangleleft$  keys make the selection.
4. Use the arrow keys to decide if you want to use AM/PM time or a 24-hour style clock. This is changed in the AmPm setting.
5. Press [EXIT] twice to return to the Opening screen when done. The new time and date settings will automatically be saved.

### Setting the user mode

There are two different user modes available on the FONIX 8000 Test System: Beginner and Advanced. In the Beginner mode:

- Extra help windows pop up automatically when function keys are pressed in order to give the user more direction in using the instrument.
- Some local menu settings will not be displayed. These settings will not affect most users.

In Expert mode, the help windows are eliminated and all local menu settings are displayed.

#### To change the user mode:

1. Press [MENU] in the Opening screen to open the Setup menu.
2. Use  $\blacktriangle$ ,  $\blacktriangledown$  to select User under Other.
3. Use  $\blacktriangleright$ ,  $\blacktriangleleft$  to choose ADVANCED or BEGINNER.
4. Press [EXIT] to return to the Opening screen. The new user mode will be in effect.

### Explaining the settings

There are three categories of default settings available: General, Coupler and Real-ear. The third category, Real-ear Default Settings, is only available when the Real-ear Option is included on the analyzer. The following is an explanation of the various settings currently available.

#### General Default Settings

PRINT LABEL: Status of the label printing option. Choose ON or OFF.

PRINTER: Printer used for printouts. Only INTERNAL is available at this time.

EXT PRINT COLOR: This setting is currently only used for use with the fcapture screen capture program. **B&W captures** black and white pictures of the current screen. **Color captures** color pictures.

EXT PRINT LANGUAGE: External printing is not supported at this time.

EXT PRINT #SCRNS/PAGE: External printing is not supported at this time.

RS232 BAUDRATE: Baud rate of the RS232 connection. This is the speed of the connection between the analyzer and a personal computer. The Windows-based program used on the computer end will need to have the same baud rate selected.

AID TYPE: Type of hearing aid being measured. Choose between Linear, AGC and ADAPTIVE AGC. This will affect the delays of pure-tone sweeps as well as some other measurements. See Section 2.3.1.2 for details.

USER: The selected user mode. See Section 2.2.3 for details.

START SCREEN: The screen shown when the analyzer is powered on or the [RESET] button is pressed. The following screens are available for this purpose: Opening, Coupler Multicurve, ANSI S3.22-1987, ANSI S3.22-1996, ANSI S3.22-2003, ANSI S3.22-2009, ANSI S3.42, IEC 60118-7 1994, IEC 60118-7 2005, JIS, Profiler, and Coupler Directional (these selections will vary depending upon the options ordered with your analyzer).

F4-F7: Function of the F4, F5, F6 and F7 navigation keys in the Opening screen. These keys can be used to create a shortcut to the selected screen. The following screens are available for this purpose: ANSI S3.22-1987, ANSI S3.22-1996, ANSI S3.22-2003, ANSI S3.22-2009, ANSI S3.42, IEC 60118-7 1994, IEC 60118-7 2005, JIS, Profiler, Coupler Directional, Battery, Coupler I/O, Attack & Release, Enhanced DSP, and None (these selections will vary depending upon the options ordered with your analyzer).

SWEEP START DELAY: The amount of time the FONIX 8000 Test System presents the first tone in a pure-tone sweep. See Section 2.3.1.2.

SWEEP MEAS DELAY: The amount of time each subsequent tone is presented before the measurement is made in a pure-tone sweep. See Section 2.3.1.2.

MISC START DELAY: The amount of time the FONIX 8000 Test System presents the first tone in one of the following measurements: reference test gain measurements (in automated test sequences), averaging, harmonic distortion measurements, equivalent input noise, and single-frequency telecoil measurements. See Section 2.3.1.2.

MISC MEAS DELAY: The amount of time each subsequent tone is presented before the measurements is made in one of the measurements listed above. See Section 2.3.1.2.

**I/O START DELAY:** The amount of time the first tone in an I/O sweep is presented before the measurement is made. See Section 2.3.1.2.

**I/O MEAS DELAY:** The amount of time each subsequent tone in an I/O sweep is presented before the measurement is made. See Section 2.3.1.2.

**RESET FREQ:** The frequency the analyzer returns to when RESET is pressed.

**AVG FREQS:** The frequencies used for averaging in pure-tone measurements. Each frequency set is represented on the screen by the highest frequency in the set. The sets are:

HFA (High Frequency Average)	1000, 1600, <b>2500</b>
SPA (Special Purpose Average)	800, 1250, <b>2000</b>
SPA	1250, 2000, <b>3150</b>
SPA	1600, 2500, <b>4000</b>
SPA	2000, 3150, <b>5000</b>
IEC–(HAIC)	500, 1000, <b>2000</b>

### Coupler Default Settings

**BATTERY MEAS:** Status of the battery current measurement. Choose ON or OFF.

**BATTERY SIZE:** Size of battery used with the hearing aid being tested. Used in battery current measurements.

**BATTERY CHEMISTRY:** Type of chemistry of the hearing aid battery. Choices are ZN-AIR(ZincAir), SILVER, and type 2.0V. This choice will almost always be ZN-AIR. *Note:* the 2.0V chemistry type is optional and only available when in advanced mode.

**NOISE RED (TONE):** Amount of pure-tone noise reduction used in coupler measurements. See Section 2.3.1.1.

**NOISE RED (COMP):** Amount of composite noise reduction used in coupler measurements. See Section 2.3.2.1.

**TONE ANALYSIS:** This is the narrowband filter that is used to reduce noise in pure-tone measurements. Choose Auto or Off. "Off" means that no narrowband filter will be used when analysing a puretone signal.

**RESET SOURCE:** The signal type selected in the Coupler screen when the [RESET] button is pushed.

**DISPLAY:** Display of the Coupler Multicurve screen. Choose between Gain and SPL.

**CURVE LABEL:** Label used for the two available "ears." Choose between LEFT/RIGHT and A/B.

**GRAPH SCALING:** Scaling used when making measurements. NORMAL scales to the upper-most curve displayed. AUTO scales to the current selected curve.

**COUPLER TYPE:** The type of coupler being used in making sound chamber measurements. Selections of CIC and MZ turn on corresponding software correction factors (see Sections 3.6 and 3.7). A selection of NONE or 2cc does not apply correction factors to the curve.

**STATIC TONE:** Status of individual frequency measurement. Choose SINGLE to emit a static tone in between composite measurements or pure-tone sweeps. Choose AVG to emit a three frequency average between other measurements. Choose OFF to turn off this measurement.

**DISTORTION:** Type of harmonic distortion used in a pure-tone measurement. Choose between 2nd, 3rd and TOTAL. See Section 2.3.1.3.

**COMPOSITE FILTER:** Filter used in Composite and Digital Speech measurements. Choose between ANSI, ICRA and FLAT.

**AUTO MODE:** Status of Auto Mode in the Coupler Multicurve screen. Choose between OFF, SEMI-AUTOMATIC and FULLY AUTOMATIC. See Section 3.8 for more details.

**CURVE GROUP LOADED:** Choose which curve group to load upon entry into the Coupler Multicurve screen. See Section 3.8 for details.

**F7 and F8:** Change the function of the F7 and F8 function keys in the Coupler Multicurve screen. This allows the user to create a shortcut to commonly used menu settings. Choose from: DISPLAY, COUPLER, BIAS AMPL, STATIC, BATT SIZE, AID TYPE, OFF/PREV, DATA/GRAPH. See Section 3.9.

**EQUIV NOISE TEST:** Status of the equivalent input noise measurement in the automated test sequences such as ANSI, JIS and IEC. Turns it ON or OFF.

**TELECOIL:** Status of the telecoil measurement in the ANSI, JIS and IEC automated test sequences. Turn it ON or OFF.

**12 dB DIST:** The status of the 12 dB harmonic distortion rule. When measuring harmonic distortion, if the amplitude of the response at the second harmonic of the frequency being measured is 12 dB greater than the amplitude of the primary frequency, the harmonic distortion measurement is ignored at the primary frequency. Turn this rule ON or OFF in the ANSI and IEC automated test sequences.

**VA CORFIG:** Software correction factors designed by the VA to produce a more realistic response curve than the normal ANSI response curve. This setting comes with the VA-CORFIG Option.

**AGC 250, 500, 1000, 2000 and 4000:** Turn ON or OFF the I/O and attack-and-release measurements at the indicated frequencies in ANSI S3.22-1996, ANSI S3.22-2003, IEC 60118-7 2005. Other automated test sequences do not offer this choice. Note that 2000 Hz is always measured in IEC 60118-7:2005 regardless of the AGC 2000 Hz setting here.

**AGC SWITCHING:** Status of compression switching during the ANSI S3.22-2003 and IEC 60118-7 2005 automated test sequences. These standards call for the hearing aid to be set with a high compression kneepoint during most of the test sequence, but for the compression kneepoint to be set to minimum (or as specified by the hearing aid manufacturer) during the I/O and attack and release measurements. Turning this setting ON allows the compression to be changed during the test sequence. Turning this setting OFF ignores this requirement and continues with the test sequence.

**CD GROUP LOADED:** This selects which, if any, group of settings for the Coupler Directional Screen are loaded.

## **Source Types**

At Frye Electronics, the acoustic signal used to test the hearing aid is called the source signal. In the past, two types of sources were available on the FONIX 8000 Test System: pure-tone and composite. With the introduction of real time digital signal processing, random noise and speech signals have been added to the list of available source signals.

Four methods of presenting pure-tone sweeps are available: long, normal, fast and short. Two types of composite signals are available: Composite and Digital Speech. The spectral content of the composite signal can also have your choice of speech weightings, including ANSI and ICRA.

Random noise with spectral weighting of flat or pink can now be used for testing hearing aids in coupler tests. Speech in the form of the ISTS signal is now available to be used in the ISTS option.

### **Understanding Pure-tone Signals**

A pure-tone sweep is a test involving a progression of pure tone signals pre-sented at a specified level. When the sweep is complete, the aid's frequency response at those frequencies is displayed on the graph (or data column).

There are four types of pure-tone signals: long, normal, fast and short.

### **Understanding Pure-tone Signals**

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## Understanding Pure-tone Signals

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There are four types of pure-tone signals: long, normal, fast and short.

- **LONG:** Contains 64 different frequencies and only does one sweep before ending the test.
- **NORMAL:** Contains 43 different frequencies and only does one sweep before ending the test.
- **FAST:** Contains 16 different frequencies and continually sweeps through them until you stop the test. The fast sweep is meant to be used as a real-time continuous signal convenient for use while adjusting hearing aids. It is an alternative to the composite signals.
- **SHORT:** Contains 10 different frequencies and only does one sweep. It is primarily used for testing loud levels in real-ear measurements.

## Noise reduction

Noise reduction is used in noisy testing environments. Pure-tone noise reduction takes several measurements at each frequency and averages those measurements together. Larger noise reduction numbers lead to smoother curves but increase the amount of time it takes to complete a pure-tone sweep.

For example, if you select "4" as the pure-tone noise reduction setting, 172 measurements (43 x 4) will be taken with every normal pure-tone sweep.

## Delay times

The FONIX 8000 Test System allows you to refine your pure-tone measurements with many different adjustments for delay times. This choice is allowed because some hearing aid circuits take a longer time than others to adjust to changes in amplitude or frequency. If the measurement is made too quickly, an artifact in testing will be created. If the measurement takes too long, the test is longer than necessary. In determining the length of time needed for a proper measurement, a good rule is to use twice the published attack time of the hearing aid. If you are unsure of the attack time, you can experiment with longer times and shorter times and see if there is any difference in the test results. Linear aids can be tested very quickly, so a delay of 20 msec is usually fine. Other aids are quite variable.

The FONIX 8000 Test System has standard delay times that are determined by the aid type selection. When you set the delay settings to Default, the following delay times will be used:

Measurement	Linear	AGC	Adaptive
SWEEP START	100 ms	500 ms	2000 ms
SWEEP MEAS	20 ms	50 ms	100 ms
MISC START	100 ms	500 ms	2000 ms
MISC MEAS	20 ms	100 ms	200 ms
I/O START	100 ms	500 ms	2000 ms
I/O MEAS	20 ms	100 ms	200 ms

In addition to the delays, the aid type will also have an effect on the way some measurements are made. With a selection of ADAPTIVE, the analyzer will throw away the first three measurements of all averaging (including reference test gain) and harmonic distortion measurements. This will increase the amount of time it takes for the test, but it should increase the accuracy of the test for adaptive AGC aids.

Note: The “Adaptive” aid type category was created for a specific type of adaptive-AGC aid, such as the model created by Telex.

### **Harmonic distortion**

When a pure tone is used for the test source, harmonic distortion can be measured by examining the multiples of the input source signal frequency.

Harmonic distortion occurs when a hearing aid amplifier modifies the shape of a pure-tone input signal, resulting in artifacts at harmonics (integer multiples)

of that input signal. For example, if you present a 500 Hz tone to the hearing aid, distortion artifacts could occur at 1000 Hz and 1500 Hz.

The harmonic distortion measurement is expressed as the percentage of the power of these distortion artifacts to the power of the input signal. All hearing aids will have some amount of distortion.

Usually, the strongest artifacts occur at the second and third harmonics of the frequency. With the FONIX 8000 Test System, you can test the amount of distortion available in the second harmonic, the third harmonic, or both harmonics (considered “total harmonic distortion”). of that input signal.

For example, if you present a 500 Hz tone to the hearing aid, distortion artifacts could occur at 1000 Hz and 1500 Hz.

The harmonic distortion measurement is expressed as the percentage of the power of these distortion artifacts to the power of the input signal. All hearing aids will have some amount of distortion.

Usually, the strongest artifacts occur at the second and third harmonics of the frequency. With the FONIX 8000 Test System, you can test the amount of distortion available in the second harmonic, the third harmonic, or both harmonics (considered “total harmonic distortion”).

### **Definitions**

2nd Harmonic: Energy of the second harmonic or twice the presented frequency.

3rd Harmonic: Energy of the third harmonic or three times the presented frequency.

TOTAL: Combined 2nd and 3rd harmonic distortion.

See Section 3.4.7 for instructions on performing the harmonic distortion measurement.



### **Pure-tone Filter**

Pure-tone signals are usually flat-weighted. That is, in a pure-tone sweep, each tone usually has the same amplitude as every other tone in the sweep. In contrast, the wideband Composite and Digital Speech signals are usually speech-weighted. That is, the lower frequencies of the wideband signals have higher amplitudes than the higher frequencies, simulating the long-term average of speech.

### **Understanding Complex Signals**

The 8000 now has the option of employing two types of complex source signals: composite waveforms and random noise.

There are two types of composite signals: Composite and Digital Speech. An additional complex signal, random noise, has been added to the choices enabled in the 8000's coupler mode of operation.

The Composite signal is a continuous broadband signal containing 79 different frequencies presented simultaneously. This signal is usually "speech weighted," in which the lower frequencies are presented with a stronger emphasis than the higher frequencies. After the composite acoustic signal has been processed by the hearing aid microphone/amplifier/receiver and picked up by the 8000's microphone, the resulting signal is digitized and then analyzed by use of a mathematical algorithm called the Fourier transform. All 79 components of the composite signal are thus processed simultaneously.

Operationally, the Composite signal is both a faster and a more realistic signal than a pure-tone sweep because there is no waiting for a progression of tones to complete, and, like speech, a broad spectrum of frequencies is used simultaneously. The Composite signal typically repeats 100 times a second. A complete response can thus be generated in 10 milliseconds.

Random noise, on the other hand, is a random signal, and does not repeat. In some ways, it is like speech, which also does not repeat. It is only over a period of time that all random signal or speech frequency components are produced. Thus it takes mathematical signal averaging over a much longer period of time to generate a reasonable display of an aid's response to a random noise or a speech signal.

"Digital Speech" is an interrupted version of the Composite signal used for testing modern digital hearing aids. Many of these digital aids (though not all) use a technology called "speech enhancement" or "noise reduction." These aids respond to any continuous signal as if it were noise, and lower the gain at those frequencies. Unfortunately, these aids regard the Composite signal or pure-tone sweeps as noise, making them difficult to test using traditional methods. Digital Speech was developed as a way to test these high-end hearing aids. Instead of presenting a continuous signal, it presents an interrupted signal that the aid interprets as speech instead of noise.

A further enhancement is seen in recent digital hearing aid algorithms. The phase of the high frequency portion of the amplified spectrum is randomized, so that the phase of the signal coming out of the aid cannot be predicted. The randomizing allows the hearing aid to provide as much as ten decibels more gain than a non randomized amplifier before feedback occurs.

And since this portion of the amplified speech spectrum usually consists of noisy sounds as is produced with phonemes like “/s/” and “/t/”, little intelligibility is lost when this algorithm is employed.

However, this HF signal randomizing destroys the ability of the analyzing instrument to use time domain averaging, since such an averaging process results in an answer of zero gain for the randomized frequency bands. The 8000 and other FONIX analyzers overcome this problem when digital speech is chosen as the source test signal by shifting averaging to the frequency domain. The averaging is done after the frequency content of the individual samples of the signal have been calculated.

Time domain averaging is still used with the Composite signal for noise reduction.

### **“FFT” and Fractional octave Complex signal analysis**

An interesting property of pure tone signals is that if an analyzer system is working properly, a pure tone presented to either a Fast Fourier Transform method of analysis or a fractional octave band analyzer method, such as one third octave analyzer, the answer is always the same. The pure tone presents only one frequency component. The same cannot be said for a complex signal with a spread of frequency components.

Complex signals have spectra that spread over many frequency bands, and the width or composition of the frequencies in the bands differ between FFT and fractional octave analyzers. A third octave analyzer has a band spread of 1/3 octave, regardless of the center frequency of the band. The FFT, on the other hand, has a frequency band spread set by the basic time window of analysis; a FFT system like the 8000 uses has a window of 10 milliseconds, setting the individual analysis windows to 100 Hz, regardless of the frequency being analyzed.

When a complex signal with a “WHITE” or “FLAT” spectrum is analyzed by a FFT analyzer, the frequency response will be flat across the spectrum. The same signal analyzed by a fractional octave band analyzer will show a rise with frequency at the rate of 3 dB per octave. It is possible to employ a mathematical conversion to convert a FFT analysis to that of a 1/3 octave analyzer. The 8000 provides this conversion in the operation of the ISTS option. The use of the PINK spectrum test source filter will provide a flat appearing response with a fractional octave band analyzer. The 8000 does not provide this spectrum analysis method in the coupler test window.

### **Spectral weighting and “leveling” of complex source signals**

Complex signals can be used with several different types of weightings: ANSI, ICRA, FLAT and PINK. Flat is generally only used for specific research purposes—it contains no speech weighting and is difficult for most hearing aid circuits to process. PINK is a recent introduction to FONIX analyzers.

The 8000 now uses real time digital signal processing (DSP) to “level” the response of the sound delivery system. All of the analog signals being routed to the speaker that delivers energy to the sound field are passed through a digital filter, the components of which have been set during the leveling process to adjust the spectrum to within a few tenths of a decibel of the level of the electrical input spectrum. The leveling process typically takes around one second. The DSP process is used in coupler and real ear sound generation.

## Noise reduction

Complex noise reduction is a little different than pure-tone noise reduction (discussed in Section 2.3.1.1), even though both are used for noisy testing environments.

When a complex signal is running, the analyzer takes several different measurements a second and displays them on the screen. Composite noise reduction performs a “running average” of these composite measurements. This means it averages together several of the previous measurements with the current measurement to produce the next curve. If you select “2X” noise reduction, it will average the last two measurements together. A selection of “4X” averages the last four measurements together. When performing composite measurements, it will take several seconds for the actual noise reduction used to reach the set value. This is due to the nature of the running average. Larger noise reduction numbers lead to smoother curves but increase the amount of time it takes the analyzer to update its composite measurements.

## Intermodulation distortion

The complex signals are helpful for identifying intermodulation distortion (IM). IM distortion occurs when amplitudes at more than one frequency in a signal combine to create an amplitude at a frequency not present in the original signal. When viewing a graph run with a composite signal, look for points along the graph where the line “breaks up.” Such an appearance indicates the presence of IM distortion. See Figure 2.3.2.4 for an example of IM distortion. This type of distortion is only apparent when a composite signal source is used because pure-tone sweeps do not present more than one frequency at a time.

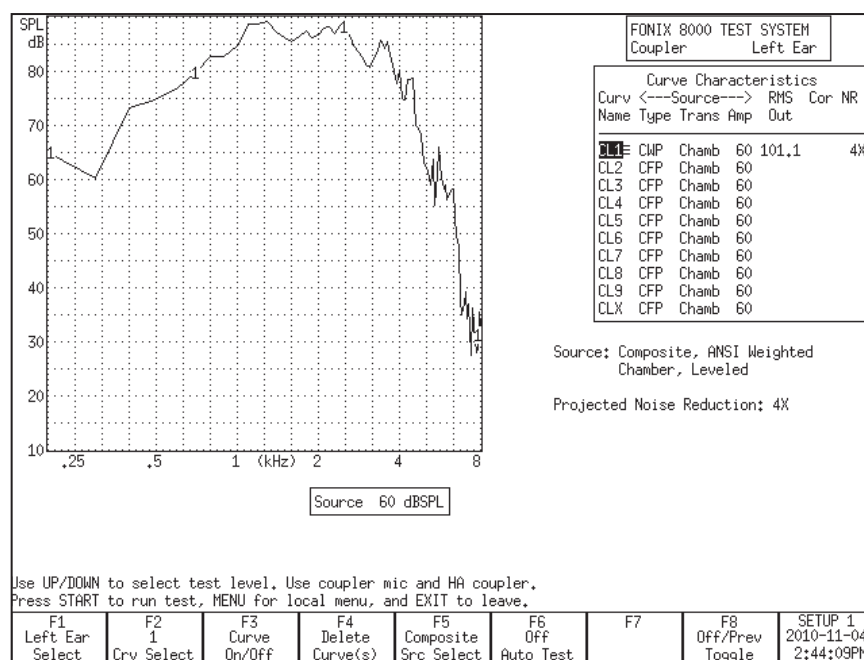


Figure 2.3.2.4 – Example of IM distortion

### Complex Signal filters

The spectral character of the Composite signal can be shaped with two main types of filters (also known as “speech weighting”): ICRA and ANSI. They differ in the speech spectrum they use.

The ANSI filter, taken from the ANSI S3.42 standard, rolls off the high frequencies at a rate of 6 dB per octave, starting with a 3 dB drop at 900 Hz. The ICRA filter uses the ICRA speech spectrum developed by the International Collegium of Rehabilitative Audiology. The ICRA spectrum is based on the Long Term Average Speech Spectrum (LTASS) and rolls off the high frequencies more rapidly than the ANSI spectrum. Figure 2.3.2.5 shows a comparison of the spectra.

In general, we recommend using the ANSI speech weighting for Composite and Digital Speech measurements.

Spectra of either FLAT or PINK may be selected when the Random Noise signal is used. The spectral weighting can be selected by use of the MENU in the coupler screen.

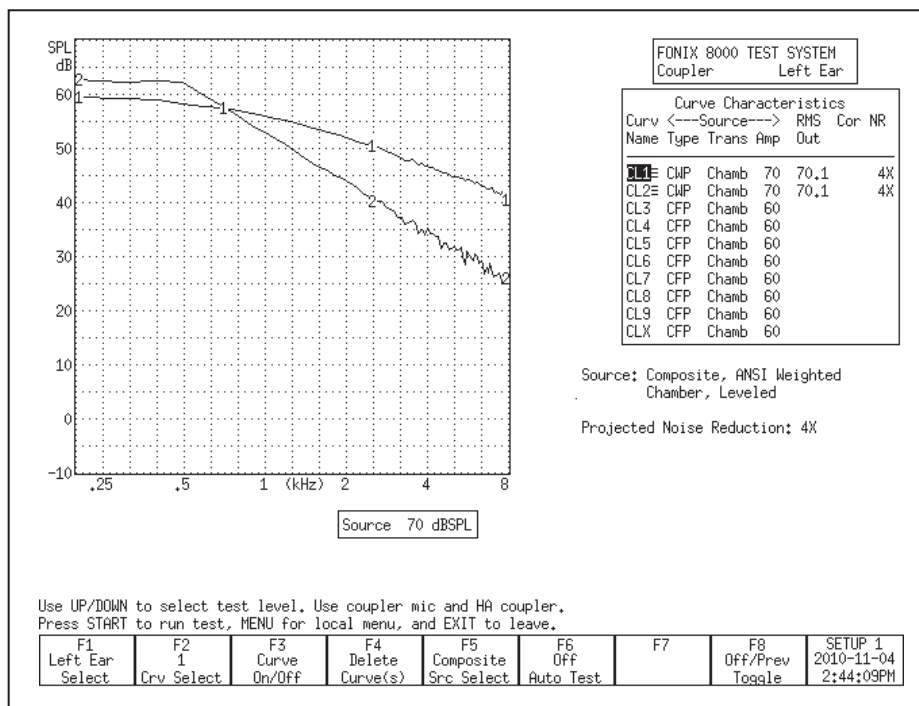


Figure - Comparison of the ICRA shape and the ANSI shape

### Composite type

There are two types of the traditional Composite signal available on the FONIX 8000 Test System. They are known as “Standard” and “Chirp.” The two signals differ in the manner that their phase is generated, and this difference has an impact on the crest factor of the signals. The crest factor of a waveform is the ratio of its highest amplitude to its RMS amplitude. Human speech is often referred to as having a 12 dB crest factor.

For the needs of most clinicians, the Standard and Chirp Composite signals are virtually identical.

The Standard Composite signal is composed of 79 different individual frequencies that are each generated with a random phase pattern that results in the signal having a crest factor of 10 dB, close to the crest factor of human speech. (If the phase components were not randomized or otherwise changed, and if all the signal components were in phase, the crest factor of the signal would increase to over 19 dB.)

The Standard Composite signal is the standard signal used on the 7000 test system, the predecessor to the 8000.

The Chirp Composite signal is another type of composite signal, but with a lower crest factor. The phase of the individual frequency components of the Chirp Composite signal is determined in a way that makes the signal appear to be presented as a “chirp,” or very fast sweep. The Chirp has a crest factor of 6 dB. The Chirp Composite signal is the standard composite signal used on the FP40 and FP35 portable hearing aid test systems.

Although the Standard and Chirp Composite signals sound the same to most people, an analysis tool such as Tempus3D will show the difference between them. Both the Standard and the Chirp Composite signals are further speech-weighted to agree with the user-selected composite filter (described in Section 2.3.2.5.)

### **Complex source levels**

The Composite signal (and its Digital Speech counterpart) is a complex signal consisting of 79 different frequency components. When you set the source level of a composite signal (50 dB, 60 dB, etc), you are actually setting its overall energy, known as the RMS (root-mean-square) of the signal; you are NOT setting the amplitude of the individual frequency components.

The actual amplitude of each of frequency of the Composite signal is less than the overall RMS of the signal. See Figure 2.3.2.7 for an example of the SPL levels of each frequency of the Composite signal with an RMS of 70 dB. Be aware of this difference, especially when viewing frequency response results in overall amplitude of dB SPL. The noise signal also has to be thought of in much the same way.

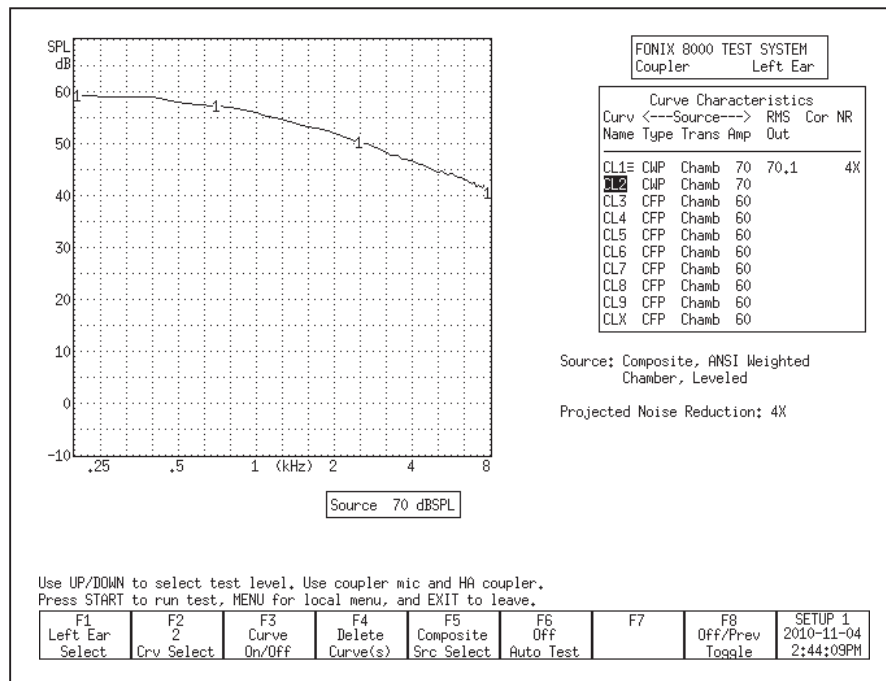


Figure 2.3.2.7: ANSI weighing of the Composite signal at 70 dB SPL RMS

### Digital Speech technical details

The digital speech signal works by turning the composite signal on for a set period of time, taking a measurement, turning the signal off for a random period of time, and turning the signal back on again. This sequence is repeated until the test ends.

The signal “on” time takes a minimum of 60 milliseconds. This includes the time to turn the signal on, take the measurement, and turn the signal off.

Some aids may require an additional delay before the measurement is taken in order to allow their circuits to settle. This additional delay time can be changed in the MISC MEAS delay setting that is available in the local menu of the measurement screens and in the Setup Menu. The MISC MEAS setting is automatically adjusted according to the aid type selected. This setting is added to the 60 ms minimum measurement time.

The default settings are:

Linear: 20 ms AGC:

100 ms ADAPTIVE:

200 ms

The signal “off” time is random between 100 and 300 milliseconds. This time is not controllable by the user.

### Changing the White/Pink Noise

1. Use [F5] to choose the RANDOM NOISE signal source. (Press [F5]. Use [▼, ▲] to select the desired signal type. Press [►] to complete the selection and close the pop-up menu.) See Section 3.4.1 for details on signal types.
2. Press [MENU] in the Coupler screen.
3. Use [▼, ▲] to select Composite Filter under Measurement Settings. Use the [START] key to skip ahead sections, if necessary.
4. Use [◀, ▶] to select **Flat** or **Pink**.
5. Press [EXIT] to return to the Coupler screen.

### Understanding the Frequency Shift Signal

The frequency shift signal generates a single puretone signal like in section 2.3.1, but analyzes it like a composite signal in section 2.3.2. This test is used to see how much the hearing aid shifts the input signal frequency.

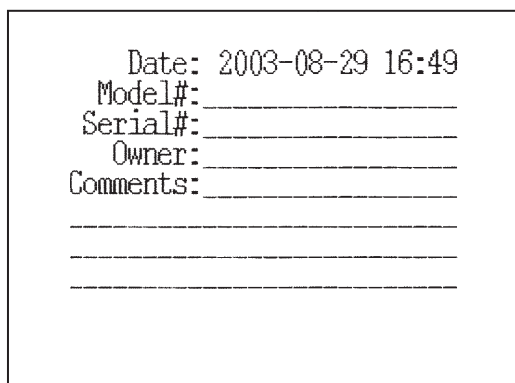
### Printing

The FONIX 8000 Test System comes equipped with an internal thermal printer. The thermal printer prints a clear, easy-to-read image of the display. At this time, there is no support for external printing.

### Adding a label

A label with your printout allows you to record useful information about the client and hearing aid to go along with the test results. See Figure 2.4.1.

If you are in the middle of a test, and you want to add a label for the printout in the local screen without changing the default setting, perform the following steps:



```
Date: 2003-08-29 16:49
Model#: _____
Serial#: _____
Owner:  _____
Comments: _____
_____
_____
_____
```

*Figure 2.4.1—Label with printed result*

1. Press [MENU] from the measurement screen to open a local menu.
2. Use [▼, ▲] to select Print Label. You may want to use the [START] button to skip ahead sections in the local menu.
3. Use [▶] to turn the label ON.
4. Press [EXIT] to return to the measurement screen. Any printout will now include a label until you turn off the analyzer.

**If you want to include a label on all printouts by default:**

1. Press [MENU] from the Opening screen to enter the Setup menu.
2. Use [▼, ▲] to select Print Label.
3. Use [▶] to select ON.
4. Use [F8] to save the settings to a user setup. This will also save all the other selections in the Setup menu.
5. Press [EXIT] to return to the Opening screen.

**Using the printer**

The internal printer of the FONIX 8000 Test System is straight-forward to use. Make sure the internal printer is selected by following the instructions in the section above. Press [PRINT] to print any displayed screen. Press the [FEED] button to feed the thermal paper through the printer without printing.

**General Information**

The following is useful information to know about the internal printer:

- Frequently inspect the printer for any residue or foreign matter, and clean as required. Paper residue or foreign matter may shorten the life of the thermal printer head or platen.
- The 8000 printer mechanism is equipped with a paper back tension device. This feature is used to eliminate paper migration from side-to-side. If paper migrates too far to one side, the edge of the paper will “krinkle” and cause a paper jam. The white plastic, spring-loaded, back tension rod located at the rear of the printer mechanism provides the required tension on the outside of the paper roll. No adjustment is required for proper operation.



**Error Messages:**

In the event that an error occurs when printing with the 8000 analyzer, we've included some error codes in the lower right corner of the screen that should help a FONIX technician troubleshoot the problem. This section describes those error codes.

There are two categories of errors that can occur with the 8000 printer: initialization errors and printing errors. Initialization errors occur only when the 8000 analyzer is first powered up; this also initializes the printer. Here are the printer initialization error codes:

- Init failed 0: No memory available for the converted screen buffer
- Init failed 1: No memory available for the label bitmap
- Init failed 2: Printer driver unresponsive
- Init failed 3: Version number from printer board is unreadable

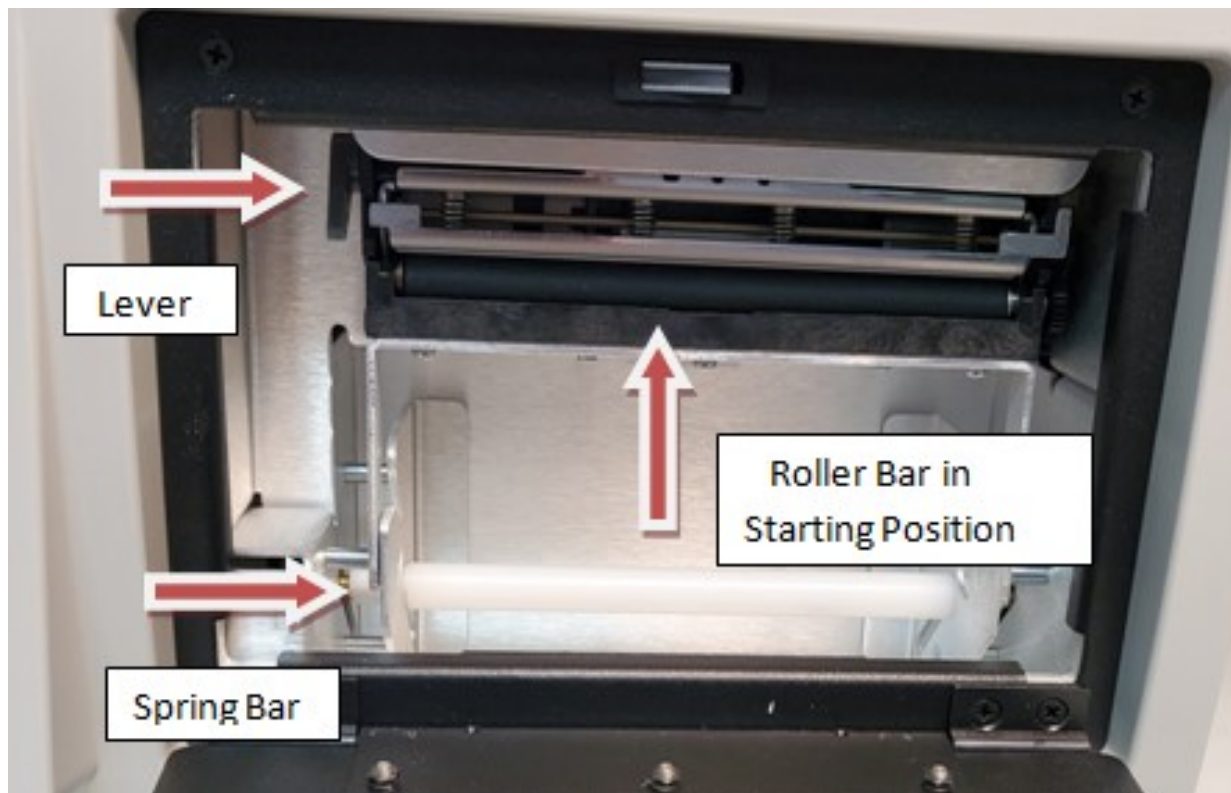
Errors that occur when actually printing have the following error codes:

- Print failed 0: Switching from internal to external printer failed
- Print failed 1: Copying the label bitmap to the printer board has failed
- Print failed 2: Converting the screen to printable version has failed
- Print failed 3: Copying the converted screen bitmap to the printer board has failed
- Print failed 4: Preparing to print; printer board is busy
- Disconnected: External printer is disconnected.
- No power: Internal or external printer is not powered.
- Offline External printer is offline.

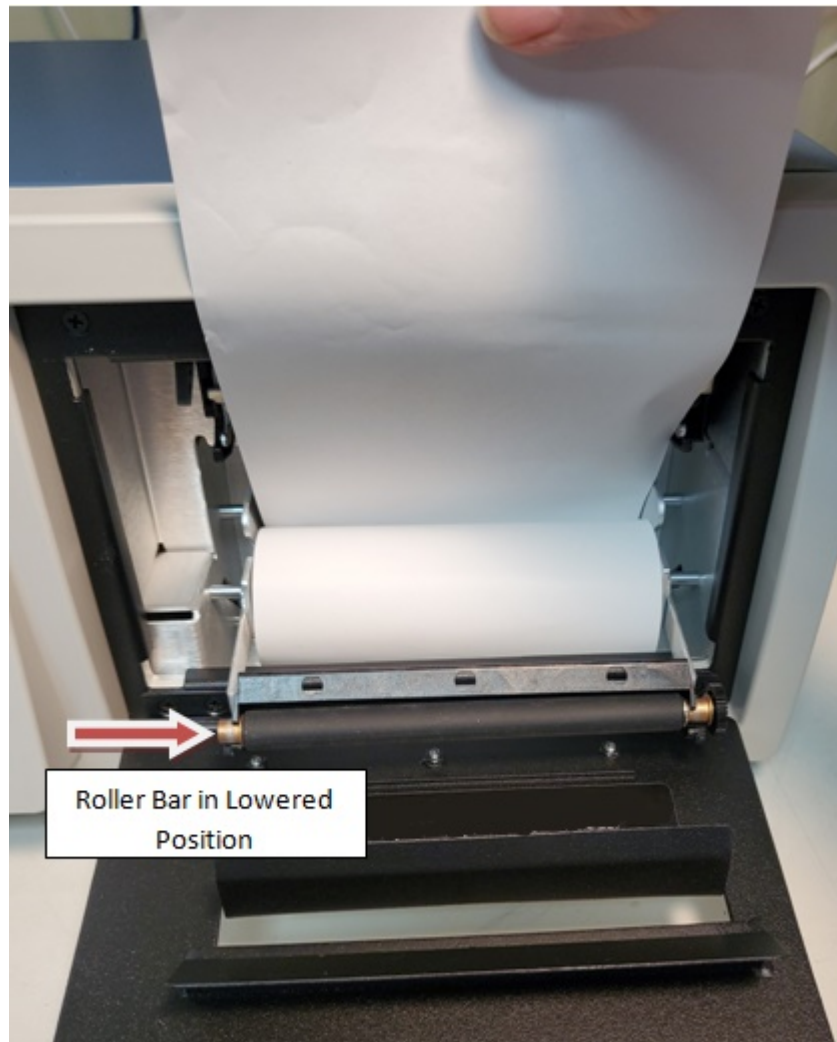
## Loading the thermal paper

### Step I: Installing the paper into the printer assembly

1. Open the printer door.
2. Press Lever back till Roller Bar pops loose and drops into lower position against open door.
3. Remove the plastic paper roller from the printer mechanism. If you are replacing an empty paper roll, remove and discard the paper spool from the printer mechanism, but **do not discard the plastic spindle**. The spring bar (white plastic back tension rod), located directly behind the paper roller is not a removable part.
4. Insert the plastic roller into a new paper roll.
5. Install the plastic roller and paper roll into the printer mechanism, with paper facing out and feeding from the top of the roll. The paper roller will fit into the slots on the left and right side of the printer mechanism. The paper roller should drop into position without additional adjustment.



6. Load paper roll so it come off the back of the spindle and drop into the slots on either side of the white bottom spring bar



7. Move roller Bar back up and push until it clicks back in to starting position with paper behind it.



8. Feed Paper through door slot, close printer door and tear off extra paper.



## Data & Display

### Viewing the Curve Characteristics Box

Each measurement screen has a Curve Characteristics Box that tells you different information about each measured curve. It has several different columns of data: Curve Name, Curve Title (real-ear only), Source Type, Source Transducer, Source Amplitude, RMS Out, Correction Factors (COR, coupler only) and NR (Noise Reduction). Figure 2.5.1 shows an example.

FONIX 8000 TEST SYSTEM							
Coupler				Left Ear			
Curve Characteristics							
Curv	<---Source---			RMS	Cor	NR	
Name	Type	Trans	Amp	Out			
CL1E	CMP	Chamb	70	70.1			4X
CL2E	CMP	Chamb	70	63.5	CIC		4X
CL3	CFP	Chamb	60				
CL4	CFP	Chamb	60				
CL5	CFP	Chamb	60				
CL6	CFP	Chamb	60				
CL7	CFP	Chamb	60				
CL8	CFP	Chamb	60				
CL9	CFP	Chamb	60				
CLX	CFP	Chamb	60				

Figure 2.5.1—Curve Characteristics Box

**Curve Name:** This identifies the name of each curve. The first letter is derived from its measurement type—coupler (C) or probe (P). The second letter is derived from its ear—left (L) or right (R). (Coupler curves can also be labeled A and B.) The third letter is the number of the curve. CR1 is the first coupler curve for the right ear. PL2 is the second probe curve for the left ear.

**Curve Title:** This identifies the title of the real-ear curve. It is only available in the real-ear measurement screens. Here are the possible titles: REUR (real-ear unaided response), REAR (real-ear aided response), REIG (real-ear insertion gain), TARG (real-ear target), HTL (hearing threshold level), UCL (uncomfortable level).

**Source Type:** This identifies the type of source used to make the curve. Each curve is identified by three letters.

#### First letter:

C = Composite  
P = Pure-tone  
D = Digital Speech

#### Second letter:

*For pure-tone:*

N = Normal pure-tone F  
= Fast pure-tone  
S = Short pure-tone

*For Composite or Digital Speech:*

W = Weighted composite F  
= Flat weighted  
S = Spectrum

**Third letter:**

P = SPL measurement (power)  
G = Gain measurement

Note: When it's possible to toggle between Gain and SPL in the local menu, the FONIX 8000 Test System will convert most curves back and forth between the two formats.

**Source Transducer:** This identifies the transducer used to make the measurement. "Chamb" means sound chamber. "S.F." means sound field. "Tcoil" refers to a telecoil board or telewand transducer.

**Source Amplitude:** This identifies the amplitude of the signal used to make the curve.

**RMS Out:** The root-mean-square of the measured curve.

**Correction Factors (COR):** The coupler correction factors used to make the measurement. Coupler screen only.

**Noise Reduction:** The noise reduction used to make the measurement. See Sections 2.3.1.1 and 2.3.2.1.

Lastly, just to the right of the Curve Name column, the FONIX 8000 Test System uses symbols to describe the display status of the curves. Here is the legend for those symbols:

- ≡ Curve is completely on the graph
- Curve is measured but turned off
- ↓ Curve is partially off the bottom of the graph
- ↑ Curve is partially off the top of the graph
- ▲ Curve is on, but is out of view above the graph
- ▼ Curve is on but is out of view below the graph
- ↕ Curve is partially off the graph in both directions

### 2.5.2 Viewing numerical data

You can display the numerical data of the response curves made in several test screens including the Coupler Multicurve screen.

To display numerical data:

1. Press [MENU] from the test screen.
2. Select Data/Graph using [ $\blacktriangle$ ,  $\blacktriangledown$ ]. (This selection is not available in the automated test screens such as ANSI 03.)
3. Use [ $\blacktriangleright$ ,  $\blacktriangleleft$ ] to select DATA.\*
4. Press [EXIT] to return to the measurement screen.
5. Use [F2] to select the curve that you want to show. See Figure 2.5.2 for an example of the data display of a composite curve.

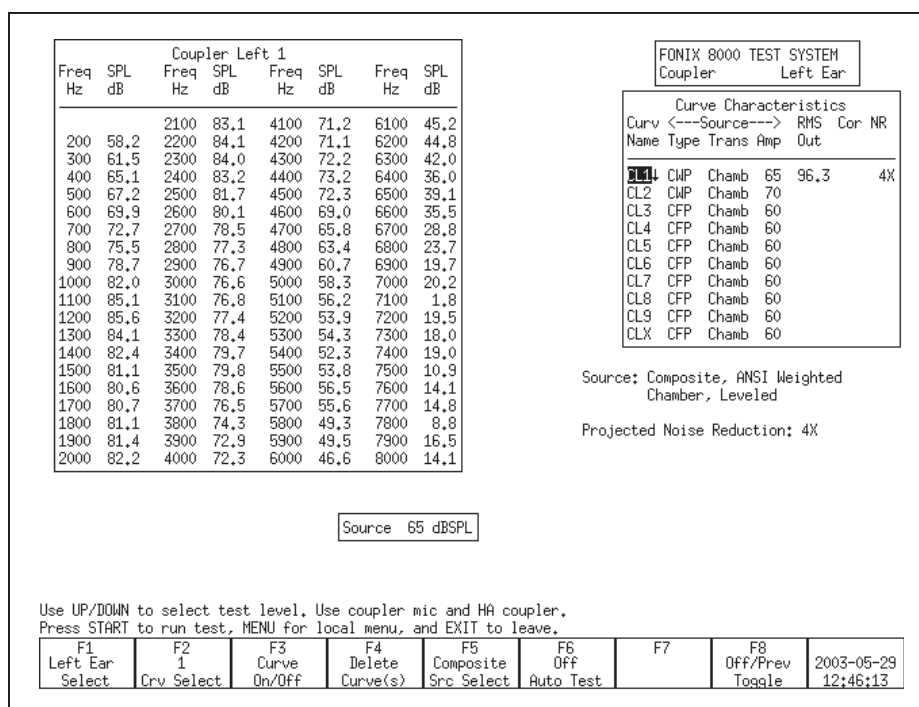


Figure 2.5.2 —Data display of a composite measurement

## Computer Connection

The FONIX 8000 Test System is equipped with an RS232 connection that will allow you to connect to a personal computer and exchange data. You will also need a software program, such as WinCHAP, on your Windows computer that can communicate with the analyzer. It is possible to make your own program using the FRYERS protocol. See [www.frye.com](http://www.frye.com) for details.

## Leveling

Leveling is the process by which the response of the sound chamber or sound field is measured and computer-corrected so that a flat sound field is achieved. Sound chamber leveling can be saved into permanent memory.



Here are some technical details on the leveling status messages.

- UNLEVELED: Leveling has not been attempted and sound is uncorrected.
- LEVEL\_ERROR or LEVEL\_FAILED: An error happened during leveling and source is uncorrected.
- LEVELED: Leveling has been achieved within  $\pm 0.25$  dB between 260–6000 Hz and  $\pm 0.5$  outside that frequency range for sound chamber leveling or within  $\pm 1$  dB between 260–6000 Hz and  $\pm 2$  dB outside that frequency range for real-ear leveling.
- SEMI\_LEVELED: Leveling has been achieved between  $\pm 0.25$  dB and  $\pm 0.5$  dB between 260–6000 Hz and between  $\pm 0.5$  and  $\pm 1.5$  dB outside that frequency range for sound chamber leveling or between  $\pm 1$  dB and  $\pm 2$  dB between 260–6000 Hz and between  $\pm 2$  dB and  $\pm 6$  dB outside that frequency range for real-ear leveling.
- WEAK\_LEVELED: Tolerances are the same as SEMI-LEVELED but the maximum output for the speaker is less than 100 dB for coupler measurements or 80 dB for real-ear measurements. To achieve a louder signal, the speaker needs to be moved closer to the analyzer microphone and re-leveled.

If a leveling error occurs during sound chamber leveling, check the connections of the sound chamber and the microphone, and make sure that you are getting noise out of your sound chamber. If those connections are good, your microphone is probably in need of calibration or it is damaged. It is also possible that your sound chamber speaker is damaged, but this is unlikely.

*Contact the factory or your local FONIX distributor if you continue to have problems with leveling.*

## Basic Sound Chamber Tests

In the Coupler Multicurve screen, you can view measurement curves in dB SPL or dB Gain, and run them with Composite, Digital Speech, or pure-tone signals. You can display up to 10 curves on the Coupler screen at the same time.

From the Opening screen of the FONIX 8000 Test System, enter the Coupler Multicurve screen by pressing [F1].

The Coupler Multicurve screen can be set as the screen that appears when the FONIX 8000 Test System is powered or the [RESET] button is pressed. See Section 2.2.1 and 2.2.4 for details.

### The Coupler Multicurve Screen Display

The display of the Coupler Multicurve Screen varies depending upon whether you have chosen a pure-tone source or a composite (including Digital Speech) source.

#### 3.1.1 Viewing a Pure-tone Display

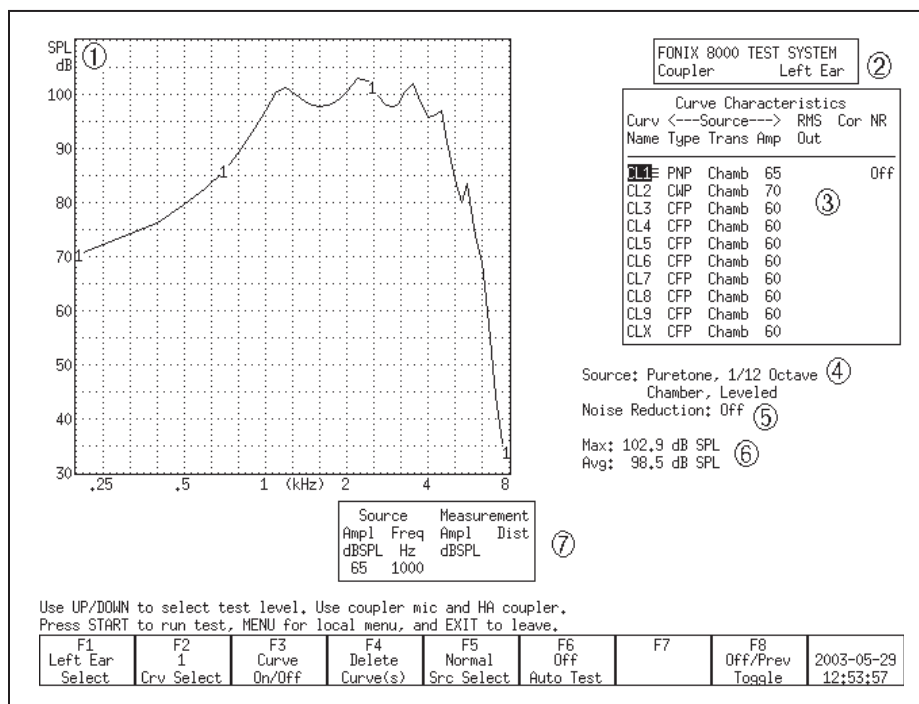


Figure 3.1.1—Coupler Multicurve Screen with pure-tone source

Refer to Figure 3.1.1 for the following explanation of the graphical display:

1. Type of display. This will be either dB SPL (coupler output) or dB Gain (coupler gain).
2. Selected ear.
3. Curve Characteristics box. See Section 2.5.1 for more details.
4. Signal type and leveling status.
5. Selected noise reduction.
6. Maximum output and three-frequency average of the selected curve.
7. Source Signal Statistics Box. Displays the source amplitude, frequency, distortion and output/gain.

### Viewing a Composite Display

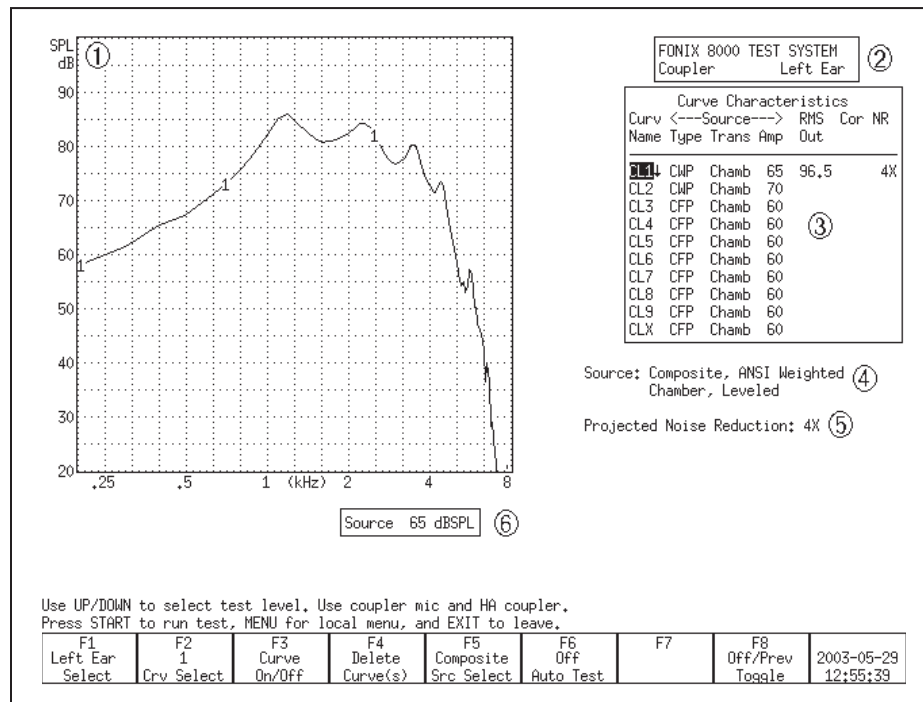


Figure 3.1.2—Coupler Multicurve screen with a Composite source

Refer to Figure 3.1.2 for the following explanation of the graphical display:

1. Type of display. This will be either dB SPL (coupler output) or dB Gain (coupler gain).
2. Selected ear.

3. Curve Characteristics box. See Section 2.5.1 for more details.
4. Signal type, speech weighting, leveling status, and bias status (Digital Speech only).
5. Selected noise reduction.
6. Source Signal Statistics Box. Displays the source amplitude.

### The Leveling Process

Leveling is the process by which the response of the sound chamber is measured and computer-corrected so that a “flat” sound field is achieved. The leveling status can be saved into the FONIX 8000 Test System’s permanent memory so that you don’t have to level the analyzer every time you turn it on. However, if you get your analyzer calibrated, or if you get a software upgrade, you should always level the chamber again (and save the leveling).

To double-check the leveling status of the analyzer, place the microphone by itself in the sound chamber at the reference point and run a composite frequency response (Figure 3.2). You should get a smooth, flat curve.

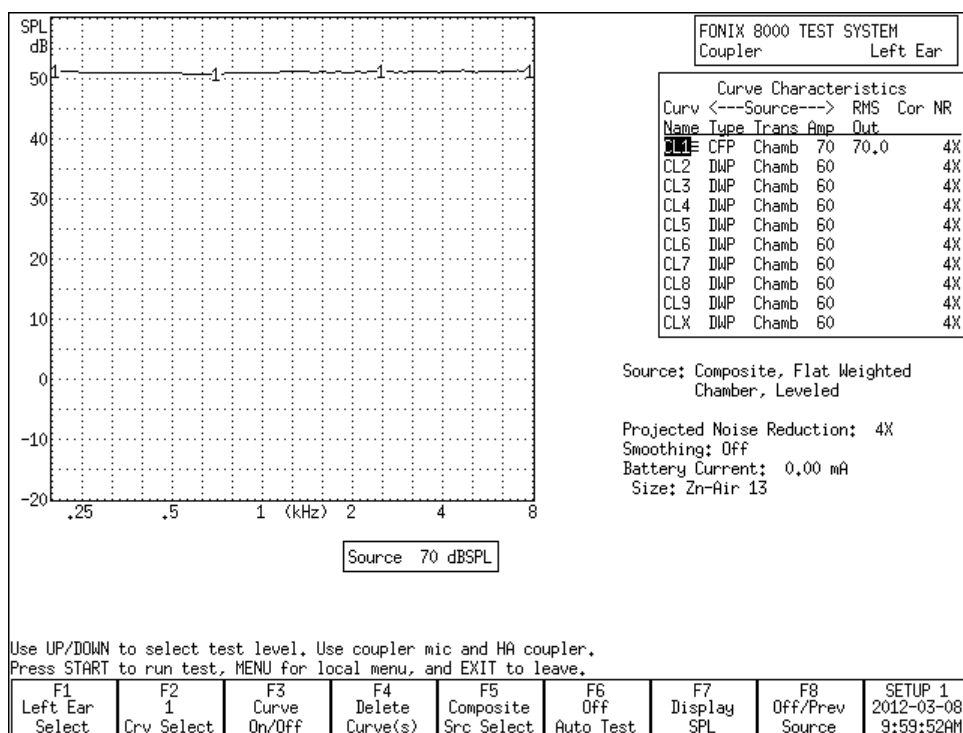


Figure 3.2

If you are getting bad coupler frequency responses that you suspect are the fault of the analyzer, rather than the fault of the hearing aid, the first step of trouble-shooting is to level the sound chamber. Even if the screen says LEVELED, the

response of the measurement microphone may have altered since the analyzer was last leveled, invalidating the leveling. When in doubt, level the sound chamber again.

See Section 2.8 for details on the leveling status and troubleshooting the leveling process. See Section 5.1.1 for the ANSI standardized leveling procedures.

### Leveling the 8050 Sound Chambers

To level the 8050 sound chambers:

1. **IMPORTANT:** Be sure nothing is plugged into the battery voltage supply.
2. Place the microphone in the sound chamber with the microphone grill over the reference point at a 90° angle the speaker in the back of the chamber (Figure 3.2.1). Close and latch the sound chamber lid.  
Warning: Leveling is valid only when the microphone position is not changed after leveling. Each significant change in microphone location requires new leveling.
3. Press [F1] to enter the Coupler Multicurve screen.
4. Press [LEVEL] to start the leveling sequence. The system responds by presenting a complex composite signal consisting of tones from 100 to 8000 Hz. It measures the signal and stores correction factors, so that the sound field is flat for testing.
5. Look at the display. After a few seconds, the video monitor should display a "Leveled" message under the Curve Characteristics box. If the FONIX 8000 Test System doesn't level, it could be an indication that your microphone needs to be calibrated or replaced.

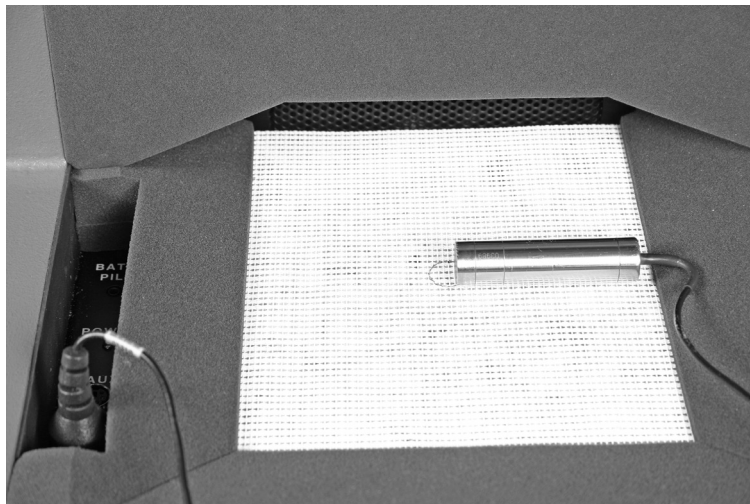


Figure 3.2.1—Leveling the 8050 & 8060 Sound Chambers

**Removing the leveling of the sound chamber:**

In some instances, you may want to look at the response of the sound chamber without the benefit of leveling. In order to do this, you will need to remove the leveling of the sound chamber. To do this:

1. Disconnect the microphone.
2. Push the [LEVEL] button. The leveling will be removed. If you don't save this new unleveled status, the analyzer will revert to its leveled status after it has been turned off and on again.

**Saving the leveling information**

To save the sound chamber leveling so that you won't have to re-level the sound chamber the next time the analyzer is turned on:

1. Follow the instructions in Section 3.2.1 or 3.2.2 to level the sound chamber.
2. Press [MENU] from the Opening screen. This will open the Setup menu.
3. Press [F5] to save the chamber leveling.
4. Press [EXIT] to return to the Opening screen.

**Hearing Aid Setup**

Coupler types and methods for attaching them to hearing aids are described in this chapter. This includes a description of the HA-1 coupler, HA-2 coupler, the ear-level adapter (used with the HA-2 coupler), the CIC coupler, and the Open Ear coupler.

Most FONIX couplers have an O-ring located deep within them that reduces pressure on the inserted microphone, thereby reducing damage to the microphone. When inserting the microphone into the coupler, you will feel a point of resistance when the microphone reaches the O-ring. You must continue to push the microphone into the coupler past that first resistance or incorrect data will be collected.

**HA-1 Coupler**

The HA-1 direct access coupler is used to test in-the-ear (ITE), in-the-canal (ITC), completely-in-canal (CIC), and other hearing aids with attached ear molds. In some cases, it may also be used to test Open Ear style hearing aids. Figure 3.3.1 illustrates a cross section of this coupler. The sound bore of the aid is sealed directly to the 2-cc cavity with putty.

The CIC coupler described in Section 3.3.3 can also be used to test CIC hearing aids for a more realistic frequency response, but in most cases the HA-1 coupler must be used to test to manufacturing specifications.

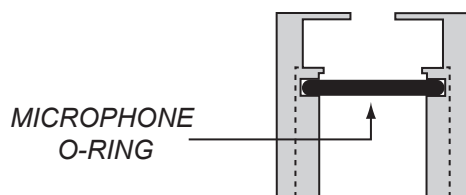
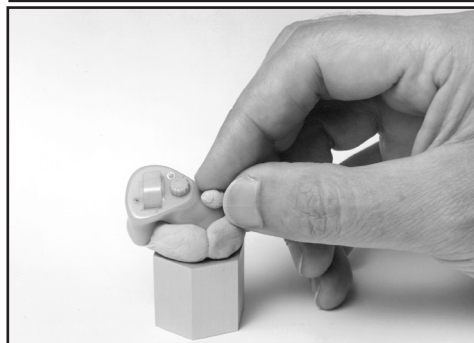
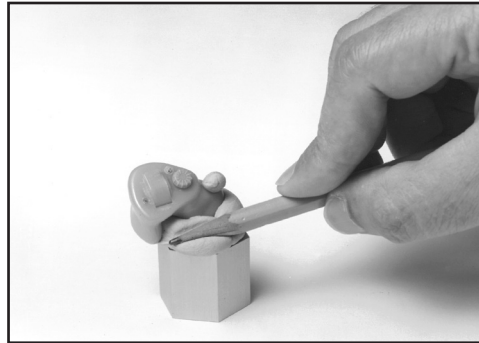


Figure 3.3.1—Direct access coupler (HA-1)

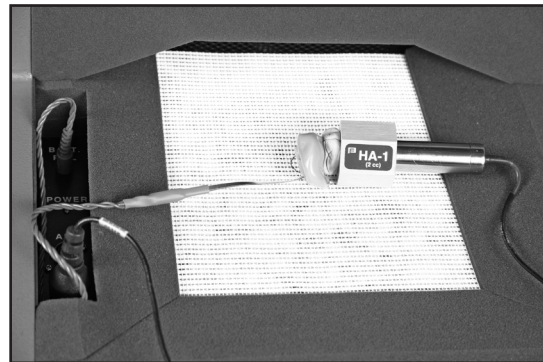
1. Roll the Fun-Tak, provided with each instrument, into a rod long enough to go around the transmitting end of the aid (approximately 2 inches). (Modeling clay can also be used, but it doesn't work as well.)
2. Bend the Fun-Tak rod around the canal of the aid, making the resulting "donut" flush with the end of the aid. (Some users choose to seal the vent opening at this end with a small amount of Fun-Tak.)
3. Align the sound opening of the aid to the hole at the conical end of the coupler. Look through the open end of the coupler to be sure the sound opening of the aid is clear of obstructions and correctly placed.
4. Seal any vent on the aid with a small kernel of Fun-Tak.



5. Complete the acoustical sealing of the aid to the coupler by using a pencil or finger. You may want to double-check the aid placement through the open end of the coupler at this point. **Slowly** reinsert the coupler microphone into its access opening.



6. Place the completed assembly at the reference position in the test chamber. With ITEs, the position of the aid can affect the frequency response. As a rule, point the faceplate of the aid toward the speaker in the back of the chamber, with the microphone opening in the reference circle.



If you are using a battery pill, be sure the metal conductor strip does not obstruct the sound path.

## HA-2 Coupler

The HA-2 coupler approximates the human ear with an earmold attached. See Figure 3.3.2A. Note the tube that simulates the earmold. Button-type receivers connect directly to this coupler. Behind-the-Ear (BTE) hearing aids connect to this coupler by means of an ear-level adapter.

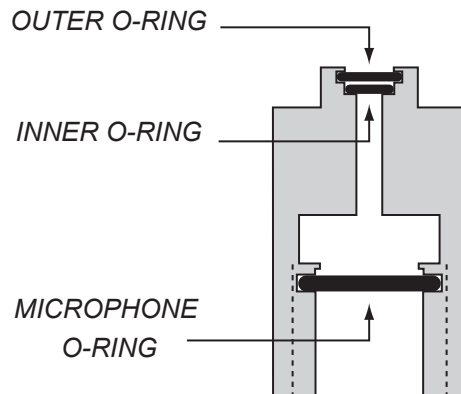
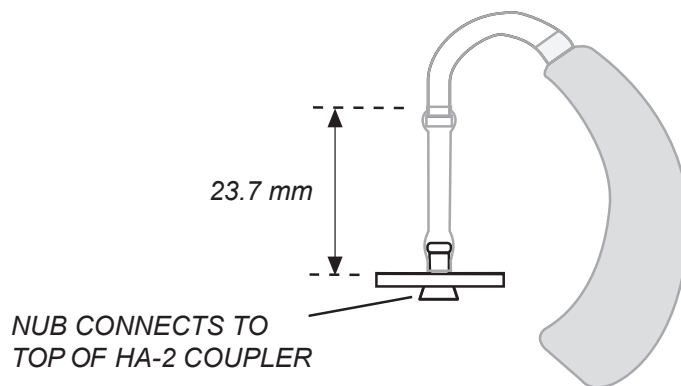


Figure 3.3.2A—Standard 2-cc Coupler (HA-2)



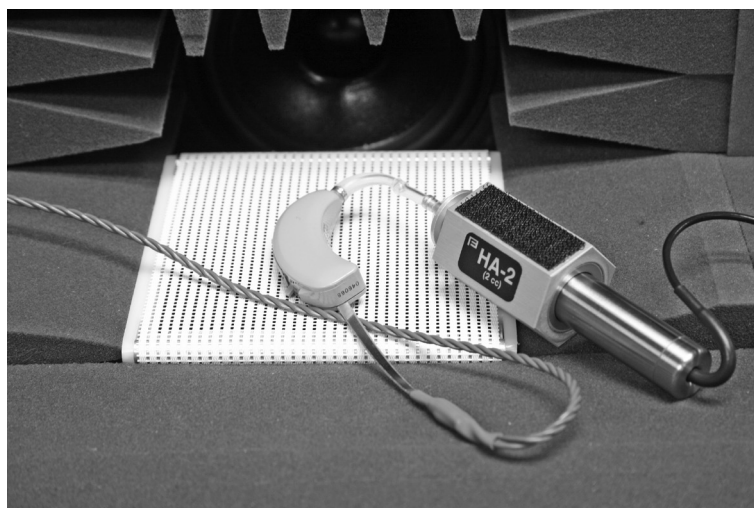
The length and thickness of the tubing of the ear-level adapter can have a significant effect on the frequency response of an aid. If an aid is being compared against the manufacturer's specifications, the tubing should be carefully chosen to duplicate that used by the manufacturer to obtain the original data. For ANSI tests, use #13 thick-walled tubing with a length of about 24 mm. See Figure 3.3.2B.



*Figure 3.3.2B—Ear-level Adapter (used with HA-2)*

To use the HA-2 coupler:

1. Insert the coupler microphone into the HA-2 2-cc coupler.
2. Couple the aid to the HA-2 coupler using the ear-level adapter. There should be about 24 mm of tubing between the nub of the ear-level adapter and the nub of the coupler adapter.
3. Place the microphone of the hearing aid at the reference point in the chamber, as shown in Figure 3.3.2C.
4. Close the lid and test as desired.



*Figure 3.3.2C—Behind-the-Ear Aid with Ear-level Adapter*

### CIC Coupler

The CIC coupler is a non-standard coupler with a 0.4 cc coupler (as opposed to the 2 cc size used by the HA-1 coupler). Together with software correction factors, this coupler is used to produce a frequency response similar to the response actually found in the patient's ear. See Figure 3.3.3.

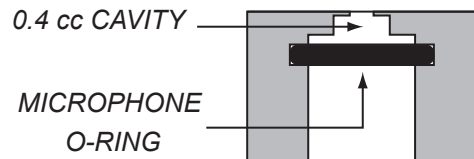


Figure 3.3.3—CIC Coupler

This coupler is recommended for use in obtaining a realistic frequency response of a CIC hearing aid when a real-ear measurement is not possible or practical. See Section 3.6 for details on measuring with the CIC coupler. CIC hearing aids are attached to the CIC coupler in the same fashion that hearing aids are attached to the HA-1 coupler (see Section 3.3.1).

The CIC coupler is not specified for use in the ANSI, IEC, or JIS standards. Therefore, to test exactly to the specification of one of these standards, the HA-1 coupler should be used instead of the CIC coupler.

### Body Aids

1. Insert the coupler microphone into the HA-2 coupler. (The most consistent results for body aids can be obtained by locating the 2-cc coupler outside the test chamber, preferably on a foam pad to isolate it from vibration.)
2. Snap the earphone (receiver) of the body aid onto the 1/4" recessed-end of the coupler (Figure 3.3.5A).
3. Place the aid in the test chamber with its microphone opening as close to the reference point as possible. See Figure 3.3.5B.
4. Turn the gain (volume) control to the desired setting and set the switch for microphone operation (not telephone coil or "T").
5. Close the lid and test as desired.

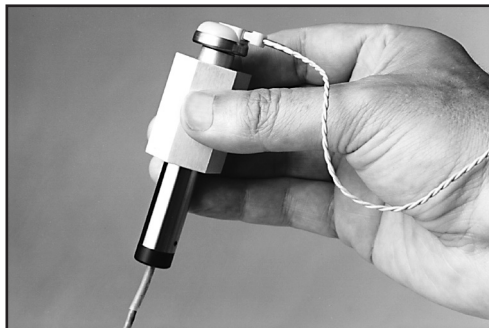


Figure 3.3.5A—Coupler setup

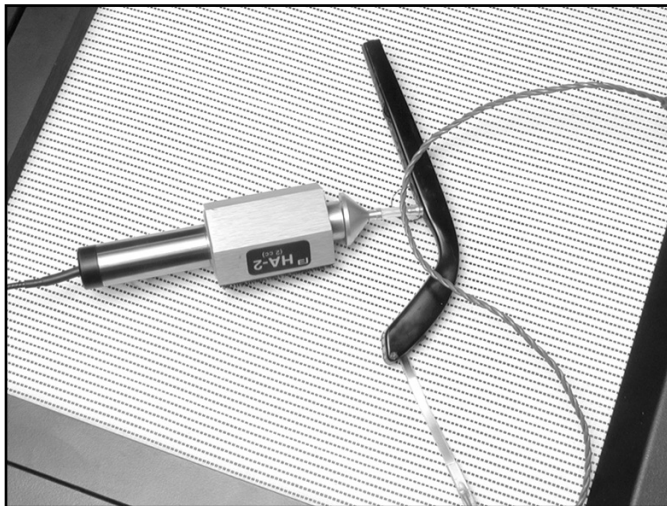


Figure 3.3.5B—Body Aid in test chamber

### **Eyeglass Aids**

1. Follow the manufacturer's instructions for removing the hearing aid assembly or the temple piece from the eyeglass frame, if possible. Should you be unable to remove the aid assembly or temple from the frame, it is possible to place the entire frame in the test chamber for testing. Be sure to fold the glasses first.
2. Insert the coupler microphone into the HA-2 coupler.
3. Couple the aid to the 2-cc coupler using the BTE aid adapter and the appropriate tubing, as shown in Figure 3.3.6.

The length and thickness of the tubing have a significant effect on the frequency response of an aid, especially in the 500 to 1000 Hz region. If an aid is being compared against the manufacturer's specifications, the tubing should be carefully chosen to duplicate that used by the manufacturer to obtain the original data. For ANSI tests, use 0.6" (15 mm) of #13 thick-walled tubing (exposed portion).



*Figure 3.3.6—Eyeglass Aid Set-up*

4. Position the microphone of the aid as close as possible to the reference point in the test chamber, as shown in Figure 3.3.6.
5. Close the lid, if possible, and then test as desired. If the lid can't be closed, measurements can be made with the lid open. But we recommend that you first re-level the chamber with the lid open, and use the quietest possible location.

### Wireless CROS and BICROS Aids

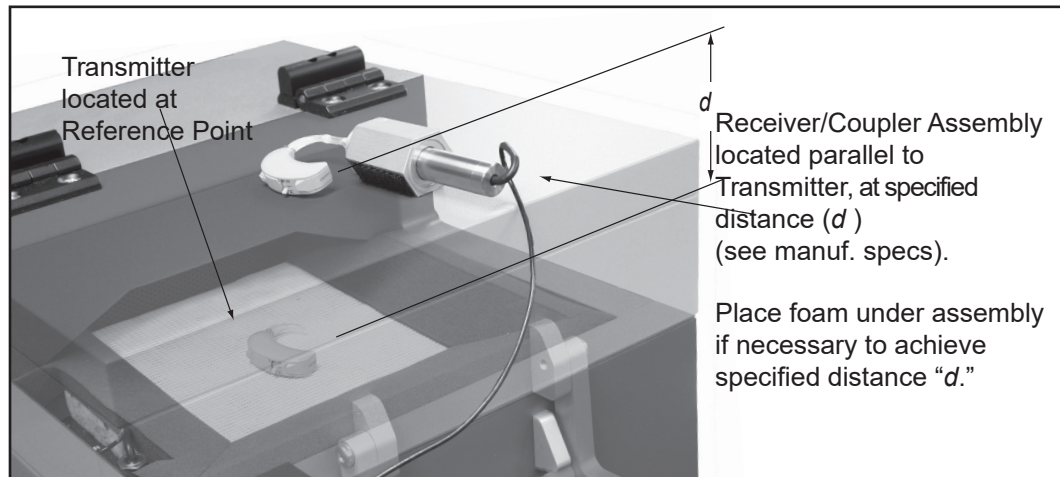
The key to testing these aids is to get the proper amount of separation between the transmitter and the receiver. This separation may be vertical. The transmitter may be in the chamber while the receiver is on top of it.

If you are using a CRT monitor, it may be necessary to turn it off while testing these aids, because CRT monitors create magnetic fields which may interfere with testing. Either turn the monitor back on to view results, or push [PRINT] to print. LCD monitors should not cause interference.

#### Wireless CROS

A CROS (Contra-lateral Routing of Signal) aid consists of a transmitter and a receiver so that sound received on one side of the head can be transmitted to the other side without a wire connection. You can test these units in the test chamber of the FONIX 8000 Test System. See Figure 3.3.7.

1. Place the microphone of the transmitter at the reference point in the test chamber. Turn on the transmitter.
2. Close the lid of the test chamber.
3. Check the specification sheet of the aid under test to determine how far apart to place the transmitter and the receiver. About 6" (15 cm) is usually sufficient.



*Figure 3.3.7—Testing Wireless CROS Hearing Aids*

4. Place the receiver on top of the lid of the test chamber. The total depth of the lid of the test chamber is about 5 ½ inches (14 cm). To increase the total separation, place foam on the top of the test chamber until the total separation equals that recommended by the aid manufacturer.
5. Attach the coupler to the receiver just as you would for an ordinary BTE or eyeglass aid.

6. Align the receiver and coupler assembly on the top of the test chamber so that the receiver is exactly parallel to the transmitter in the test chamber.
7. Test as you would any ordinary hearing aid.

### **Wireless BICROS**

BICROS systems have two microphones: one on the transmitter side and the other on the receiver side.

1. Test the receiver side as an ordinary hearing aid first.
2. Arrange the transmitter parallel to the receiver, but as far as possible from it while still in the chamber. You may have to unscrew the ear hooks one-quarter turn to accomplish this. Fun-Tak may help to keep the units in position, but be careful not to obstruct the sound paths to the microphones.
3. Test the hearing aid again. Adding the transmitter should increase the gain by the amount specified by the manufacturer. It is not possible to get exact measurements by this measure because at least one of the microphones will not be at the reference point.

### **Additional Notes for Testing Wireless Instruments**

1. There must not be any metal objects between the transmitter and the receiver sides.
2. The two sides must be directly parallel as illustrated (See Figure 3.3.7).
3. The distance between the two sides should be as specified by the manufacturer.

THE GAIN OF THE AID INCREASES AS THE TRANSMITTER AND RECEIVER MOVE CLOSER TO EACH OTHER. EVENTUALLY, THE RECEIVER WILL OVERLOAD.

4. No other wireless CROS/BICROS/MultiCROS transmitters are to be turned on near the test box.
5. Calculators should be kept at least a foot (300 mm) from the test box.

### **Wire-Type CROS and BICROS aids**

#### **CROS**

CROS aids are similar to ordinary hearing aids, except that the microphone and amplifier are separate units connected by a wire. Both units may be placed inside the test chamber during testing.

1. Place the orifice of the microphone unit at the reference position in the test chamber.
2. Connect the amplifier unit to the appropriate 2-cc coupler. (See earlier sections for details.)

3. Place the coupler with the amplifier unit at the left side of the test area.
4. Test as desired.

### **BICROS**

Test wire-type BICROS aids just as you would wireless BICROS aids, except instead of separating the two units and keeping them parallel, place both units as close as possible to one another with the microphone openings as close as possible to the reference circle. (Otherwise, follow the steps given in Section 3.3.7 for BICROS aids.)

## **Basic Measurements**

In the Coupler Multicurve screen of the FONIX 8000 Test System, you can perform the following measurements: response curves, single-frequency measurements, three-frequency averages, harmonic distortion, and intermodulation distortion.

### **Signal Types**

The following signal types are available:

**RANDOM NOISE**—Two spectral shapes of random noise are commonly used. They are white and pink. The long term average spectral shape of white noise is flat when using a Fourier Analysis method of spectral analysis. The long term average spectral shape of pink noise is flat when using a fractional octave analysis method.

**DIGITAL SPEECH**—A randomly interrupted composite signal designed to mimic speech. This signal is for use with hearing aids with a “noise reduction” or “speech enhancing” feature that lowers the gain of the aid in the presence of a continuous signal (such as the regular composite signal).

**COMPOSITE**—A continuous, real-time, speech-weighted signal made up of 79 different frequencies. The composite signal gives you the advantage of seeing how an aid responds to noise that more closely simulates speech, and it lets you see immediately how the aid responds to any change in the amplitude of the signal.

**FREQUENCY SHIFT**—A pure tone source signal. The pure tone frequency and level can be set to just like a Single Tone source type. The source frequency is indicated on the graph by a vertical line cursor. The hearing aid output is displayed on a composite curve. The peak output frequency and level are also displayed. This source type is used to test a hearing aid that does frequency shifting.

**TONE LONG**—A detailed frequency response curve that gives you information on the amplification of 64 different pure-tone frequencies between 200 and 8000 Hz

**TONE NORMAL**—A detailed frequency response curve that gives you information on the amplification of 43 different pure-tone frequencies between 200 and 8000 Hz.



**TONE FAST**—A continuous pure-tone sweep that takes measurements at 16 different frequencies between 200 and 8000 Hz.

**TONE SHORT**—A single pure-tone sweep of 10 different frequencies.

### Running a Test Curve

1. Press [MENU] to make any necessary selections. See Section 3.10 for details on available menu selections.
2. Set up the aid in the sound chamber as described in Section 3.3 and level if necessary.
3. Select signal type with [F5]. (Press [F5]. Use [▲, ▼] to select the desired signal type. Press [►] to complete the selection and close the pop-up menu.) See Section 3.4.1 for details on signal types.
4. Press [START] to initiate the frequency sweep. If you are using the LONG, NORMAL, or SHORT selections, the test will stop when the sweep is complete. The COMPOSITE, DIG SPEECH, RANDOM NOISE and FAST signals are continuous, making it necessary to press [STOP] when you want the signal to stop.
5. Use [F2] to select the next curve to be measured.
6. Repeat steps 3-5 to take additional measurements.

Figure 3.4.2 shows a completed normal pure-tone sweep.

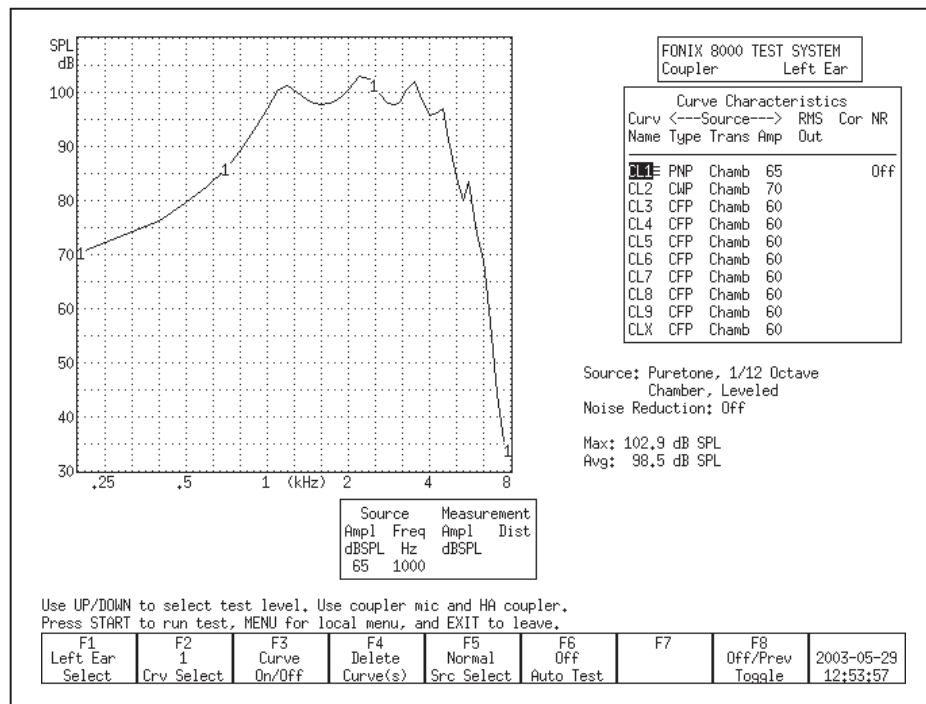


Figure 3.4.2—Pure-tone measurement

## Examples

### **COMPOSITE Source Type Example**

Following the instructions above, run 4 Gain curves using amplitudes 50, 60, 70, and 80 dB SPL. Use a signal source of COMPOSITE.

This scenario will provide you with a family of curves. Whenever the curves sit on top of each other, the gain of the aid is the same for the amplitudes of those curves. This indicates the aid is running linearly. If the curves provide progressively less gain as the input rises, then the aid has some sort of compression circuit. Figure 3.4.3 shows two examples of this scenario.

Here are the steps:

1. Look at the graph. If it has a display of SPL, press [MENU] and change the DISPLAY from SPL to GAIN, using the arrow keys. Press [EXIT] to return to the Coupler screen.
2. Use [F2] to select CRV 1. (Press [F2]. Use [▲, ▼] to select CRV1. Press [►] to complete the selection and close the pop-up window.)
3. Use [▲, ▼] to select a source level of 50 dB SPL.
4. Use [F5] to select a source type of COMPOSITE.
5. Press [START] to run the first measurement. Press [STOP] when the measurement has stabilized.
6. Use [F2] to select CRV 2.
7. Use [▲] to select a source level of 60 dB SPL.
8. Use [F5] to select a source type of COMPOSITE.
9. Press [START] to run the second measurement. Press [STOP] when the measurement has stabilized.
10. Use [F2] to select CRV 3.
11. Use [▲] to select a source level of 70 dB SPL.
12. Use [F5] to select a source type of COMPOSITE.
13. Press [START] to run the third measurement. Press [STOP] when the measurement has stabilized.
14. Use [F2] to select CRV 4.
15. Use [▲] to select a source level of 80 dB SPL.
16. Use [F5] to select a source type of COMPOSITE.
17. Press [START] to run the fourth measurement. Press [STOP] when the measurement has stabilized. You now have a family of curves.



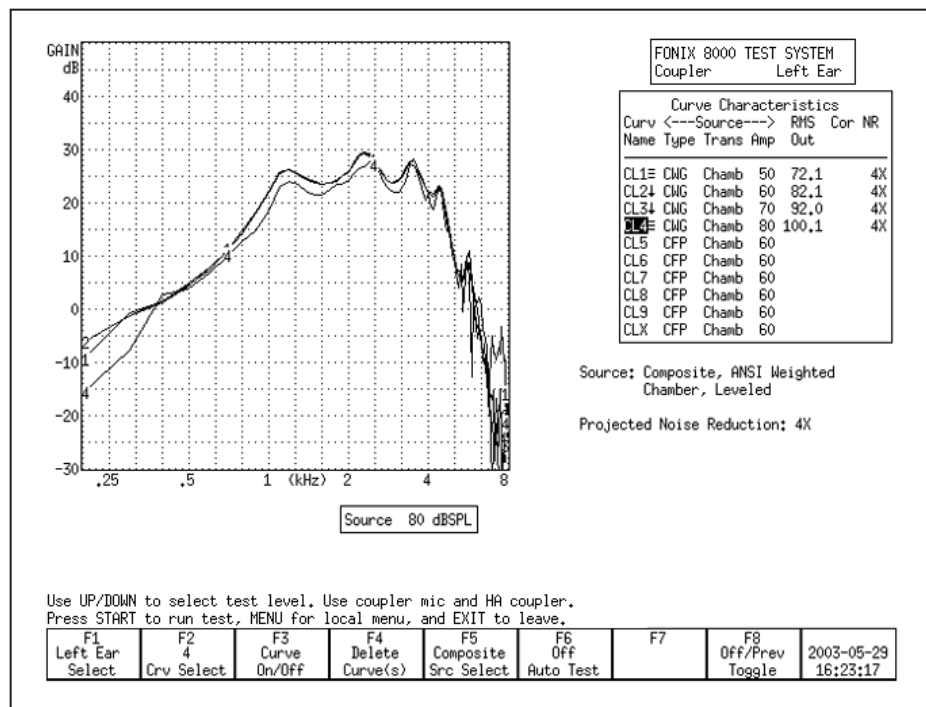


Figure 3.4.3.1A—Family of curves. Notice how all the curves are on top of each other. This aid has very little compression between 50 dB and 80 dB SPL.

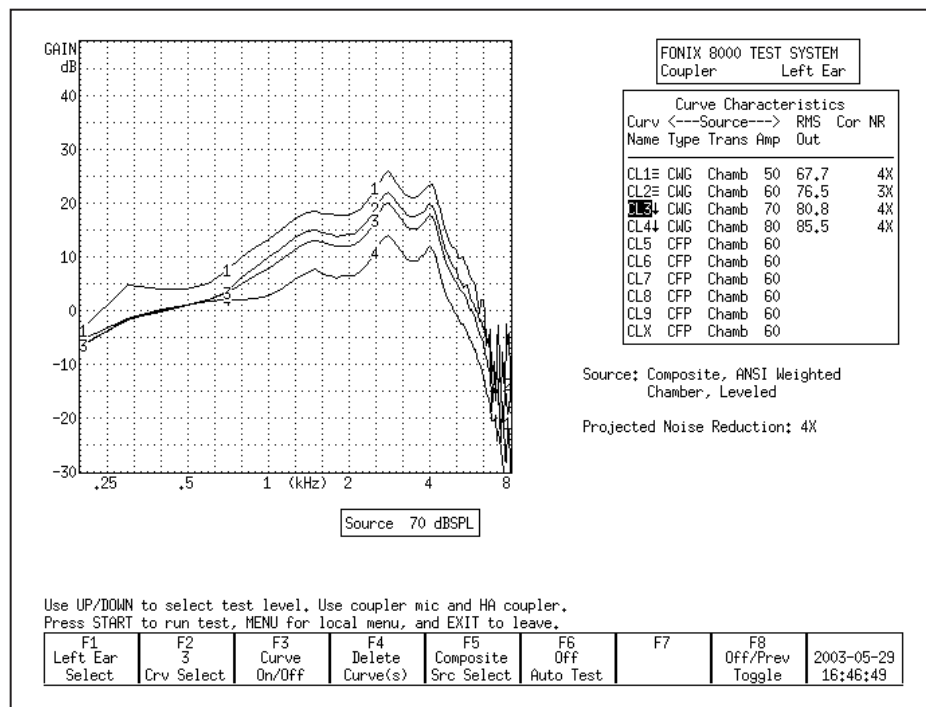


Figure 3.4.3.1B—Family of curves. Notice how the curves show less gain as the amplitude increases. This aid shows a great deal of compression between 50 dB and 80 dB.

### Frequency Shift Source Type Example

1. Follow the instructions in section 3.4.2 except select the "Freq Shift" signal type. Only measure one curve. Select the source tone frequency with the left and right keys.
2. Look at the screen shot for the following discussion.
  - 2a. The dotted vertical line is the source frequency of the puretone that the 8000 is generating in the chamber speaker. The source frequency is also shown in the Curve information area as the "Source: Frequency:".
  - 2b. The curve on the graph is the hearing aid output in response to the tone the 8000 is producing. The highest point on the curve should be the shifted tone frequency. If it's at the same frequency as the dotted line, then the aid is not shifting the frequency.
  - 2c. The measured frequency in the aid output is also shown in the Curve information area as the "Measured Frequency:".

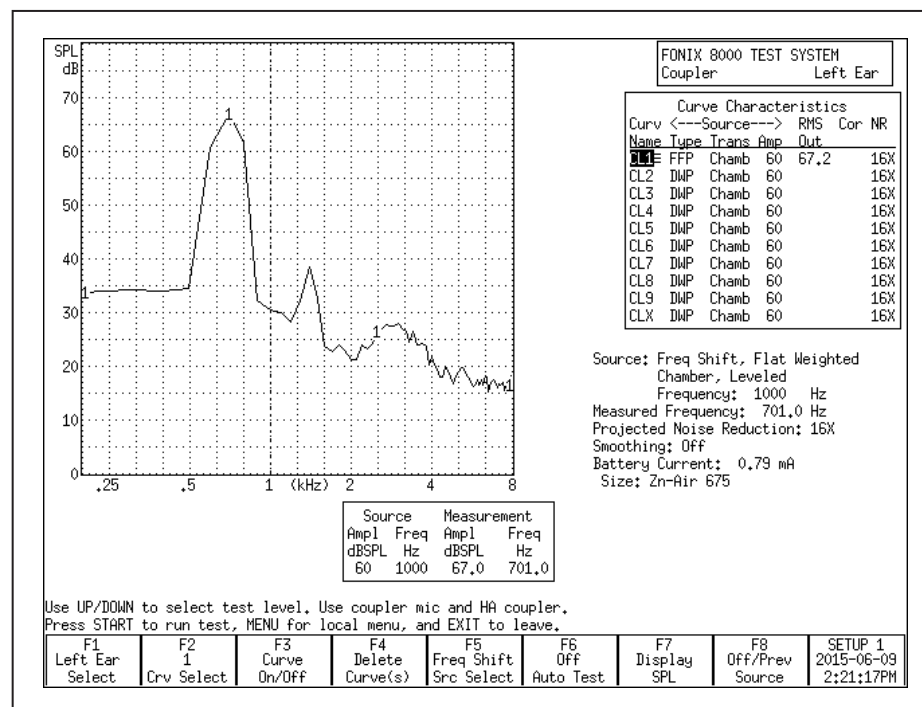


Figure 3.4.3.2—Frequency Shift Source Type curve.

### Deleting measurements and settings

Use the [F4] key to permanently delete measurement curves. When you press it, there are four possible selections:

- Selected Curve: Delete only the selected curve, but keep the curve selections (usually source type and level).

- Sel Curve & Settings: Delete selected curve and return curve to analyzer default setting.
- All Curves: Delete all curves, but keep the curve selections.
- All Curves & Settings: Delete all curves and return them all to analyzer default settings.

To delete a curve:

1. Press [F4].
2. Use [▲, ▼] to make the desired deletion type.
3. Press [►] to perform the deletion and close the pop-up menu.

### Running a Single Frequency Measurement

At times, you may want to find out what the frequency response of the hearing aid is to a single pure-tone signal. See Figure 3.4.5.

1. Press [MENU] from the Coupler screen.
2. Use [▲, ▼] to select Static Tone under Source Settings.
3. Use [►, ◀] to choose SINGLE.
4. Press [EXIT] to return to the Coupler screen. The single tone will automatically be running.
5. Adjust the frequency using the [►, ◀] buttons. Adjust the amplitude using the [▼, ▲] buttons.

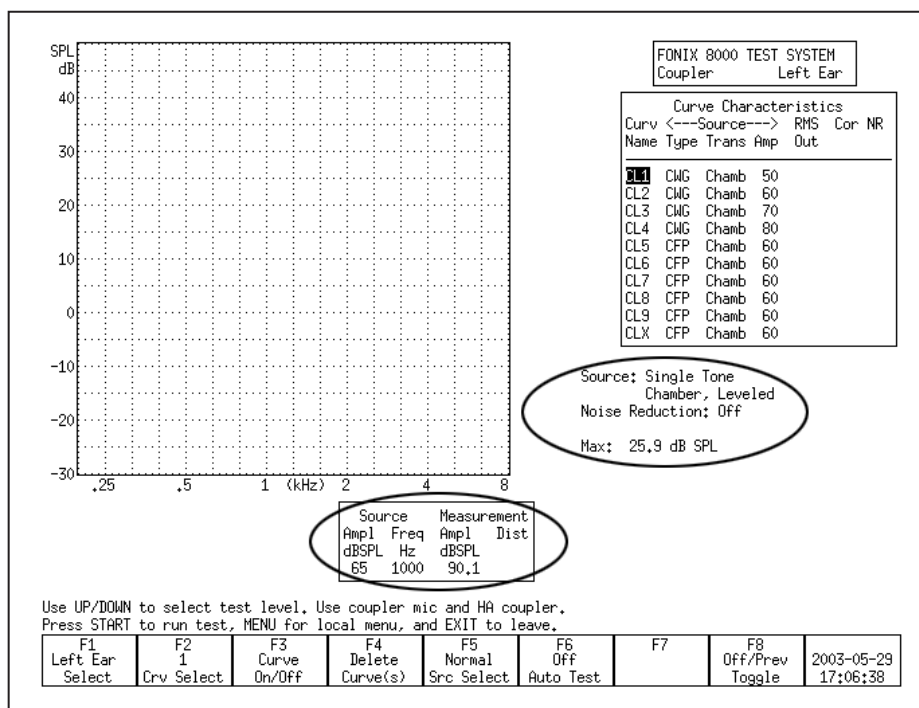


Figure 3.4.5—Measuring a single frequency

### Running a Three-Frequency Average

The ANSI standard includes some three frequency average tests. You can run a three frequency average test (apart from the test sequence) in the Coupler screen. See Figure 3.4.6. To do this:

1. Press [MENU] from the Coupler screen.
2. Use [▲, ▼] to select Static Tone under Source Settings.
3. Use [▶, ◀] to choose AVERAGE.
4. Use [▲, ▼] to select Avg Freqs under Aid Settings.
5. Use [▶, ◀] to choose the highest frequency of the three frequency average. See Section 2.2.4 for a complete list of frequencies.
6. Press [EXIT] to return to the Coupler screen. The three frequency average will automatically be running.
7. Adjust the amplitude using the [▼, ▲] buttons.

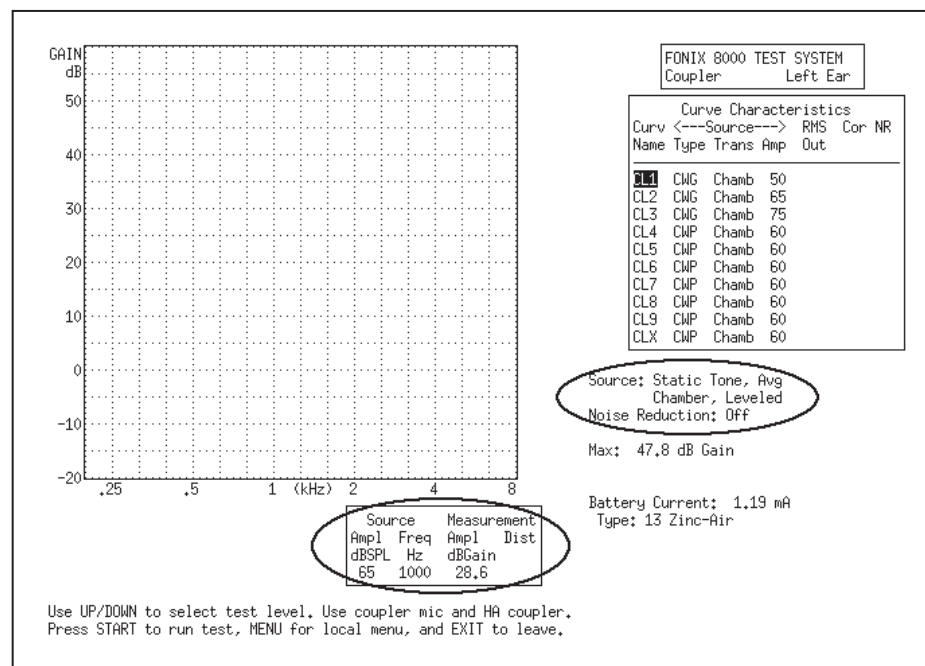


Figure 3.4.6—Measuring a three frequency average

### Measuring Harmonic Distortion

Harmonic distortion is when the hearing aid returns energy at frequencies not present in the source signal. The FONIX 8000 Test System allows you test for this phenomenon very easily.

1. Press [MENU] from the Coupler screen.
2. Select Distortion under Measurement Settings using the [▲, ▼] buttons.

3. Select the distortion type desired by using the [►, ◀] buttons.

The selections are:

2ND: Distortion present at the second harmonics, or twice the presented frequency.

3RD: Distortion present at the third harmonics, or three times the presented frequency.

TOTAL: Distortion present at the second and third harmonics.

4. Press [EXIT].
5. Use [F5] to select a signal type of TONE NORMAL. (Press [F5]. Use [▲, ▼] to select TONE NORMAL. Use [►] to complete the selection and close the pop-up menu.)
6. Press [START] to run normal frequency sweep.

After running a normal sweep, the harmonic distortion data will appear on the measurement graph as a series of red bars. The scale for the bars is on the right side of the graph

In general, you should ignore the harmonic distortion measurement when the amplitude of the response curve measurement at the second harmonic is more than 12 dB greater than the amplitude at the first harmonic. This is called the 12 dB rule and is part of the ANSI S3.22 standard.

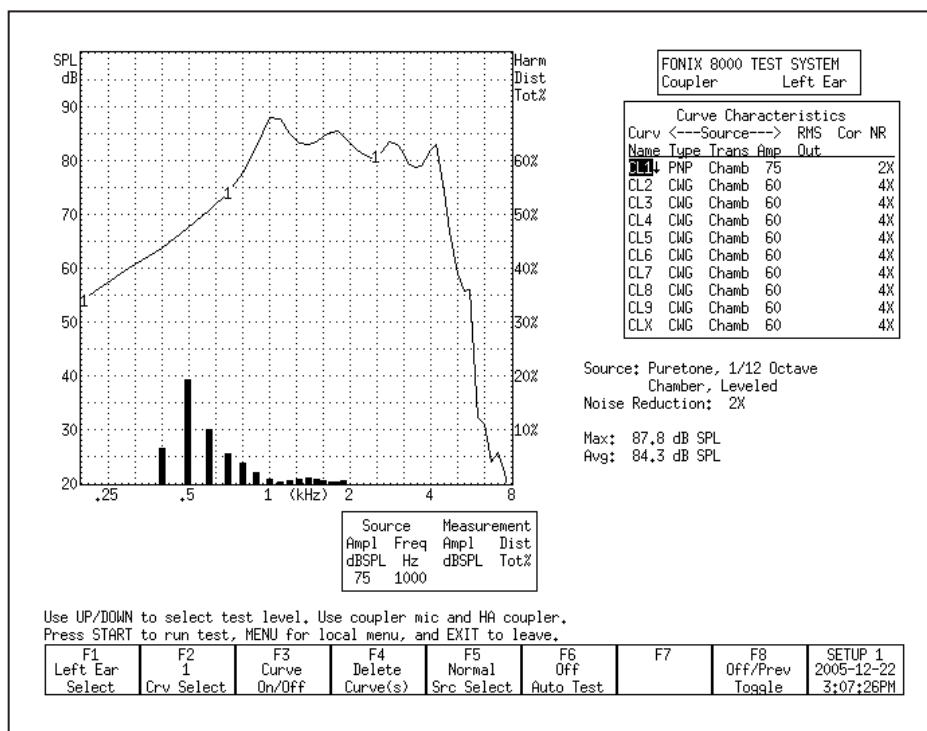


Figure 3.4.7—Measuring Harmonic Distortion

## Intermodulation Distortion

The composite signal is helpful for identifying intermodulation distortion (IM), a type of distortion that sometimes occurs in a hearing aid response.

IM distortion occurs when more than one frequency is present in the source signal and those frequencies combine to create new frequencies not actually present in the source. IM distortion is disturbing to the client, often more so than harmonic distortion. When viewing a graph run with the composite signal, look for points along the graph where the line “breaks up.” Such an appearance indicates the presence of intermodulation distortion. As IM distortion increases, the curve becomes more disconnected. See Figure 3.4.8 for an example of IM distortion.

This type of distortion is only apparent when the composite signal source is used because pure-tone source types do not contain more than one frequency at the same time.

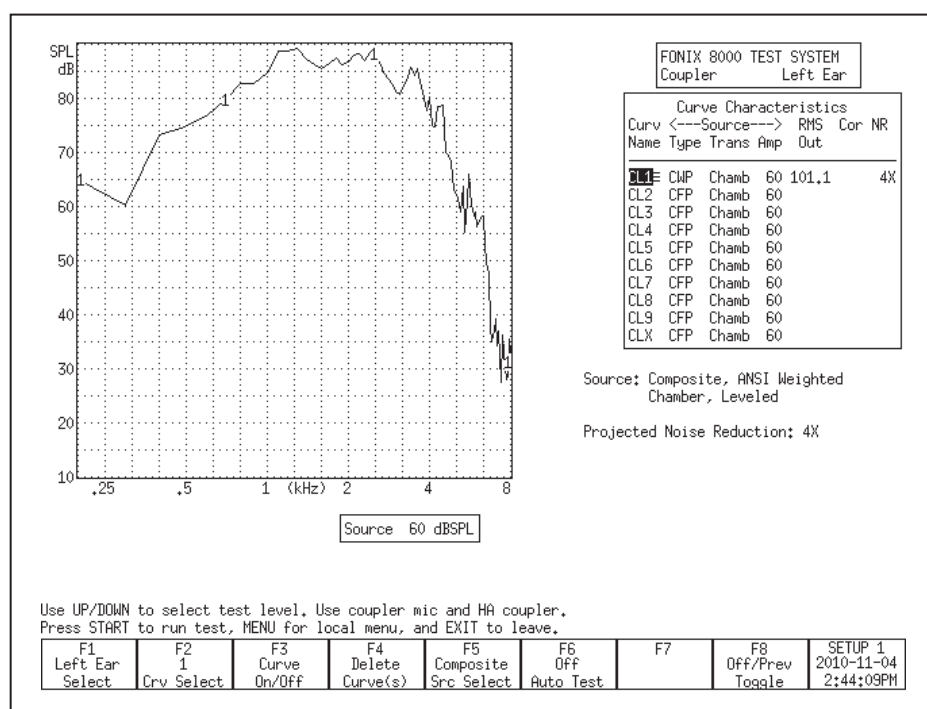


Figure 3.4.8—Measuring intermodulation distortion

## Battery Current Drain

You can measure the battery current drain in the Coupler screen if you use battery pills (instead of regular batteries) in the hearing aid while performing

your measurements. To turn on the battery current drain measurement in the Coupler screen:

1. Set up the hearing aid in the sound chamber for testing. You must use a FONIX battery pill to test for current drain.
2. Close the lid of the sound chamber and latch it.
3. Press [MENU] in the Coupler screen.
4. Use [▲, ▼] to select Battery Meas under Misc Settings. (You can use [START] to skip between groups of selections.)
5. Use [▶] to turn ON the Battery Meas.
6. Use [▼] to select Battery Size and use [▶, ◀] to select the hearing aid's battery size.
7. Press [EXIT] to return to the Coupler screen. You should now see the battery current drain measurement below the Curve Characteristics box. See Figure 3.4.9.
8. Start a frequency response measurement to display the battery current drain.

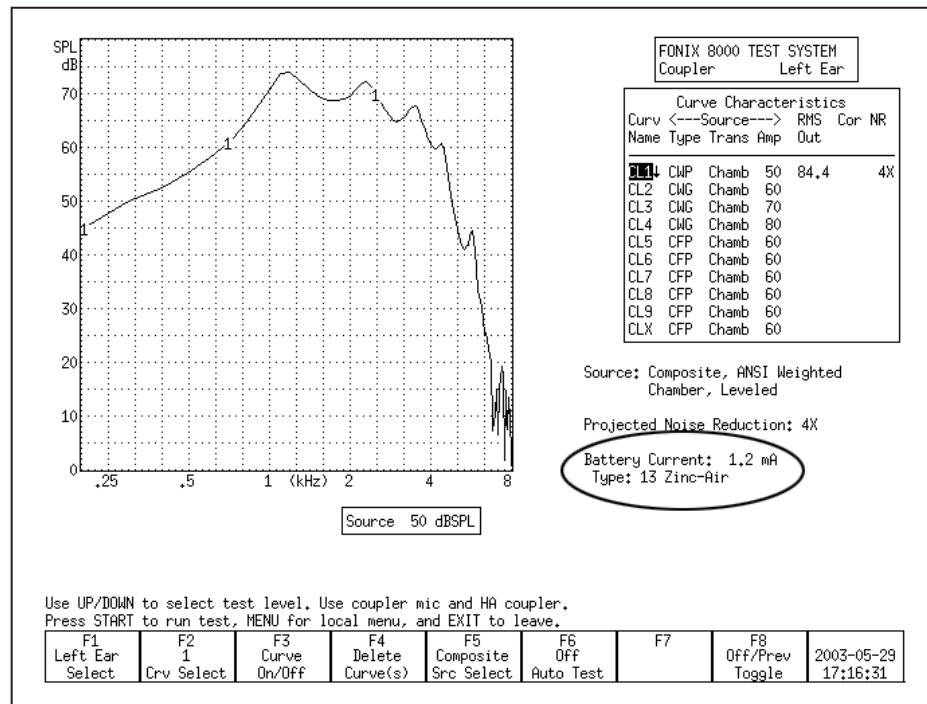


Figure 3.4.9—Battery Current Drain

**Telecoil**

Telecoil measurements can be performed in the Coupler screen using any of the source signals available on the 8000 Test System. During a telecoil measurement, a magnetic field is used that simulates the field of a telephone receiver. A telecoil capable of producing this field is built into every 8120 Polar Plot and 8050 & 8060 sound chambers. When the analyzer has the ANSI option, the external Telewand can also be used for the measurement.

Telecoil measurements can be performed with puretone, composite or digital speech signals. The filter of the signal is always set to flat. The resulting display is always in SPL (not gain).

**Analyzer Setup**

It is very important to pick a testing location that is free of magnetic disturbances, especially those caused by fluorescent lights and power lines. To do this:

1. Locate a wide-range linear hearing aid with good low frequency response and a telecoil switch.
2. Set the hearing aid to operate in the telecoil position and turn the gain control up to its full-on position.
3. Connect the hearing aid to a coupler. Don't insert the measurement microphone.
4. Walk around your possible testing location and listen for raspy humming sounds from the hearing aid. This will be the aid responding to magnetic fields in the room.
5. Pick a location that is as free of such sounds as possible. Rotate the aid in all directions when looking for a good site.

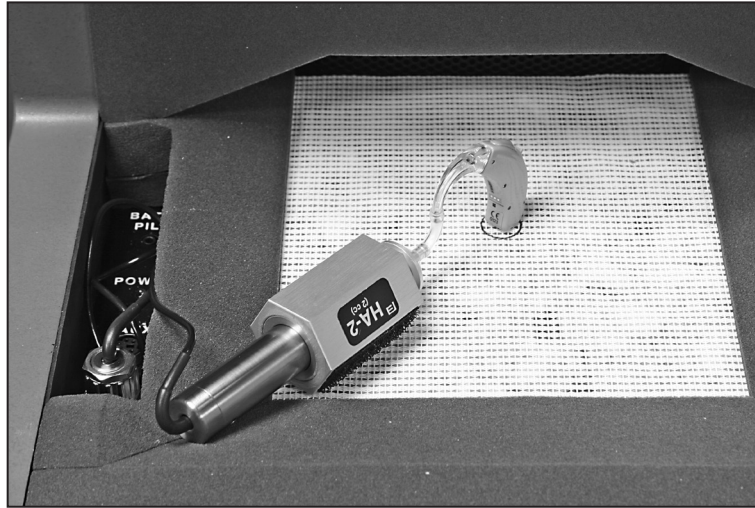
**Testing with the Sound Chamber Telecoil board**

Every 8120 Polar Plot Chamber and 8050 & 8060 Chambers has a built-in telecoil that can be used for telecoil testing.

1. Set up the hearing aid for testing in the usual way by connecting it to the appropriate coupler and inserting the measurement microphone.
2. Enter the Coupler screen by pressing [F1] in the Opening screen.
3. Press [MENU] in the Coupler screen to open the local menu. Set the TRANSDUCER to TELECOIL under Source Settings and press [EXIT] to close the local menu.
4. Use [F5] to set the Source Type to Composite.
5. Press [START] to start a composite measurement.
6. Look at the RMS OUT in the Curve Characteristics box. This shows the current output of the hearing aid to the magnetic field input.



7. Position the hearing aid for maximum output. For BTE hearing aids, this usually occurs when the body of the aid is in a vertical position. If necessary, use Fun Tak to help hold the aid in that position. See Figure 3.4.10A.
8. Use [▼,▲] to change the intensity of the magnetic field. The choices are: OFF, 1.00, 1.78, 3.16, 5.62, 10.0, 17.8, 31.6, 56.2 and 100 mA/m. 31.6 is the default source intensity.
9. Press [STOP] to stop the measurement or continue to test, as desired.



*Figure 3.4.10A—Testing with the Sound Chamber Telecoil Board*

**Note:** 8000 Version 2.50 is the first software version to support calibrated telecoil for the 8070 and TBS25 chambers. If you have an older Chamber Remote Module, it may need to be updated as well to use it with the 8070 and TBS25.

#### **Testing with the Telewand**

When the ANSI Option is ordered with the 8000 Hearing Aid Test System, the Telewand device is also included. Otherwise, you can order it from the factory as an optional accessory. The Telewand is supposed to provide a more realistic test of the telecoil features of a hearing aid than the built-in telecoil in the sound chamber because it more closely simulates the magnetic field produced by a telephone receiver.

1. Set up the hearing aid for testing in the usual way by connecting it to the appropriate coupler and inserting the measurement microphone.
2. Enter the Coupler Multicurve screen by pressing [F1] in the Opening screen.
3. Press [MENU] in the Coupler screen to open the local menu. Set the TRANSDUCER to TELEWAND under Source Settings and press [EXIT] to close the local menu.
4. Use [F5] to set the Source Type to Composite.

5. Press [START] to start a composite measurement.
6. Plug the Telewand into the Telecoil connector on the back of the 8050 Sound Chambers.
7. Hold the hearing aid in one hand and the Telewand in the other hand. Position the Telewand as you would position the receiver of a telephone. That is, hold the Telewand a few millimeters next to the hearing aid, positioned parallel to the body of a BTE aid or against the faceplate of an ITE aid.
8. Look at the RMS OUT in the Curve Characteristics box. This shows the current output of the hearing aid to the magnetic field input.
9. Position the hearing aid (with the Telewand held against it) for maximum output. For BTE hearing aids, this usually occurs when the body of the aid is in a vertical position. If necessary, use Fun Tak to help hold the aid in that position. See Figure 3.4.10B.
- 10 Use [▼,▲] to change the intensity of the magnetic field. The choices are: OFF, 1.00, 1.78, 3.16, 5.62, 10.0, 17.8, 31.6, 56.2 and 100 mA/m. 31.6 is the default source intensity.
11. Press [STOP] to stop the measurement or continue to test, as desired.



*Figure 3.4.10B—Testing with the Telewand*

### **Measuring directionality with the 8050 Sound Chambers**

Although directional hearing aids can have different types of polar plots and two or even three microphones, the basic concept is fairly simple: speech sound from in front of the hearing aid wearer is louder than noise from behind him. If you have purchased the Coupler Directional Option including the 8120 Polar Plot Sound Chamber and the Coupler Directional test screen, you can perform a polar plot measurement of a directional hearing aid. See Chapter 6 for details. If you do not have this option, however, you can still get a rough idea of directionality by using the 8050 & 8060 Sound Chambers.

The directional test with the 8050 Sound Chambers takes advantage of the horizontal speaker placement and the flat testing surface that makes it easy to position the hearing aid for testing. There are two measurements: one where the hearing aid is positioned so that it is facing towards the sound chamber speaker, and one where the hearing aid is positioned so that it is facing away from the sound chamber speaker. You should use the same input signal for both measurements. The source amplitude used for this measurement should be greater than the noise floor of the testing environment, but less than the compression knee point of the hearing aid, if possible. 50 dB SPL is usually a good choice.

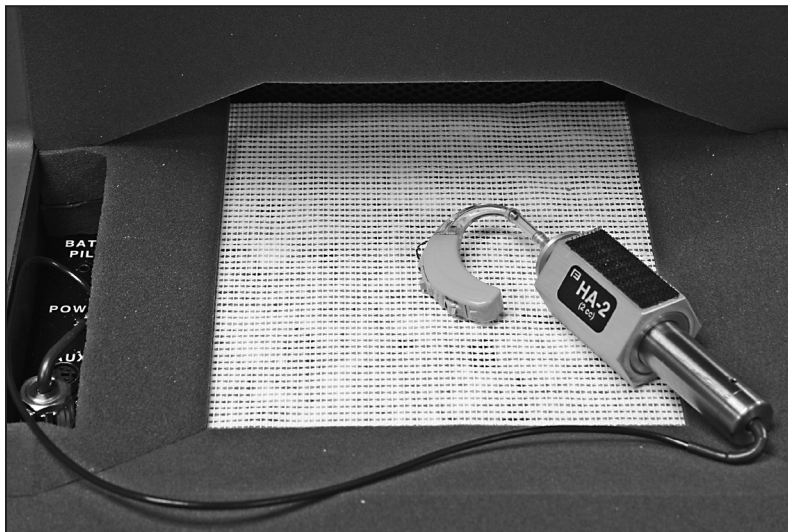
### **Speaker Placement**

The speaker in the 8050 Chambers is positioned horizontally in the back of the chamber. This makes it easy to visualize how the hearing aid should be positioned for the directional test.

### **Forward measurement**

The first step in doing a directional test is to position the hearing aid in the sound chamber so that the front of the hearing aid is pointing towards the back of the chamber. See Figure 3.4.11A. Close the sound chamber lid and perform the following steps:

1. Enter the Coupler Multicurve screen by pressing [F1] from the Opening screen.
2. Use [F5] to set the source type to Digital Speech.
3. Use [▲, ▼] to set the source amplitude to 50 dB SPL.
4. Press [START]. After the measurement has stabilized, press [STOP]. The measured curve is the “forward” measurement of the directional test.



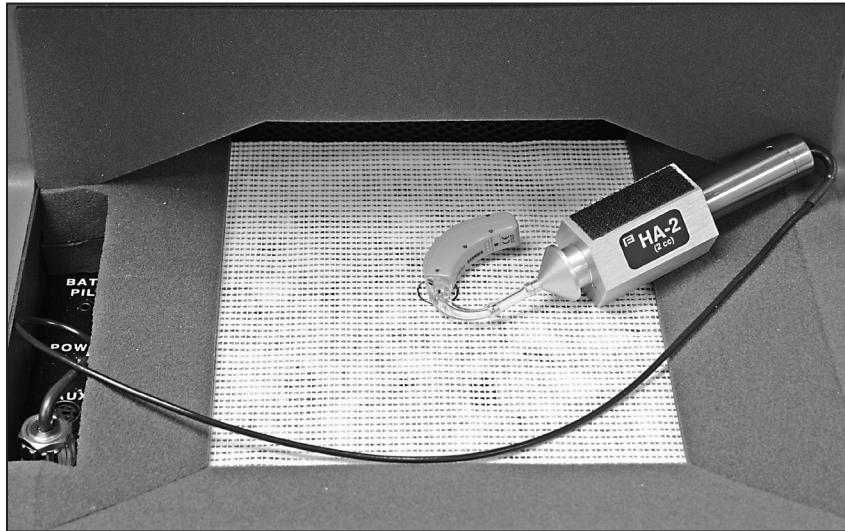
*Figure 3.4.11A—Forward directional measurement.*

**Reverse measurement**

Next, open the sound chamber and position the hearing aid so that the front of the hearing aid is pointing away from the back of the chamber. See Figure 3.4.11B. Different hearing aids have different null points so you will want to adjust the positioning so that the sound chamber speaker is pointing towards what should be the null point of the directional aid (this may be 135 degree instead of 180 degrees). Close the sound chamber lid when finished and perform the following steps:

1. Use [F2] to select the next curve.
2. Use [F5] to set the source type to Digital Speech.
3. Use [▲, ▼] to set the source amplitude to 50 dB SPL.
4. Press [START]. When the measurement has stabilized, press [STOP]. The measured curve is the “reverse” measurement of the directional test. If the directional microphones of the hearing aid are working properly, this curve should have less output or gain than the forward measurement.

The difference in the RMS Out of the two curves will give you the average over-all advantage provided by the directional microphones. See Figure 3.4.11C. In this example, the hearing aid has an 8 dB average directional advantage.



*Figure 3.4.11B—Reverse directional measurement*

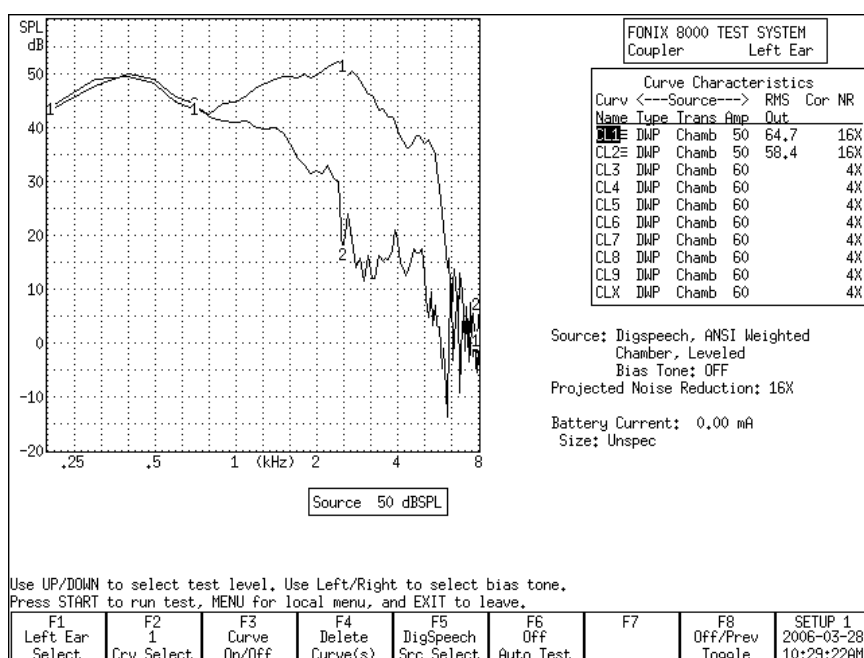


Figure 3.4.11C—Directional measurement screenshot

## Digital hearing aids

All digital aids can be tested, but some of the high-end models require a little more thought and care; these aids have a “noise suppression” feature (also known as “speech enhancement”). This noise suppression, not to be confused with the automatic compression of AGC hearing aids, checks if the sound going into the hearing aid is a continuous signal that could be regarded as noise. If the aid decides that the sound is noise, it lowers the gain at the corresponding frequencies. Conventional testing techniques, such as a pure-tone sweep or the Composite signal, can cause the high-end digital aid to go into this noise reduction mode. This means that the gain or output you see on the analyzer’s display will not necessarily reflect the normal response of the aid in speech.

The Digital Speech signal was developed in order to test noise-reducing digital hearing aids without concerns of them going into noise suppression mode. It does this by taking the standard Composite signal and interrupting it randomly. The digital hearing aid responds to this modulated signal as it would respond to normal speech.

## Using Digital Speech

The FONIX 8000 Test System seamlessly incorporates the testing of digital hearing aids into its normal testing procedures.

To test a digital hearing aid, follow the steps outlined in Section 3.4.2, choosing DIG SPEECH in Step 3. Digital Speech can be used to accurately test any hearing aid, so if you aren’t sure if the hearing aid is digital, you can always use Digital Speech and be assured that the frequency response is correct.



## Changing the Speech Shape

By default, the Digital Speech (and Composite) signal use the ANSI S3.42 speech weighting. This speech weighting rolls off the high frequencies at a rate of 6 dB per octave, starting with 3 dB down at 900 Hz. Some clinicians, however, may prefer to use the ICRA speech weighting.

The ICRA speech weighting was taken from a CD of sounds developed by the International Collegium of Rehabilitative Audiologists (ICRA) and based on the long term average speech spectrum. The ICRA rolls off the high frequencies much more quickly than the ANSI spectrum. To switch to using ICRA:

1. Press [MENU] in the Coupler screen.
2. Use [▲, ▼] to select Composite Filter under Measurement Settings. Use the [START] key to skip ahead sections, if necessary.
3. Use [▶, ◀] to select ICRA.
4. Press [EXIT] to return to the Coupler screen.
5. Use [F5] to choose the DIG SPEECH signal source. It will now have the ICRA speech weighting. See Figure 3.5.2 for a comparison of an aid tested with the ANSI and ICRA speech weightings.

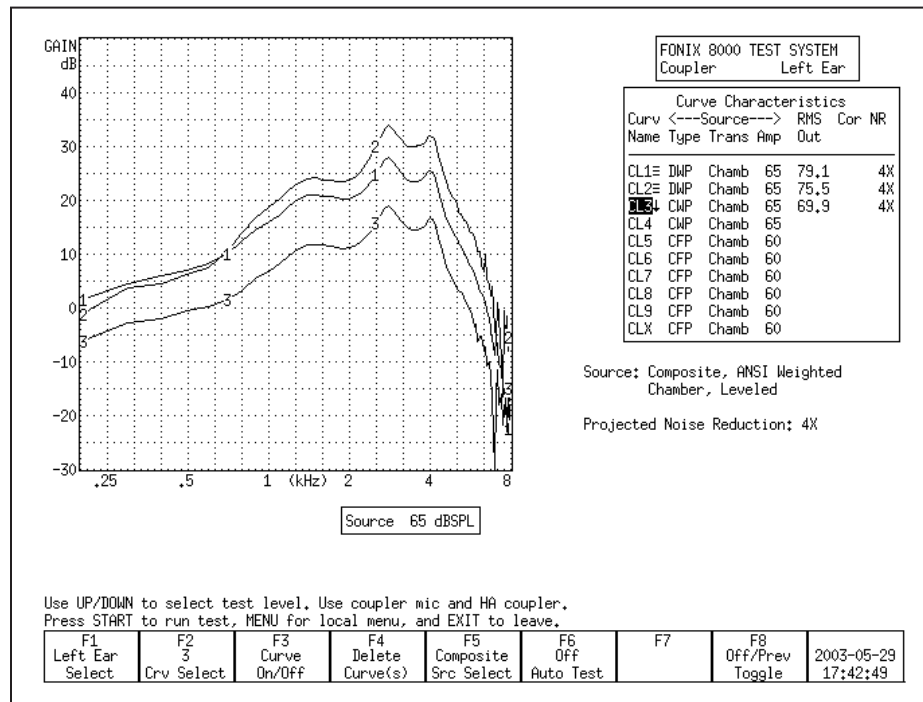


Figure 3.5.2—Comparison of a digital aid tested with Digital Speech ICRA (CRV1), Digital Speech ANSI (CRV2), and the Composite signal (CRV3).

### Testing with Bias Signals

You can add a pure-tone bias signal to the Digital Speech signal, creating a continuous signal at the frequency of your choice. This will allow you to see how the aid reacts to the presence of noise at different frequencies. To add a bias signal:

1. Select the DIG SPEECH signal with [F5] in the Coupler screen.
2. Press [MENU] to enter the local menu.
3. Use [▲, ▼] to select Bias Tone under Source Settings. Use the [START] key to skip ahead sections, if necessary.
4. Use [▶, ◀] to select the bias amplitude.
5. Press [EXIT] to return to the Coupler screen.
6. Press [START] to start the frequency response measurement. The Digital Speech signal will include a bias signal at the amplitude you specified in Step 4.
7. Use [▶, ◀] to change the frequency of the bias signal. The current selected frequency will be displayed on the screen below the Curve Characteristics Box.
8. Press [STOP] when done with the measurement. See Figure 3.5.3 for an example of using the bias signal at several different frequencies.

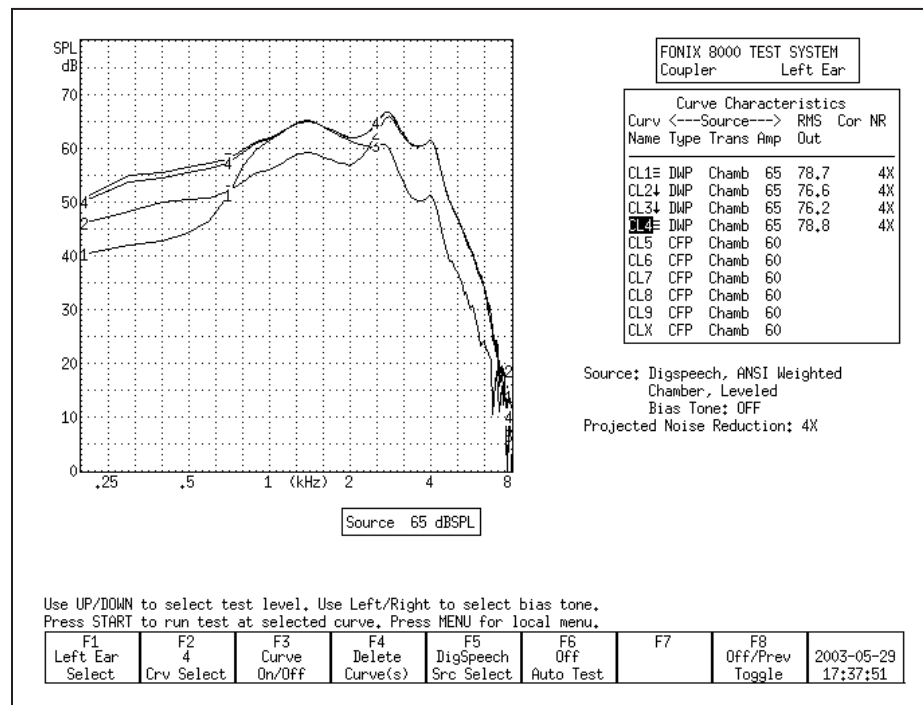


Figure 3.5.3—Using the bias signal with Digital Speech. CRV 1-3 have bias signals at 500 Hz, 1000 Hz, and 4000 Hz respectively. CRV 4 was performed with Digital Speech and no bias signal.

### Checking Noise Suppression

When testing a digital hearing aid that is supposed to be programmed with a noise suppression or speech enhancement feature, it is useful to make sure the feature is working correctly. You can use a combination of Digital Speech and the Composite signal to test noise suppression.

1. Look at the top left corner of the graph on the Coupler screen. It should read “dB GAIN.” If it reads “dB SPL,” you will need to change the display to GAIN. To do this:
  - a. Press [MENU] from the Coupler screen to open the local menu.
  - b. Use [▲ , ▼] to select Display under Display Settings.
  - c. Use [▶ , ◀] to choose GAIN.
  - d. Press [EXIT] to return to the Coupler screen.
2. Use [F2] to select CRV 1. (Press [F2]. Use [▲ , ▼] to select CRV 1. Use [▶] to complete the selection and close the pop-up menu.)
3. Use [F5] to select DIG SPEECH in the same manner as described above.
4. Use [▲ , ▼] to select a normal speech amplitude, such as 65 dB SPL.
5. Make sure the digital noise suppression feature is enabled on the hearing aid, and set it up for testing in the sound chamber.
6. Press [START] to begin the measurement. When the response curve has stabilized, press [STOP] to stop the measurement.
7. Use [F2] to select CRV 2.
8. Use [F5] to select COMPOSITE.
9. Make sure the signal amplitude is the same as selected in Step 4.
10. Press [START] to begin the measurement. Leave the signal on for at least 15 seconds. This should allow the noise suppression feature time to activate. When the measurement has stabilized, press [STOP].
11. Compare CRV 1 and CRV 2. If the curves are right on top of each other, the aid is responding to the Digital Speech signal just as it would respond to the Composite signal. This could be an indication that the digital suppression feature is either not enabled or not present on the hearing aid. Figure 3.5.4 gives an example of a hearing aid that is amplifying the Digital Speech signal and suppressing the Composite signal.



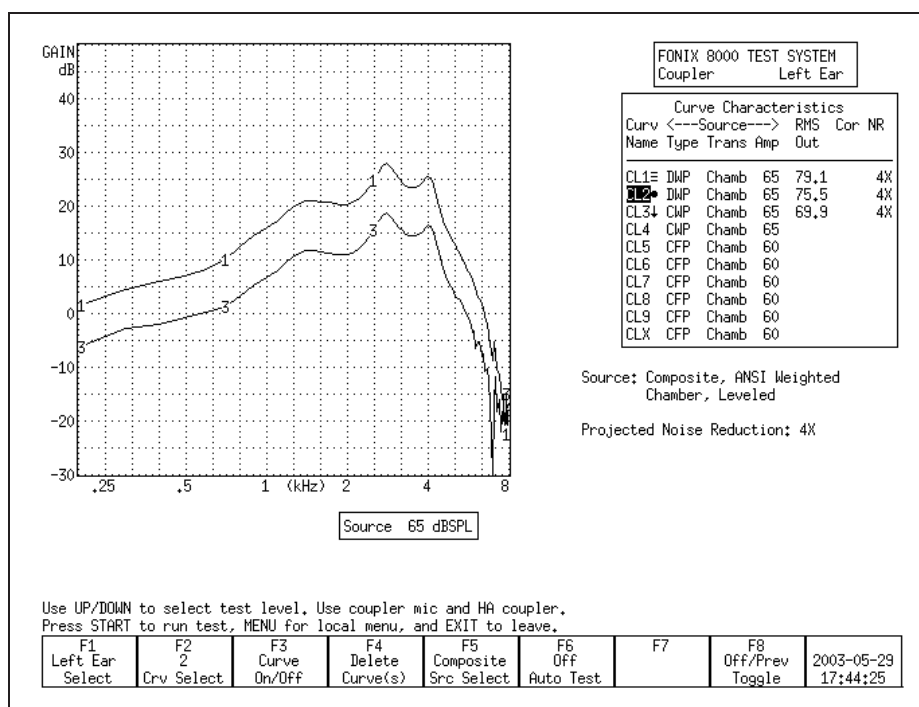


Figure 3.5.4—Digital Noise Suppression test. CRV 1 was measured with Digital Speech. CRV 2 was measured with the Composite signal.

### Understanding Terminology

With the new testing terminology of hearing aid analyzers combined with the new technology of hearing aids, it's easy to get terminology confused. "Noise Reduction" is a term that Frye Electronics has always used to denote the averaging that the analyzer makes when analyzing data to achieve a smooth curve. This process is described in Section 2.3.1.1 and Section 2.3.2.1.

Some high-end digital hearings have digital signal processing features that try to detect noise in the environment and lower the gain at the frequencies in which it detects the noise. Different manufacturers have different terminology for these features, but they are most commonly called "Speech Enhancement," "Noise Suppression" or "Noise Reduction."

Just keep in mind that these are two separate applications of the phrase "Noise Reduction" that mean two completely different things. When you set the Noise Reduction on your FONIX 8000 Test System, you are setting the amount of averaging the analyzer does. When you set Noise Reduction on your hearing aid, you are usually setting the amount of noise suppression that the hearing aid does.

**CIC Feature**

The CIC Feature is a way of performing a coupler test of a CIC hearing aid that more accurately reflects the real-ear performance of that aid than a regular 2-cc coupler measurement. It is not a way to check the manufacturing specifications of CIC hearing aids because those specifications are based upon 2-cc coupler measurements.

The CIC Feature consists of a CIC coupler (0.4 cc) and software correction factors. Both need to be used in order to correctly perform the measurement.

To measure a CIC hearing aid:

1. Attach the CIC coupler to the CIC aid just as you would attach an HA-1 coupler to the aid, and set the hearing aid up for testing as shown in Section 3.3.2.
2. Press [MENU] in the Coupler screen.
3. Highlight Coupler Type under Measurement Settings with [▲ , ▼].
4. Select CIC with [► , ◀].
5. Press [EXIT].
6. Select the desired source type with [F5]. (Press [F5]. Use [▲ , ▼] to select the desired source type. Press [►] to complete the selection and close the pop-up menu.)
7. Select the desired source amplitude with [▲ , ▼].
8. Press [START] to perform the measurement. You should see CIC appear in the Curve Characteristics box in the “Cor” column of the selected curve. If you are using the FAST, COMPOSITE, or DIG SPEECH signal, press [STOP] to end the measurement once it has stabilized.

Figure 3.6 shows the difference between a CIC hearing aid tested with an HA-1 coupler, and the same aid tested with a CIC coupler and correction factors.

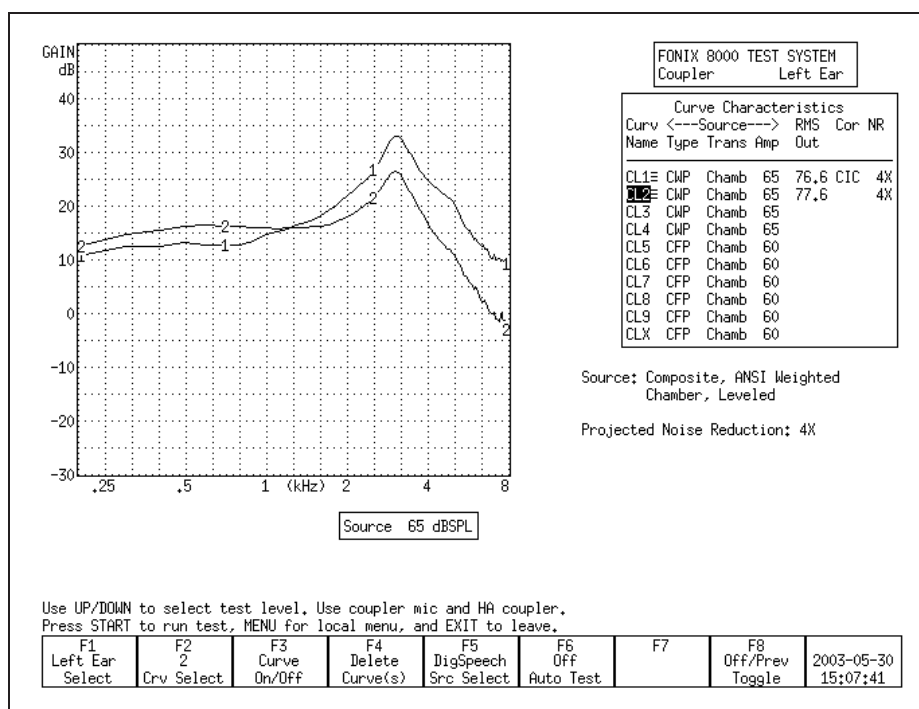


Figure 3.6— CURVE 1 uses CIC coupler + correction factors  
CURVE 2 uses 2-cc HA-1 coupler

### Automatic Testing—Loading & Saving Groups

You can use the FONIX 8000 Test System to program simple automated or semi-automated test sequences that will help you test hearing aids more efficiently. Each test sequence can contain up to 10 different response curves with your choice of source types, source levels, noise reduction, and other adjustments.

In automatic mode, the analyzer will quickly run through all designated tests without pausing. In semi-automatic mode, the analyzer will automatically advance to the next curve and stop. This curve will not be measured until you start the test, but you are saved the step of using F2 to select the next curve num-ber.

Tests are programmed into the analyzer using the Program mode. In this mode, you set the source type, source level and noise reduction for each curve. You can program any of the available 10 curve slots in the Coupler screen. This is described in Section 3.7.1.

If there is a sequence of tests that you would like to perform frequently, you can save it into the FONIX 8000 Test System's permanent memory using the SAVE GROUP function. Three groups of up to 10 curves can be saved into SAVE GROUP 1, 2, and 3, respectively. The settings for both ears are saved when SAVE GROUP is used, so it is possible to program one set of settings for the left ear and an other set for the right ear.

When you want to manually load a group that has previously been saved, you use the LOAD GROUP function. It is also possible to have the FONIX 8000 Test System automatically load a saved group and put itself in Fully-Auto or Semi-Auto mode when the analyzer is first turned on or the [RESET] button is used. This is described in Section 3.7.2. When the "Factory" group is loaded, the factory default settings are loaded.

### **Setting up a test sequence**

The first step in running your custom automated test sequence is deciding on the source types and levels of the frequency response curves. When finished, these selections can be stored into the analyzer's permanent memory.

1. Use [F4] to delete ALL CURVES & SETTINGS in the Coupler screen. (Press [F4]. Use [▲, ▼] to select ALL CURVES & SETTINGS. Use [▶] to complete the selection and close the pop-up menu.)
2. Use [F6] to select PROGRAM. This will open a pop-up window with helpful programming instructions.
3. Use [F1] to select the ear.
4. Use [F2] to select the curve number.
5. Use [F5] to select the desired source type.
6. Use [▲, ▼] to select the desired source level.
7. Press [MENU] and use the arrow keys to change other menu settings, if desired. Press [EXIT] to return to the coupler screen.
8. Save and advance to the next curve. This can be done two ways:
  - Press [START] if you want the analyzer to be programmed to automatically advance to the next curve and start measuring it.
  - Press [STOP] if you want the analyzer to be programmed to advance to the next curve, but then pause and wait for user intervention before taking the next measurement. Use this if you want to make an adjustment to the aid before taking the next measurement. A horizontal line will be drawn across the Curve Characteristics box when a pause is inserted in this fashion.
9. Repeat steps 5-8 to select the desired source type and level for all the curves that you want to measure in the automated test sequence.
10. Press [STOP] after you have set up the last curve that you want to run in the test sequence. For instance, if you want to run only 4 curves, press [STOP] after setting up CRV 4. This will make the analyzer pause after the four measurements – the remaining 6 available curves will not be run.
11. Use [F6] to SAVE GROUP 1, 2 or 3, if desired. This will permanently save the automated sequence.

### Loading a Saved Test Sequence

It is not necessary to permanently save a custom test sequence, but doing so allows you to bring it up in the Coupler screen at any time, even if you've turned off the analyzer between tests. There are two ways to load a saved group: manually and automatically. In both cases, you must first follow the directions in Section 3.7.1 to first create and save a group.

To manually load a saved group, use [F6] in the Coupler Multicurve screen to LOAD GROUP 1, 2, or 3. Choose the group you saved in Step 11 of Section 3.7.1. (Press [F6]. Use [▲, ▼] to select the correct LOAD GROUP number. Use

⇒] to complete the selection and close the pop-up menu.)

To automatically load a saved group when the analyzer is powered on or when the [RESET] button is used:

1. Press [MENU] from the Opening screen to open the Setup Menu.
2. Press F1. Use [▲, ▼] to select COUPLER. Use [►] to complete the selection and bring up the Coupler Default Settings.
3. Select the desired AUTO MODE setting. Choose from FULLY AUTO (see Section 3.7.3), SEMI AUTO (see Section 3.7.4), or OFF.
4. Select the desired CURVE GROUP LOADED. Choose the group you saved in Step 11 of Section 3.7.1.
5. Change any other desired settings.
6. Use F8 to save the settings to a Setup.
7. Press [EXIT] to close the Setup Menu and return to the Opening screen. Now, if you power on and off the unit, or if you use [RESET], the selected curve group will automatically be loaded and the analyzer placed in the selected auto mode when you enter the Coupler Multicurve screen.

### Testing in Fully-Automatic Mode

The fully-automatic mode will automatically run through a programmed test sequence without the need of user intervention. The analyzer will pause only when it reaches a programmed pause, which allows the user to make adjustments to the hearing aid before proceeding with the rest of the test sequence. A programmed pause will be indicated by a horizontal line across the Curve Characteristics box.

1. Load a test sequence. You can do this by following the directions in Section 3.7.1 to create a new sequence, or by loading a previously saved sequence by following the directions in Section 3.7.2.
2. Use [F6] to select FULLY AUTOMATIC. (Press [F6]. Use [▲, ▼] to select FULLY AUTOMATIC. Use [►] to complete the selection and close the pop-up menu.)

3. Use [F2] to select the curve number to start the sequence.
4. Use [START] to begin the test sequence. The test sequence will continue until the analyzer reaches a programmed pause.
5. Adjust the hearing aid, if desired, and press [START] to continue the test sequence if there are more curves to measure after the programmed pause.

Use [F6] to turn the AUTO TEST OFF when you want to return to normal test-ing mode.

### Testing in Semi-Automatic Mode

In semi-automatic mode, once you have finished a measurement by pressing the [STOP] button or allowing a pure-tone sweep to complete, the analyzer will automatically advance to the next curve. However, the next measurement will not be taken until you explicitly press the [START] button.

1. If desired, follow the instructions in Section 3.7.2 to load a test sequence. You can do this by following the directions in Section 3.8.1 to create a new sequence, or by loading a previously saved sequence by following the direc-tions in Section 3.7.2.
2. Use [F6] to select SEMI-AUTOMATIC. (Press [F6]. Use [▲ , ▼] to select SEMI-AUTOMATIC. Press [►] to complete the selection and close the pop-up menu.)
3. Use [START] to start the automated test sequence. If you are using a source of type COMPOSITE, DIG SPEECH or FAST, press [STOP] to stop the mea-surement when it has stabilized. The FONIX 8000 Test System will auto-matically advance the curve selection to the next curve.
4. Make any desired adjustments to the hearing aid and repeat Step 3 until you have measured all your curves.

Use [F6] to turn the AUTO TEST OFF when you want to return to normal test-ing mode.

### Custom Functions for F7/F8

The [F7] and [F8] keys can be customized to perform many different functions. This allows you to quickly adjust settings without going into the local menu. The following functions are available:

- Display: Switch between Gain and SPL.
- Coupler: Change the coupler type (2cc, CIC).
- Bias Ampl: Change the amplitude of the bias signal (see Section 3.5.3)
- Static: Turn on/off single tone or three frequency average (see Sections 3.4.5 and 3.4.6).

- **Batt Size:** Change the battery size. This is used in battery current drain measurements.
- **Aid Type:** Change the aid type (Standard, AGC, Adaptive AGC). This affects the delay times used in pure-tone sweeps and Digital Speech.
- **Off/Prev:** Switch between the signal being in spectrum analysis mode (source off but measurement running) and at the previous selected amplitude level.
- **Data/Graph:** Switch between displaying test results in numerical format and graphical format.

The F7/F8 selections are set in the local menu. In the Coupler Multicurve screen, press [MENU] to open the local menu. Change the F7 and F8 selections using the arrow keys. The default selection for these settings can be changed in the Setup Menu. See Sections 2.2.1 and 2.2.4 for details.

### Complete List of Menu Items

The function of all items in the local menu of the Coupler screen are described in this section. Enter the local menu by pressing [MENU] in the Coupler screen. Selections are made by using [▲, ▼] to choose an item and [►, ◄] to change the setting.

There is a dotted or dashed line in between an item and its selection. If the line is dotted, the selection will only effect the Coupler screen. If the line is dashed, the selection is *global* and will have an effect on other measurement screens.

The local menu is divided into five main categories: Display, Measurement, Source, Aid and Misc Settings. To skip ahead to the next category, use the [START] button.

### Display Settings

- **Data/Graph:** The method of data display. Choose between DATA (numerical data) and GRAPH.
- **Display:** Type of display. Choose between SPL (output) and Gain (difference between input and output).
- **Smoothing:** Choose whether or not to smooth the frequency response of the measurement. Smoothing makes the frequency response less peaky, but could also eliminate some information about the response, especially in the high frequencies. This can be turned on and off even after a measurement is taken, allowing you to see both the smoothed and unsmoothed result if desired.
- **Graph Scale:** Scaling used when making measurements. NORMAL scales to the upper-most curve. AUTO scales to the current selected curve.
- **Curve Label:** Label used for the two available “ears.” Choose between LEFT/RIGHT and A/B.

**Measurement Settings**

- **Coupler Type:** The type of coupler being used in making sound chamber measurements. A selection of CIC turns on corresponding software correction factors (see Sections 3.6). A selection of 2CC does not apply correction factors to the curve, but will note a 2-cc coupler was used in the COR column of the Curve Characteristics Box. The NONE selection will apply no corrections and leave the COR column blank.
- **Distortion:** Type of harmonic distortion used in a pure-tone measurement. Choose between 2nd, 3rd and TOTAL. See Section 2.3.1.3.
- **Noise Red (Tone):** Amount of pure-tone noise reduction used. See Section 2.3.1.1.
- **Noise Red (Comp):** Amount of composite noise reduction used. See Section 2.3.2.1.

**Source Settings**

- **Output Trans:** Transducer used for the measurement. CHAMBER uses the test box. TELECOIL uses the built-in telecoil. TELEWAND uses the external telecoil connector that connects to the Telewand.
- **Static Tone:** Status of individual measurement. Choose SINGLE to emit a static tone in between composite measurements or pure-tone sweeps. Choose AVG to emit a three frequency average between other measurements.
- **Bias Tone:** Amplitude of the bias tone used with Digital Speech. OFF turns the bias tone off entirely.
- **Composite Type:** Type of composite signal used. Choose between STANDARD and CHIRP. See Section 2.3.2.4.
- **Composite Filter:** Filter used in Composite and Digital Speech measurements. Choose between ANSI, ICRA and FLAT.

**Aid Settings**

- **Aid Type:** Type of hearing aid being measured. Choose between Linear, AGC and ADAPTIVE AGC.
- **Avg Freqs:** Selection of three frequencies used in a three frequency average. See Section 2.2.4.
- **Sweep Start Delay:** The amount of time the FONIX 8000 Test System presents the first tone in a pure-tone sweep. See Section 2.3.1.2.
- **Sweep Meas Delay:** The amount of time each subsequent tone is presented before the measurement is made in a pure-tone sweep. See Section 2.3.1.2.
- **Misc Start Delay:** The amount of time the FONIX 8000 Test System presents the first tone in one of the following measurements: reference test



gain measurements (in automated test sequences), averaging, harmonic distortion measurements, and equivalent input noise measurements. See Section 2.3.1.2.

- **Misc Meas Delay:** The amount of time each subsequent tone is presented before the measurements is made in one of the measurements listed above. See Section 2.3.1.2.

### **Misc Settings**

- **Battery Meas:** Status of the battery current measurement. Choose ON or OFF.
- **Battery Size:** Size of battery used with the hearing aid being tested.
- **Print Label:** Status of the printing label. Choose ON or OFF.
- **Printer:** Printer used for printouts. Only INTERNAL is available at this time. See Section 2.4.
- **F7/F8:** Function of the F7 and F8 function keys in the Coupler Multicurve screen. See Section 3.8.

### Advanced Coupler Tests

#### Enhanced DSP

The Enhanced DSP measurement screen was designed to give you more information about digital hearing aids. The new technology in digital hearing aids has added a great deal of capability, such as increased clarity and flexible programming. However, the same technology can also have its pitfalls. This test will tell you the *digital processing delay* (also known as group delay) and the *signal phase* of the hearing aid.

The digital processing delay measurement will help you determine whether or not a hearing aid is suitable for a monaural fitting. The phase measurement will help you determine whether custom binaural hearing aids are working properly together as a team.

#### Digital Processing Delay

One of the properties of digital technology not normally mentioned in the literature is that it always takes time to process digital data. Imagine the digital hearing aid as a miniature computer: it takes an analog sound wave, turns it into digital information, performs some kind of algorithm to amplify the signal, and turns it back into an analog sound wave for the ear to hear. All of this calculating takes precious time; it's never instantaneous. The processing delay for some hearing aids is so slight that it is imperceptible to the human ear. The processing delay for other aids can extend to several milliseconds.

Why is this a problem? Well, if you fit a client monaurally with an aid with a significant digital processing delay, that person might experience some confusion because his unaided ear will be hearing sounds slightly faster than his aided ear. Problems can also be predicted for patients with open canal fittings. However, if you fit the same patient with an occluded binaural set, then both ears will be listening with the same delay, and the confusion will be alleviated.

What is a significant delay? At what magnitude does this delay start to affect speech intelligibility? These are good questions. Unfortunately, we don't have an answer at this time; the field of digital hearing aids is still too young, and there has not yet been enough research done to establish necessary guidelines. A conservative approach would be to avoid monaural and open canal fittings with digital aids that have delays of more than 1 to 2 milliseconds.

For now, this measurement will give you more information about what's really going on in that digital hearing aid circuit, and, hopefully, it will help you troubleshoot why some aids work better than others with monaural or binaural fittings.

**Technical details**

The digital processing delay measurement is taken by sending a short impulse from the sound chamber speaker to the hearing aid. The FONIX 8000 Test System microphone collects information from the hearing aid for 20 milliseconds from the time the impulse is delivered. This information is a series of numbers of varying amplitudes.

The FONIX 8000 Test System finds the maximum peak amplitude of the resulting information. Since the impulse response of a hearing aid is not always simple, the analyzer also checks for any peaks occurring before this maximum peak. If a smaller peak exists, and it has an amplitude of at least 50% of the maximum peak, the time of the smaller peak will be considered the processing delay point. Otherwise, the time of the maximum peak will be considered the processing delay point. The 8000 Test System delay is subtracted from this delay point in order to form the actual aid processing delay time. (The 8000 Test System delay is determined during the sound chamber leveling process.)

The data collected in the digital processing delay measurement is displayed in graphical format as amplitude vs. time. A dashed vertical line is placed at the calculated delay point. The numerical value is also displayed. A second dotted vertical line shows the 8000 system delay for reference.

**Signal Phase**

The signal phase measurement is a test of the “pushing” and “pulling” of the amplified sound of the hearing aid. Vibrations in the air create sound—these vibrations can be thought of as air pushing and pulling against the ear. If sound goes through a hearing aid, the hearing aid might cause a phase shift, turning a “push” of the sound wave into a “pull.” This isn’t necessarily a bad thing; there may be good reasons for a phase shift of the sound wave.

The components of a custom hearing aid are usually wired by hand. The receiver is typically wired into the amplifier in such a way that it may or may not cause a phase shift of the signal. If care is not taken, it’s entirely possible to wire one hearing aid of a custom binaural set one way, and wire the other aid in the opposite way. This could cause one of the hearing aids to be “pulling” while the other aid is “pushing,” resulting in strange sound quality for the hearing aid wearer.

We propose that it could be very important to check the signal phase of the hearing aids when fitting a client with a binaural set in order to ensure that the aids are working together as a team.

**Technical Details**

The signal phase measurement works by generating a 1 kHz cosine wave, turning it into a test signal and delivering it to the aid. The cosine wave signal is offset at the time of generation so that it starts at the baseline (the zero point).

It then continues through a complete cycle and terminates when it reaches the baseline again. This signal, although consisting of only a single pulse, contains very few frequencies above 1 kHz and is one millisecond wide at its base.

The data collected from this measurement is displayed in a graphical format 20 milliseconds wide. The system delay and the digital processing delay are noted for reference on the phase graph in the form of vertical lines.

### Procedure

1. Press [F3] in the Opening screen to enter the Advanced Coupler Navigation screen.
2. Press [F4] in the Advanced Coupler Navigation screen to enter the Enhanced DSP screen.
3. Set up the hearing aid for testing in the sound chamber. See Section 3.3. Make sure the sound chamber is leveled.
4. Use [F1] to select the desired ear.

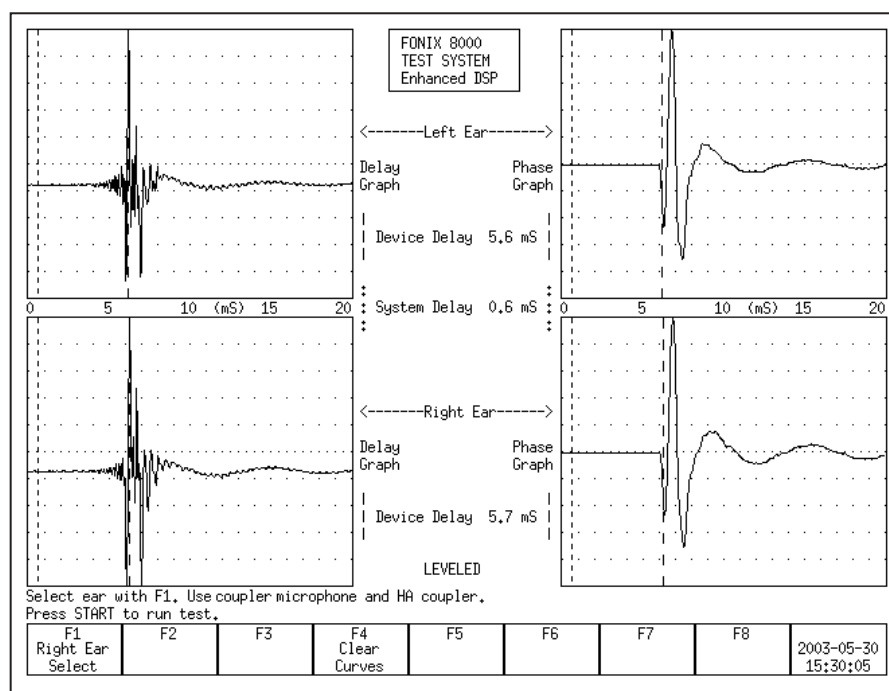


Figure 4.1.3—Enhanced DSP measurement results

5. Press [START] to perform the delay and phase tests for that hearing aid. If the left ear was designated in Step 4, the results will be shown in the upper two graphs. Otherwise, they will be shown in the lower two graphs.

6. Set up a second hearing aid in the sound chamber, if desired, and use [F1] to select the other ear. Press [START] to perform the measurements on this second aid. This will allow you to compare the results of the two hearing aids. See Figure 4.1.3.

When measuring a set of binaural hearing aids, both the phase and the delay graphs should match fairly closely.

### Battery Current Test

The Battery screen lets you perform extensive tests on the amount of battery current that the hearing aid uses. These tests were designed to give you a complete picture of the amount of battery current that the hearing aid drains when exposed to different situations. There are three primary tests:

- **Static Test:** This test estimates the battery life of the hearing aid by presenting the hearing aid with a single static tone.
- **mA/Freq:** This test measures battery current drain as a function of frequency. This shows how the battery current varies as you present the hearing aid with different frequencies.
- **mA/Ampl:** This test measures battery current drain as a function of amplitude. This shows how the battery current varies as you present the hearing aid with different amplitudes.

To run these tests, toggle the test status with [F4], [F5] and [F6], respectively. Pressing [START] will run the mA/Freq and mA/Ampl tests. The tests will automatically stop when finished. The Static test is always on when its status has been toggled to On.

**In order to perform these measurements, you need to insert a battery pill into the hearing aid, and plug the battery pill into the sound chamber.**

**To enter the Battery screen, first press [F3] from the Opening screen to enter the Advanced Coupler Navigation screen. Then press [F1] to enter the Battery Test screen.**

A short list of the functions of this screen can be displayed by pressing [HELP].

Note: Many hearing aids do not vary when exposed to signals of varying frequency and amplitude. For those hearing aids, you will see a flat horizontal line when running both the mA/Freq and mA/Ampl measurements.

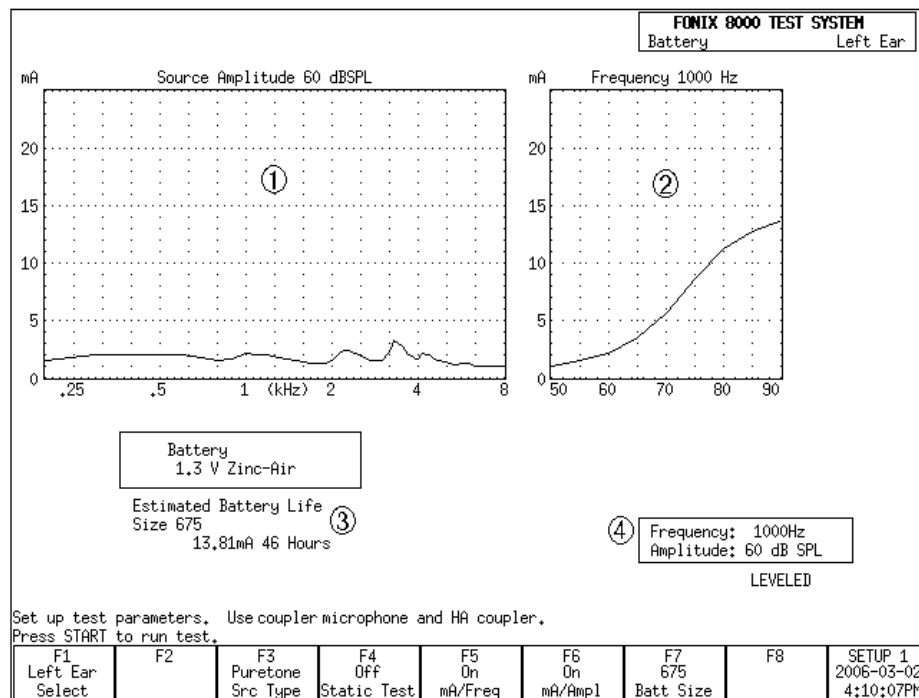


Figure 4.2—Battery Current Test

1. mA/Freq graph
2. mA/Ampl graph
3. Static test (estimated battery life)
4. Selected test settings.

### Static Test (Estimated Battery Life)

The Static test estimates the battery life of the hearing aid. To turn on the test:

1. Enter the Battery screen (as described above).
2. Use [F7] to set the battery size: Press [F7]. Use [▲, ▼] to select the battery size of the hearing aid. Use [►] to complete the selection and close the pop-up menu.
3. Use [F4] to toggle the Static Tone to On. The estimated battery life should now be displayed below the ma/Freq graph. See Figure 4.2.

By default, this test uses a pure-tone stimulus of 1000 Hz at 60 dB SPL. The current source selections are shown in a box below the mA/Ampl graph on the right side of the screen. You can:

- Change the source Type by using [F3]. Toggle between Puretone and Composite,
- Change the source Amplitude by using [▲, ▼], and
- Change the source Frequency by using [►, ◀]. This setting is only available when the source type is set to Puretone with [F3].

### **mA/Freq**

The mA/Freq test shows how much battery current the hearing aid drains when exposed to different frequencies. By default, it runs a 60 dB SPL LONG pure-tone sweep. The selected amplitude is displayed below the mA/Ampl graph. This amplitude can be changed by using [▲ , ▼].

Press [START] to run the test.

A few technical details about this test:

- The amplitude used for a test currently being displayed on the screen is shown above the mA/Freq graph.
- The source type selected with [F3] does NOT affect this test; this test always uses a pure-tone sweep.
- You can view the numerical data results by entering the local menu by pressing [MENU] and setting DATA/GRAPH to DATA by using the arrow keys. Close the local menu by using [EXIT] or [MENU] again. Test results will now be shown in tabular data format.
- You can turn this test off by toggling the test status with [F5]. If the mA/Freq graph is not displayed, it will not be measured when [Start] is pressed.
- Use [F1] to switch between left and right ear. Test results for each ear can be temporarily stored. (All data is lost when the analyzer is turned off or when the [RESET] button is pressed.)

### **mA/Ampl**

The mA/Ampl test shows how much battery current the hearing aid will drain when exposed to different input level. A test very similar to the I/O measurement in the ANSI S3.22 test sequence is run. That is, the test begins with a stimulus being presented at 50 dB SPL. This amplitude increases in 5 dB steps until the final stimulus at 90 dB SPL is presented. This shows how the battery current drain varies as the aid is exposed to different amplitudes.

By default, the frequency of the stimulus is 1000 Hz. This can be changed by using [► , ◀] buttons. The selected frequency is shown in a box below the mA/Ampl graph. You can also change the source type from Puretone to Composite by toggling [F3]. The [► , ◀] buttons will not be active when Composite is selected.

Press [START] to run the test.

A few technical details about this test:

- The frequency used for a test currently being displayed on the screen is shown above the mA/Ampl graph.
- You can view the numerical data results by entering the local menu by pressing [MENU] and setting DATA/GRAPH to DATA by using the arrow

keys. Close the local menu by using [EXIT] or [MENU] again. Test results will now be shown in tabular data format.

- You can turn this test off by toggling the test status with [F6]. If the mA/Ampl graph is not displayed, it will not be measured when [Start] is pressed.
- Use [F1] to switch between left and right ear. Test results for each ear can be temporarily stored. (All data is lost when the analyzer is turned off or when the [RESET] button is pressed.)

## Coupler I/O

The Coupler I/O Test measures the input/output of the hearing aid from 50 dB SPL to 90 dB SPL in 5 dB steps. Test results are shown in both graphical format and numerical format and can be displayed in either Gain or SPL (Output). See Figure 4.3.

**To enter the Coupler I/O screen: press [F3] from the Opening screen to enter the Advanced Coupler Navigation screen. Then press [F2] to enter the Coupler I/O screen. Press [START] to run the I/O test.**

By default, this test is done with a puretone stimulus at 2000 Hz. The frequency of this stimulus can be changed by using [►, ◀]. You can also toggle the source type between Puretone and Composite by using [F5]. (The frequency selection is only available when the source type is set to Puretone.)

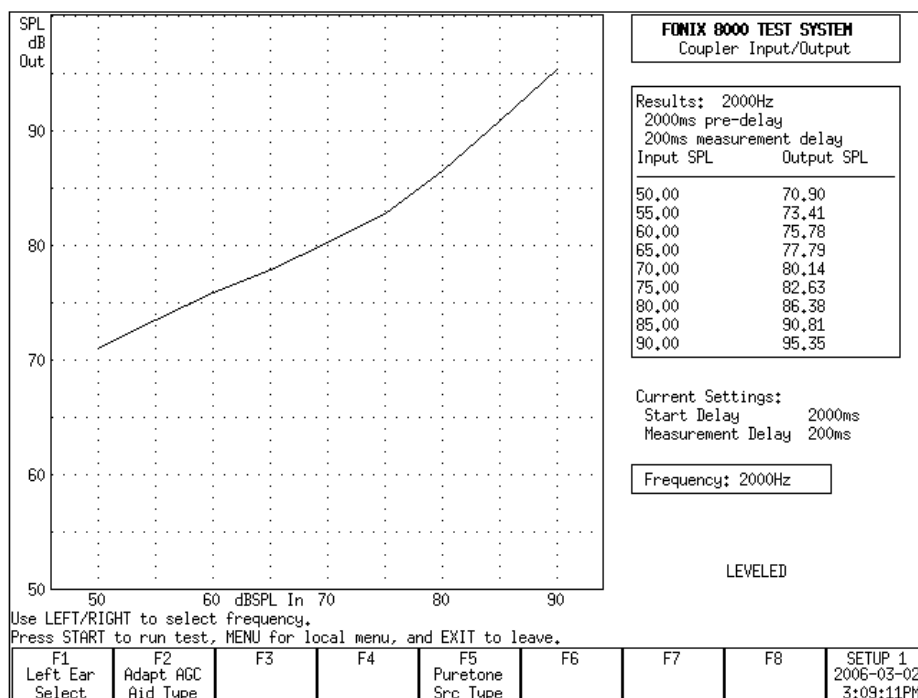


Figure 4.3—I/O Test



A few technical details about this test:

- Choose between showing test results in SPL (Output) and Gain in the local menu. (Use [MENU] to open the local menu, the arrow keys to adjust the selections, and [EXIT] or [MENU] again to close the local menu.)
- [F2] sets the aid type. This changes the length of time each stimulus is presented before the measurement is taken. Suitable default delay times are set when the aid type is selected. You can make further adjustments to the delay settings in the local menu. See Section 2.3.1.3 for details.
- The settings used for the test displayed on the graph are shown above the data results on the right side of the screen. The settings used when [START] is pressed are shown below the data under “Current Settings.”

## Attack & Release

The Attack & Release test demonstrates how the hearing aid reacts to noise at different intensity levels. The test works by presenting a loud-soft-loud-soft stimulus sequence to the aid. The first loud-soft tones are done to prepare the analyzer and the hearing aid for the test. The second loud-soft tones are used for the actual measurements.

The loud stimulus demonstrates the hearing aid's *attack* time. That is, how the hearing aid reacts to the test stimulus going from a soft level to a loud level. The last soft stimulus demonstrates the hearing aid's *release* time. That is, how the hearing aid reacts to the test stimulus going from a loud level to a soft level.

**To enter the Attack & Release screen: From the Opening screen, press [F3] to enter the Advanced Coupler Navigation screen. Then press [F3] to enter the Attack & Release screen.**

Press [START] to run the Attack & Release test.

Measurement results are displayed in graphical and numeric format. See Figure 4.4. The top graph contains the response of the aid over time to the Attack test. The bottom graph shows the response of the aid over time to the Release test. These graphical displays let you see how the device performs over the attack and release phases. Erratic performance during these critical phases could result in effects that are audible to a hearing-impaired listener. These effects could be annoying or could even obscure parts of a conversation. The actual attack and release times determined by the analyzer are shown in a box to the right of the graph.

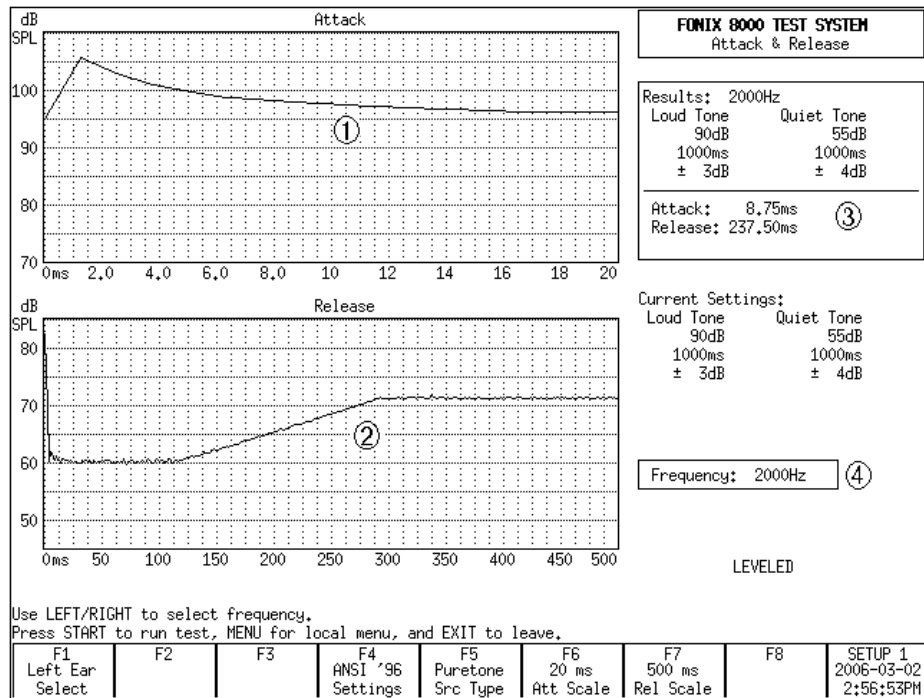


Figure 4.4—Attack &amp; Release Test

1. Attack graph
2. Release graph
3. Measured Attack & Release times and test settings.
4. Current Attack & Release settings

By default, the Attack & Release test uses the settings specified by the ANSI 96 test sequence at 2000 Hz. If you want to perform attack and release measurements using a different standard, use the [F4] key. The available test selections are: IEC Loud, IEC Speech, JIS, IEC and ANSI 96. (The ANSI 03 test sequence uses set-tings identical to ANSI 96.) This changes the test settings to those specified by the selected standard.

You can further customize the test settings by pressing [MENU] to open the local menu. Use the arrow keys to make the desired adjustments, and use [MENU] again or [EXIT] to close the menu. See the Technical Details section below for more information.

In addition to the settings adjustable in the local menu, you can also change the frequency and the source type of the test. Use [F5] to toggle between Puretone and Composite. Use the [►, ◄] keys to change the selected frequency. (You can only change the frequency when the Source Type is set to Puretone with [F5].) Please note that manufacturer specifications normally assume a puretone source type.

For most hearing aids, the most interesting part of the attack and release measurements occurs at the beginning of each test. After the aid reaches its settling amplitude, the test result just records a rather uninteresting flat line. The user can zoom in on the beginning of the test by using [F6] and [F7]. These keys re-scale the test results to show only the selected time interval. The beginning of the interval is always the beginning of the test. The end of the interval is the time selected by the user with [F6] and [F7] for the Attack and the Release tests, respectively. The available time intervals range from 10 ms to 2000 ms. These settings do NOT change the duration of the test.

### **Technical Details**

- In order to determine the attack and the release times of the hearing aid, the 8000 analyzer calculates the settling amplitude of each measurement and uses the tolerance setting to achieve the final test result. The settling amplitude is calculated by averaging the last 16 measurements of the test. The attack (or release) time is the first time the aid reaches this amplitude within the set tolerance. The tolerance is one of the settings that is changeable in the local menu.
- Use [F1] to select ears. The 8000 analyzer can temporarily store one Attack & Release test per ear. This data is erased by measuring over it, pressing [RESET], or turning off the analyzer.
- The settings used for a displayed test are shown in a box to the right of the attack graph. The settings that will be used when [START] is pressed are shown below this box.

### Automated Test Sequences

There are several automated coupler test sequences available for the FONIX 8000 Test System. The test sequences present on your analyzer are dependent upon the features purchased when you ordered your unit. If you would like access to a test sequence not present on your unit, you can always order an upgrade. Call the factory or your local distributor for more information.

The following test sequences are available:

- ANSI S3.22-2009
- ANSI S3.22-2003 (ANSI 03)
- ANSI S3.22-1996 (ANSI 96)
- ANSI S3.22-1987 (ANSI 87)
- ANSI S3.42-1992 (ANSI 92)
- IEC 60118-7-1994 (IEC 94)
- IEC 60118-7-2005 (IEC 05)
- JIS
- Profiler

### ANSI S3.22

The ANSI S3.22 automated test sequences allow you to test hearing aids according to the ANSI S3.22 standards. You can use the ANSI tests to control the quality of the hearing aids that you dispense. Compare the manufacturer's specifications with your own ANSI measurements of an aid. If they do not conform within expected tolerances, you can contact the manufacturer.

There are four different versions of the ANSI S3.22 standard: ANSI 09, ANSI 03, ANSI 96, and ANSI 87. This is because the standard periodically gets upgraded by the ANSI standards committee. After the ANSI S3.22 standard has been updated, the FDA reviews it and eventually approves it to be used for labeling the specifications of all hearing aids manufactured in the United States.

The ANSI 96 standard was officially approved by the FDA on March 17, 2000. This means that any hearing aid designed after this date must be labeled to the ANSI 96 standard. However, if a manufacturer designed a hearing aid before this date, they can continue labeling newly manufactured aids of the same design to the older ANSI 87 standard.

ANSI 03, which was approved by the FDA in November of 2005, is the newest version of the ANSI S3.22 standard.

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ANSI 09 has been approved by the FDA for use in manufacturing facilities in the United States, but it has not yet been required. Therefore hearing aids can be labeled to either the ANSI 03 or ANSI 09 standard.

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Here are the main differences between ANSI 87 and ANSI 96:

- AGC aids are tested at reduced reference test gain in ANSI 96, but tested at full-on gain in ANSI 87. This will have an effect on nearly all measurement results in the ANSI test sequence.
- The input/output and attack & release measurements are performed at up to five different frequencies in ANSI 96. ANSI 87 only measures those functions at 2000 Hz.
- ANSI 96 measures the telecoil function of all aids using a telecoil device with a stronger magnetic field than the telecoil device used by ANSI 87, and a whole frequency sweep of measurements is performed in ANSI 96, instead of only one measurement at a single frequency in ANSI 87.

Here are the main differences between ANSI 96 and ANSI 03:

- In ANSI 03, the frequency response curve is always measured at 60 dB SPL. In ANSI 96, AGC aids are tested at 50 dB SPL.
- At the beginning of an ANSI 03 test, AGC aids should be set to have minimum compression. Just before the I/O and attack and release measurements, the analyzer will pause to let you turn on the compression controls to maximum.
- The EIN measurement uses a 50 dB SPL input instead of a 60 dB SPL input. This should give better results for AGC aids with knee points between 50 and 60 dB SPL.
- In ANSI 96, full-on gain is measured at 50 or 60 dB SPL for linear aids and 50 dB SPL for AGC aids. In ANSI 03, full-on gain is always measured at 50 dB SPL.
- The ANSI 96 Simulated Telephone Sensitivity (STS) measurement is called Relative Simulated Equivalent Telephone Sensitivity (RSETS) in ANSI 03.

Here are the main differences between ANSI 03 and ANSI 09:

- In ANSI 09, the response curve is displayed in dB Gain instead of dB SPL. In ANSI 03, the response curve was displayed in dB SPL.
- In ANSI 09, the response curve can be measured with either a pure-tone sweep or a composite curve. In ANSI 03, the response curve was always measured with a pure-tone sweep.
- In ANSI 03, when the hearing aid is set to AGC or Adaptive AGC, I/O and attack and release measurements were made. In ANSI 09, these measurements are no longer taken.
- In ANSI 03, an entire frequency response was made of the telecoil functionality. In ANSI 09, only a single measurement of the telecoil response is displayed.

### Entering/Exiting the ANSI S3.22 Screens

By factory default, the [F4] key in the Opening screen will immediately open the ANSI 03 test screen. You can verify this operation by looking at the label for [F4] in the Opening screen. However, the [F4] through [F7] keys are user configurable and may have been changed. If this is the case, or if you want to enter the ANSI 09, ANSI 96 or ANSI 87 test screen, you may have to assign one of these keys to your desired ANSI test.

To configure the F4-F7 keys:

1. Press [MENU] in the Opening screen.
2. Change one of the F4-F7 selections in the General Default Settings window under Opening Screen to the desired ANSI S3.22 test. You can even assign one key to one test sequence (such as F4 to ANSI 03) and another key to another test sequence (such as F5 to ANSI 96).
3. Use [F8] to save the setting (and all other settings in the Setup Menus) as default selections. See Sections 2.2.1 and 2.2.4 for details.
4. Press [EXIT] to return to the Opening screen. Your new selection for the F4-F7 keys should be displayed in the function key list at the bottom of the screen.
5. Press the function key you selected in Step 2 to enter the ANSI screen.

When inside the ANSI screen, the [EXIT] button is used to leave the screen. This will take you to the ANSI navigation screen, which contains function keys selections pointing to all of the available ANSI S3.22 test selections. Use one of those function keys to enter a different ANSI test screen, or press [EXIT] again to return to the Opening screen.

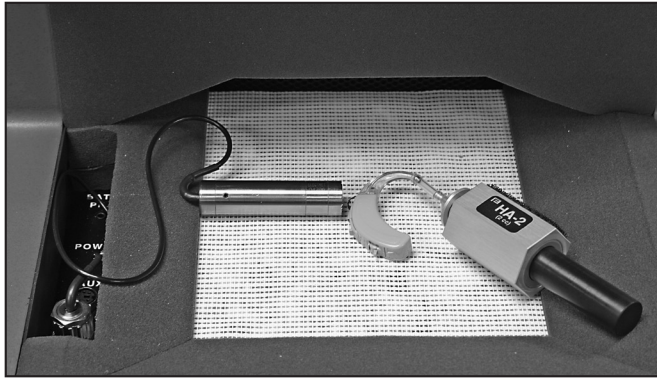
### Leveling for ANSI

Before you run an ANSI test, you should make sure the sound chamber is leveled. Even if the screen says that the chamber is leveled, it is a good idea to periodically re-level it to account for any differences that might have entered into the testing environment.

The ANSI standard requires that you do a special leveling that accounts for everything that will be in the chamber during the test. (For most practical office settings, the leveling procedure explained in Section 3.2 is adequate. If you are using the 8120 Polar Plot Chamber, you will need to place the 8120 basket cover over the cavity inside the chamber.

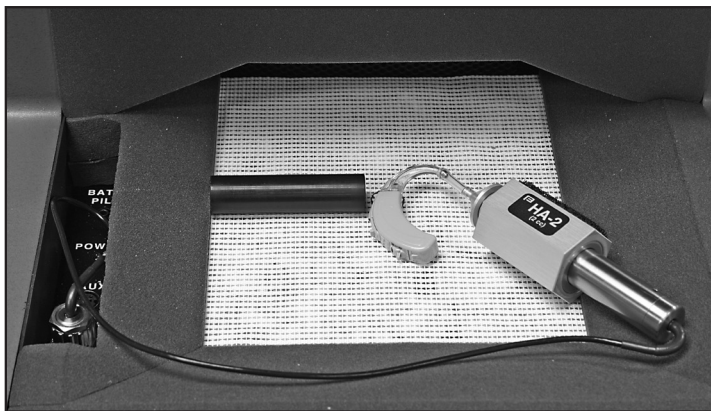
1. Place the dummy microphone (a black cylinder, provided when ANSI Option is ordered) into the coupler.
2. Attach the hearing aid to the coupler in the way appropriate for the type of aid under test. See Section 3.3.
3. Position the hearing aid/coupler assembly in the test chamber with the microphone of the aid at the reference point of the chamber.

4. Place the test microphone as close as practical to the hearing aid microphone (3-5 mm). See Figure 5.1.2A.



*Figure 5.1.2A—Setup for leveling*

5. Close the lid of the sound chamber.
6. Press the [LEVEL] button. The sound chamber will level.
7. Exchange the position of the dummy microphone and the test microphone and plug the battery pill into the battery voltage supply. See Figure 5.1.2B.



*Figure 5.1.2B—Setup for aid testing/ equivalent substitution method*

### **Setting up the hearing aid for ANSI**

The hearing aid controls must be set to conform with ANSI requirements for the test results to be valid.

1. Set the controls on the aid (except for the compression controls) to give the greatest possible output and gain.
2. Set the aid for the widest frequency response range.



3. For ANSI 87 and ANSI 96, set AGC aids to achieve the greatest possible compression or as otherwise specified by the manufacturer. For ANSI 09 or ANSI 03, set AGC aids to have the minimum compression possible or as otherwise specified by the manufacturer.
4. Put the hearing aid in “test mode,” if applicable. All noise suppression and feedback cancellation features should be turned off.
5. Set the gain control of the aid to the full-on position.
6. Set the aid up in the sound chamber as described in Section 3.3.

#### **5.1.4 Setting up the analyzer for ANSI**

1. Enter the ANSI test screen as described in Section 5.1.1.
2. Use [F1] to select LEFT or RIGHT ear.
3. Use [F2] to select the aid type: LINEAR, AGC or ADAPTIVE AGC. (Press [F2]. Use [▲, ▼] to choose the selection. Press [►] to complete the selection and close the pop-up menu.)
4. Use [F3] to select the full-on gain (FOG) amplitude used in the test sequence. We recommend setting this to AUTO, which will automatically use the appropriate amplitude. This step does not apply for ANSI 03 or ANSI 09.
5. Use [F5] to select whether or not to perform a telecoil measurement.
6. Press [MENU] to enter the local menu and make any desired selections. See Section 5.1.10.

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Use [F7] to return all ANSI settings to their power-on default conditions. Use [F8] to display all selected ANSI settings.

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#### **Running an ANSI 09, ANSI 03, or ANSI 96 Test**

After leveling the sound chamber as described in Section 5.1.2, setting up the aid as described in Section 5.1.3, and setting up the analyzer as described in Section 5.1.4, follow these instructions:

1. Press [START] to begin the test. Usually the 8000 test system will pause during the measurement process in order to let you adjust the gain of the hearing aid to the reference test position.
  - a. Lift the sound chamber lid and adjust the gain control of the aid until the RTG MEASURED gain matches RTG TARGET.
  - b. Close the sound chamber lid when finished.
  - c. Look at the display again. The MEASURED gain should be within 1 dB of the TARGET gain for ANSI 96, or 1.5 dB for ANSI 03 or ANSI 09.
2. Push [START] to continue the test.



- 3A. If you chose to perform a telecoil measurement, do the following steps when the analyzer pauses. If you are running an ANSI 03 test of an AGC aid and are not performing a telecoil measurement, skip to step 3B. Otherwise, just wait for the test sequence to complete.
- Open the lid of the sound chamber.
  - Switch the aid to telecoil mode.
  - Plug the telewand into the side of the sound chamber, just above the cable that connects the sound chamber to the Frye box.
  - Hold the telewand over the aid as if it were the ear piece on a phone. That is, hold the telewand parallel to the body of a BTE or against the faceplate of an ITE. It's also usually best to position the hearing aid vertically to get the best telecoil response. See Figure 5.1.5.
  - Press [START] to measure the telecoil response. The analyzer will pause after the telecoil measurements are complete.
  - Return the aid to the normal microphone mode, set the AGC controls to max (ANSI 03 and AGC aids only), reposition the hearing aid in the sound chamber, close the lid, and press [START] to complete the test sequence.
- 3B. If you're running an ANSI 03 test of an AGC aid without a telecoil measurement, the analyzer will run several measurements and then pause to allow you to set the AGC controls of your aid to maximum. Do so, close the lid of the chamber, and press [START] to complete the test sequence.



*Figure 5.1.5—Holding telewand parallel to the body of a BTE*

### **Running an ANSI 87 Test**

After leveling the sound chamber as described in Section 5.1.2, setting up the aid as described in Section 5.1.3, and setting up the analyzer as described in Section 5.1.4, follow these instructions:

1. Press [START] from the ANSI 87 screen to start the test.
2. If you have enabled the telecoil test, do the following when the sequence stops for the telecoil measurement. Otherwise, skip to step 3.
  - a. Open the lid of the sound chamber.
  - b. Switch the aid to telecoil mode.
  - c. While viewing TCOIL 10 mA/m near the upper right corner of the screen, try many positions for the hearing aid, near the reference point, until you find the position that gives the highest output with the least variability. Usually the best position is with the hearing aid held in the vertical position.
  - d. Hold that position and press [START]. This measures the telecoil output.
  - e. Switch the aid back to normal, microphone mode.
  - f. Press [START] to resume testing.
3. Depending on the aid type selected and the gain of the hearing aid, the ANSI sequence may stop for you to adjust the gain control to the reference-test. If the sequence stops:
  - a. Open the lid of the sound chamber.
  - b. While viewing the HF AVG readings in the lower center of the screen, turn the gain control on the aid down until the MEASURED value matches the TARGET value within 1 dB.
  - c. Close the lid. If the MEASURED number is still correct, press [START] to complete the test sequence.

### Viewing ANSI Results

The test results for ANSI 03, ANSI 96 and ANSI 87 have a similar display. See Figure 5.1.7A for an explanation of ANSI 03 results. See Figure 5.1.7B for an explanation of ANSI 09 results.

1. OSPL 90 curve: Full-on gain frequency sweep taken at 90 dB SPL.
2. RESP 60 curve: Reference test gain frequency sweep taken at 60 dB SPL.
3. SPLITS curve: Frequency response of the telecoil.
4. Aid type (selected with F2)
5. OSPL 90 MAX: Amplitude and frequency of the maximum output of the aid.
6. OSPL 90 HFA/SPA: Three-frequency response of the OSPL 90 curve.
7. HFA/SPA FOG: Full-on gain three frequency average and the amplitude at which it was taken.
8. RTG Target: Target reference test gain
9. RTG Measured: Measured reference test gain
10. EQ Inp Noise: Equivalent input noise measurement

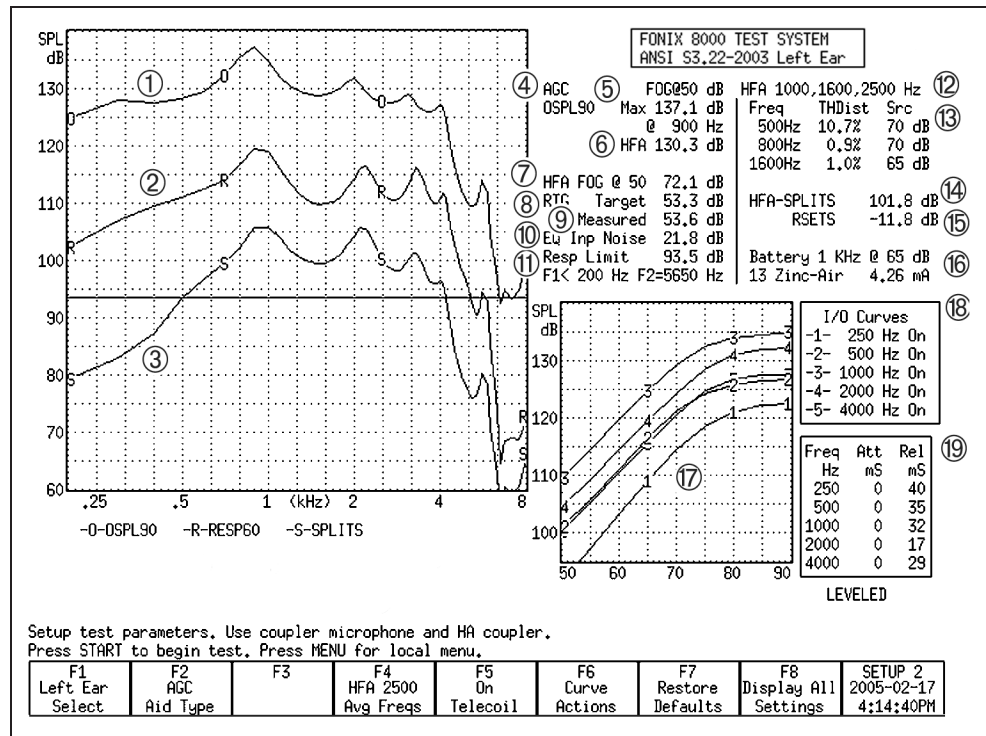


Figure 5.1.7A—ANSI 03 test results, Frequency Response Screen

11. Resp Limit: The response limit level is determined by taking the three frequency average of the RESP 50 curve and subtracting 20 dB.  
F1 is where the RESP 50 curve crosses the response limit level on the way up.  
F2 is where the RESP 50 curve crosses the response limit level on the way down.
12. HFA/SPA: Three frequency average chosen in the MENU.
13. TDH: total harmonic distortion measurements and the frequencies and amplitudes at which they are taken.
14. HFA/SPA-SPLITS: Three-frequency average of the telecoil frequency response curve.
15. RSETS: The difference between the HFA/SPA of the microphone response curve and the telecoil response curve.
16. Battery Current measurement
17. I/O curves: the input/output measurements taken of AGC aids. Only selected frequencies are tested.
18. I/O curve selection box: the key to the I/O graph, listing which frequencies go with which curve.
19. Attack and release measurements, including the frequencies at which they were measured.

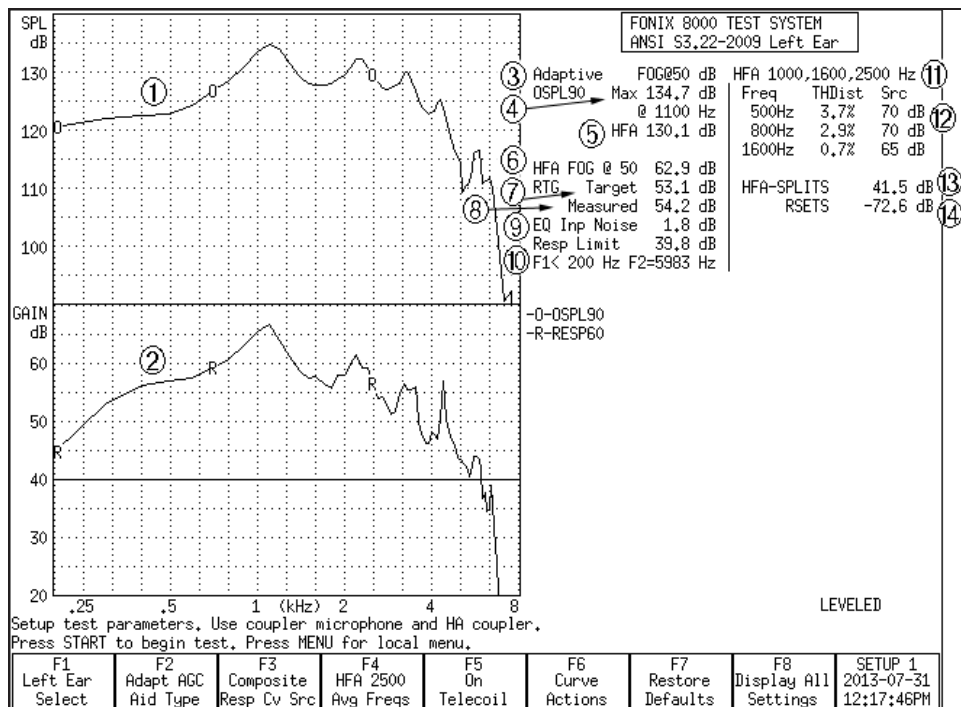


Figure 5.1.7B—ANSI 09 test results

1. OSPL 90 curve: Full-on gain frequency sweep taken at 90 dB SPL.
2. RESP 60 curve: Reference test gain measurement curve taken at 60 dB SPL with either a Composite or Pure-tone source type.
3. Aid type (selected with F2)
4. OSPL 90 MAX: Amplitude and frequency of the maximum output of the aid.
5. OSPL 90 HFA/SPA: Three-frequency response of the OSPL 90 curve.
6. HFA/SPA FOG: Full-on gain three frequency average and the amplitude at which it was taken.
7. RTG Target: Target reference test gain
8. RTG Measured: Measured reference test gain
9. EQ Inp Noise: Equivalent input noise measurement
10. Resp Limit: The response limit level is determined by taking the three frequency average of the RESP 60 curve and subtracting 20 dB.  
F1 is where the RESP 60 curve crosses the response limit level on the way up.  
F2 is where the RESP 50 curve crosses the response limit level on the way down.
11. HFA/SPA: Three frequency average chosen in the MENU.

12. TDH: total harmonic distortion measurements and the frequencies and amplitudes at which they are taken.
13. HFA/SPA-SPLITS: Three-frequency average of the telecoil frequency response curve.
14. RSETS: The difference between the HFA/SPA of the microphone response curve and the telecoil response curve.
15. (not shown) Battery current drain measurement

#### **Test Result Differences with ANSI 96 and ANSI 87**

- In ANSI 87 and ANSI 96, the response curve (2) is sometimes measured at 50 dB SPL
- In ANSI 87, I/O (17) is only measured at 2000 Hz
- In ANSI 87, attack and release (19) is only measured at 2000 Hz
- In ANSI 87, AGC aids are measured at full-on gain for the entire test sequence
- In ANSI 87, the OSPL90 curve is called SSPL90
- In ANSI 96, RSETS (15) is called STS-SPLITS
- In ANSI 87, the telecoil measurement (3, 14, 15) is much different. There is only one measurement called “TCOIL 10 mA/m”

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To delete the displayed results, press [F6] and use [▲, ▼] to select DELETE ALL CRVS. Press [►] to perform the deletion.

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#### **Testing Digital Hearing Aids**

The ANSI S3.22 “labeling” standard for hearing aids was not designed with digital hearing aids in mind. In fact, most of the testing methods employed by ANSI have been around since the 1970s. However, since ANSI is a standard, in order to conform to that standard, it must use only the testing techniques outlined in the standard. For this reason, **the 8000 test system has no provisions for incorporating composite or digital speech into the ANSI test sequences.**

In order to test digital hearing aids with “noise reduction” or “speech enhancement” features to the ANSI standards, put the aid in “test” mode via its programming software and do the steps outlined in Section 5.1.5. Contact your manufacturer to get further suggestions on performing an ANSI specification test.

In order to get an accurate picture of the aid’s actual performance when it goes home with your client, put the aid in the mode you will use for that client, and perform response curve measurements in the coupler and in the real-ear via the procedures described in Chapter 3 and Chapter 6 using the digital speech (DIG SPEECH) signal source.

### Viewing ANSI measurements in the Coupler screen

It's possible to copy ANSI response curves to the Coupler screen where they can be compared to other response curves. To do this:

1. Run the ANSI test sequence.
2. Press [F6].
3. Use [▼] to select Store Crvs Coup, if necessary.
4. Press [►] to store the curves and close the menu. The following is a list of where the curves are stored in the Coupler screen. Any previous measurements stored in these curve locations will be overwritten.
  - SPLITS – CRV 4
  - VA CORFIG – CRV 5
  - Response – CRV 6
  - OSPL90 – CRV 7
5. Press [EXIT] and [F1] to enter the Coupler screen and view the ANSI response curves.

### Explaining the Menu Settings

The following is an explanation of all the ANSI menu selections:

#### Measurement Settings

- Noise Red (Tone)—The amount of noise reduction used in the pure-tone measurements. See Section 2.3.1.1 for details.
- Battery Meas—The status of the battery current measurement. Turns it ON or OFF. (Battery pill required for this measurement.)
- Battery Size—The size of the battery for the hearing aid being tested.
- 12 dB Dist—The status of the 12 dB harmonic distortion rule. When measuring harmonic distortion, if the amplitude of the response at the second harmonic of the frequency being measured is 12 dB greater than the amplitude of that primary frequency, the harmonic distortion measurement should be ignored at the primary frequency. Turn this rule ON or OFF.
- Equiv Noise Test—Status of the EIN measurement. Turns it ON or OFF. In ANSI 87 and ANSI 96, this should probably be turned off for compression aids with a knee point below 60 dB SPL.
- Option—Used with the test sequence. This can be CIC, which adds CIC correction factors, (make sure to use the CIC coupler with this option), or VA-CORFIG, which includes software correction factors designed by the VA to produce a more realistic response curve than the normal ANSI response curve.

**ANSI Settings**

- OSPL90 Sweep Start Delay—The delay after the first tone is presented in the OSPL90 sweep and before the first measurement is taken.
- OSPL90 Sweep Meas Delay—The delay between frequencies in the OSPL90 sweep.
- Res Crv Sweep Start Delay—The delay after the first tone is presented in the response curve (at 50 or 60 dB SPL) sweep and before the first measurement is taken.
- Res Crv Sweep Meas Delay—The delay between frequencies in the response curve (at 50 or 60 dB SPL) sweep.
- Misc Start Delay—The delay after the first tone is presented and before the first measurement is taken in the HFA/SPA, reference test gain, equivalent input noise, and harmonic distortion measurements.
- Misc Meas Delay—The delay between frequencies in the measurements mentioned above.

Note: ANSI 87 combines the “OSPL90” and “Res Crv” delays into the “Sweep Start” delay settings.

**AGC Settings**

The purpose of the following settings is identical for each I/O frequency.

- AGC frequency—Status of the I/O test at the selected frequency. Turn the test ON or OFF.
- I/O Start—The delay after the first tone is presented in the I/O sweep and before the first measurement is taken.
- I/O Meas—The delay between frequencies in the I/O sweep.
- Attack Window—The amount of time the analyzer measures the attack time of the hearing aid. Select a time that is at least twice as long as the attack time specified by the manufacturer.
- Release Window—The amount of time the analyzer measures the release time of the hearing aid. Select a time that is at least twice as long as the release time specified by the manufacturer.

Note: ANSI 87 only measures I/O at 2000 Hz, and the Attack and Release window settings are not available.

**Misc Settings**

- Print Label—Status of the printing label. Choose ON or OFF.
- Printer—Printer used for printouts. Only INTERNAL is available at this time. See Section 2.4.
- AGC Switching—Pause during the test sequence that allows the user to change the compression setting of AGC aids according to the IEC standard. Turn ON or OFF.

### **ANSI S3.42-1992 (ANSI 92)**

The ANSI Option includes a test sequence based on the ANSI S3.42-1992 standard. This standard has been developed to test non-linear hearing aids with a broadband noise signal. The need for this standard stems from the importance of evaluating the performance of these circuits in a more real-world environment. ANSI 92 gives you: noise saturation sound pressure level, noise gain, a family of frequency responses, and a noise input/output curve.

#### **Understanding ANSI 92**

The original signal used in the 8000 test system is that of a speech-weighted set of pure tones starting at 200 Hz and ending at 8000 Hz, with a gradual high frequency roll off of 6 dB per octave. The knee point of the roll off is placed at 900 Hz. The spectrum was developed from data supplied by the National Bureau of Standards, and is the signal used for the testing of hearing aids submitted for use in the Veterans Administration hearing aid program.

In 1992, the ANSI standards committee for hearing aid test standards published S3.42-1992. This standard describes a noise signal that is very similar to the one we use in the 8000 test system. There are some differences, mostly in the low frequencies and in the way that the signal spectral shape is specified. The committee wanted a system that could be built easily by anyone, and assumed that a manufacturer who would develop equipment to make tests for this standard would use a white noise signal to produce the roll off above the 900 Hz knee point.

In order to produce a signal that met with the provisions of the S3.42 standard, Frye Electronics decided to slightly modify the Composite signal for use in this ANSI 1992 test sequence. This modified signal is not used in the normal composite operation of the 8000 test system.

Only the most observant operator will see any significant difference in the hearing aid performance between the two signals. The ANSI S3.42 signal may result in an increase in noise gain by about 1 dB.

#### **Entering the ANSI 92 Screen**

To enter the ANSI 92 test screen, you must configure one of the function keys in the Opening screen to point to that test screen.

To configure the F4-F7 keys in the Opening screen:

1. Press [MENU] in the Opening screen.
2. Change one of the F4-F7 selections in the General Default Settings window under Opening Screen to ANSI S3.42.
3. Use [F8] to save the setting (and all other settings in the Setup Menus) as default selections. See Sections 2.2.1 and 2.2.4 for details.



4. Press [EXIT] to return to the Opening screen. Your new selection for the F4-F7 keys should be displayed in the function key list at the bottom of the screen.
5. Press the function key you selected in Step 2 to enter the ANSI 92 screen.

### **Running ANSI 92.**

1. Level the sound chamber and set up the hearing aid to full on gain as specified in Section 5.1.2 and 5.1.3.
2. Press [F4] in the Opening screen to enter the ANSI 92 screen.
3. Use [F1] to select the desired ear.
4. Use [F2] to select the settle time used for the test.
5. Use [F3] to set the noise reduction used for the test. See Section 2.3.2.1 for more information on composite noise reduction.
6. Press [START] to begin the test sequence.

For some aids, the analyzer will pause the test and tell you to turn the aid down to reference test gain. Adjust the volume of the aid until it comes within 1 dB of the target gain. Take care not to move the aid from its position. If you must move it in order to adjust the gain control, replace the aid as close as possible to its original position. Push [START] to complete the test.

To delete the displayed results, press [F4] and use [▲, ▼] to select DELETE ALL CRVS. Press [►] to perform the deletion.

### **Viewing ANSI 92 Results**

1. Family of composite gain curves made at 50, 60, 70, 80 and 90 dB SPL,
2. NSPL90—Maximum RMS output sound pressure level (SPL) produced with a 90dB RMS speech-weighted noise input SPL signal.
3. Full-On Noise Gain—Maximum RMS gain with a 60dB SPL noise input signal. (Note: This test may not elicit a true reading of maximum gain for hearing aids with an onset of non-linear operation below 60dB.)
4. Target Reference Gain—This information is only displayed when the actual gain is greater than the calculated desired setting of gain. This target is used to adjust the hearing aid's actual gain to a level of  $\pm 1$  dB of the target. The figure is calculated by adding the 60dB SPL input + 17dB and subtracting it from the NSPL90 RMS output. (NSPL90 D-77 = desired setting of gain)
5. Actual Reference Gain—The measured amount of gain when the hearing aid is set to the reference test position.
6. Noise I/O Curve—This demonstrates the compression or limiting of the non-linear circuit.

For a more detailed explanation of these terms, consult the ANSI S3.42-1992 standard.

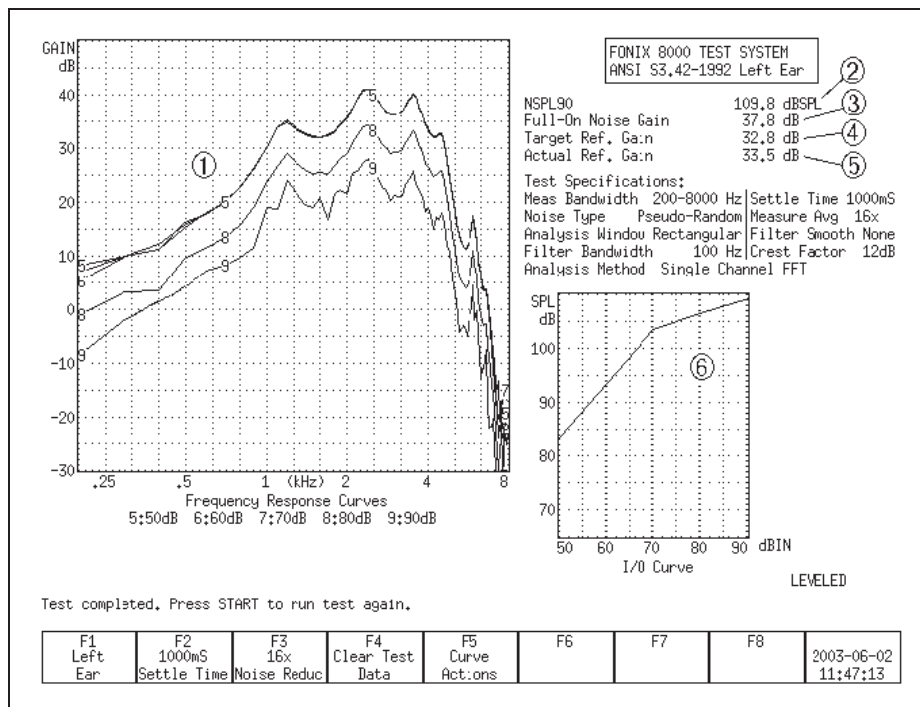


Figure 5.2.4—ANSI 92 test results

### Viewing ANSI measurements in the Coupler screen

It's possible to copy ANSI response curves to the Coupler screen where they can be compared to other response curves. To do this:

1. Run the ANSI 92 test sequence.
2. Press [F6].
3. Use [▼] to select Store Crvs Coup, if necessary.
4. Press [►] to store the curves and close the menu. The following is a list of where the curves are stored in the Coupler screen. Any previous measurements stored in these curve locations will be overwritten.
  - 50 dB SPL—CRV3
  - 60 dB SPL—CRV4
  - 70 dB SPL—CRV5
  - 80 dB SPL—CRV6
  - 90 dB SPL—CRV7
5. Press [EXIT] and [F1] to enter the Coupler screen and view the ANSI response curves.

### 5.2.6 Explaining the Menu Settings

There are only a couple of menu settings in the local menu of the ANSI 92 screen.

#### Misc. Settings

- Print Label—Status of the printing label. Choose ON or OFF.
- Printer—Printer used for printouts. Only INTERNAL is available at this time. See Section 2.4.

## IEC

The International Electro-technical Commission (IEC) 60118-7 standard in the international community is analogous to the ANSI standard in the United States.

There are two versions of the IEC standard in common use: IEC 60118-7 1994 (IEC 94) and IEC 60118-7 2005 (IEC 05). IEC 05 is very similar to the ANSI 03 standard.

#### Technical note for IEC 94:

Most of the IEC 94 measurements are made with the aid set to reference test gain. You can either set the aid to the reference test gain calculated by the 8000 analyzer, or you can set it to the reference test gain specified by the manufacturer.

We calculate the reference test gain used by IEC 94 with the following method:

The reference frequency is measured at 90 dB SPL (value A) and 60 dB SPL (value B).

- If  $B \geq A - 68$ , the calculated reference test gain is  $A - 75$
- Otherwise, the calculated reference test gain is  $B - 7$ .

### Entering the IEC 94 or IEC 05 Test Screen

By factory default, the [F5] key in the Opening screen will immediately open the IEC 05 test screen when the IEC Option is included. You can verify this operation by looking at the label for [F5] in the Opening screen. However, the [F4] through [F7] keys are user configurable and may have been changed. If this is the case, you may have to assign one of these keys to IEC 94 or IEC 05. Once inside one of the IEC test screens, you can change the standard version in the local menu.

To configure the F4-F7 keys:

1. Press [MENU] in the Opening screen.
2. Change one of the F4-F7 selections in the General Default Settings window under Opening Screen to the desired IEC 60118-7 test. You can even assign one key to one test sequence (such as F4 to IEC 94) and another key to another test sequence (such as F5 to IEC 05).

3. Use [F8] to save the setting (and all other settings in the Setup Menus) as default selections. See Sections 2.2.1 and 2.2.4 for details.
4. Press [EXIT] to return to the Opening screen. Your new selection for the F4-F7 keys should be displayed in the function key list at the bottom of the screen.
5. Press the function key you selected in Step 2 to enter the IEC screen.

Once inside the IEC test screen, press [MENU] to open the local menu. Use the IEC Standard selection to change the test version between IEC 94 and IEC 05, if desired.

### **Setting up the hearing aid for IEC**

The hearing aid controls must be set to conform with IEC requirements for the test results to be valid.

1. Set the controls on the aid (except for the compression controls) to give the greatest possible output and gain.
2. Set the aid for the widest frequency response range.
3. Set AGC aids to have the minimum compression possible or as otherwise specified by the manufacturer.
4. Put the hearing aid in “test mode,” if applicable. All noise suppression and feedback cancellation features should be turned off.
5. Set the gain control of the aid to the full-on position.
6. Set the aid up in the sound chamber as described in Section 3.3.

### **Setting up the analyzer for IEC**

1. Enter the IEC test screen as described in Section 5.3.1.
2. Use [F1] to select LEFT or RIGHT ear.
3. Use [F2] to select the aid type: LINEAR, AGC, or ADAPTIVE AGC. (Press [F2]. Use [▲ , ▼] to choose the selection. Press [►] to complete the selection and close the pop-up menu.)
4. If testing to IEC 94, use [F3] to select the full-on gain (FOG) amplitude used in the test sequence. Choose 50 or 60 dB SPL. This step does not apply for IEC 05.
5. If testing to IEC 94, use [F4] to select the reference frequency to use for the test sequence (1600 or 2500 Hz), and use [F5] to choose the distortion frequency (400, 500, 650, 800, 1000, 1250, 1600 Hz). If testing to IEC 05, use [F4] to choose the three frequency average used for the test, and use [F5] to select whether or not to perform a telecoil measurement.
6. Press [MENU] to enter the local menu and make any desired selections. See Section 5.3.7.

**Running an IEC 05 Test**

After leveling the sound chamber as described in Section 5.1.2, setting up the aid as described in Section 5.3.2, and setting up the analyzer as described in Section 5.3.3, follow these instructions:

1. Press [START] to begin the test.
2. If you choose to perform a telecoil measurement, do the following steps when the analyzer pauses. Otherwise, skip to Step 3.
  - a. Open the sound chamber.
  - b. Switch the aid to telecoil mode.
  - c. Position the hearing aid vertically in the sound chamber as shown in Figure 3.4.10A. Move the aid around in the chamber until the Telecoil running measurement shows the maximum amount of gain. This may not be the reference position in the sound chamber.
  - d. Press [START] to perform the telecoil measurement. The sound chamber lid does not need to be closed for this test. The analyzer will pause after the telecoil measurement is complete.
  - e. Return the aid to normal microphone mode and reposition in the sound chamber for normal testing.
3. Usually the 8000 test system will pause during the measurement process in order to let you adjust the gain of the hearing aid to the reference test position.
  - a. Lift the sound chamber lid and adjust the gain control of the aid until the Reference Test Gain Measured gain matches Reference Test Gain Target.
  - b. Close the sound chamber lid when finished.
  - c. Look at the display again. The MEASURED gain should be within 1.5 dB of the TARGET gain.
4. Push [START] to continue the test sequence.
  - 5A. If you chose to perform a telecoil measurement, do the following steps when the analyzer pauses. If you are testing an AGC aid and are not performing a telecoil measurement, skip to step 5B. Otherwise, just wait for the test sequence to complete.
    - a. Open the lid of the sound chamber.
    - b. Switch the aid to telecoil mode.
    - c. Position the hearing aid as it was positioned in Step 2.
    - d. Press [START] to perform the telecoil measurement. The sound chamber lid does not need to be closed for this test. The analyzer will pause after the telecoil measurement is complete.
    - e. Return the aid to the normal microphone mode, set the AGC controls to max (AGC aids only), reposition the hearing aid in the sound chamber, close the lid, and press [START] to complete the test sequence.
  - 5B. If you're running an IEC 05 test of an AGC aid without a telecoil measurement, the analyzer will run several measurements and then pause to allow you to set the AGC controls of your aid to maximum. Do so, close the lid of the chamber, and press [START] to complete the test sequence.

## Running an IEC 94 Test

After leveling the sound chamber as described in Section 5.1.2, setting up the aid as described in Section 5.3.2, and setting up the analyzer as described in Section 5.3.3, follow these instructions:

1. Press [START] from the IEC 94 screen. The instrument will run a measurement and then pause.
2. Turn the gain of the aid down to the reference test position. Match the target value within 1 dB.
3. Press [START] to complete the test sequence.
4. Press [PRINT] to print test results.

## Viewing IEC 05 Results

1. OSPL 90 response curve
2. RESP curve measured at reference test gain with a 60 dB SPL input
3. Full-on gain (FOG) curve with a 50 dB SPL input
4. Maximum output and its frequency
5. Three frequency average of OSPL90
6. Maximum gain of the FOG curve and its frequency
7. Three frequency average of FOG curve
8. Reference test gain calculated (target) and measured (actual)

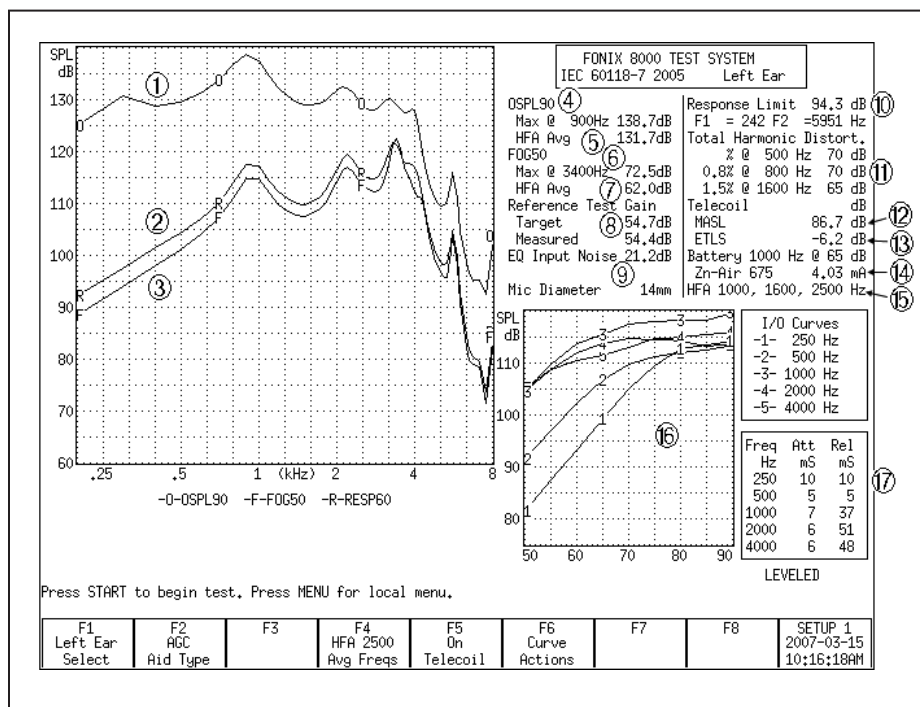


Figure 5.3.6—IEC test results

9. Equivalent input noise
10. Response limit and its maximum and minimum frequencies
11. Total harmonic distortion
12. Maximum HFA magneto-acoustical sensitivity level (HFA MASL) of induction pick-up coil: three frequency average of the telecoil measurement made at full-on gain with a magnetic input of 1 mA/m
13. Equivalent test loop sensitivity (ETLS): three frequency average of the telecoil measurement made at the reference test position with a magnetic input of 31.6 mA/m.
14. Battery current drain
15. Frequencies used in three frequency average measurements
16. I/O curve(s) measured at specified frequencies (2000 Hz is always measured)
  
17. Attack & release measurements at specified frequencies (2000 Hz is always measured)

### **Understanding the Menu Settings**

The following menu settings are available in the local menu of the IEC screen.

#### **General Settings**

- User – FONIX user type. Beginner mode provides extra help messages and eliminates menu settings unnecessary for most users. Advanced mode eliminates some help messages and adds extra menu settings.
- IEC Standard – Selected version of the IEC 60118-7 standard. Choose from 1994 (IEC 94) and 2005 (IEC 05).
- Noise Red (Tone) – The amount of noise reduction used in the IEC measurements. See Section 2.3.1.1 for more details.
- Battery Meas. – The status of the battery current measurement. Turns it ON or OFF. (Battery pill required for this measurement.)
- Battery Size – The size of the battery of the hearing aid being tested.
- 12 dB Dist – The status of the 12 dB harmonic distortion rule. When measuring harmonic distortion, if the amplitude of the response at the second harmonic of the frequency being measured is 12 dB greater than the amplitude of that primary frequency, the harmonic distortion measurement should be ignored at the primary frequency. Turn this rule ON or OFF.
- Equiv Noise Test – Status of the EIN measurement. Turns it ON or OFF.

#### **Printer Settings**

- Print Label – Status of the printing label. Choose ON or OFF.
- Printer – Printer used for printouts. Only INTERNAL is available at this time. See Section 2.4.

### **AGC Settings**

These settings only appear when the IEC 2005 test is selected in the IEC Standard setting above.

- AGC Switching – Pause during the test sequence that allows the user to change the compression setting of AGC aids according to the IEC standard. Turn ON or OFF.
- AGC 250, 500, 1000, 4000 – Status of the AGC measurements at the specified frequency. Turn ON or OFF the I/O and attack-and-release measurements at each frequency. 2000 Hz is always measured, so it is not select-able.

### **Delays**

The following settings only appear when the User mode is set to Advanced.

- OSPL90 Sweep Start Delay – The delay after the first tone is presented in the OSPL90 sweep and before the first measurement is taken.
- OSPL90 Sweep Meas Delay – The delay between frequencies in the OSPL90 sweep.
- Res Crv Sweep Start Delay – The delay after the first tone is presented in the response curve and FOG sweeps and before the first measurement is taken.
- Res Crv Sweep Meas Delay – The delay between frequencies in the response curve and FOG sweeps.
- Misc Start Delay – The delay after the first tone is presented and before the first measurement is taken in the HFA/SPA, reference test gain, equivalent input noise, and harmonic distortion measurements.
- Misc Meas Delay – The delay between frequencies in the measurements mentioned above.
- I/O Start Delay – The delay after the first tone is presented in the I/O sweep and before the first measurement is taken. This is settable for each I/O frequency.
- I/O Meas. Delay – The delay between frequencies in the I/O sweep. This is settable for each I/O frequency.
- Attack Window – The amount of time the analyzer measures the attack time of the hearing aid. Select a time that is at least twice as long as the attack time specified by the manufacturer. This is settable for each frequency at which attack time is measured.
- Release Window – The amount of time the analyzer measures the release time of the hearing aid. Select a time that is at least twice as long as the release time specified by the manufacturer. This is settable for each frequency at which release time is measured.



## JIS

The JIS 2000 automated test sequence allows you to testing hearing aids according to the Japanese Instrument Standard.

### Entering the JIS Screen

By factory default, the [F6] key in the Opening screen will immediately open the JIS test screen when the JIS Option is included. You can verify this operation by looking at the label for [F6] in the Opening screen. However, the [F4] through [F7] keys are user configurable and may have been changed. If this is the case, you may have to assign one of these keys to JIS.

To configure the F4-F7 keys in the Opening screen:

1. Press [MENU] in the Opening screen.
2. Change one of the F4–F7 selections in the General Default Settings window under Opening Screen to JIS.
3. Use [F8] to save the setting (and all other settings in the Setup Menus) as default selections. See Sections 2.2.1 and 2.2.4 for details.
4. Press [EXIT] to return to the Opening screen. Your new selection for the F4–F7 keys should be displayed in the function key list at the bottom of the screen.
5. Press the function key you selected in Step 2 to enter the JIS screen.

### Running JIS

Follow these instructions to run a JIS automated test sequence.

1. Enter the JIS test screen as described in Section 5.4.1.
2. Use [F1] to select the ear.
3. Use [F2] to select the aid type: Press [F2], use [▲ , ▼] to make your selection, and [►] to complete the selection and close the pop-up menu.
4. Use [F3] to select the amplitude of the full-on gain measurement.
5. Use [F4] to select the test frequency that you want to use.
6. Use [F5] to select the type of coupler you are using for the test. The 2-cc selection is used for the HA-1 and HA-2 coupler. The MZ selection is used for the MZ couplers.
7. Press [MENU] and use the arrow keys to make any desired changes to the menu items. See Section 5.4.5 for more details. Press [EXIT] to close the local menu.
8. Press [START] to start the test sequence. The instrument will run a measurement and then pause.
9. Turn the gain of the aid down to the reference test position. Match the target value within 1 dB.

10. Press [START] to complete the test sequence.

11. Press [PRINT] to print test results.

### Viewing JIS Results

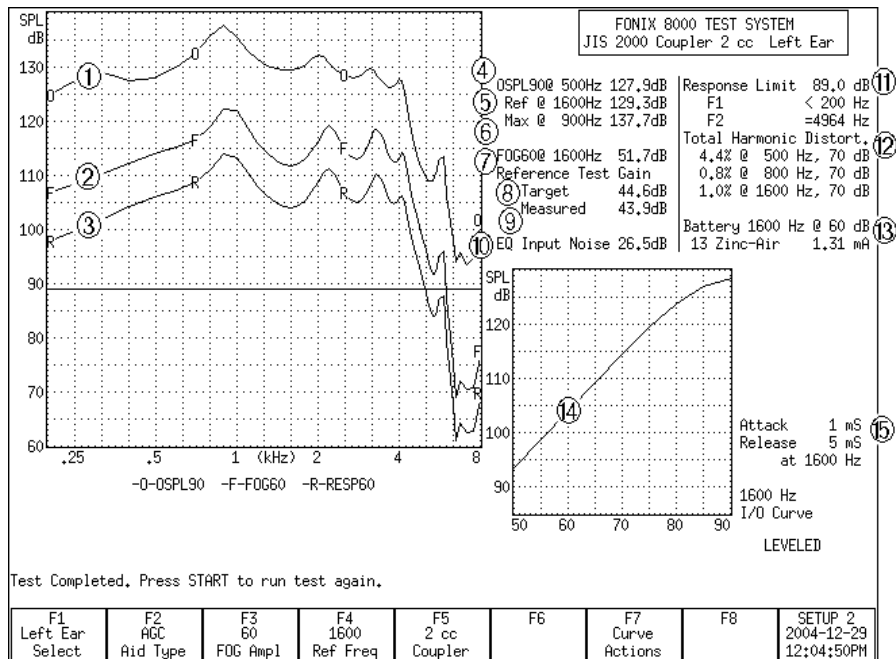


Figure 5.4.3—JIS test results

See Figure 5.4.3 for the following explanation of test results.

1. OSPL90 response curve
2. Full-on gain response curve measured at 50 or 60 dB SPL
3. Response curve measured at reference test gain at 60 dB SPL
4. Output with a 90 dB input at 500 Hz
5. Output with a 90 dB input at the reference frequency
6. Maximum output and the frequency at which it was measured
7. Gain of the FOG curve at the reference frequency
8. Reference test gain calculated (target)
9. Reference test gain measured (actual)
10. Equivalent input noise
11. Response limit and the two frequencies (F1 and F2) at which the response curve crosses its horizontal line.
12. Total harmonic distortion at 500, 800, and 1600 Hz

13. Battery current drain with 60 dB input at the reference frequency
14. I/O curve measured at the reference frequency.
15. Attack & release measurements at the reference frequency

### **Viewing JIS measurements in the Coupler screen**

It is possible to copy JIS response curves to the Coupler screen where they can be compared to other response curves. To do this:

1. Run the JIS test sequence.
2. Press [F7].
3. Use [▲] to select Store Crvs Coup, if necessary.
4. Use [▶] to “store” the curves (that is, copy them to the Coupler screen) and close the pop-up menu. The following is a list of where the curves are cop-ied in the Coupler screen. Any previous measurements stored in those curve locations will be overwritten.
  - Full-on Gain—CRV 5
  - Response—CRV 6
  - OSPL90—CRV 6
5. Press [EXIT] and [F1] to enter the Coupler screen and view the JIS response curves.

### **Understanding the menu settings**

The following menu settings are available in the local menu of the JIS screen.

#### **Measurement Settings**

- Noise Red (Tone) – The amount of noise reduction used in the JIS measurements. See Section 2.3.1.1 for more details.
- Battery Meas. – The status of the battery current measurement. Turns it ON or OFF. (Battery pill required for this measurement.)
- Battery Size – The size of the battery of the hearing aid being tested.

#### **Aid Settings**

- Sweep Start Delay – The delay after the first tone is presented in a pure-tone frequency sweep and before the first measurement is taken.
- Sweep Meas. Delay – The delay between frequencies in a pure-tone frequency sweep.
- Misc. Start Delay – The delay after the first tone is presented and before the first measurement is taken in the HFA/SPA, reference test gain, equiv-alent input noise, and harmonic distortion measurements.
- Misc. Meas. Delay – The delay between frequencies in the measurements mentioned above.

- I/O Start Delay – The delay after the first tone is presented in the I/O sweep and before the first measurement is taken.
- I/O Meas. Delay – The delay between frequencies in the I/O sweep.

### JIS Settings

- Equiv Noise Test – Status of the EIN measurement. Turns it ON or OFF.

### Misc. Settings

- Print Label – Status of the printing label. Choose ON or OFF.
- Printer – Printer used for printouts. Only INTERNAL is available at this time. See Section 2.4.

## Profiler

The Profiler is a comprehensive, diagnostic tool. It includes ten tests, each selected because of its potential to identify common customer complaints. The tests included are an OSPL 90 test, a total harmonic distortion test, a maximum output reading, an equivalent input noise measurement, the RMS gain of the medium speech curve, a battery current drain measurement, three speech curves run at soft, medium, and loud levels, and a reserve gain test.

The sequence is performed in a very short period of time, and, with the exception of the reserve gain measurement, it is done with the hearing aid set at the user gain and settings.

### Running Profiler Test

1. Make sure Profiler is a test sequence selected for navigation from the Opening Screen:
  - a. Press [MENU] in the Opening Screen.
  - b. Use the up-down arrow keys to select one of the function key settings [F4] through [F7].
  - c. Use the right-left arrow keys to change the selection to Profiler
  - d. Press [EXIT]. Profiler will now be displayed as an option under the function key selected above.
2. Press the function key indicating the Profiler test sequence in the Opening Screen.
3. Select the Source Type with [F5]. Normally, this should be Digsp ANSI. This is the digital speech signal with an ANSI filter.
4. Select the Digital Speech Duration with [F2]. This is the amount of time the signal will be presented to the hearing aid when measuring a response curve. This time should depend on how long it takes for the hearing aid to settle in response to an input signal. Some hearing aids require up to ten seconds whereas other hearing aids respond very quickly. This setting will greatly effect the length of the test sequence.

5. Select whether or not to test the battery current with [F7]. The battery current test requires the hearing aid be connected to a battery pill. If you are testing the hearing aid with a normal battery, you can leave the battery current test off (this will not affect other measurements.)
6. Select whether or not you want to perform an EIN (equivalent input noise) test. If the hearing aid is not set to have completely linear amplification below 60 dB SPL, the EIN test results will be artificially high as a result of a test artifact. Keep this in mind when deciding whether to perform the EIN test and in interpreting test results.
7. Press [START] to perform the Profiler test sequence.

### Viewing Profiler Test Results

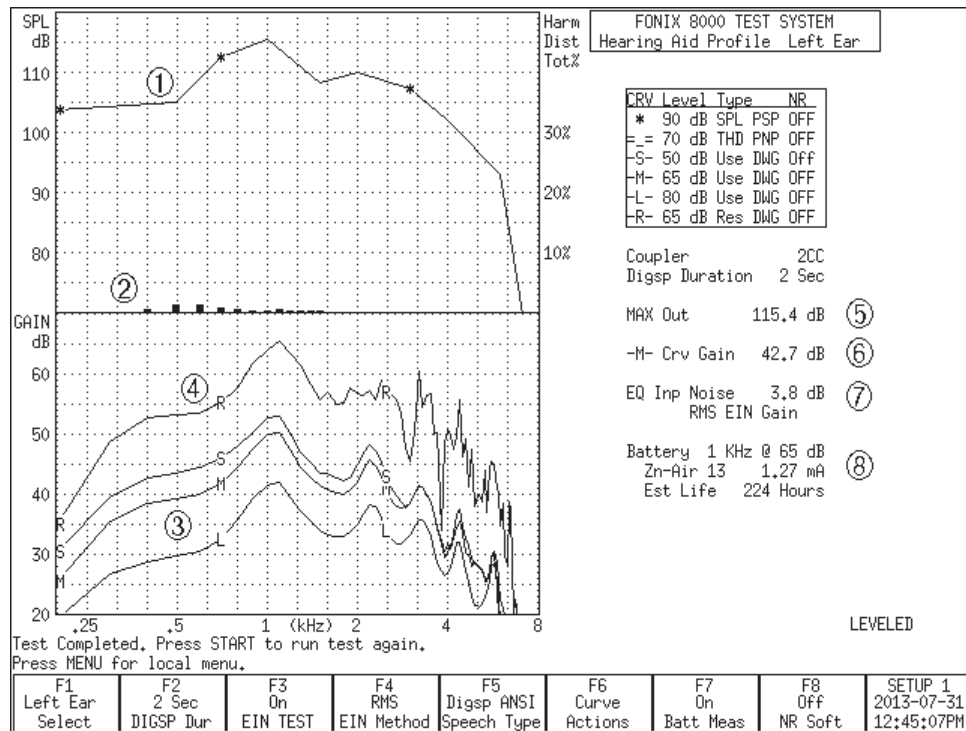


Figure 5.5.2: Completed Profiler Test Sequence

See Figure 5.5.2 for the following explanation of test results.

1. OSPL90 curve: Pure-tone curve measured at 90 dB SPL and displayed in output
2. Harmonic distortion tested at 70 dB SPL and displayed as a series of vertical bars. The scaling for these bars is located on the right side of the graph.
3. Soft (S), Medium (M), and Loud (L) curves measured with the source selected with [F5] at 50, 65, and 80 dB SPL respectively. Results are displayed in dB Gain, allowing the clinician to quickly determine the overall compression characteristics of the hearing aid.

4. Reserve gain curve. While every other measurement in this test sequence is performed with the hearing aid set to normal user gain, this measurement is performed with the hearing aid set to full-on gain. This shows the clinician how much “headroom” the hearing aid has.
5. Maximum Output: This is the maximum output of the hearing aid as measured during the OSPL90 curve.
6. M Curve Gain: This is the RMS of the medium speech curve measured at 65 dB SPL. This is the overall gain of the hearing aid when tested at normal speech levels.
7. Equivalent Input Noise and the method used to measure it (RMS vs HFA/SPA).
8. Battery current drain and the estimated battery life of the hearing aid.

### **IS: 16127-2013**

The IS: 16127-2013 automated test sequence allows you to test BTE type hearing aids according to the Indian standard.

#### **Running an IS: 16127-2013 Test**

After leveling the sound chamber as described in Section 5.1.2, setting up the aid as described in Section 5.3.2, and setting up the analyzer as described in Section 5.3.3, follow these instructions:

1. Press [START] to begin the test. The 8000 will now run the OSPL90 and Full On Gain microphone curves.
2. If you choose to perform a telecoil measurement, do the following steps when the analyzer pauses. Otherwise, skip to Step 3.
  - a. Open the sound chamber.
  - b. Switch the aid to telecoil mode.
  - c. Position the hearing aid vertically in the sound chamber as shown in Figure 3.4.10A. Move the aid around in the chamber until the Telecoil running measurement shows the maximum amount of output. This may not be the reference position in the sound chamber.
  - d. Press [START] to perform the Full on Gain Telecoil curve measurement. The sound chamber lid does not need to be closed for this test. The analyzer will pause after the telecoil measurement is complete.
  - e. Return the aid to normal microphone mode and reposition in the sound chamber for normal testing.
3. Usually the 8000 test system will pause during the measurement process in order to let you adjust the gain of the hearing aid to the reference test position.
  - a. Lift the sound chamber lid and adjust the gain control of the aid until the Reference Test Gain Measured gain matches Reference Test Gain Target.
  - b. Close the sound chamber lid when finished.

- c. Look at the display again. The MEASURED gain should be within 1.5 dB of the TARGET gain.
4. Push [START] to continue the test sequence. The 8000 will then measure the Response curve, the distortion, the Battery Current, and the Equivalent Input Noise.

If you're running a test of an AGC aid with AGC switching turned on, the analyzer will pause to allow you to set the AGC controls of your aid to maximum. Do so, close the lid of the chamber, and press [START] to complete the test sequence.

If you're running a test of an AGC aid, the I/O curves and Release and Attack measurements are now made.

### 5.6.2 Viewing IS: 16127-2013 Results

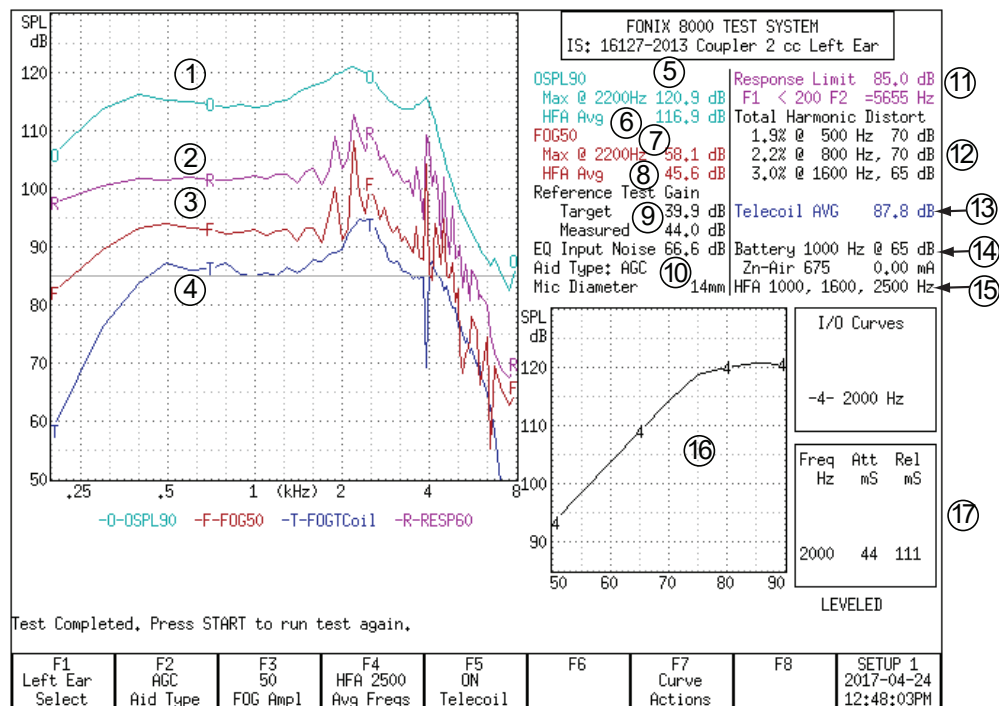


Figure 5.6—IS: 17127-2013 test results

1. OSPL 90 response curve
2. RESP curve measured at reference test gain with a 60 dB SPL input
3. Full-on gain (FOG) curve with a 50 or 60 dB SPL input
4. FOG Telecoil curve.
5. Maximum output and its frequency
6. Three frequency average of OSPL90

7. Maximum gain of the FOG curve and its frequency
8. Three frequency average of FOG curve
9. Reference test gain calculated (target) and measured (actual)
10. Equivalent input noise
11. Response limit and its maximum and minimum frequencies
12. Total harmonic distortion
13. Maximum HFA magneto-acoustical sensitivity level of induction pick-up coil:  
three frequency average of the telecoil measurement made at full-on gain with  
a magnetic input of 10 mA/m
14. Battery current drain
15. Frequencies used in three frequency average measurements
16. I/O curve(s) measured at specified frequencies.
17. Attack & release measurements at specified frequencies.

### **Understanding the Menu Settings**

The following menu settings are available in the local menu of the IS: 16127-2013 screen.

#### **Measurements Settings**

- Noise Red (Tone) – The amount of noise reduction used in the measurements. See Section 2.3.1.1 for more details.
- Battery Meas. – The status of the battery current measurement. Turns it ON or OFF. (Battery pill required for this measurement.)
- Battery Size – The size of the battery of the hearing aid being tested.
- Battery Chemistry – The chemistry of the battery of the hearing aid being tested.

#### **Aid Settings**

- Sweep Start Delay – The delay after the first tone is presented in each sweep and before the first measurement is taken.
- Sweep Meas Delay – The delay between frequencies in the each sweep.
- I/O Start Delay – The delay after the first tone is presented in the I/O sweep and before the first measurement is taken.
- I/O Meas. Delay – The delay between frequencies in the I/O sweep.
- Misc Start Delay – The delay after the first tone is presented and before the first measurement is taken in the HFA/SPA, reference test gain, equivalent input noise, and harmonic distortion measurements.
- Misc Meas Delay – The delay between frequencies in the measurements-mentioned above.



- **Attack Window** – The amount of time the analyzer measures the attack time of the hearing aid. Select a time that is at least twice as long as the attack time specified by the manufacturer.
- **Release Window** – The amount of time the analyzer measures the release time of the hearing aid. Select a time that is at least twice as long as the release time specified by the manufacturer.

### **IS Settings**

- **Equiv Noise Test** – Status of the EIN measurement. Turns it ON or OFF.
- **12 dB Dist Rule** – The status of the 12 dB harmonic distortion rule. When measuring harmonic distortion, if the amplitude of the response at the second harmonic of the frequency being measured is 12 dB greater than the amplitude of that primary frequency, the harmonic distortion measurement should be ignored at the primary frequency. Turn this rule ON or OFF.
- **AGC Switching** – Pause during the test sequence that allows the user to change the compression setting of AGC aids according to the IEC standard. Turn ON or OFF.
- **AGC 250, 500, 1000, 2000, 4000** – Status of the AGC measurements at the specified frequency. Turn ON or OFF the I/O and attack-and-release measurements at each frequency.

### **Misc Settings**

- **Print Label** – Status of the printing label. Choose ON or OFF.
- **Printer** – Printer used for printouts. Only INTERNAL is available at this time. See Section 2.4.

### The ISTS Test

The ISTS Test screen performs coupler measurements to the upcoming IEC 60118-15 standard titled, “Electroacoustics – Hearing Aids – Part 15: Methods for characterizing signal processing in hearing aids with a speech-like signal.” The ISTS is part of a new way of performing coupler measurements on advanced digital hearing aids, representing a major departure from the traditional ANSI method of evaluating hearing aid performance.

The acronym ISTS actually refers to the speech-like signal that is used as part of the test. It stands for “International Speech Test Signal,” and was developed by the European Hearing Instrument Manufacturers Association which holds the copyright. This signal was developed from recordings of female speakers of Arabic, English, French, German, Mandarin and Spanish. The recordings were cut into short segments and recomposed in random order.

During the test, third octave analysis is performed on the hearing aid response to the ISTS signal for a choice of 10, 20 or 45 seconds (actual test times are slightly longer). When the test is complete, the results are displayed as the long-term speech spectrum (LTASS), and the 30%, 65% and 99% of the distribution of sound pressure level.

See Figure 7.0 for a screenshot of a completed ISTS Test. Notice that the results are shown as a series of connected horizontal segments. These segments represent the third octave intervals used for the measurements. That is, each segment shows the frequency response across the entire third octave interval. In all other respects, however, they can be interpreted similarly to any hearing aid frequency response curve.

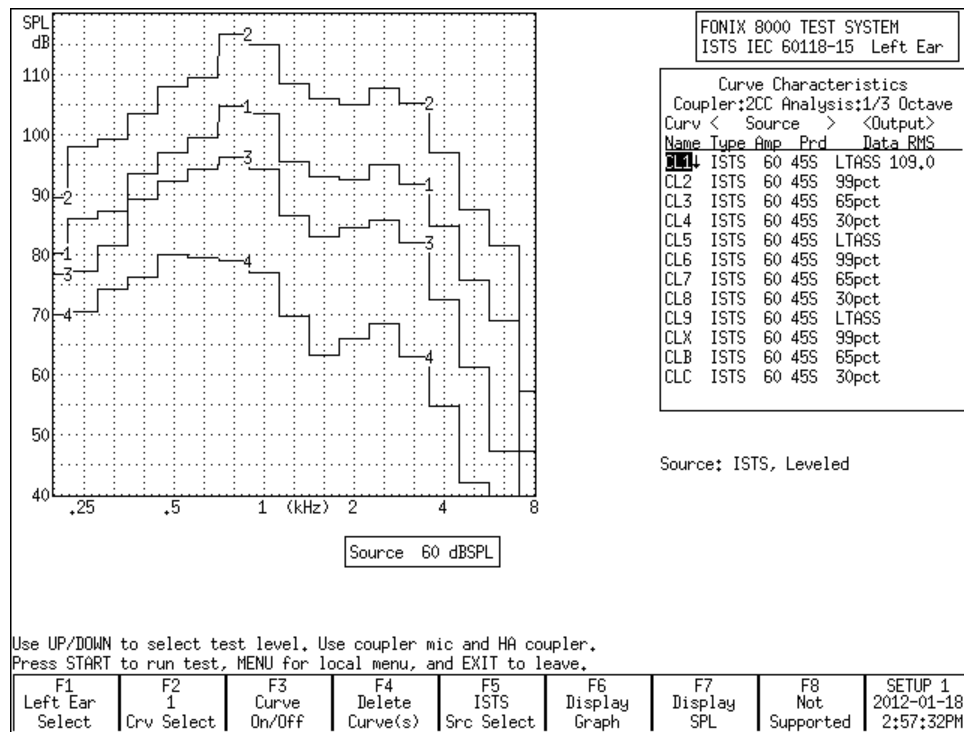


Figure 7.0: A Completed ISTS Test

## Hearing Aid Setup

This section describes how the hearing aid should be programmed and set up in the sound chamber.

The sound chamber should be leveled (Section 3.2), and the hearing aid should be arranged in the test chamber in the usual way (Section 3.3). BTE hearing aids should be tested with the HA-2 coupler and canal hearing aids with the HA-1 coupler. The IEC 60118-15 standard specifies that hearing aids with the receiver in the canal or using thin coupling tubes should use the HA-1 coupler.

All settings of the hearing aid should be set to end-user settings, including noise reduction algorithms, feedback suppression systems, echo cancellation, etc. Features like frequency transposition should be disabled since they may give measurement results that are difficult to interpret.

It is recommended to program the hearing aid for a closed vent since actual measurements will take place using a coupler and no venting. Directional hearing aids should be set to omni-directional mode.

The hearing aid should be programmed for the patient's measured audiogram. However, if there is no patient yet, you can use one of the following audiograms found in Table 7.1 for flat and moderately sloping audiograms or Table 7.2 for steeply sloping audiograms. Make sure you make a note of which audiogram you used to program the hearing aid for reference purposes later.

No	HL	250 Hz	375 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz
<b>N1</b>	16	10	10	10	10	10	10	15	20	30	40
<b>N2</b>	31	20	20	20	22.5	25	30	35	40	45	50
<b>N3</b>	46	35	35	35	35	40	45	50	55	60	65
<b>N4</b>	63	55	55	55	55	55	60	65	70	75	80
<b>N5</b>	76	65	67.5	70	72.5	75	80	80	80	80	80
<b>N6</b>	89	75	77.5	80	82.5	85	90	90	95	100	100
<b>N7</b>	103	90	92.5	95	100	105	105	105	105	105	105

*Table 7.1: Standard audiograms for flat and moderately sloping group*

No	HL	250 Hz	375 Hz	500 Hz	750 Hz	1000 Hz	1500 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz
<b>S1</b>	23	10	10	10	10	10	10	15	30	55	70
<b>S2</b>	49	20	20	20	22.5	25	35	55	75	95	95
<b>S3</b>	63	30	30	35	47.5	60	70	75	80	80	85

*Table 7.2: Standard audiogram for the steep sloping group*

## The ISTS Test

Performing the ISTS Test is very straightforward.

1. Enter the ISTS Test screen by selecting [F3] Advanced Coupler from the Opening Screen and then pressing [F7] ISTS Noise.
2. Set up the hearing aid for testing as described in Section 7.1.
3. Use the up-down arrow keys to adjust the source level, if desired. The default is 60 dB SPL.
4. Use the [F5] key to choose the source type. Normally, this will be the ISTS Wave, but you can also choose Pink Noise or White Noise.
5. Press [MENU] and adjust the Test Period, if desired. This changes the measurement time for the test. Choose between 10, 20 and 45 seconds. Keep in mind actual test time is longer. Press [MENU] again to close the local menu.
6. Press [START]. The ISTS test will run and four curves will be displayed when the test is complete. These curves represent the LTASS (long term average speech spectrum), the 99, 65 and 30 percentile curves. This means that in the 99 percentile curve, 99 percent of the measured response is below this line. In the 65 percentile curve, 65 percent of the measured response is below this line. Similarly, in the 30 percentile curve, 30 percent of the measured response is below this line.
7. Use [F2] to select Crv 4 and repeat if desired. Three separate tests can be measured and displayed together using a total of 12 different curves.

## Specifications

### ACOUSTICAL

<b>OUTPUTS</b> Frequencies:	200-8000 Hz in 100 Hz intervals (user interface) 200-8000 Hz in 50 Hz intervals (RS232)
Frequency Accuracy:	1%
Amplitudes:	40-100 dB in 5 dB intervals coupler, 40-90 dB in 5 dB intervals real-ear (user interface) 40-100 dB in 0.01 dB intervals coupler, 40-90 dB in 0.01 dB intervals real-ear (RS232)
Accuracy	Coupler: $\pm 1$ dB from 300 to 5000 Hz, all others $\pm 3$ dB (after leveling) Real-ear: $\pm 3$ dB, 200-8000 Hz (after leveling)
Distortion (at 70 dB SPL):	Puretone: < 0.5%, 400-2500 Hz

### TELECOIL OUTPUTS

Field Strength:	1, 1.78, 3.16, 5.62, 10, 17.8, 31.6, 56.2, 100 mA/m (user interface) 0-180 mA/m in 0.01 mA/m specified intervals (RS232)
Accuracy:	$\pm 2$ dB

### BATTERY CURRENT

Readout Range:	0.00-25.00 mA
Available Current:	greater than 50 milliamps
Accuracy:	$\pm 5\%$ of reading $\pm$ one digit
Resolution:	8 $\mu$ A
Voltages supplied:	1.5 (silver), 1.3 (zinc air)
Voltage Accuracy:	$\pm 15$ millivolts. (open circuit)
Resistance	( $\pm 6\% \pm 0.5$ ohm)

accuracy:

### DIGITAL READOUT OF SOUND PRESSURE

<b>LEVEL</b> Frequency Range:	200-8000 Hz
Amplitude Range: 0-	150 dB SPL
Resolution:	0.1 dB
Accuracy:	Coupler mic: $\pm 1.0$ dB $\pm 1$ digit, 300-5000 Hz, $\pm 2$ dB $\pm 1$ digit all other frequencies Probe mic: $\pm 2.5$ dB $\pm 1$ digit, 250-8000 Hz Ref mic: $\pm 3$ dB $\pm 1$ digit, 100-8000 Hz

**HARMONIC DISTORTION ANALYZER**

Type: 2nd, 3rd, Total (2nd plus 3rd)  
Resolution: 0.1%

**ATTACK/RELEASE**

Range: 1.25 to 5000 mSec.  
Accuracy: Accuracy:  $\pm 10\%$  or  $\pm 2$  ms, whichever is larger  
Signals: Puretone: 200-8000 Hz, in 100 Hz intervals (user interface), 50 Hz intervals (RS232), Composite

**AVAILABLE TESTS**

Automated Test Sequences: ANSI S3.22-1987, ANSI S3.22-1996, ANSI S3.22-2003, ANSI S3.22-2009, IEC 60118-7:1994, IEC 60118-7:2005, ANSI S3.42-1992, JIS:2000  
Additional Coupler Tests: Profiler, ISTS, Enhanced DSP, Input/Output, Attack & Release, Battery Current, Coupler Multicurve  
Real-Ear: Audiogram Entry, Target Edit, Insertion Gain, Real-ear SPL, Visible Speech  
Optional: Coupler Directional (requires 8120 Polar Plot Chamber)

**POWER**

Source voltage: 100-240 volt AC.  
Frequency Range: 50-60 Hz.  
Power: 0.6 A.  
Requirement: Fuse: T 630mAL, 0.63A / 250 V~, Type T, IEC 60127-2 Sheet III (Slo-Blo Type, Glass, 5mm x 20mm). Qty 2.

**ELECTRONICS MODULE**

Size: 17.3"W x 10.8"D x 6.5"H (43.9 x 27.4 x 16.5 cm).  
Weight: 14.3 lbs.(6.49 kg).

**PRINTER, INTERNAL**

Type: High speed line thermal printer  
Paper width: 4.41" (112 mm)

**TEST CHAMBER: 8050 COMPACT**

Test Area: 5"W x 6"D x 1.5"H (12.7 x 15.2 x 3.8 cm).  
Ambient Noise Isolation: 45 dB at 1 kHz (allows THD measurement to within 3% at 60 dB source level and a 60 dB ambient).

Size: 11.5"W x 13.5"D x 9.2"H (29.2 x 34.3 x 23.4cm).  
Weight: 21.8 lbs. (9.9 kg).

## **ENVIRONMENTAL CONDITIONS**

Shipping/Storage Humidity: 5 to 95 percent relative humidity (non-condensing)  
Shipping/Storage Temperature: -20 to 60 degrees Celsius (-4 to 140 degrees Fahrenheit)  
Operating Relative Humidity: 5 to 90 percent relative humidity (non-condensing)  
Operating Temperature: 15 to 35 degrees Celsius

## **GUARANTEE**

The FONIX 8000 and its accessories are guaranteed to be free from manufacturing defects which would prevent the products from meeting these specifications for a period of one year from date of purchase.

## 8000 Software Upgrades

As new features and options become available on the 8000 analyzer, you may need to upgrade your instrument. The 8000 analyzer is upgraded using computer software.

It is recommended that you close any open programs on your computer before executing the software upgrade. It is particularly important to close any other programs that are Frye programs. It is also recommended that you disable your screensaver.

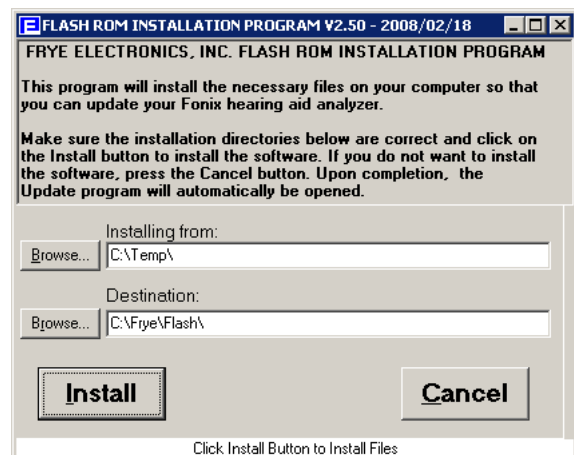
Software upgrades are usually delivered via email in a .zip file. **These instructions assume that you have unzipped this file.** Ask your local computer technician for help, if needed.

**Important Note:** Your computer will not be available for other programs during the software upgrade due to the intensive nature of the RS232 communications. The upgrade may take approximately 45 minutes to complete if you use the FastLoad option within the update program.

### B.1 Installing the Update Software

The software used to update your hearing aid analyzer needs to be installed on a Windows computer that is connected to your analyzer.

1. Open setup.exe in the directory where you unzipped your emailed software. This will open the Flash ROM Installation Program. Please note that your version of Windows may intentionally hide known file extensions such as “exe”. The file name “setup.exe” maybe displayed as just “setup”.
2. Click **Install** to begin the installation. Do not alter the installation directory unless you are an expert computer user.
3. Click **OK** to acknowledge when the Installation is complete. The Flash Rom Update Program will automatically start.



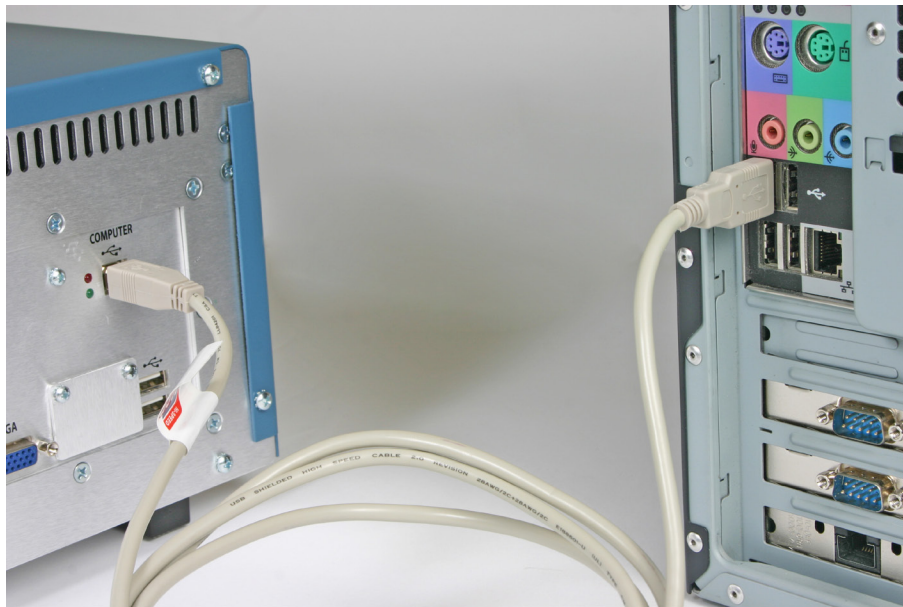


## B.2 Connecting the 8000 to the Computer

If you regularly use your computer to connect to your FONIX hearing aid analyzer (for instance, when using the NOAH Real-ear Module or WinCHAP), then close those programs and skip this section; your analyzer should already be connected to your computer. Otherwise, you will need to establish a connection between your hearing aid analyzer and your computer by using a USB port. Contact a local computer technician for computer support if necessary.

### USB Computer Connection

The best way to connect your FONIX hearing aid analyzer to your computer is to use the USB cable supplied to you with your 8000. This is a standard High Speed USB cable. The two photos below show the cable alone and when it is connected to the back of a computer.



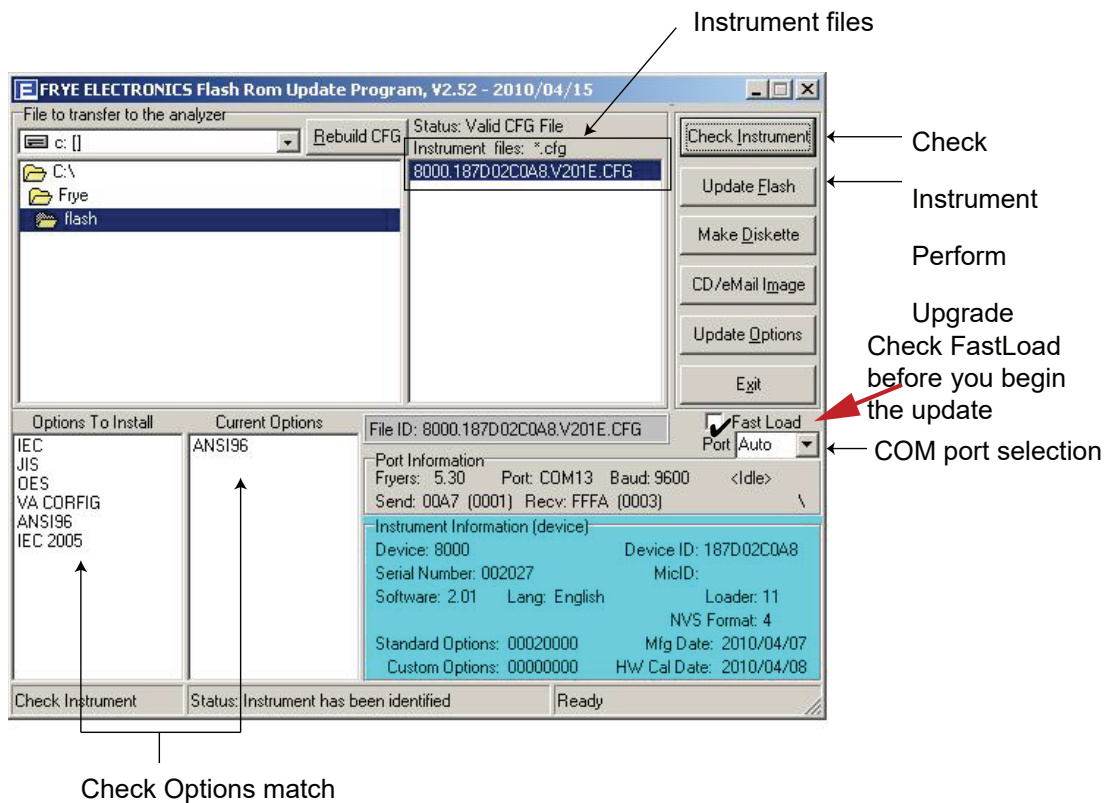
### High Speed USB Cable

All FONIX 8000 hearing aid analyzers are provided with a USB cable at the time of shipment. Please retrieve this cable and associated USB driver disk. The cable and driver installation disk come with instructions. Make sure to install this cable on your computer and the 8000 (The hardware installation wizard for the USB cable normally runs twice as noted on the instruction).



### B.3 Updating the FONIX 8000 Analyzer

If the Flash Rom Update Program is not already open, open the file: **C:\frye\flash\update.exe**.



1. If necessary, click the Instrument File that matches the Instrument ID found on the Opening Screen of your FONIX analyzer. In most cases, there will be only one file and it will already be highlighted.
2. The update screen shot shown above is installing the options such as IEC, JIS, OES, VA Corfig, and IEC 2005. If you are only upgrading the firmware and the installed options are not changing, check that the Options to Install column matches the Current Options column. These two columns are intended to be self-explanatory.
3. Check the FastLoad checkbox to increase the transfer speed and reduce the time needed to update.
4. Click Update Flash to perform the flash ROM update. The computer will then proceed to rewrite the flash memory on your FONIX analyzer. This process may take up to 120 minutes. Do not use the computer for other activities while this transfer is in process. Options will also be transferred together with the new software upgrade.
5. During the 120 minute upgrade process, the monitor on your instrument 8000 may go blank. This is a normal screen saver process within the boot loader of the 8000. Do not be alarmed. Do not take any action.
6. When the Fonix 8000 opening screen logo is displayed, verify the desired software version or new options are installed.
7. Click Exit to close the FlashRom Update Program.

### Troubleshooting the Update

**Important Note:** You may experience errors such as “Port Not Found”, “Response Error”, “No Poll”, or “Command Error” after the upgrade is complete because the 8000 is rebooting after the upgrade. Click the **OK** button to exit Error window, the “Exiting Transfer Mode” window should close automatically. Click **Exit** button in the Flash Rom Update Program.

- If your computer crashes during the upgrade process, or if the transfer is interrupted in any way, take the following steps:
  - a. Please be patient. Wait at least five minutes for the system to repair itself (transfer may take up to 45 minutes.)
  - b. Reboot the 8000 by turning off the power switch then turning it on.
  - c. Reboot your computer if it is locked up. Close all computer screen savers, virus protection programs or any power saver feature that may be interrupting the upgrade.
  - d. Before attempting to upgrade the analyzer again, ensure that all programs are closed, all screensavers and power management functions are turned off, all desktop programs such as Office toolbar are closed, all programs running in the Tray are closed.

- The Flash ROM Update program automatically detects the communications port used in connecting to the 8000 analyzer. However, if you are having trouble connecting, you might try specifying the COM port that the Update program should use. Contact a local computer technician for computer support if necessary.
- When using a USB cable, the computer turns the USB port into a COM port. In your Windows Device Manager, make sure the USB Cable is using COM 1-9. If it is using a higher COM port, the installation may not work. You may need to ask your local computer technician for help if necessary.
- The lower right corner of the screen displays instrument information. If you want to display information currently on the connected analyzer, click **Check Instrument**.
- Sometimes the instrument configuration file name can be damaged. This can happen if the package was copied through a computer system or program that does not understand long file names. If the name does not look right, or the Status says that the selected CFG file is not valid, try clicking on the Rebuild CFG button just above and to the left of the software CFG file selection. Normally that will correct a corrupted CFG file. If it does not, you will need to obtain a replacement file from Frye Electronics.

## Microphone Calibration

There are few calibration adjustments on the 8000, both external and internal to the instrument. Those available are covered in this section.

### C.1 Microphones

A sound level calibrator, such as the Quest QC-10 (with the supplied adapter), is used to generate a signal level at a calibrated intensity.

From the Opening Screen, press [MENU] to enter the setup menu. Then press F6 to enter the microphone calibration screen. Place the M1958E in a sound level calibrator. Position the cursor with the left/right key till the selected level matches the calibrator level. Press the Start key to make the calibration.

There are three possible microphones on the FONIX 8000 analyzer:

- Coupler microphone (M3058E or M3000E)
- Probe microphone
- Reference microphone

All 8000 analyzers include a coupler microphone. The procedure for calibrating this microphone is described in Section C.1.1. 8000 analyzers that do not include the Real-ear Option will only have the coupler microphone.

8000 analyzers with the Real-ear Option have an integrated probe microphone set in addition to the coupler microphone. This consists of a probe microphone integrated into the earhook and a rectangular reference microphone that attaches to the top of the earhook. The procedure for calibrating the integrated probe microphone is described in Section C.1.2. The procedure for calibrating the rectangular reference microphone is described in Section C.1.3.

To perform the microphone calibrations, you will need the following equipment, depending on what type of microphones you are calibrating. The adapters come standard with the analyzer. You can purchase additional adapters and a sound calibrator from the factory. (Sound calibrators are special orders and may not be immediately available for purchase.)

- Sound calibrator such as a QC-10 (all calibrations)
- 14 mm-to-1 inch microphone adapter (coupler and old-style reference microphone calibration)
- Probe microphone adapter (probe microphone calibration)
- Rectangular reference microphone adapter (rectangular reference microphone on integrated probe microphone)

*Figure C-1: Calibration equipment*

### C.1.1 Calibrating the Coupler Microphone

This procedure describes how to calibrate the coupler microphone.

1. From the Opening Screen, press [MENU] to enter the Setup Menu.
2. Press [F6] to enter the Microphone Calibration screen.
3. Put the 14-mm-to-1 inch microphone adapter into the sound level calibrator.
4. Place the coupler microphone in the adapter.
5. Turn on the sound level calibrator.
6. Position the cursor with left/right keys till the selected level matches the calibrator level. Press the [START] key to make the calibration.

*Figure C-2: Coupler microphone inserted into sound calibrator.*

### C.1.2 Calibrating the Probe Microphone

1. From the Opening Screen, press [MENU] to enter the Setup Menu.
2. Press [F6] to enter the Microphone Calibration screen.
3. Use the down arrow key to select "Probe Left or Right", "Probe"
4. Put the 14-mm-to-1 inch microphone adapter into the sound level calibrator.
5. Attach a new probe tube to the probe microphone.

# Troubleshooting Guide

These are the most common problems that typically cause instrument failure. Please check these troubleshooting suggestions and follow the procedures outlined in this manual before contacting your local service representative or Frye Electronics.

## General Problems:

### No power

- a. Check ON/OFF switch(s).
- b. Make sure the power cable is plugged into a working outlet.
- c. Check the fuse in the power entry module.

### CRT/VGA/LCD display monitor is not working

- a. Check the ON/OFF switch.
- b. Make sure the power cable is plugged into working outlet.
- c. Check the monitor brightness and contrast controls.
- d. Check the cable between the monitor and instrument.
- e. Make sure nothing is resting against the keyboard and causing a stuck button.

## Test Chamber Problems:

### Test Chamber Microphone does not Level

- a. Check your mic calibration. (See Appendix B)
- b. Is the mic properly plugged into the instrument?
- c. Are all connections clean and tight?
- d. Is the mic head (element) screwed on tightly?
- e. Is the mic cable loose, broken, cut, worn or frayed?
- f. Make sure everything is out of the test chamber (except the mic) when trying to level.
- g. Open the test chamber and listen for the leveling signal.
- h. Check the test chamber cable connections.
- i. Is there an unusual amount of background noise in the test area? (air conditioning/heating fans, street noise, people talking, computer fans, etc.)

**Coupler Problems:**

- 1. HA-2 Coupler (BTE) adapter tubing is missing, loose or cracked**  
Replace with #13 thickwall tubing. Length: 23.7 mm.
- 2. Test microphone is difficult to get into coupler or the ear level adapter does not easily seal to the other end of the HA-2 coupler**  
Lubricate the black "O" ring with light petroleum-type lubricant.
- 3. A bump or peak in the low frequency response curve**
  - a. There may be a hearing aid vent leak. Be sure to close the vent with adhesive putty.
  - b. There may be a coupler vent leak.
  - c. The #13 coupler tubing could be cracked or broken.

**Printer Problems:**

- 1. Printer does not work**
  - a. Check for a paper jam.
  - b. Press the FEED Button.
  - c. Make sure the print head lock-down lever is down.
- 2. Test results do not print on paper**  
Make sure you are using thermal paper. To check it, take a hard object, e.g. a car key, and scratch the surface of the paper on both sides. If a black mark appears it is thermal paper. If not, it is plain paper and will not work.



# The FONIX CIC Feature

## Background

Zwislocki built an ear simulator coupler years ago to better approximate the real ear's impedance variation with frequency. The ear's volume appears to get larger at lower frequencies. Mahlon Burkhard at Industrial Research Products agreed with this approach, especially when they built the KEMAR, and designed an ear simulator that had impedance changes that matched the Zwislocki figures. This ear simulator was later standardized by the publication of American National Standards Association standard, S3.25. Another ear simulator that has similar characteristics was introduced in Europe a few years later by Bruel and Kjaer, and is characterized in the standard IEC 711.

Frye Electronics introduced a slightly different approach in the 1980's when it came out with the INSITU option (and later, the OES option) for its 5500-Z hearing aid Analyzer. Realizing that ear simulators which contain frequency sensitive elements are somewhat fragile and can be damaged as they are handled in every day use, Frye made a coupler which it labeled the MZ (for Modified Zwislocki). This coupler had a central volume very similar to the standardized Zwislocki, but had no frequency sensitive elements. Instead, an analyzer program was used with the coupler to apply correction factors to the measured curves from the hearing aid so that the output was very similar to that which would be obtained if the aid were tested on a standardized ear simulator as built by Knowles or B&K.

These software corrections work well for most regions in the frequency response of the aid. In low frequency areas up to about 1500 Hz, if the aid has a response peak that is influenced by the volume of the cavity, the peak will be slightly higher in amplitude and slightly higher in frequency than that peak would be if the aid were measured in a standardized ear simulator. The CIC hearing aid is not usually affected by this problem.

## The Need for a CIC Coupler

The introduction of the CIC hearing aids has made it desirable to be able to test them with a coupler that more closely approximates the actual volume and frequency response characteristics of the real ear. The CIC aid fits so close to the tympanic membrane (TM) of the ear that the volume of the cavity is reduced greatly and the aid produces significantly more gain. Further, its response can be substantially influenced by the frequency-dependent impedance variations of the TM.

Frye Electronics felt that the use of a CIC coupler with a proper response correction would give better data to a hearing professional than the use of the standard 2 cc coupler or even a Zwislocki ear simulator when attempting to produce

a good hearing aid fitting. It also felt that the approach taken in the use of the MZ coupler has been well accepted by professionals throughout the world and that the new CIC coupler should use a similar approach, with response corrections modified to take the smaller CIC volume into account.

### **The Basic Problem**

The ear is not a simple structure. It is a biological coupling device that converts sound energy to nerve impulses. It also has a pinna that helps to direct higher frequency sounds into the external canal. The part of the structure we are concerned with is the external ear canal, or cavity, which is terminated by the TM. The ear canal can be considered to be fairly rigid when it is compared to the TM. In the lower frequencies below 2000 to 3000 Hz, the frequency-related changes in impedance that we see in an ear are thought to be mostly caused by the TM. When we reduce the volume of the cavity between the hearing aid and the TM by moving the aid closer to it, we should expect to see the TM play a more important part in determining the response of the aid.

For more shallow standard earmolds, the volume of the central cavity of the ear reduces the effect of the TM's frequency impedance changes. This is because the volume of the cavity is added to the equivalent volume of the TM. If the cavity volume is large and does not change with frequency, then the large changes in impedance of the TM are swamped by the large volume of the ear canal. If, on the other hand, the TM is working into a very small volume, then it would affect a large change in impedance across the frequency range.

### **CIC Hearing Aid—Gain and Frequency Response Changes**

From the above discussion we see that we can expect that the frequency response of the CIC hearing aid will be greatly influenced by the frequency dependent impedance changes of the TM. What is the magnitude of these changes? A fairly typical ear fitted with a standard hearing aid and earmold should have characteristics that would normally be predicted by a KEMAR manikin and standardized ear simulator. When that ear is fitted with a CIC aid, what is the volume between the hearing aid and the TM? Because of the tilt of the TM, most professionals probably don't fit the aid right next to the TM. A reasonable figure may be 0.25 cubic centimeters. It should be realized that this number could be higher or lower, depending on circumstances. 0.2 to 0.4 cc may be a reasonable range.

Now, how much response variation will be introduced because of the smaller volume of 0.25 cc? This variation is what is used in the frequency response correction table used with the CIC coupler. One assumption that we make in calculations of volumes is that the simulator is small as compared to the wavelength of sound at the frequency we are examining. In the case of the standard ear simulator, the length of the cavity begins to affect its response to sound at frequencies above about 3000 Hz.

Knowing the physical volume of the occluded ear canal and its frequency response variations, it is possible to calculate the equivalent volume of the TM itself at each frequency and to apply this figure to the response of the 0.25 cc cavity between the hearing aid and the TM.

When the calculated volume variation of the TM is applied to the smaller volume of the CIC coupler, the total response variation comes out to be from -8.6 dB at 200 Hz to +5.5 dB at 8000 Hz for a total variation of 14.1dB.

### **Summary**

Using the CIC coupler with its software option gives the dispenser an immediate idea of how much gain that this new type of hearing instrument is going to give the hearing impaired individual. It is nice to see that the CIC hearing aid can really produce significant amounts of gain in spite of its apparently poor performance in the 2cc world of the ANSI standard test.

The user must remember that an actual ear may produce differences from the predicted values.

### **Acknowledgment**

Mead Killion, Mahlon Burkhard and Elmer Carlson are to be thanked for helping assemble the data from which the CIC corrections were derived.

**CIC CORRECTION FACTORS**

<b>dB</b>	<b>Hz</b>	<b>dB</b>	<b>Hz</b>	<b>dB</b>	<b>Hz</b>	<b>dB</b>	<b>Hz</b>
-8.7	200	-0.95	2200	3.2	4200	4.54	6200
-8.6	300	-0.5	2300	3.3	4300	4.55	6300
-8.7	400	-0.2	2400	3.5	4400	4.6	6400
-8.75	500	0	2500	3.6	4500	4.65	6500
-9	600	0.3	2600	3.7	4600	4.7	6600
-8.9	700	0.5	2700	3.8	4700	4.75	6700
-8.8	800	0.7	2800	3.85	4800	4.8	6800
-8.2	900	1	2900	3.95	4900	4.85	6900
-6.55	1000	1.2	3000	4	5000	4.9	8000
-6	1100	1.4	3100	4.07	5100	4.95	7100
-5.4	1200	1.65	3200	4.12	5200	5	7200
-4.95	1300	1.9	3300	4.18	5300	5.05	7300
-4.2	1400	2.1	3400	4.2	5400	5.1	7400
-3.6	1500	2.2	3500	4.25	5500	5.15	7500
-3.3	1600	2.4	3600	4.3	5600	5.2	7600
-2.8	1700	2.5	3700	4.35	5700	5.25	7700
-2.3	1800	2.7	3800	4.4	5800	5.3	7800
-2	1900	2.85	3900	4.45	5900	5.4	7900
-1.7	2000	2.91	4000	4.5	6000	5.5	8000
-1.2	2100	3	4100	4.52	6100		

# Fitting Formula Tables

The conversions used by the FONIX 8000 Test System to convert audiograms to target gain curves are the following:

## NAL-RP FITTING FORMULA CALCULATION

The insertion gains at each frequency are calculated according to the following formulas:

Freq (Hz)	Insertion Gain (dB)
250	$X + .31 \text{ HTL} - 17\text{dB} + S$
500	$X + .31 \text{ HTL} - 8\text{dB} + S$
750	$X + .31 \text{ HTL} - 3\text{dB} + S$
1000	$X + .31 \text{ HTL} + 1\text{dB} + S$
1500	$X + .31 \text{ HTL} + 1\text{dB} + S$
2000	$X + .31 \text{ HTL} - 1\text{dB} + S$
3000	$X + .31 \text{ HTL} - 2\text{dB} + S$
4000	$X + .31 \text{ HTL} - 2\text{dB} + S$
6000	$X + .31 \text{ HTL} - 2\text{dB} + S$
8000	$X + .31 \text{ HTL} - 2\text{dB} + S$

Where you calculate X and S (Slope correction values) as follows:

- $T = (\text{HTL @ } 500\text{Hz}) + (\text{HTL @ } 1000\text{Hz}) + (\text{HTL @ } 2000\text{Hz})$
- If T is less than or equal to 180dB, then  
 $X = .05 \times T$   
 If T is greater than 180dB, then  
 $X = (.05 \times 180\text{dB}) + (.116 \times (T - 180\text{dB}))$
- If the HTL at 2000 Hz is less than 95dB,  $S = 0$   
 If the HTL at 2000 Hz is greater than or equal to 95dB, then  
 apply the following slope correction factors at each frequency  
 based on the 2000Hz measurement:

2000Hz HTL (dB)	250	500	750	1000	1500	2k	3k	4k	6k	8k
95	4	3	1	0	-1	-2	-2	-2	-2	-2
100	6	4	2	0	-2	-3	-3	-3	-3	-3
105	8	5	2	0	-3	-5	-5	-5	-5	-5
110	11	7	3	0	-3	-6	-6	-6	-6	-6
115	13	8	4	0	-4	-8	-8	-8	-8	-8
120	15	9	4	0	-5	-9	-9	-9	-9	-9

## POGO

### *Prescription of Gain/Output (POGO) for Hearing Aids*

by: Geary A. McCandless, PhD,  
& Poul Erik Lyregaard, MSc  
*Hearing Instruments vol 34 #1, 1983*

Required insertion gain is calculated as follows:

Frequency (Hz)	Insertion Gain (dB)
250	1/2 HTL - 10 dB
500	1/2 HTL - 5 dB
* 750	1/2 HTL - 2.5 dB
1000	1/2 HTL
* 1500	1/2 HTL
2000	1/2 HTL
3000	1/2 HTL
4000	1/2 HTL
* 6000	1/2 HTL
* 8000	1/2 HTL

Note: Frequencies preceded by an asterisk (\*) are interpolated because the article does not reference them.

## BERGER

### *A Method of Hearing Aid Prescription*

by: Kenneth W. Berger, PhD, Eric N. Hagberg, M.A.,  
& Robert L. Rane, PhD  
*Hearing Instruments July 1978*

Required insertion gain is calculated as follows:

Frequency (Hz)	Insertion Gain (dB)
* 250	1/2 HTL
500	1/2 HTL
* 750	1/2 HTL
1000	1/1.6 HTL
* 1500	1/1.5 HTL
2000	1/1.5 HTL
3000	1/1.7 HTL
4000	1/2 HTL
* 6000	1/2 HTL
* 8000	1/2 HTL

Note: Frequencies preceded by an asterisk (\*) are interpolated because the article does not reference them.

### 1/3, 1/2, 2/3 Gain

*The 1/3-2/3 Insertion Gain Hearing Aid Selection Guide*

by: Robert Libby

*Hearing Instruments vol 37 #3, 1986*

Required insertion gain is calculated as follows:

FREQ. (Hz)	INS GAIN (dB) (2/3 rule)	INS GAIN (dB) (1/3 rule)	INS GAIN (dB) (1/2 rule)
250	2/3 HTL - 5 dB	1/3 HTL - 5 dB	1/2 HTL -5 dB
500	2/3 HTL - 3 dB	1/3 HTL - 3 dB	1/2 HTL -3 dB
750*	2/3 HTL	1/3 HTL	1/2 HTL
1000	2/3 HTL	1/3 HTL	1/2 HTL
1500*	2/3 HTL	1/3 HTL	1/2 HTL
2000	2/3 HTL	1/3 HTL	1/2 HTL
3000	2/3 HTL	1/3 HTL	1/2 HTL
4000	2/3 HTL	1/3 HTL	1/2 HTL
6000	2/3 HTL - 5 dB	1/3 HTL - 5 dB	1/2 HTL -5 dB
8000*	2/3 HTL - 5 dB	1/3 HTL - 5 dB	1/2 HTL -5 dB

Note: Frequencies marked by an asterisk (\*) are interpolated because the article does not reference them.

# Glossary of Terms

<b>AGC</b>	Automatic Gain Control (or Automatic Volume Control). A feature on a hearing aid that automatically adjusts the gain, depending either on the input level (AGC-I) or the output level (AGC-O). Also known as “Compression.”
<b>AMBIENT NOISE</b>	The environmental sounds in a testing area.
<b>ANECHOIC CHAMBER</b>	A room with little sound reverberation; a room constructed to be acoustically absorptive.
<b>AMPLITUDE</b>	A measure of the magnitude of a signal.
<b>ANSI</b>	American National Standards Institute. A national organization that determines standards for testing equipment. A section number and date (year) following the initials “ANSI,” designate the standard referred to.
<b>ARTIFACT</b>	A false reading.
<b>ASP</b>	Automatic Signal Processing. A feature on a hearing aid intended to overcome the effects of background noise, making it easier to understand speech when noise is present. The term ASP is not standardized, and may refer to various forms of signal processing. Usually, however, ASP refers to a reduction in low-frequency gain in the presence of ongoing background noise.
<b>AVG</b>	Short for Averaging. A feature on the 8000 Test System that uses three pure tones and averages them for the final measurement.
<b>BATTERY SUBSTITUTION PILL</b>	A battery simulator that conforms to the size and shape of a battery used in a hearing aid. It connects to the Battery Voltage Supply, providing the proper voltage to the hearing aid.
<b>BERGER</b>	A prescription formula developed by Kenneth W. Berger.
<b>BIAS FREQUENCY</b>	The background frequency, acting as noise, when using the Digital-Speech-in-Noise test.
<b>BIAS AMPL</b>	The amplitude of the background frequency used in the Digital-Speech-in-Noise test.
<b>BICROS</b>	A CROS aid that has two microphones, one at each ear, sending both signals to one ear.
<b>BLOOMING EFFECT</b>	A characteristic of pure tone testing at high levels, that typically shows low frequencies being amplified more than they are under normal use conditions.



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<b>BLUE ADHESIVE PUTTY</b>	A modeling clay-like substance used to attach and seal hearing aids to couplers.
<b>CALIBRATOR</b>	A sound generator that produces a tone at a precisely controlled frequency and amplitude.
<b>CHAP</b>	Computer Hearing Aid Program. A program designed to interface with Fonix instruments in order to make the storage of information in computer files quick and easy. The current version is known as WinCHAP.
<b>CIC COUPLER</b>	Completely-in-the-Canal Coupler. A coupler designed to better handle the unique acoustic qualities of completely-in-the-canal aids. Included with the CIC Coupler is internal software which provides corrections to increase the accuracy of CIC measurements even further.
<b>CONCHA RESONANCE</b>	The major part of the acoustic effect of the pinna, contributing significant energy to the External Ear Effect in the region of 5000 Hz.
<b>COIL</b>	Abbreviation for telephone pickup coil.
<b>COMPOSITE</b>	The FONIX test signal consisting of 79 pure tones presented simultaneously.
<b>CONVERSION FORMULA</b>	A hearing aid prescription formula, used to convert an audiogram to a target curve. Common formulas are the NAL, Berger, POGO, and the 1/2, 1/3 or 2/3 Gain rules.
<b>CORFIG</b>	Coupler Response for Flat Insertion Gain (or "correction figure"). This is the transformation that, when added to a target insertion-gain response, will give the target coupler response. The inverse of "CORFIG" is "GIFROC."
<b>COUPLER</b>	A device that connects a test microphone to a hearing aid to provide an accurate testing situation.
<b>CROS</b>	Contralateral Routing of Signal. A type of hearing aid that uses a wired or wireless system to send a signal to the opposite ear.
<b>CRT</b>	Cathode Ray Tube. The device in a computer system that projects information onto a display screen.
<b>CURVE</b>	A visual diagram of a measurement using two variables. In testing hearing aids, one variable may be frequency, shown on the horizontal axis of the curve, and the other variable amplitude, shown on the vertical axis of the curve.
<b>DATA</b>	In FONIX analyzers, the word "data" refers to displaying curve information as a table of numbers.
<b>DEFAULT</b>	A choice automatically made by a computer program.

<b>DIN CONNECTOR</b>	A European-standard connector with pins surrounded by a round metal shell.
<b>DISTORTION</b>	Elements of a reproduced sound that deviate from the original.
<b>DSIN</b>	Digital speech-in noise. The source signal used for testing digital aids. The ANSI and ICRA speech weightings are available.
<b>EAR CANAL RESONANCE</b>	An acoustic property of the ear canal, often characterized by a peak at or near 3000 Hz. Along with the acoustic properties of the head, torso and pinna, the Ear canal Resonance contributes significantly to the External Ear Effect.
<b>EIN</b>	Equivalent Input Noise. The amplitude of internal noise created by a hearing aid.
<b>ERROR</b>	The latitude of inaccuracy in a testing system. It usually is expressed in +/- units and/or percent.
<b>FAST FOURIER ANALYSIS</b>	A computer "short-cut" of the FOURIER TRANSFORM method for determining the frequency content of a signal.
<b>FLAT WEIGHTED</b>	Same as UNWEIGHTED, referring to a signal that has equal amplitude at every frequency.
<b>FOURIER TRANSFORM</b>	A mathematical procedure that changes "time" information into "frequency" information.
<b>FREQUENCY</b>	The number of vibrations, or cycles, per second of a periodic wave. The unit of measurement is Hertz (Hz).
<b>FREQUENCY RESPONSE</b>	A measure of the output or gain of a device across a range of frequencies of the input signal.
<b>FUNDAMENTAL FREQUENCY</b>	The lowest frequency in a harmonic complex tone, such as the FONIX Composite signal. The fundamental frequency determines the "pitch" of a tone.
<b>GAIN</b>	The amplification or increase in sound power in a hearing aid. In testing, it results from subtracting the level of the input from the level of the output of the aid.
<b>GIFROC</b>	The inverse of "CORFIG." GIFROC is the transformation that, when added to a coupler response, will give the estimated insertion-gain response.
<b>GRAPH</b>	A grid of lines, with the vertical lines representing one set of information and the horizontal lines representing another. A "Curve" superimposed on a graph grid, gives information about test results.
<b>HAIC</b>	Hearing Aid Industry Conference.

<b>HARMONICS</b>	Integral multiples of a pure tone. The tone itself is the 1st harmonic, or fundamental frequency; twice the frequency of the tone is the 2nd harmonic; three times the frequency of the tone is the 3rd harmonic; etc.
<b>HARMONIC DISTORTION</b>	The presence of harmonics in a reproduced signal that are not present in the original signal.
<b>HFA</b>	High frequency average: according ANSI S3.22-1987, the averaged response at 1000, 1600 and 2500 Hz.
<b>HEAD Baffle EFFECT</b>	Refers to the comparative augmentation of high-frequency sound caused by the acoustic diffraction of low-frequency sound by the head and pinna blending to produce a baffle.
<b>HL</b>	Hearing Level. The amount of decibels above audiometric zero at which a measured ear barely hears a sound.
<b>Hz</b>	Hertz. Unit of frequency, referring to cycles per second.
<b>ICRA</b>	International Collegium of Rehabilitative Audiology.
<b>IEC</b>	International Electrotechnical Commission. An international organization that sets standards for measurements.
<b>IN-SITU</b>	Latin for "in position." In audiometry, it designates measurements taken with the hearing aid "in place" in the ear.
<b>INTER-MODULATION DISTORTION</b>	Distortion generated by the faulty mixture of different input frequencies. This is a primary cause of harshness and lack of intelligibility in a hearing aid.
<b>JIS</b>	Japanese Industrial Standard. The organization which sets standards for measurements in Japan.
<b>KEMAR</b>	Knowles Electronics Manikin for Acoustic Research. A model, which nearly reproduces the acoustic qualities of an average adult head and torso, that is utilized in the assessment of hearing aid performance.
<b>LED</b>	Light Emitting Diode. A small light on an instrument panel.
<b>LEVELING</b>	An automatic calibration procedure, establishing a "zero line" for measurements, taking into account all the acoustic properties of the test chamber or the testing room.
<b>MENU</b>	A list of choices offered by a computer software program.
<b>MULTI-CROS</b>	A hearing aid system that has a switch to select either a CROS, a BI-CROS, or a Monaural arrangement.
<b>COUPLERS</b>	Modified Zwislocki Couplers. Three couplers based on the Zwislocki design, but sturdier; provided with the OES option.

<b>NAL</b>	National Acoustic Laboratories of Australia.
<b>NBS</b>	National Bureau of Standards (U.S.), now known as National Institute of Standards and Technology.
<b>NOISE REDUCTION</b>	The 8000's method of producing a more stable reading by averaging many samples.
<b>OCCLUSION EFFECT</b>	Low-frequency intensification in the loudness level of bone-conducted signals resulting from the blocking of the ear canal.
<b>OES</b>	Occluded Ear Simulator. An option on the 8000, using three special couplers, that provides the same data obtained with a standard ear simulator.
<b>POGO</b>	Prescription Of Gain and Output. A hearing aid prescription formula.
<b>POWER</b>	The output of an aid, in dB SPL.
<b>PT BURST</b>	A burst of ten pure tones corresponding to standard audiometric frequencies. The entire signal lasts for less than two seconds.
<b>PURE TONE</b>	A testing tone consisting of only one frequency.
<b>REAL-TIME TESTING</b>	The ability to view <i>instantly</i> the results of hearing aid tests.
<b>REFERENCE POINT</b>	The location in a test chamber where the microphone of a hearing aid must be placed for accurate testing. In the 8000, it is the small circle in the center of the test chamber.
<b>RESONANCE</b>	The tendency of an acoustic system to reinforce sounds of a certain frequency, the frequency determined by the shapes and sizes of the components of the system.
<b>RESPONSE LIMIT</b>	The high and low points of the frequency range found in the ANSI test sequence conditions.
<b>RMS</b>	Root Mean Square. An overall measurement of the signal going in or coming out of a hearing aid. When measuring with Pure tones, the RMS level at each individual frequency will be the same as the level shown at each frequency on a response curve. When measuring with a Composite Tone, the (overall) RMS level will be several dB higher than the level at each frequency on a response curve, since all the frequencies are presented at once.
<b>SATURATION</b>	The condition where any further increase in input level will yield no further increase in output level.
<b>SMOOTHING</b>	A "rounding-off" of a curve, removing minor peaks and valleys, to create a more readable curve, using a method that is equivalent to warbling the input signal.

<b>SPA</b>	Special purpose average: according to ANSI S3.22, the averaged response at specially designated frequencies.
<b>SPL</b>	Sound Pressure Level. Expressed in decibels (dB), a logarithmic measure of the energy (amplitude) of a particular sound as compared to the energy of a specified reference sound.
<b>SSPL (OSPL)</b>	Saturation Sound Pressure Level. The greatest SPL that a given amplifier can produce.
<b>SSPL-90 (OSPL-90)</b>	Saturated Sound Pressure Level for an input of 90 dB SPL.
<b>SWEEP</b>	A sequence of pure tone frequencies, which generates a frequency response curve.
<b>TELECOIL</b>	Same as COIL. In the 8000, it is an accessory that generates a magnetic field for testing the telephone pickup of a hearing aid. The telecoil is a standard feature with the 8050 & 8060 and 8120 sound chambers.
<b>UNWEIGHTED GAIN</b>	A measurement of the amplification (gain) of an aid using an input signal (source) that has equal power across all test frequencies.
<b>WARBLE TONE</b>	A pure tone with slight, but rapid, frequency variations.
<b>WEIGHTED GAIN</b>	A measure of the amplification (gain) of an aid, using an input signal (source) that has a spectral shape similar to that of the long term average of speech.
<b>WEIGHTED POWER</b>	The measurement of amplitude, in SPL, of the output of an aid, using an input signal (source) that has a spectral shape similar to that of the long term average of speech.
<b>WHITE NOISE</b>	A signal composed of all frequencies, which vary randomly in phase, each frequency having equal long-term energy levels.
<b>WINCHAP</b>	Windows® Computer Hearing Aid Program used for storing hearing aid tests and client information on a personal computer.

# The FONIX Keyboard App

The FONIX 8000 Hearing Aid Test System can be controlled wirelessly from an Android tablet using the FONIX keyboard app. When the Android Tablet Package is purchased, this app is pre-installed on the tablet. However, you can also install the FONIX keyboard app on any Android tablet with Bluetooth® technology. You will need the wireless dongle that you can purchase from the Frye factory. The FONIX Keyboard App can be purchased from the Android Marketplace.

## H.1 Configuring the FONIX Keyboard App

1. Make sure the wireless dongle is installed on the FONIX 8000. See Figure 1 - 3.

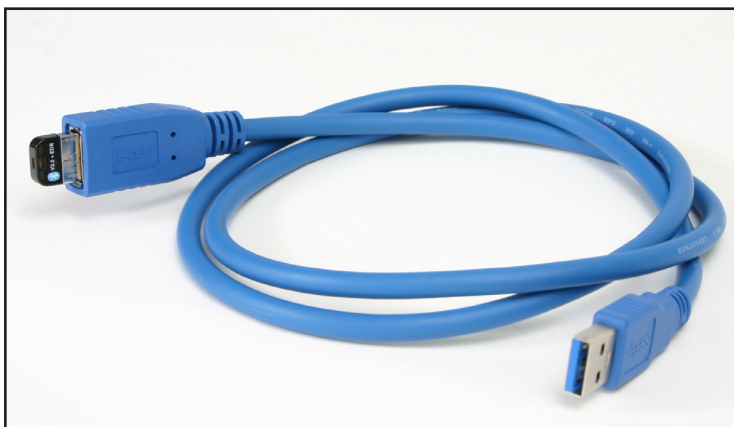


Figure 1: Wireless dongle & USB cable



Figure 2: Plug USB cable into 8000



Figure 3: Place the wireless dongle in clear sight

2. Turn on your 8000 and then turn on Android tablet (or phone).
3. Select "Settings."

4. Select “Wireless and network.”
5. Select “Bluetooth settings.”
6. Make sure Bluetooth is enabled on the tablet (or phone).
7. Select “Scan devices.”
8. Look for a Bluetooth device with the name “Fonix-8000-” and the serial number of your 8000. Select that device.
9. Type “1234” into the “Enter PIN” to Pair with the 8000. Press “OK”. The FONIX keyboard should now be configured correctly.

## **H.2 Running the Android FONIX Keyboard App**

1. Select the “Fonix Remote Keyboard” app icon on the Android device.
2. Press the Android Menu key (NOT the [MENU] key on the FONIX Android keyboard, but the standard Android menu key that is used to change settings on many different Android apps) and select “Connect a device”.
3. Select your FONIX 8000 device. In the upper right corner of the keyboard application, you should get a message confirming the connection.
4. Press an 8000 key on the tablet and verify the FONIX 8000 responds accordingly. You can now run your FONIX 8000 from the Android app.



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