

# Testing Digital Hearing Aids

with the FONIX 6500-CX  
Hearing Aid Analyzer



Frye Electronics, Inc.

## Introduction

The following is a quick guide for testing digital hearing aids using the FONIX 6500-CX. 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, using signals such as a pure-tone sweep or a composite signal, can cause the high-end digital aid to go into this noise suppression 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.

We at Frye Electronics, Inc. have come up with a great way for testing noise reducing digital hearing aids. We have taken our standard continuous-sounding composite signal and interrupted it at random intervals long enough to trick the hearing aid into thinking it is hearing speech instead of noise. This program is called “Digital Speech in Noise,” (DSIN) and it comes equipped with two different speech spectra: the ANSI S3.42 that is similar to the composite signal spectrum, and the ICRA spectrum, used in the development of many digital hearing aids.



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# Digital Speech with ANSI 87/ANSI 96

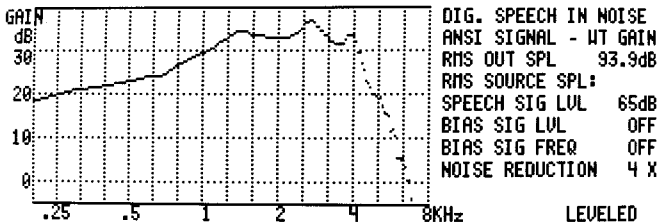
A commonly asked question is: How do I use DSIN in ANSI 87 or ANSI 96? Unfortunately, the answer is that you can't. The ANSI S3.22-1987 and ANSI S3.22-1996 standards were written and published in the days before noise reducing digital hearing aids. The ANSI committee has made no provisions for testing digital hearing aids. So, for ANSI purposes, treat digital aids as you would any other type of hearing aid. Many digital aids have a "test mode" recommended by the manufacturer when performing hearing aid specification checks.

However, you can still perform accurate frequency response measurements using the Digital Speech signal. Read on.

## DSIN coupler measurements

1. Set up the hearing aid as you would for a normal composite test.
2. Press [MENU] and [\*].
3. Use the arrow keys to select "Dig. Speech in Noise."
4. Press [START].

This will start the digital speech signal. Your screen will look something like this:



SPEECH SIGNAL CONTROLS:  
↑, ↓ TO CHANGE SPEECH AMPL

[MENU] TO CHANGE SETTINGS  
[CONT] TO EXIT

Figure 1—Digital Speech in Noise

Looking at the results of the digital speech test is just like looking at the results of the normal composite measurement.

To switch between the ICRA and ANSI speech spectra, use the [MENU] button in the DSIN screen, and use the arrow keys to switch back and forth between the two available speech spectra.

### ICRA vs.ANSI—a technical note

There are two different speech spectra available for Digital Speech: ANSI and ICRA. The ANSI spectrum is from the ANSI S3.42 standard (used in the ANSI 92 test), which rolls off the high frequencies at a rate of 6 dB per octave. The ICRA spectrum is from the ICRA CD of speech sounds created by the International Collegium of Rehabilitative Audiology. It rolls off the high frequencies more quickly than ANSI, at a rate of 9 dB per octave.

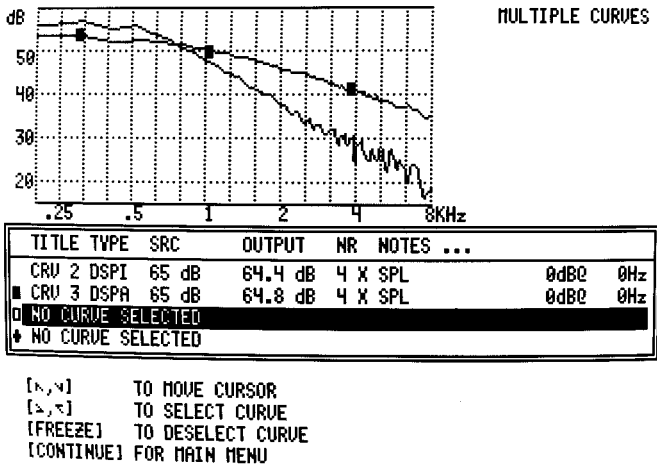


Figure 2—ICRA & ANSI

We prefer the ANSI spectrum to the ICRA spectrum, which we feel rolls off the high frequencies too quickly. However, either spectrum can be used as long as the user is aware of the differences between them. See Figure 2 for a display of the two speech spectra.

## Digital Testing with a Bias Tone (coupler)

Adding a puretone bias signal allows you to see how well the hearing aid filters out background noise. It is a feature unique to the 6500-CX. To add the puretone bias,

1. Press [MENU] from the DSIN program.
2. Highlight “Bias Signal”.
3. Use the right arrow key to switch to “Puretone”
4. Press [CONTINUE].

If you open the sound chamber, you should be able to hear the bias puretone amongst the interrupted composite signal. Use the left and right arrow keys to change the frequency of the bias tone. If you have an aid that filters continuous noise, you should notice a definite difference in the curve at the frequency of the bias puretone. The hearing aid should be trying to filter out that continuous sound and thus show a decrease in amplitude at that frequency. If the hearing aid does not react to the bias tone, that's a good indication that the aid is not speech sensitive.

You can change the amplitude of the bias tone by pressing the [START] button. Now, the up and down arrow keys will control the amplitude of the bias tone instead of the amplitude of the speech signal. Press the [START] key again to go back to controlling the amplitude of the speech signal.

Figure 3 is an example of a digital hearing aid tested with and without a bias tone at 4000 Hz. Notice how the filters of the aid lower the perceived bias “noise” by 6 or 7 dB.

Using the bias tone in the digital-speech-in-noise program is an excellent way to find out how the different bands of the digital hearing aid react to noise. You'll find that some aids really have multiple true independent channels while other aids have channels which are more dependent upon each other than is perhaps advertised.

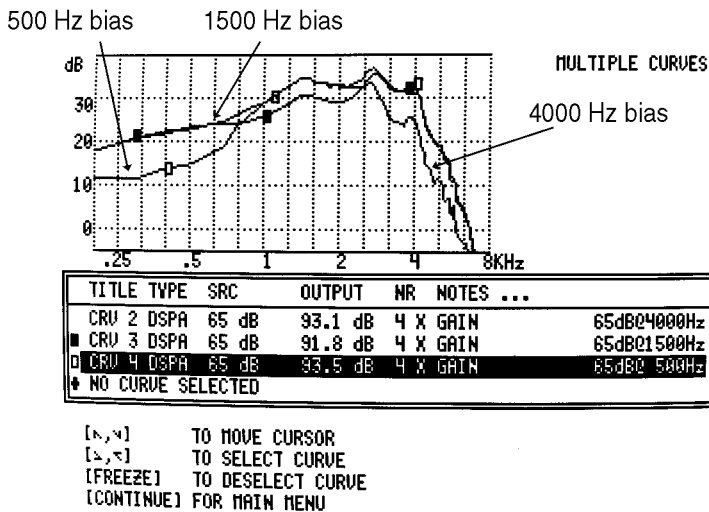


Figure 3—Digital testing with a bias signal

## DSIN Real-Ear Measurements

You can use the Digital Speech ICRA and ANSI signals in the real-ear SPL testing screen. This screen is a very useful tool for looking at the “big picture” in a hearing aid fitting. It lets you look at the patient’s threshold levels, uncomfortable levels, real-ear target, and three measurement curves all on one graph.

The SPL Testing screen has three goals:

- Soft speech sound be audible (above threshold levels)
- Medium speech should meet the real-ear target
- Loud sounds should be comfortable (below uncomfortable levels)

### **Step 1: Create a Target SPL**

Note: Even if you do not want to create a real-ear target, you have to enter the SPL audiogram entry screen to enter the SPL Testing screen, but it’s not necessary to enter any audiogram values.

1. From the Real-Ear Insertion Gain screen, press [MENU] to enter the Quik-Probe menu.
2. Use the up-down arrow keys to highlight CREATE TARGET.
3. Use the right-left arrow keys to select SPL TARGET.
4. Press [START/STOP]. This will take you to the SPL audiogram entry screen shown in Figure 4. Steps 5-9 are optional and can be skipped if you don't want to create a real-ear target.

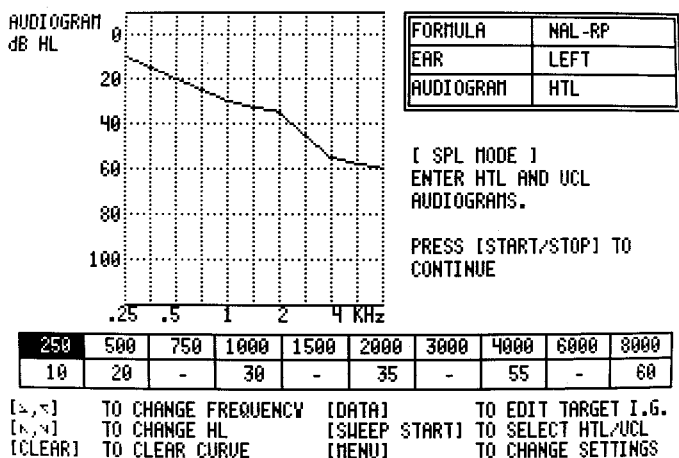


Figure 4—SPL Audiogram Entry Screen

5. Press [MENU] to enter the SPL Setup Menu. (Optional)
6. In the SPL Setup Menu, select the “Ear Tested,” “Fitting Formula,” whether or not you want the program to predict UCLs, and whether to use the measured unaided response (recommended) or to use the average unaided response (KEMAR average) when creating a target. (Optional)

**Note: If you choose “Measured” for Unaided Response, you must measure the unaided response in the insertion gain screen.**

7. Press [MENU] to return to the audiogram screen. (Optional)

8. Input the audiogram using arrow keys. (Optional)
9. To enter UCLs, press [SWEEP START]. (Optional)
10. Press [START/STOP] to enter SPL testing screen.

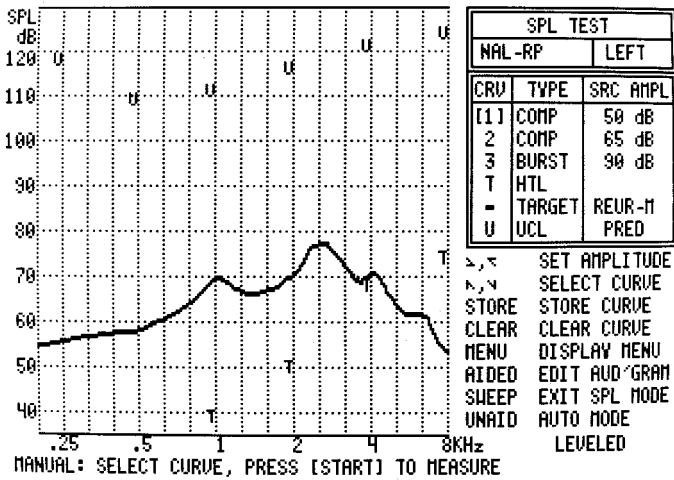


Figure 5—SPL Testing Screen without measurements

If you've input the patient's audiogram, your screen should look similar to figure 5. The dark line is the target, the "T"s are the thresholds, and the "U"s are the uncomfortable levels. All targets are actually insertion gain targets converted to SPL. Note that for severe to profound losses, the thresholds might be above the target!

**Step 2: Select the Digital Speech signal source**

1. Press [MENU] in the SPL Testing screen.
2. Use the arrow keys to change the source type of AIDED 1 and AIDED 2 to DIGSP ANSI or DIGSP ICRA. We recommend using the BURST pure-tone source type for AIDED 3, since it is normally used to test UCL levels at 90 dB SPL.
3. Press [MENU] to return to the SPL Testing screen.

**Step 3: Perform the real-ear measurements**

1. Level the sound field speaker if necessary by using the [LEVEL] button. (See your operator’s manual for instructions on leveling.)
2. Use the up-down arrows to highlight AIDED TEST 1. Use the right-left arrows to change the amplitude.
3. Press [START/STOP] to begin the test. This will start the digital speech signal. Press it again when you are satisfied with the results.
4. Use the down arrow to select AIDED TEST 2. Repeat step 3.
5. Use the down arrow to select AIDED TEST 3. Repeat step 3. If you are using the BURST signal type, you will not need to press [START/STOP] a second time to end the test.

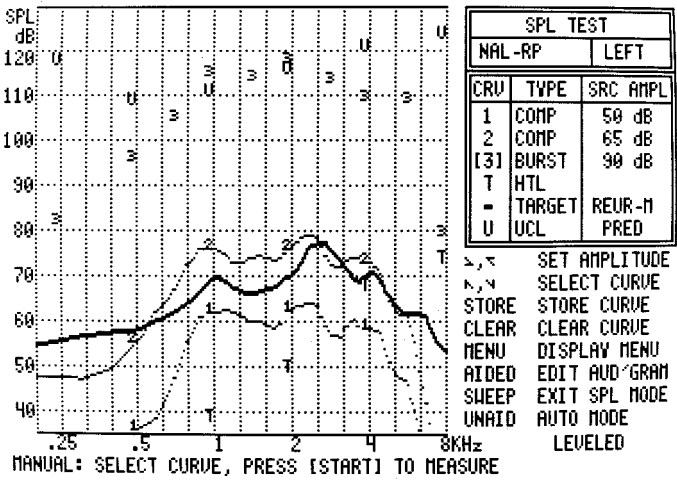


Figure 6—SPL Testing Screen with measurements

## Digital Testing with a bias tone (real-ear)

If desired, you can add a bias tone to the real-ear digital speech signal. The reasons for doing this are described in the section above on digital speech coupler testing with a bias signal.

To add a bias signal:

1. Press [MENU] in the SPL Testing screen.
2. Use the up-down arrow keys to select DIGITAL MENU.
3. Press [START/STOP].
4. Use the arrow keys to set BIAS SIGNAL to PURETONE, select the BIAS LEVEL, and select the BIAS FREQ.
5. Press [MENU] twice to return to the SPL Testing Screen. The bias signal will now be included with any Digital Speech signal.

## SPL Testing Screen troubleshooting

The SPL target in the SPL Testing screen is a converted insertion gain target. The conversion process always uses an unaided response. In the menu of the SPL audiogram entry screen, you can select whether this unaided response is the client's measured REUR, or the KEMAR average REUR. If you select MEASURED (see step 6 in the above section on creating an SPL target), then you must measure the unaided response in the Insertion Gain screen in order to create a target.

To see which unaided response was used in the SPL Testing screen, look in the curve identification box, just to the right of TARGET. You will see one of the following:

- REUR-A: Uses the KEMAR “average” unaided response
- REUR-M: Uses the client's measured unaided response
- NO-REUR: You have selected MEASURED UNAIDED RESPONSE, but you have not yet measured an unaided response. To fix this, either select AVERAGE UNAIDED RESPONSE from the SPL Setup Menu by pressing [AIDED] and [MENU], or you can measure a response by pressing [SWEEP START] to exit SPL mode and enter the main probe screen where you can take an unaided response measurement.