

Testing Digital Hearing Aids

**with the FONIX FP40
Hearing Aid Analyzer**



Introduction

The following is a quick guide for testing 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 reduction” feature. This noise reduction feature, 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 puretone sweep or a 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.

We at Frye Electronics have come up with a great way for testing noise-reducing digital hearing aids without fear of them going into noise-reduction mode. We have taken our standard continuous-sounding composite signal and interrupted it at intervals just long enough to trick the hearing aid into thinking it is hearing speech instead of noise. This program is called “digital speech” and comes equipped with two different speech spectra: the ANSI S3.42 that is similar to the composite signal spectrum, and the ICRA spectrum which Widex used in developing the Senso digital hearing aid.

The nice thing about digital speech on the FP40 is that it works the same way that any other type of test signal works. You don’t have to learn any new button pushes, and you can treat the digital aid just as you would any other hearing aid. In fact, there’s no reason that you can’t use the digital speech signal for testing an analog hearing aid.

If you don’t have digital speech, but you do have the composite option, you can still test digital aids even when their noise reduction feature is on. It’s not quite as convenient as using digital speech, but you can still get good results. Unfortunately, if you have a puretone-only FP40, the only way you can accurately test the high-end digital hearing aids is to turn the noise reduction feature off in the hearing aid programming software. Most aids do have a way to turn this feature off for testing purposes.

One of the great strengths of the FP40 is its flexibility; the hearing health professional can choose for him/herself which tests would be the most beneficial for the situation at hand. Please feel free to deviate from these instructions when desired.

A few frequently asked questions:

Question: How do I use digital speech in ANSI '87 or ANSI '96?

Answer: 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. These types of aids weren't even conceived when these standards were written, let alone the testing techniques for them. So, for ANSI purposes, treat digital aids just as you would any other type of hearing aid. If the aid has a "test" mode or a way to turn off the noise reduction, I would recommend doing this before performing the ANSI test.

Q: What if I have the composite signal but don't have the digital speech signal?

A: You can still perform the measurements outlined below using the composite signal instead of digital speech, but you will have to be a little more careful. You will have to figure out how much time it takes for the noise reduction circuit on your hearing aid to kick in and then present the composite signal for less than this time. Each hearing aid model varies.

To figure this out, present the composite signal to your hearing aid. You should see a constant curve for a few seconds followed by a drop in amplitude when the noise reduction feature turns itself on. Time how long it takes for this to happen – a rough estimate will do. If you are waiting more than 15 seconds and the gain hasn't dropped, that's a good indication that either the noise reduction isn't turned on, or it's not strong enough to affect the measurement in any large way.

Q: What if I have a puretone-only FP40?

A: Unfortunately, the only way to test a high-end digital hearing aid using only a puretone sweep is to put it in "test" mode and turn off the noise-reduction feature of the hearing aid. Give us a call! The composite/digital speech option is now only \$1000.

Coupler Measurements using Digital Speech

The best way to test a digital hearing aid is to take a few frequency responses at various input levels.

1. Turn your analyzer on and press [START/STOP].
2. Press F1 – MENU
3. Highlight SOURCE using the FP40 knobs
4. Press [START/STOP] to toggle DIGSP ANSI
HINT: To store DIGSP ANSI as your default coupler signal, press F8 – STORE ITEM
5. Highlight MAIN F2 in the FUNCTION KEY DEFIN.
6. Press [START/STOP] to toggle MULTICRV
7. Press F1 – EXIT
8. Press F2 to toggle Multicrv ON
9. Set up hearing aid in the chamber and level if needed
10. Use AMPLITUDE knob to select desired amplitude
11. Press [START/STOP] to begin test
12. When satisfied with result, press [START/STOP] to end test
13. Press F6 to toggle next curve
14. Repeat steps 10-13 for curves 2, 3, and 4

When you're all finished with the above steps, you will have the coupler frequency responses at four different levels. This will tell you what sort of gain the aid is giving you at different speech levels. It will also tell you what sort of compression is present on the aid. If all the gain curves run on top of each other, the aid is running linearly. If the louder curves are giving less gain than the soft curves, the aid is compressing.

Curious at how well the **noise reduction feature** on your hearing aid works? The following test will tell you! (These instructions assume that you have already completed the instructions listed above.)

1. Press F8 to clear curves
2. Use AMPLITUDE knob to select 65 dB (or desired amplitude)
3. Press [START/STOP] to take digital speech measurement and press [START/STOP] again when finished.
4. Press F6 to select the next curve
5. Press [MENU]
6. Highlight SOURCE and toggle COMPOSITE

7. Press F1 to exit
8. Press [START/STOP] to take composite measurement. Leave the composite measurement on for at least 15 seconds since it often takes that long for the noise reduction circuit to kick in. Press [START/STOP] again when satisfied.

The resulting two curves will show you the difference between what happens when the noise reduction circuit is kicking in or when it is listening to speech. For some hearing aids, this will only be a 2-3 dB and only in some frequency bands. For other aids, like the Widex Senso, the difference can be 10-12 dB across all frequencies.

Probe/Real-ear Measurements using Digital Speech

Real-ear measurements of digital hearing aids work just the same as real-ear measurements of analog hearing aids. The only difference is in the type of test signal you use. There are three main modes of real-ear measurements in the FP40: Sound Pressure Level (SPL), Insertion Gain (IG), and Audibility Index (AI).

Note: The Aided measurements performed in any of the three modes of the FP40 probe will be automatically transformed into the other modes, saving you from having to redo any probe measurements.

IG is the traditional real-ear measurement. You take the patient's unaided response and subtract it from their aided response in order to get the insertion gain of the hearing aid that you compare to an insertion gain target.

SPL is a real-ear measurement concept that has become very popular in the last few years. In the SPL mode, you can see the patient's thresholds, their uncomfortable levels, the target, and the speech measurement curves all on one screen. This is useful for making sure that soft speech levels meet the patient's thresholds, the medium speech measurement meets the target, and the loud speech level is below the uncomfortable levels.

AI is similar to SPL except that it displays the thresholds, target, and measurement curves in HL instead of SPL. The target and measurement curves become "aided audiograms," incorporating insertion gain measurements into the unaided audiogram inputted by you. It also indicates the percentage of speech sounds that are audible to the client with the aided audiograms you have obtained. This can be particularly useful as a counseling tool when persuading a client that they do indeed need a hearing aid – you can point out to them the percentage of speech they understand without an aid versus the percentage of speech they get *with* a hearing aid.

Before your patient comes into the office:

1. Press F5 – PROBE
2. Press F2 to select type of probe measurement you will be performing: IG (Insertion Gain), SPL (Sound Pressure Level), AI (Audibility Index). You can always change this later
3. Press F4 – TARGET
4. Press F3 – Select fitting rule. If you selected IG or AI in step 3, DSL will NOT appear as a selection.
5. F1 to select ear
6. Enter Audiogram with Amplitude and Frequency knobs
7. If desired, press F2 to select UCL and enter UCLs with Amplitude and Frequency knobs
8. Press F5 to generate Target and UCLs (if not entered)
9. If necessary, press F1 to select other ear and repeat steps 6-8.
10. Press F4 to go back to Probe screen

When your patient is in your office:

1. Put ear hook and reference microphone on patient's ear, and arrange patient at a 45 degree angle to the speaker
2. Press [LEVEL] and [START/STOP]

Insertion Gain Measurements

1. If necessary, press F2 to highlight IG UNAIDED
2. Use AMPLITUDE knob to select 70 dB SPL
3. Press [START/STOP] to begin measurement
4. When satisfied with measurement, press [START/STOP] again.
5. Insert probe tube and hearing aid into patient's ear.
6. AIDED 1, above F3, should automatically be highlighted. Press F7 to toggle DIGSP ANSI
7. Use AMPLITUDE knob to select desired amplitude
8. Press [START/STOP] to begin measurement
9. When satisfied with measurement, press [START/STOP] again.
10. Press F3 to select next AIDED curve
11. Repeat steps 7-10 for curves 2 and 3.

SPL Measurements

1. If necessary, insert probe microphone and hearing aid. The SPL method does not measure the unaided response.
2. Press F7 to toggle DIGSP ANSI (or DIGSP LTASS if DSL is selected fitting rule).
3. If desired, use Amplitude knob to change amplitude
4. Press [START/STOP] to begin measurement and [START/STOP] again when satisfied
5. The soft speech curve should be above the patient's thresholds (T's)
6. Press F3 to select AIDED 2
7. If desired, use Amplitude knob to change amplitude
8. Press [START/STOP] to begin measurement and [START/STOP] again when satisfied
9. The medium speech curve should meet the target (A's)
10. Press F3 to select AIDED 3
11. If desired, use Amplitude knob to change amplitude
12. Press F7 to select SHORT SWEEP to minimize client exposure to loud signal
13. Press [START/STOP] to perform short sweep
14. The loud sweep should be below the UCLs (U's)

Audibility Index Measurements

1. Press F2 to select AI.
2. If you have input the audiogram and generated a target, you will see them displayed in dB HL on the left hand graph. The percentages indicated under "AI" in the box on the screen are the amount of speech the person understands without a hearing aid (THRESH), and the amount of speech the person would understand if the aid were to meet the target (TARGET).
3. If you have already performed the insertion gain measurements in the above section, you should see those measurements automatically translated into the AI HL graph, and you can skip the rest of this section.
4. If necessary, adjust amplitude to 70 dB and press [START/STOP] to take unaided response. If you have already taken the unaided response, press F3 to highlight AIDED 1.
5. Press F7 to select DIGSP ANSI.
6. If desired, use the Amplitude knob to adjust the amplitude.
7. Press [START/STOP] to begin measurement and [START/STOP] again when satisfied.
8. You should now see a percentage next to AIDED 1 in the box on the screen. This is the amount of speech the person understands at that input level.
9. Press F3 to select AIDED 2 and repeat steps 5-7.
10. Press F3 to select AIDED 3 and repeat steps 5-7.