ALL DIGITAL HEARING AIDS ARE NOT CREATED EQUAL

Hearing Aid	Directional Performance	SNR Change
INNOVA™	**11.1**	**10.4**
Siemens	7.1	2.63
Widex	5.3	5.0
Oticon	7.2	3.06
Phonak	6.1	3.69
GN Resound	5.7	4.57

It is critical to determine whether hearing aid features translate into benefit. The above benchtop measurements provide objective performance data regarding directionality, as well as the hearing aid's ability to improve the signal over noise.

Directional Performance using Average Angular Attenuation (A^3)

Traditional measures of polar patterns, such as the Directivity Index (DI) cannot be performed with today's adaptive directional systems. Therefore, SONIC innovations has adopted an approach that applies a weighting to the difference in sensitivity of the directional system to sounds from the front versus sounds from all other directions. This measurement is conducted with compression, expansion, and noise reduction turned off and adaptive directionality engaged.

Noise Reduction Index (NRI)

Using a measurement called the Noise Reduction Index (NRI), one can quickly assess whether a hearing aid is improving the signal-to-noise ratio (SNR). The NRI score is the measured change in signal vs. noise, with a positive score indicating an improvement in the signal over the noise. With the signal and the noise presented at an equal level (0 dB SNR) the products above deliver the indicated NRI numbers.

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METHODOLOGY

Directional Measure using Average Angular Attenuation (A^3)

Directional polar patters were measured with a BTE hearing aid in a test fixture attached to the end of a stick in a 6'X6'X6.5' room where approximated free field cond-itions exist. An MLS signal was generated at 84 dB SPL and the frequency response of the hearing aid was measured every 10 degrees as the hearing aid was rotated 360 degrees. The hearing aid was programmed with 15 dB linear gain, no expansion or noise reduction,* and adaptive directionality engaged. To create the polar plot, the amplitude of the signal, normalized to the amplitude at 0 degrees at each angle for a given frequency, was plotted as a function of the angle of rotation. The frequencies plotted correspond to the frequencies used to calculate the Mueller-Killion AI-DI of the hearing aid.

**Widex Diva hearing aid does not allow noise reduction to be turned off.*

Noise Reduction Index (NRI)

The noise reduction index is an objective bench top measurement developed by Licklieder and refined by Hagerman. The measurement is conducted by making two recordings of the output of the hearing aid, one with speech in noise and the other with speech in phase-inverted noise. The sum of the two recordings cancels noise, leaving an estimate of the speech signal present; the difference between the two recordings cancels the speech, leaving an estimate of the noise signal present. This calculated SNR is compared to the known SNR used as the input. The resulting change in SNR is the NRI score.

NRI measurements were conducted with BTE hearing aids programmed with 15 dB linear gain, coupled to a B & K 2cm3 coupler attached to a 4144 one inch microphone. Noise reduction and adaptive directionality were engaged. The speech signal used was 16 seconds of concatenated HINT sentences; the noise masker was HINT spectrally matched noise presented uncorrelated from four speakers, with a 30-second onset. The speech and the noise materials were presented at 0 dB SNR (65 dB A).

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