

Situation Analyser

Hearing instruments continue to become more automatic with advanced signal processing. For example, wide dynamic range compression (WDRC) automatically adjusts the gain based on the input intensity. This helps to make soft sounds audible, moderate sounds comfortable, and keep loud sounds from being too loud.

Sometimes WDRC is referred to as an automatic volume control (AVC). There have been many debates on whether or not an individual with WDRC needed a volume control. Most agreed that WDRC did not eliminate the possible need for a volume control in some situations.

The Danalogic Situation Analyser automatically optimises the overall hearing instrument volume based on situational preferences. This occurs even if there is no physical volume control on the hearing instrument itself. If the hearing instrument has a volume control, the automatic adjustments made by the Situation Analyser can be overridden by the user. This feature can also decrease the need for multiple programs, especially when volume is the main difference between programs. The Situation Analyser includes a Classifier and the Situation Analyser tool within the Aventa software.

Classifier

The Classifier determines the listening environment based on (a) the estimated speech-to-noise ratio and (b) the signal loudness. The estimated speech-to-noise ratio is obtained from the Noise Reduction analysis system. This system extracts the speech peaks from the acoustic waveform and estimates the background noise when speech is not present. When the ratio is estimated to be high, the environment is classified as speech and when estimated to be low, the environment is classified as noise.

The environment is classified into one of seven different acoustic environments. These are listed in Table 1. Information on hearing aid usage in these environments is also used for data logging analysis and display.

Sound Input	Environment
Quiet	1. Quiet
Speech	2. Soft Speech
	3. Loud Speech
Speech in Noise	4. Moderate Speech in Noise
	5. Loud Speech in Noise
Noise	6. Moderate Noise
	7. Loud Noise

Table 1: The Classifier determines the listening environment to be one of seven different acoustic environments.

Situation Analyser tool in Aventa

This provides an automatic volume control adjustment based on the classified listening environment. For example, if the quiet environment is set at -3dB, the volume will automatically be turned down in soft, non-speech listening situations. When a new environment is detected, the new volume setting is applied. This adjustment is an overall gain change across all frequencies.

Danalogic and an external research facility (Oldenburg University, Germany) conducted a study to determine the optimum setting for the Situation Analyser. In this research study, test subjects experienced with using volume controls 'taught' the hearing instrument the desired setting. The research project used a volume control feature which logged and gradually applied situational gain preferences in acoustic environments where the listeners consistently made volume adjustments.

The findings from the Oldenburg University study were used to develop default settings for the Situation Analyser. The default settings are shown in Table 2, and a screen shot of the default settings in Aventa fitting software are shown in Figure 1. Results from the study also indicated a preference based on the degree of hearing loss. Thus, the default settings are also based on the audiometric profile.

Environment	Pure Tone Average	
	<60dB	>60dB
Quiet	+2dB	+3dB
Soft Speech	+2dB	+3dB
Loud Speech	+2dB	+3dB
Moderate Speech in Noise	+1dB	+2dB
Loud Speech in Noise	0dB	0dB
Moderate Noise	-2dB	-1dB
Loud Noise	-3dB	-2dB

Table 2: Default Situation Analyser settings in Aventa.

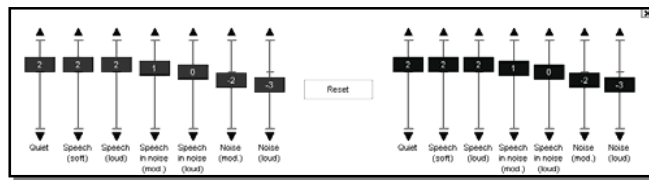


Figure 1: Aventa screen with the settings for a hearing loss with <60dB pure-tone average.

The Situation Analyser settings can be further personalised during the programming session. This is accomplished by using the slider controls. These screens can be found in the Situation Analyser tab on the left hand side in the Fitting Screen.

Target Rule	Gain Handles	Default Situation Analyser	
Average Data	Individual	Average Data	Individual
Prescribed gain specific across frequency and input level independent of environment	Frequency and input level gain adjustments independent of environments	Overall gain in specific environments (average based on research)	Overall gain in specific environments (personalized)

Summary of adjustments available in Aventa.

If it is desired to return to the default values, select the “Reset” button between the sliders for the right and left hearing instruments. To deactivate the Situation Analyser, set the sliders to 0dB across listening environments. This can also be done with the Reset button (see Figure 2).

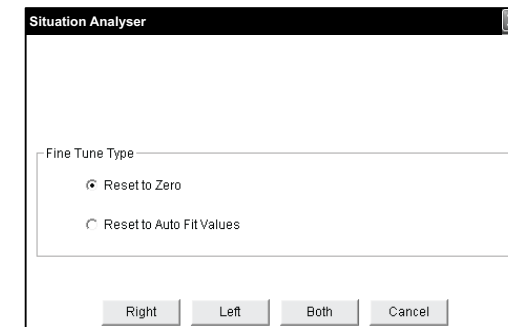


Figure 2: Reset screen in Aventa.

It is recommended to use the Aventa gain handles to make audibility and sound quality adjustments (e.g. too soft in all situations or too tinny or muffled). The Situation Analyser should be used to make situational-based volume adjustments. If large differences (greater than 3-4dB) are programmed between environments, the user may perceive that the hearing instrument pumps or changes volume significantly in some situations. In these situations, reduce the volume differences between environments to be within 3-4dB. For individuals who require large volume adjustments, it might be advisable for the user to use the manual volume control in these unique situations.

Fitting Example

A 56-year-old woman with a bilateral mild-to-moderate hearing loss was fitted bilaterally with Danalogic i-FIT 71 BTE hearing instruments. The woman had no prior experience with hearing instruments. During the initial fitting, the gain handles were set automatically based on the Audiogram+ fitting rule. The Situation Analyser was left on the default settings. The woman's initial reaction to the Danalogic i-FIT was favourable.

At the follow-up visit, she expressed overall satisfaction but had the following concerns:

- Loud sounds were sometimes too loud. For example, the action scenes at the movie theatre were too loud. She was not bothered by the loudness of the movie dialogue.
- She described difficulty hearing soft-spoken friends in quiet situations.

One situation would indicate an overall gain reduction, while the other indicated an overall gain increase. These situations might be improved with adjustments to the gain handles; however adjustments might cause problems in other listening situations. It was decided to use the Situation Analyser.

- For moderate and loud noisy environments, the Situation Analyser sliders were

reduced an additional 2 dB compared to the default settings. This reduces the gain for loud, non-speech situations such as the action scenes when watching movies at the theatre.

- For soft speech situations, the Situation Analyser slider was increased by 3 dB. While this addresses difficulties hearing soft speech, gain handle adjustments may also be appropriate. An increase of the gain for 50dB input would also increase audibility of soft speech and other non-speech sounds. If the concern was understanding instead of not hearing soft-spoken friends, increasing the high-frequency gain for 50dB inputs might improve intelligibility without increasing loudness. For this individual, the Situation Analyser adjustment solved the concern.

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