**IntriCon**
The Body-Worn Device Company

Audion™ 16

Wind Noise Suppression

A key component of Audion 16, a module that
effectively suppresses wind noise.

Wind continues to be a major source of dissatisfaction for hearing instrument users. As a key component of Audion 16, the Wind Noise Suppression module is a sophisticated algorithm that effectively suppresses wind noise.

Wind noise is created as the air passes the instrument user's head, hearing device, or other obstacles. Research has shown that even in a light breeze of 6.7 mph the long-term average wind noise level is approximately 80 dB SPL. By 27 mph, the wind noise level is limited to approximately 115 dB SPL by saturation in the microphone.

The wind noise spectrum is dominated by the lower frequencies (< 500 Hz), although at 27 mph when saturation is present, the wind noise level can be greater than 60 dB SPL at 8 kHz. It is clear that wind noise is at high levels at commonly encountered wind speeds and needs to be suppressed.
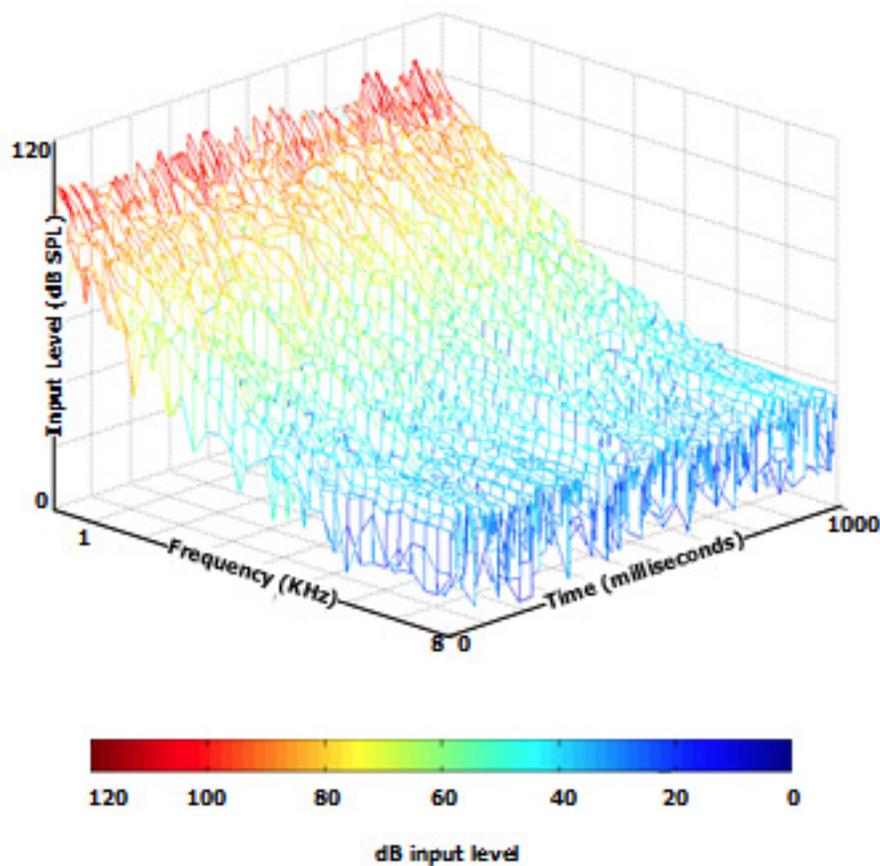
<< Figure 1.
3D image of wind input to a BTE hearing instrument for 1 second. Wind was located at 0 degree azimuth and was at a speed of 13.4 mph (6m/s). The intensity level exceeded 100 dB SPL in the low frequencies

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Wind Noise Detection

The Wind Noise Suppression module operates in two modes: single-microphone and dual-microphone. The wind detection mechanism differs between the two modes, but once wind is detected the amount of suppression that is applied is the same for both modes.

Single-Microphone Mode
In the single-microphone mode, the Wind Noise Suppression module compares the time-averaged, low-frequency spectrum with the spectral levels and shape that would be expected for wind. This gives a fairly stable estimate of the wind spectrum level, but it slows the reaction of the Wind Noise Suppression module to the onset of wind and limits the ability to suppress brief gusts of wind. Thus, the single-microphone mode is best for dealing with constant rather than intermittent wind conditions, and suppression begins when the wind noise level exceeds 85 dB SPL.

Note that it is possible that constant, loud, non-wind, low frequency sounds may trigger suppression.

Dual-Microphone Mode
In the dual-microphone mode, the Wind Noise Suppression module takes advantage of the correlation between the two microphone signals. When there is no wind, the microphone signals are highly correlated (i.e. the audio signal is similar at both microphones). This is because speech and similar types of signals tend to reach both microphones at approximately the same time.

When wind noise dominates, the correlation between the two microphone signals is poor. This is because the amount of turbulence that causes wind noise depends on the location of each microphone, and wind moves relatively slowly compared with speech sounds. Wind is detected when the correlation is sufficiently low and the time averaged input level is greater than 75 dB SPL. The dual-microphone detection method can also react more quickly to sudden gusts of wind than the single-microphone method.

Wind Noise Suppression

Both the single-microphone and dual-microphone detection methods apply the same amount of low frequency suppression. In dual microphone mode, additional suppression is obtained by averaging and filtering the output of the two omni microphones.

The base suppression method was best accomplished by taking advantage of IntriCon's state of the art layered noise reduction system. When the wind is detected, an additional gain factor is calculated and applied to the low frequency noise reduction bands. The greatest reduction in gain occurs in the 250 Hz band with progressively less reduction in bands up to 2500 Hz.

When suppression is initially triggered, the hearing instrument user will probably notice it "kick in" as the compression reduces the gain over 200 ms. This happens because the wind noise level is likely to be above the suppression kneepoint when the wind is detected. If the wind level continues to increase, the amount of suppression will increase according.

Configuration
The only adjustable parameter for wind noise is the Enable parameter to turn the module on or off.

Dual-microphone mode is automatically enabled whenever any one of the fixed directional or adaptive directional input modes is selected.