

Audion™ 16

Feedback Cancellation Improvements

Summary

Audion 16 has an improved Feedback Cancellation (FBC). The main improvements are in suppressing oscillations that can occur during large rapid changes to the acoustic feedback path. Both the duration of oscillation and the amplitude of oscillations are reduced. The other improvement is that there is an added “aggressive” mode option for the FBC. This provides a means to handle difficult feedback problems.

Faster Response and Squelch of Feedback Oscillation

In both the normal and aggressive modes there is an improvement in the handling of rapid feedback path changes. During and after large changes to the Feedback path there can be periods of oscillation (squeal sounds) while the FBC tries to adjust its cancellation. In prior designs, these oscillation times could be bothersome both due to their duration and amplitude. Sometimes these oscillations could be heard by people near the hearing aid wearer, leading to embarrassment to the hearing aid user.

Audion 16 address the amplitude of oscillation by a squelch feature. This function provides a limiter that rides above the level of the input signal but prevents oscillations from becoming too loud. The duration of the oscillation is addressed by faster calculations of changes to the cancellation filter. The processor used in Audion 16 has more digital processing power than earlier products, allowing for the improvements and still reducing the battery current.

Normal and Aggression Modes

There are two FBC modes available on the Audion 16. The differences in the modes is described below:

Normal Mode: The cancellation filter response is fast, as described above. Intervention techniques are used to prevent sinusoidal and musical input from causing erroneous behavior.

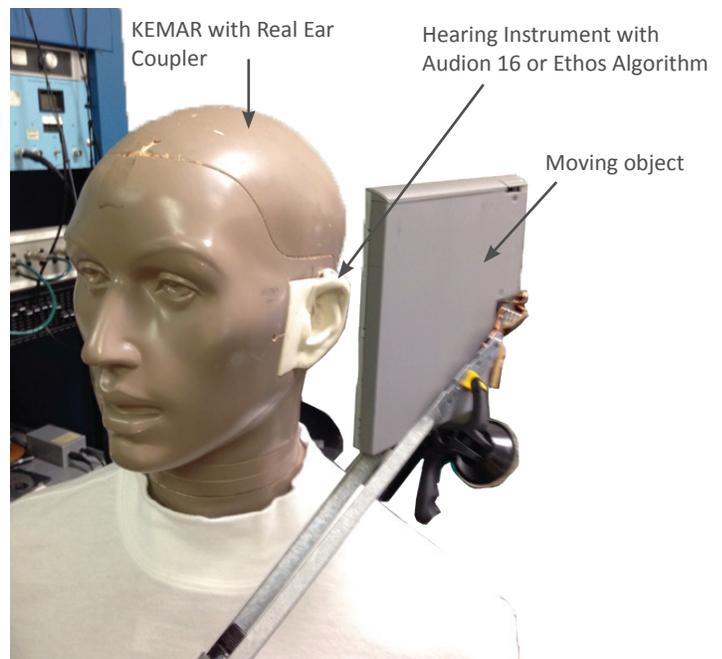
Aggressive Mode: Here the cancellation filter responds at an extra fast rate. Also a more aggressive intervention technique was implanted to identify feedback signals sooner. The more

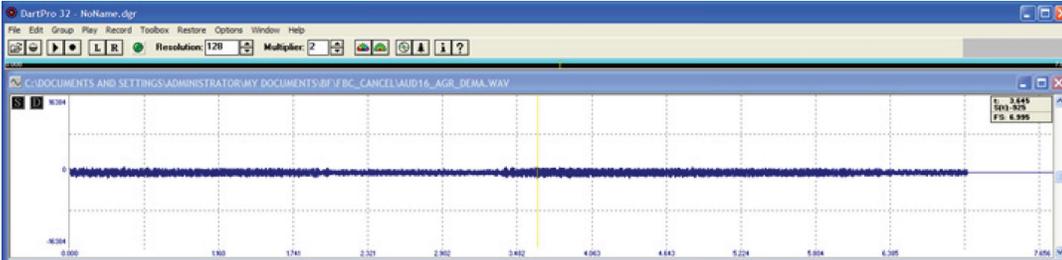
aggressive intervention technique is not normally noticeable with speech, however, for some input signals there may be a perceived degradation in sound quality.

Demonstration of the FBC Improvements

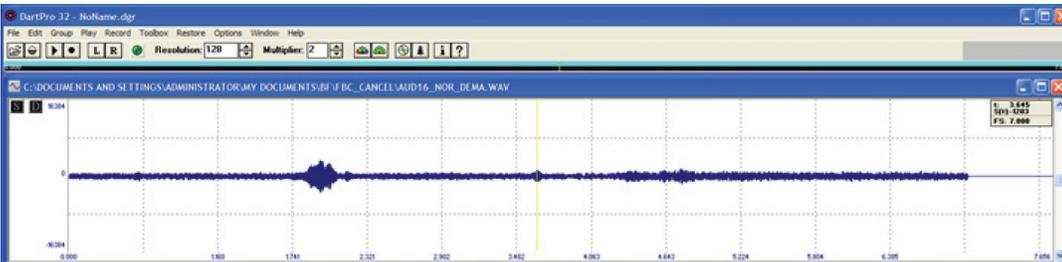
The improvements to the FBC are shown by the tests of a moving object near the KEMAR manikin's ear. The figure below shows the test setup. A moving arm allows a flat 3x4 inch object to be moved quickly near and far from the ear. An open canal BTE device is placed in KEMAR's ear. Three feedback algorithms are tested:

(a) Ethos, which is a prior IntriCon amplifier design (b) Audion 16 normal and (c) Audion 16 aggressive. All the conditions have matching gain and other parameters. The compression used is modest, CR = 1.5, kneepoint = 50 dB. A low amplitude random sound source is used and the output in the simulated ear canal is recorded.

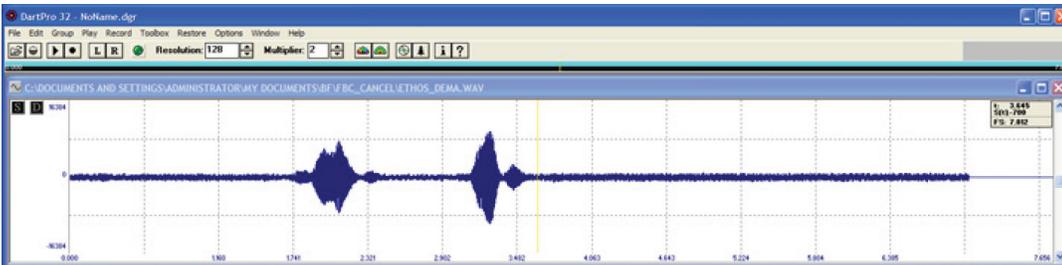




Recorded output for Audion 16 Aggressive



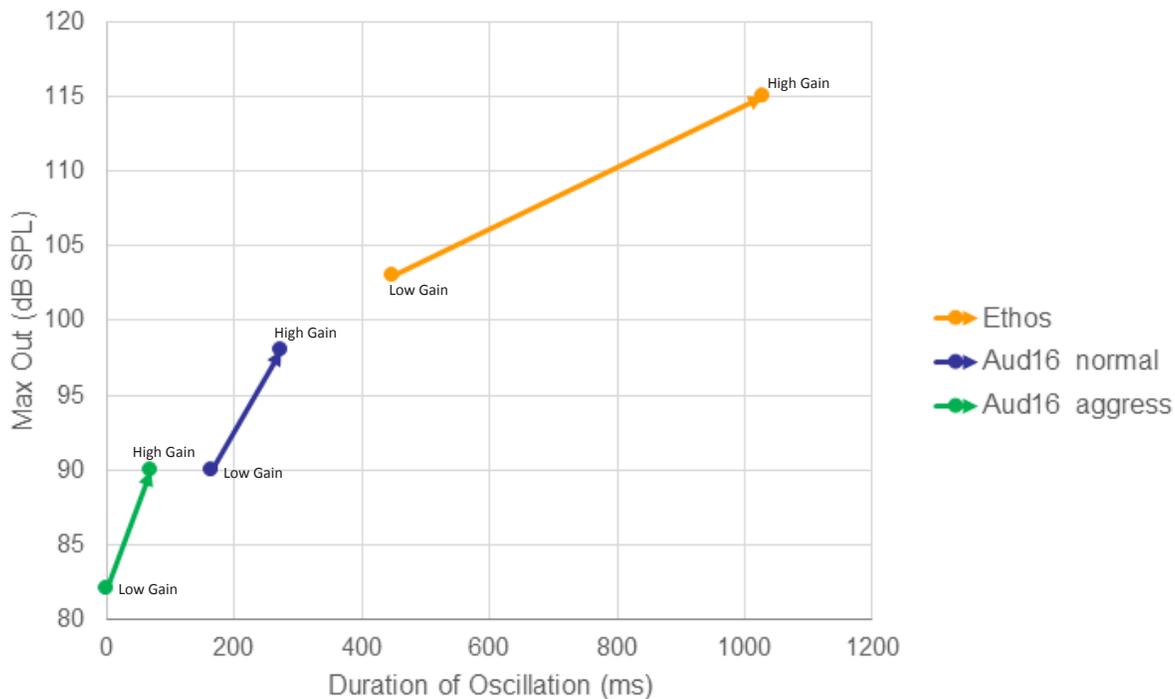
Recorded output for Audion 16 Normal



Recorded output for Ethos

The figures above shows examples of the recorded output. Oscillation periods are identified, the maximum SPL level determined, and the duration of the oscillation measured. The experiment was repeated for two different gain settings for the devices. The low gain and high gain settings were with a REIG of about 27 dB and 33 dB respectively. The example waveforms above are with the lower gain.

Oscillation Level & Duration When Object Moved Near Ear



The test results are summarized in the figure above. The horizontal axis is the oscillation duration while the vertical axis is the maximum SPL level. The lower and left of the figure are the better devices. The data is an average of multiple trials.

As expected, in all devices the lower gain performs better than the high gain. The result is that the Audion 16 performs significantly better than Ethos. In this test, the High gain Audion 16 is even better than the low gain Ethos.

Conclusion

Audion 16 responds earlier to changes in the acoustic feedback path, the adaptation is faster, and if feedback does occur, the amplitude of the oscillation is reduced compared to earlier products.

An additional FBC option is provided in Audion 16 – an “aggressive” setting to minimize feedback in the most challenging situations.