A New Invention Designed to Increase the Output of High-Power Hearing Aids

For years, invisibility has been the overall aim in hearing aid design, and high-power hearing aids have been no exception. However, ensuring the necessary output for high-power users with severe or profound hearing loss is a major challenge within the constraints of a small-size design.

In the past, high-power devices have been very large and heavy, because it was necessary to allow room for a very large receiver that could provide the necessary output. But even if we were prepared to accept the cosmetic drawbacks of such a large device, increasing the output by inserting a more powerful receiver is only possible up to a point. A 3 dB increase in output doubles the current drain, so the increase in sound level comes at a considerable cost in terms of battery drain. And beyond a certain point, the current drain will be so massive that the hearing aids will shut down during the attempt to generate maximum output.

These issues prompted Widex to search for new ways of designing high-power hearing aids that would be small, yet able to produce the output needed by people with severe to profound hearing loss without an ensuing increase in battery drain. This led to the invention of the Output Extender – an optimally-folded sound bore designed to increase the hearing aid's output.

Addressing the needs of high-power users

When designing hearing aids for high-power users, it is important to bear in mind that this target group has special needs compared to the hearing-impaired population in general.

First and foremost, they have very little residual hearing. People with severe hearing loss cannot hear sounds below 70 dB HL, and people with profound hearing loss cannot hear anything below 90 dB HL[1]. Their residual hearing is typically restricted to the lower frequencies, and the hearing loss is often accompanied by dead regions in the high-frequency region[2]. This target group is therefore likely to derive little or no benefit from high-frequency amplification. The focus when designing high-power devices should therefore be on providing adequate low-frequency amplification.

In traditional high-power BTEs, loud output levels are achieved by a combination of powerful receivers, large batteries, and long tubing. The long tubing contributes to the total output by amplifying the sound travelling through it from the hearing aid to the earmould.

A further advantage is that the tubing also functions as an acoustic sound shaper that shifts resonances to lower frequency regions where they are needed by the target group.

Among the drawbacks of traditional high-power BTEs are their lack of cosmetic appeal and acoustic precision. The length of the tubing will vary from user to user, and this variation will alter the exact location of the resonance peaks, which will affect both the sound quality and the precision of the fitting.

Figure 1. The long tubing of a traditional BTE increases the output by amplifying the sound that travels through it.

Combining the best of both worlds

The challenge in designing a new generation of high-power hearing aids is to create a solution that is small, yet capable of providing the sound pressure level and acoustic advantages of a traditional BTE. This is what has been achieved with the new Receiver-in-the-Ear (RITE) style hearing aids, WIDEX SUPER and FUSION, in combination with the Output Extender earmould. This combination offers the best of both worlds; the optimum acoustic properties of a traditional BTE, and the cosmetic appeal and comfort of a modern RITE device.

Figure 2. A WIDEX SUPER hearing aid with an Output Extender earmould. The earmould contains the receiver and the folded sound bore.

What is the Output Extender?

The Output Extender is a 60 mm long folded sound bore which is inserted into a hard custom earmould by means of CAMISHA technology. The main difference between

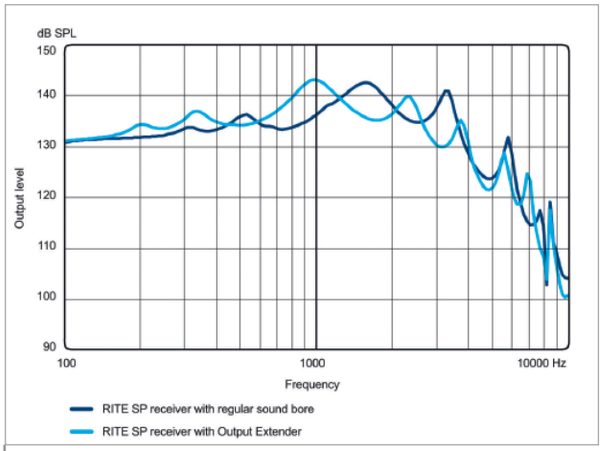

Figure 3. The maximum output response of WIDEX SUPER with the super-power (SP) receiver, and an earmould with Output Extender or a regular straight sound bore, respectively. The largest resonance peak, located at 1600 Hz with the regular sound bore, is shifted downwards to around 1 kHz with the Output Extender. This provides greater low-frequency output around 1 kHz (approx. 7 dB) and generates a BTE-like sound quality.

the Output Extender and a regular straight sound bore is that the Output Extender increases the maximum output at specific frequencies.

The sound-shaping effect of the Output Extender means that it will provide approx. 7 dB more output than a straight sound bore in the 1 kHz region. If the wearer has a "left corner" audiogram where every dB counts, and where the limited amount of residual hearing is restricted to the low frequencies, the extra output can make an important contribution towards ensuring audibility.

A comparison with other high-end super-power hearing aids reveals that WIDEX SUPER, with the SP-receiver and Output Extender earmould, offers unparalleled output in the low frequencies. As shown in Figure 4, the maximum output of WIDEX SUPER is 3-5 dB greater than the output provided by two of the most recent competing super-power products across the low-frequency range. For hearing aid users with profound hearing loss, the extra 3-5 dB can make a considerable difference in terms of achieved audibility.

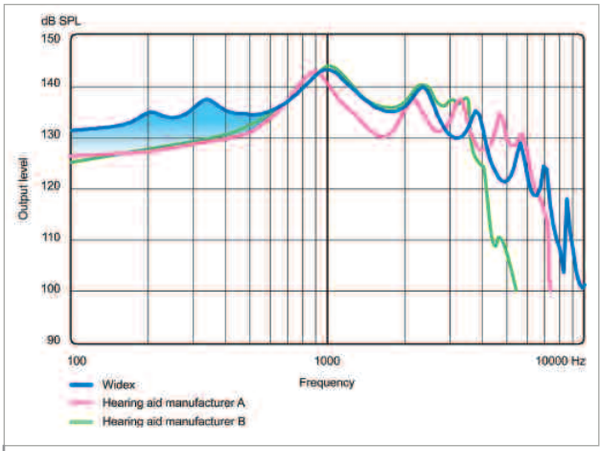

Figure 4. WIDEX SUPER with the SP-receiver and Output Extender provides 3-5 dB more low-frequency output than two of the most recent competitive super-power products.

Optimum folding by means of laser technology

The hard custom-made Output Extender earmoulds are constructed by means of CAMISHA technology. Advanced laser technology is used to turn an impression of the client's ear canal into a 3D model. Within this model, the sound bore is folded optimally according to the shape and size of the individual ear canal. The computer model is then used to build up the earmould layer by layer, with the folded sound bore inside it.

Figure 5. The sound bore is folded optimally for the individual client's ear canal.

User acceptance

In addition to increasing the low-frequency output, the sound-shaping effect of the Output Extender may also contribute towards increased user acceptance.

It is important to acknowledge that for many high-power users, who are extremely dependent on their hearing aids, getting a pair of new devices with a different sound quality and processing strategy is not something to look forward to. On the contrary, high-power users are often reluctant to try new devices, because they expect the problems to be greater than the benefits[3]. The Output Extender may make the transition to a modern RITE device easier by being able to meet the sound preferences of long-term BTE users.

Summary

Until recently, hearing aid users with severe to profound hearing loss have had little choice with respect to the size and cosmetic appeal of their hearing aids. The combination of the RITE solutions SUPER or FUSION and the Output Extender earmould provides a small, lightweight solution capable of producing the appropriate output for high-power users.

The folded sound bore inside the earmould shifts important resonances to the low-frequency region, thereby providing more low-frequency amplification.

The sound-shaping effect of the Output Extender also results in the improved ability to meet the sound quality preferences of long-term BTE users.

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