

Stream Boost: All About That Bass

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Stream Boost is an automatic feature that activates hearing aid settings optimized for high-quality streamed audio. Stream Boost settings are not part of the standard memory rotation; rather, they are automatically applied whenever streaming starts with no interaction required by the patient. When streaming stops, the hearing aids revert to previous settings. This feature is available in the Z Series™ and Halo™ product lines.



Stream Boost Feature Design

For vented or open-canal fittings, Stream Boost gain offsets differ from the typically used Normal memory settings that are designed for acoustic input. In a vented or open fitting, there are two paths for acoustic inputs: the direct path by which sound enters the ear through the vent or open fitting (and is not processed by the hearing aid) and the amplified path by which sound is picked up by the hearing aid microphone and processed through the hearing aid. For acoustic inputs, the direct path input naturally provides low-frequency audio that contributes to sound quality. With streamed input, there is no direct path. All input is transmitted by the wireless antenna housed in the hearing aid. In the case of a vented or open fitting, low-frequency streamed audio energy is still lost through the vented or open fitting. This loss of low-frequency

energy through the vent or open fit (vent loss) without any compensating direct path energy results in less overall low-frequency energy in the hearing aid output for streamed audio inputs. This is illustrated in [Figure 1](#).

Acoustic Input to Microphone

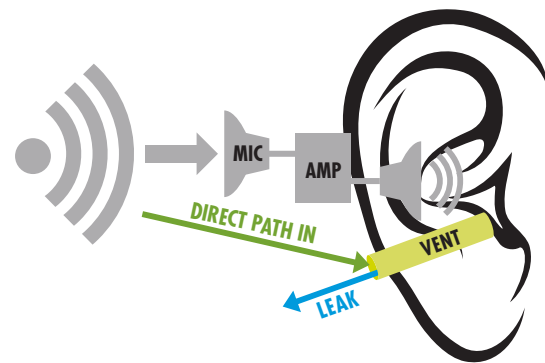
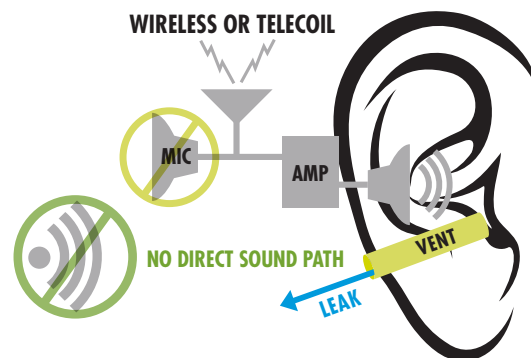


Figure 1: Illustration of direct sound in and amplified sound leaking out for an acoustic input (top) and a non-acoustic input (bottom). The gray crescents represent sound waves impinging on the hearing aid microphone and entering the ear. Note that there are no sound waves for the non-acoustic input condition on the bottom. The table (below) summarizes input type and sound in/out of the ear.

Non-acoustic Input to Antenna or Coil



Input Type	Sound Enters Ear Directly?	Amplified Sound Leaks Out?	Direct and Amplified Sound?
Microphone (above top)	YES	YES	YES
Antenna or Telecoil (above bottom)	NO	YES	NO

The impact to sound quality resulting from this loss of low-frequency streamed audio energy may be described as “tinny” or “thin” as compared to sound quality for acoustic inputs if the same gain settings are used. To compensate for the vent loss with streamed audio, low- and mid-frequency gain is automatically increased for vented and open-canal fittings when the Stream Boost feature is active.

The amount of gain boost provided will change with the openness of the hearing aid fitting and the severity of low-frequency hearing loss. Selection of the appropriate Acoustic Options in Inspire® is essential to ensuring that Stream Boost settings provide the optimal sound quality for the patient. The required amount of Stream Boost is automatically calculated and applied by Inspire and customized for every fitting. This difference in settings between Normal and Stream Boost is

most clearly seen in the 2cc Coupler Gain view in Inspire, shown in [Figure 2](#).

Because the goal is to have similar gain for both memories for the particular input type (acoustic input for Normal and streamed input for Stream Boost), the Real-Ear Response View curves in Inspire, which show predicted output in the real ear, will not look dramatically different for these two memories. It is intended that the real-ear response will be the same for acoustic and streaming inputs. The coupler gain, which does not include direct path, may appear significantly different.

Stream Boost & Z Series Products

In the new Z Series wireless product family, Stream Boost is automatically enabled when a streaming accessory is selected for use with the hearing aids. When an audio stream starts from one of the accessories, the hearing aid will automatically switch to the Stream Boost settings to process the audio stream. If desired, this automatic switch to Stream Boost can be disabled and streamed audio will be processed using active memory bank settings.

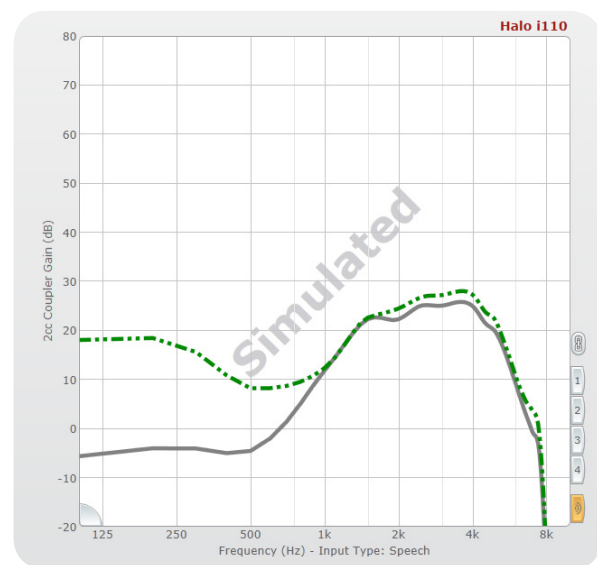
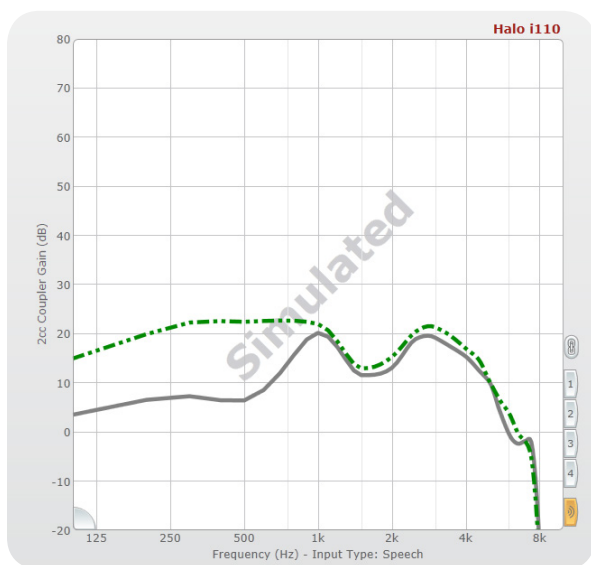


Figure 2: Inspire modeled 2cc coupler gain for Normal (gray, solid curve) and Stream Boost (green, dotted curve) for an open-canal RIC fitting (left panel) and large vent BTE fitting (right panel), showing the boost in low- and mid-frequency gain provided by the Stream Boost feature for open canal fittings.

Stream Boost and Halo Products

For patients with Halo hearing aids, the compatible TruLink mobile application provides patient control of Auto-Streaming settings via the Settings screen (Figure 3).

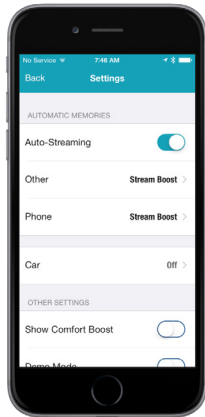


Figure 3: TruLink screen capture showing the Auto-Streaming feature enabled and Stream Boost memory selected for Phone and Other.

The automatic switch to the Stream Boost settings will be on by default for new Halo products for both “Other” and “Phone” streams. While streaming, the patient can further tweak Stream Boost settings for desired sound quality using the SoundSpace feature to create custom memories. The saved custom memory settings (created based on the Stream Boost settings and named by the patient) can then be selected for Auto-Streaming. This provides even greater opportunity for patients to find settings that provide them the best sound quality. The patient can also choose to disable the feature and stream audio in the active memory.

Clinical Trial Results

Twenty-three individuals, 14 females and nine males, participated in a clinical trial of the Halo behind-the-ear (BTE) and receiver-in-canal (RIC) hearing aids with the TruLink application. The Stream Boost feature automatically activated during wireless audio streaming. This clinical trial consisted of a minimum of four visits over seven weeks. The mean age of the participants was 62.2 years, with a range of 28 to 80 years. Mean audiometric data, as well as group minimum and maximum thresholds, are shown in Figure 4.

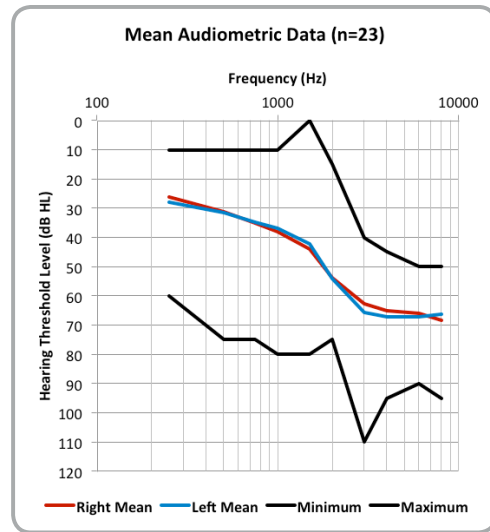


Figure 4: Mean audiometric thresholds for right and left ears are displayed in red and blue lines, respectively. Black lines represent group minimum and maximum thresholds.

Most participants were fit with the Halo BTE, while a smaller number were fit with the Halo RIC. All participants were fit with either a vented earmold or open earbud. Venting was selected based on the degree and configuration of hearing loss. All hearing aids were best-fit to Starkey Hearing Technologies' proprietary e-STAT® fitting targets at the initial session and real-ear aided response (REAR) measurements were completed using the Audioscan Verifit system (Scheller & Rosenthal, 2012). The International Speech Test Signal (ISTS) was used for all real-ear measurements and was presented at levels of 50, 65 and 75 dB SPL, with the purpose of measuring the output of the devices in the ear canal and ensuring audibility. With the exception of the Stream Boost memory, the gain and frequency response of the hearing aids were adjusted as needed at each subsequent visit in order to optimize listening comfort for each participant. The gain and frequency response of Stream Boost was not adjusted by the clinician in Inspire at any point throughout the duration of the study, as there were no specific requests for significant adjustments to Stream Boost settings by participants. Participants were free, however, to adjust Stream Boost settings via SoundSpace in the TruLink application.

Nineteen participants also completed a paired comparison between the Normal memory, which had been fine-tuned prior to the task, and Stream Boost at default settings, while listening to streamed music and speech in a laboratory setting.

For the music streaming portion, participants were asked to pick their song of choice from an iTunes media library. The song was streamed to the hearing aids and processed using either Normal or Stream Boost settings; the order of which had been randomized prior to the start of the study. Participants were allowed to listen to the stream for approximately one minute. The song was then stopped; the opposite memory was selected; and the song was streamed to the hearing aids one additional time. Upon completion of the task, participants were asked to rank their order of preference between Normal and Stream Boost. They were also given the option of “No Difference” between the two memories. Participant judgments are plotted in [Figure 5](#). Results indicate that 15 of 19 participants preferred listening to streamed music with Stream Boost settings, as compared to streamed music in Normal. Two participants reported hearing “No Difference” between the two memories.

Part two of the evaluation involved the clinician calling a voicemail recording from the participant’s iPhone® to simulate a streamed phone call. Again,

participants listened in either Normal or Stream Boost and were allowed to listen for approximately one minute.

They then listened in the opposite memory and ranked their order of preference following this condition. Results are shown in [Figure 6](#), which uses the same conventions as the previous figure. Results indicate that 13 of 19 participants preferred listening to the recorded voicemail message (i.e., phone call) using Stream Boost settings as opposed to listening with Normal settings. Additionally, one participant reported “No Difference” between the two memories.

Conclusion

Starkey Hearing Technologies’ Stream Boost feature, available in Z Series and Halo products, provides automatic access to hearing aid settings that optimize sound quality for wirelessly streamed audio. In Halo clinical trials, participants strongly preferred Stream Boost settings over Normal settings during streaming of both music and phone calls because of the improvements to streamed audio sound quality provided by these settings. With Stream Boost, the patient does not have to remember to change memories during audio streaming to achieve the sound quality he or she desires; the hearing aid does this automatically and seamlessly.

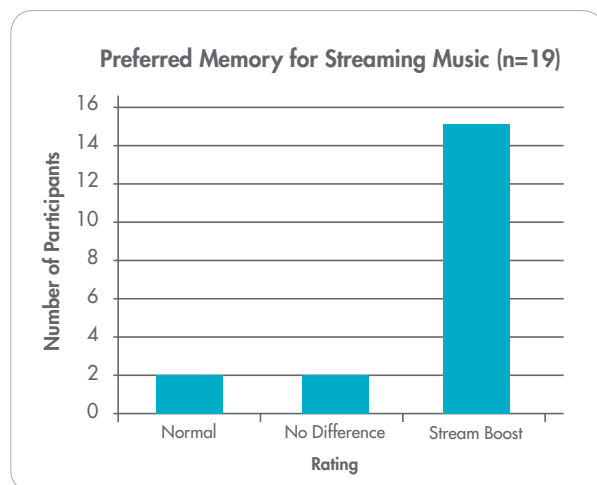


Figure 5: Participant preference ratings for listening to streamed music through iPhone.

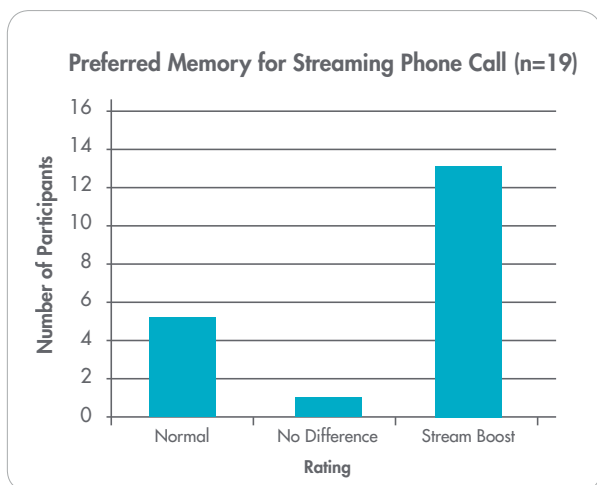


Figure 6: Participant preference ratings for listening to a streamed phone call from iPhone.

References

Scheller, T. & Rosenthal, J. (2012). Starkey Hearing Technologies' e-STAT Fitting Formula: The rationale behind the rationale. *Innovations*, 2(2), 41-45.



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