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- Click layout
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- Click Print
- Choose # of pages per sheet from dropdown menu
- Choose Black and White from "Color" dropdown

AB Front End Processing and Sound Processing

AB Front End Processing and Sound Processing

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Principal Training Manager
Advanced Bionics

A Look Inside Advanced Bionics CI

Front End Processing

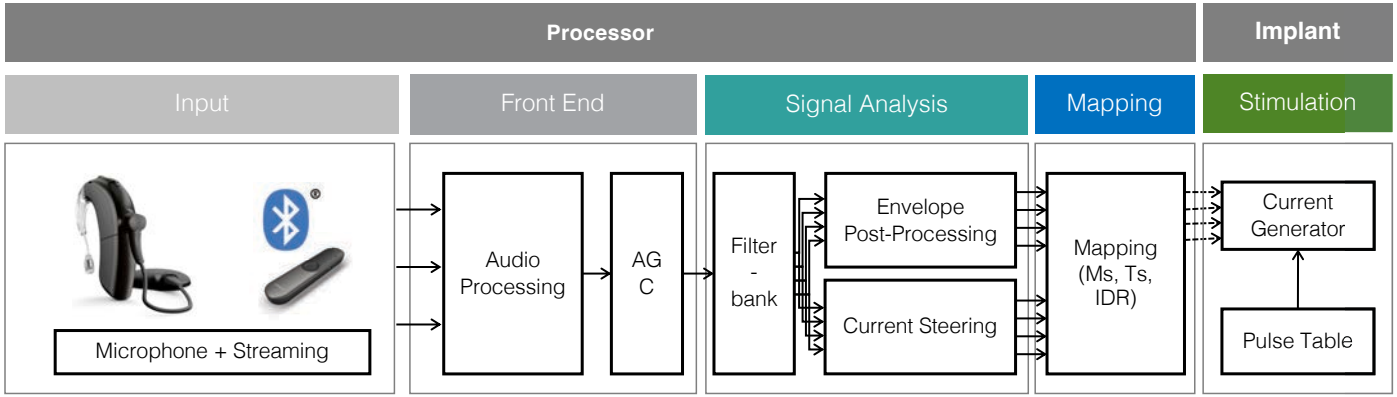
*Product and service availability varies by region.

A Sonova brand

D000038203 RevA

Front End Processing and Sound Processing

Front End Processing and Sound Processing



Front End Processing and Sound Processing

By the end of this session, you will be able to:

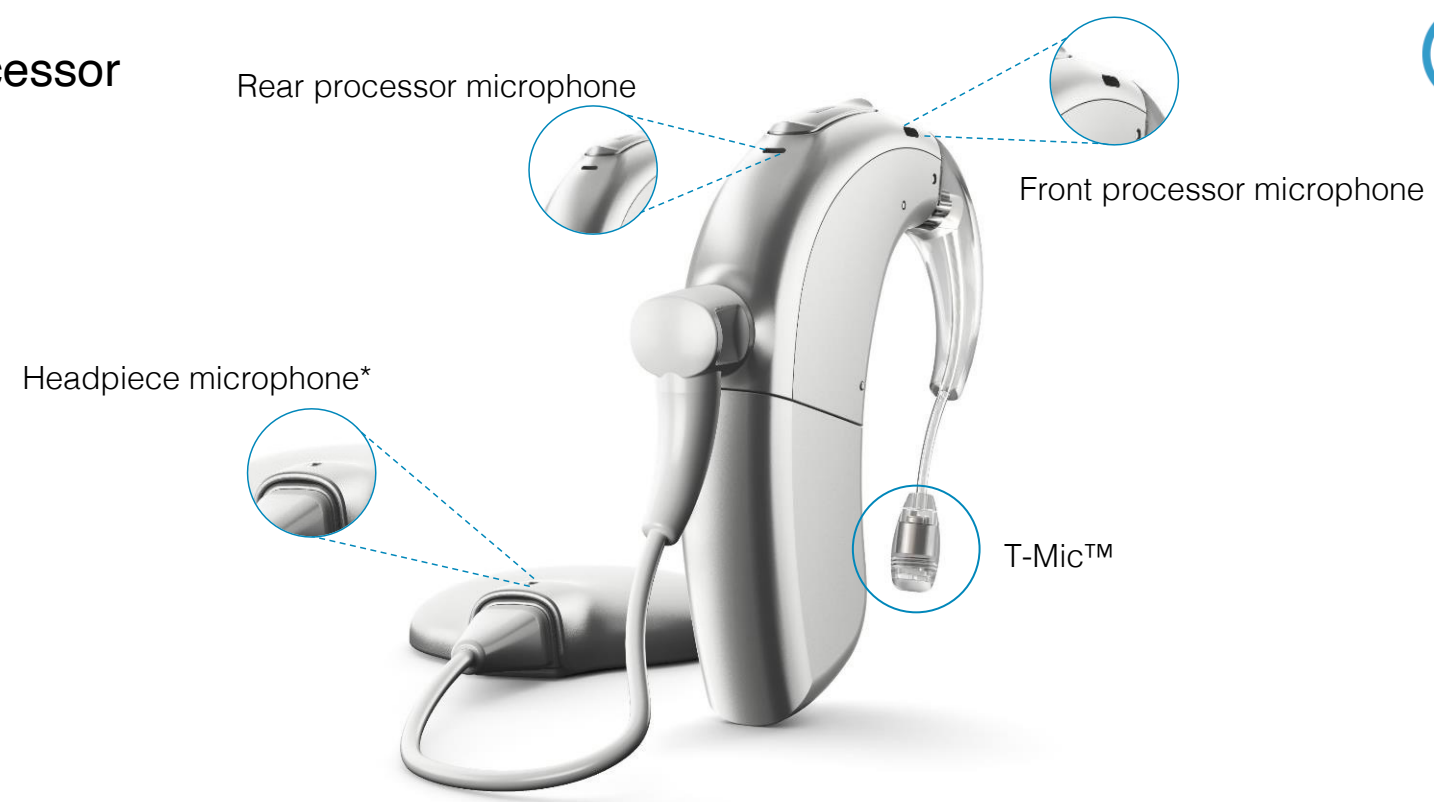
- Identify at least three technologies (front end and/or sound processing) that are unique to AB.
- Explain how AutoSense OS benefits your patients.
- Recommend sound processing features that provide improved performance for your patients.

Powerful Hearing Experiences

Microphone modes, comfort features, and the AutoSense OS™ operating system work together to meet recipients' listening needs to provide a powerful hearing experience.

Sound Processor

Microphones

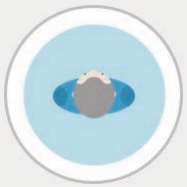


AB Advantage: AB and Phonak calibrate all microphones in the same way which ensures alignment for bilateral and bimodal recipients and helps create seamless transitions between microphones.

*Available with Slim HP Mic and Slim HP AquaMic

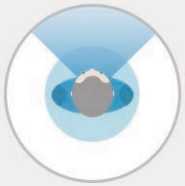
Sound Processor

Microphone modes



Omnidirectional

T-Mic/Real Ear Sound (RES)



Fixed Directional

UltraZoom & SNR-Boost

StereoZoom

Sound Processor

Comfort features

SoundRelax

Automated comfort feature that attenuates sudden loud sounds to provide a more comfortable listening experience

WindBlock

Automated comfort feature that reduces wind noise and improves comfort when in the presence of wind

EchoBlock

Improves comfort and ease of listening when in environments with echo or reverberation

What percentage of your recipients want multiple programs and use them effectively?

AutoSense OS

AutoSense OS

Having an automatic classification system that manages programs for the recipient is highly beneficial

Julie H.

AB Recipient

The testimonials, statements, and opinions depicted reflect the opinions and experiences of the individual. They have been voluntarily provided and are not paid, nor were they provided with any products, services or benefits in exchange for the statements. Exact results will be unique and individual to each patient. If you have specific questions regarding your cochlear implantation, please contact your surgeon directly. This product may not be approved in your region. Please check with your local AB representative.

AutoSense OS

How does it work?

- Identifies the recipient's environment
- Analyzes incoming sounds every 400 ms
- Classifies sounds based on this analysis
- Uses artificial intelligence to automatically activate the appropriate blend of settings

AutoSense OS

How does it work?

AutoSense OS is designed to draw upon multiple features to blend sound classes to create over 200 distinct settings based on the specific listening environment*.

Inputs are classified as Acoustic or Streaming.

Acoustic

- Calm situation
- Speech in noise
- Comfort in echo
- Comfort in noise
- Speech in car
- Speech in loud noise
- Music

Streaming

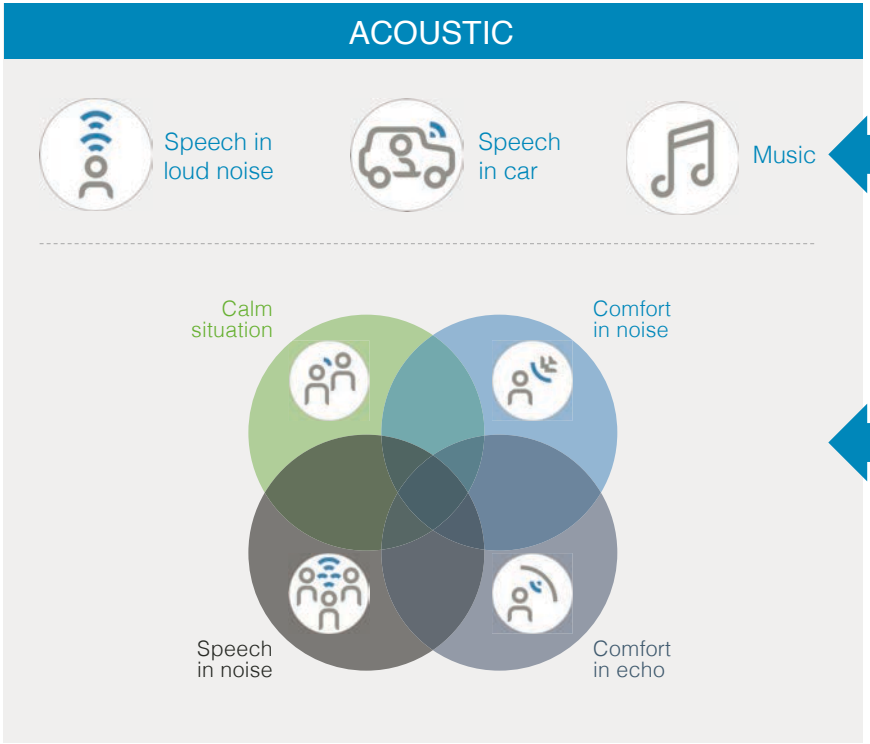
- Media Speech
- Media music

AB Advantage: optimize the listener's streaming experience

*User experience with AutoSense OS may vary based on the listening situations encountered and may be limited by the user's selected settings.

AutoSense OS

Acoustic input

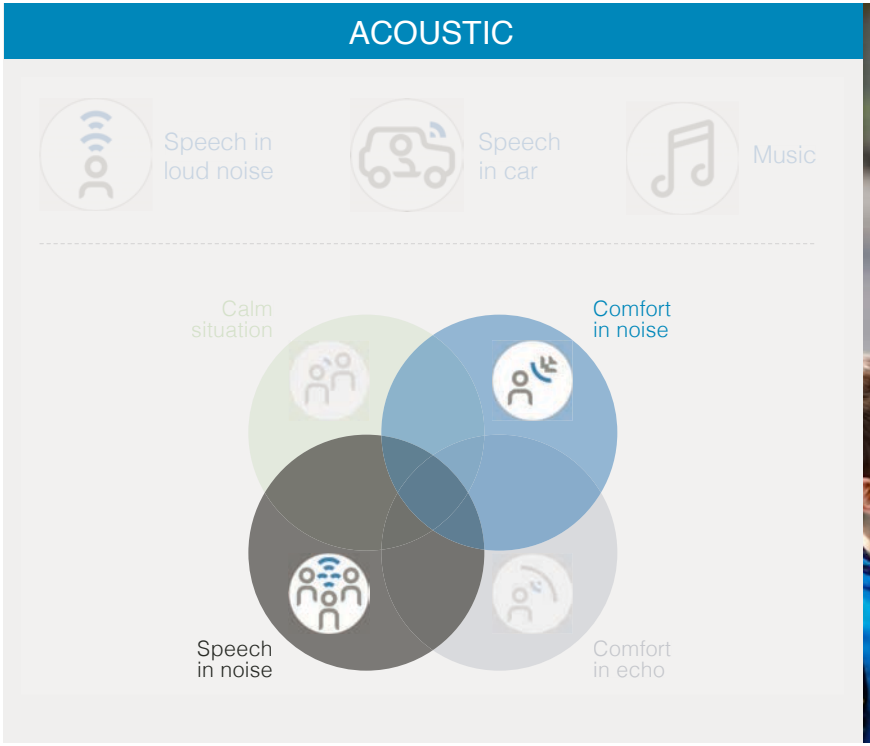


The three exclusive programs are activated independently and will not be blended.

The four non-exclusive programs can be blended, when it is not possible to define complex, real-world environments by one acoustic classification.

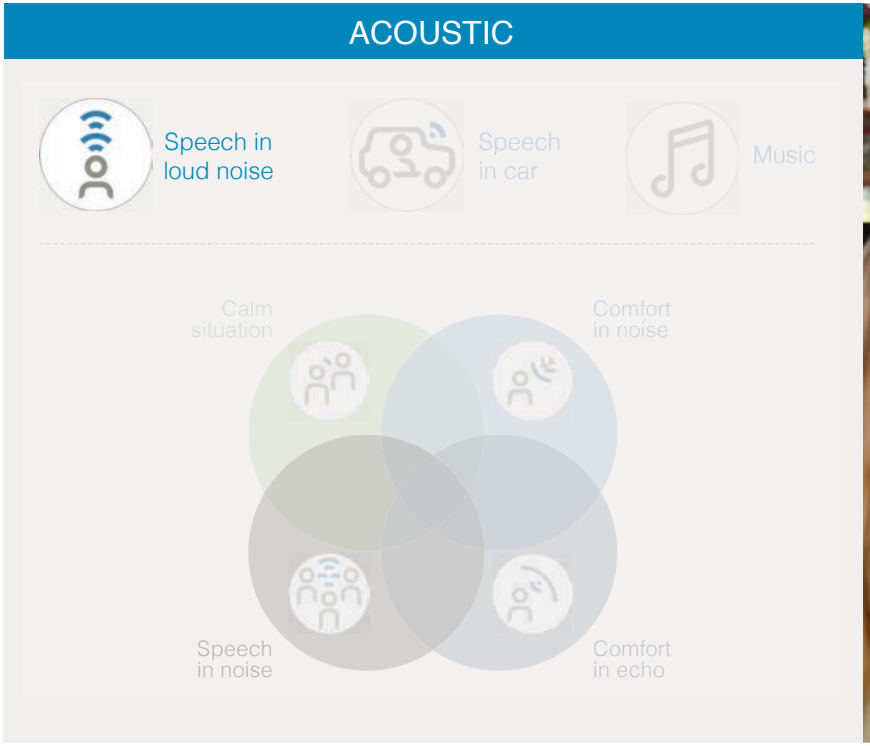
AutoSense OS

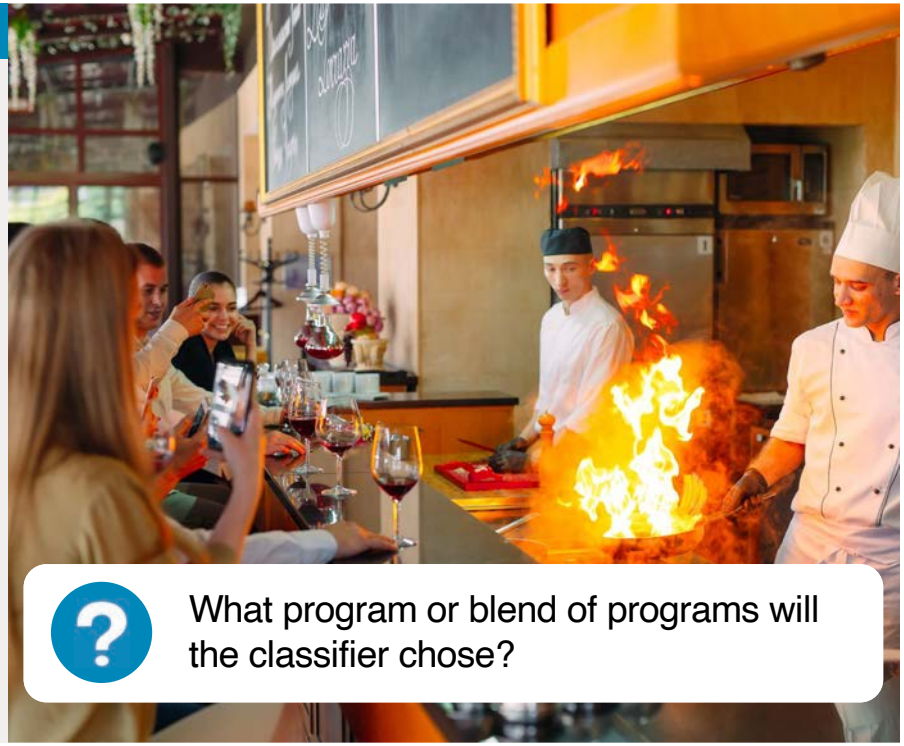
Acoustic input



AutoSense OS

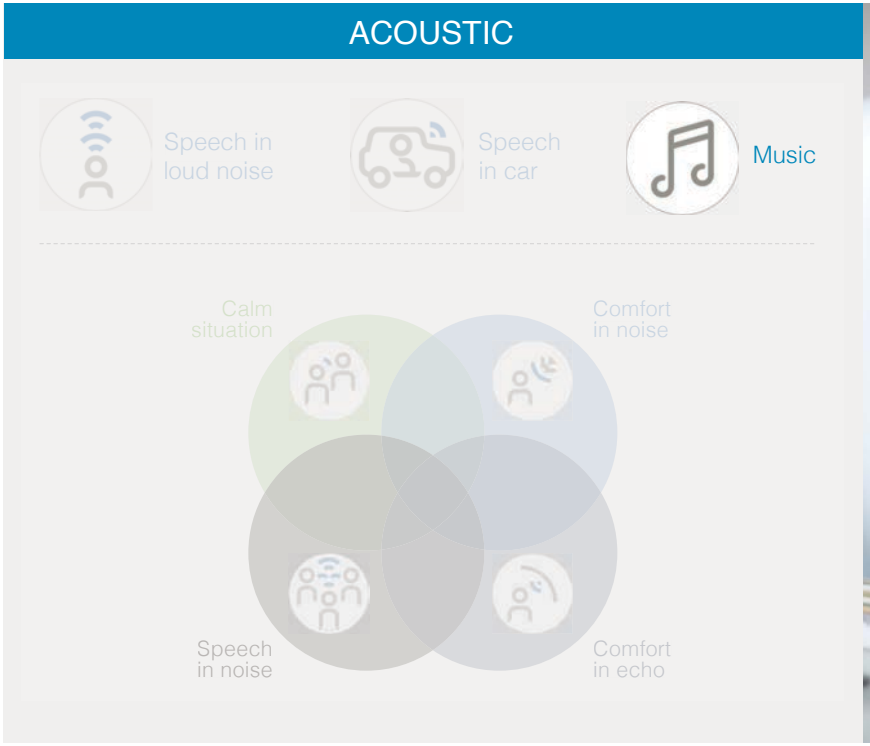
Acoustic input





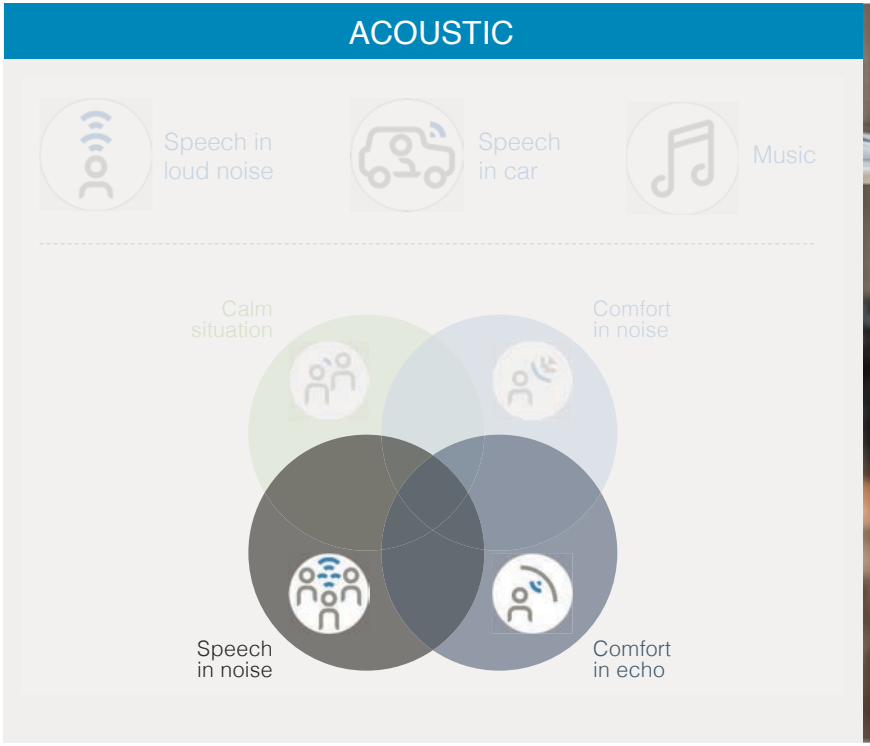
AutoSense OS

Acoustic input



AutoSense OS

Acoustic input



AutoSense OS

Streaming input

Phonak and AB classify the difference between streamed speech vs. music media for an enhanced listening experience.

Streaming signals are delivered in stereo to bimodal and bilateral recipients.

AutoSense OS automatically detects the presence of streamed input from Bluetooth phone calls, Phonak PartnerMic, or Roger microphones.

AutoSense Sky OS 3.0

Dedicated pediatric operating system

World's First

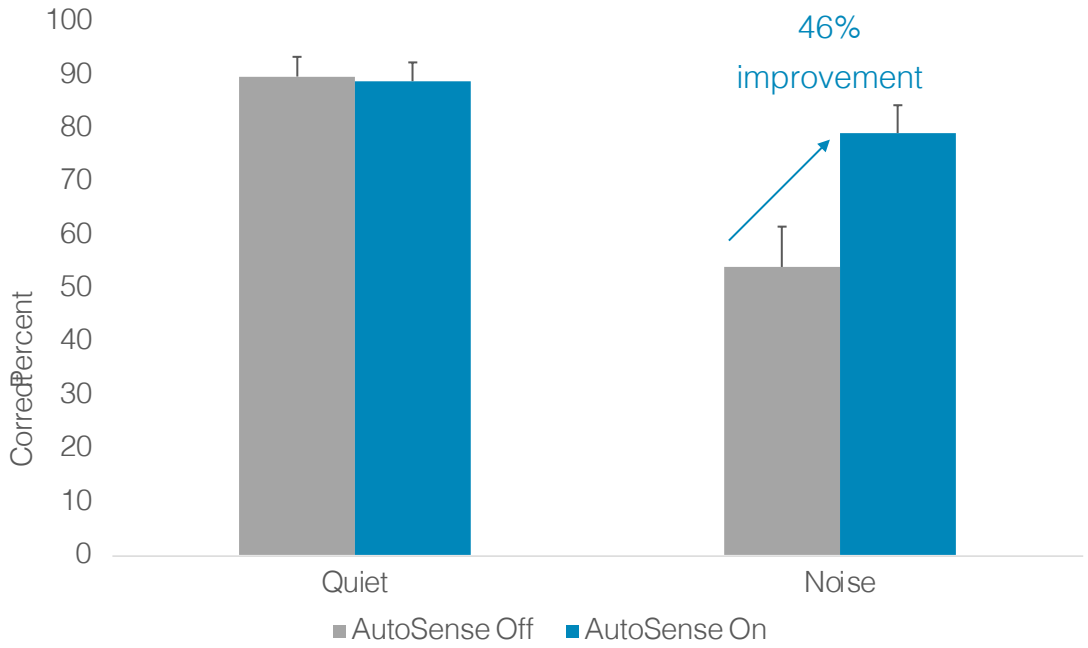
AutoSense Sky OS 3.0 is the world's first dedicated pediatric operating system for a cochlear implant sound processor[3].

- Developed specifically for the listening environments that children experience to ensure that kids and teens have an optimal listening experience
- Applies customized settings automatically so kids and their parents can focus on more of life's great adventures

Research

AutoSense OS

Advanced Bionics study[27]



Performance in noise was better for all subjects with AutoSense OS 3.0 ON relative to AutoSense OS 3.0 OFF.

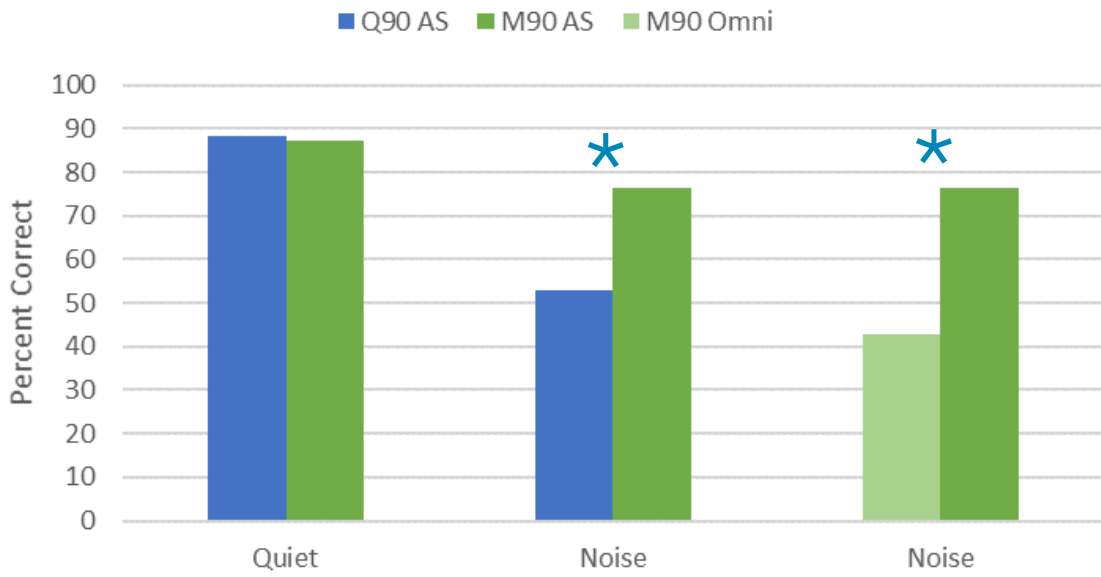
AutoSense OS

Multi-center study

"I felt like my hearing with [Marvel CI] was better. **Car noise was reduced, wind noise did not seem to be as much of a problem.** I was in several restaurant situations and felt **I could hear well.** I tried it in a small group setting and always had to use my Roger mic, **I tried it without Roger and was able to hear all of the conversations** – that was a really nice experience."

Participating Centers

- Vanderbilt University
- Washington University
- University of Colorado
- Austin ENT
- Tampa Bay
- Mid-West Ear Institute

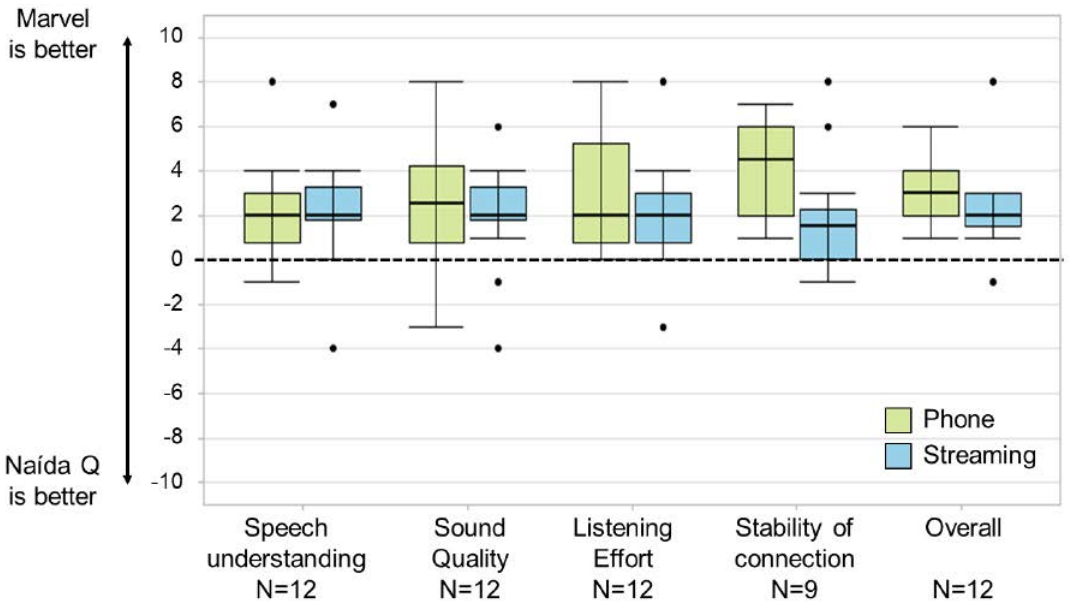


Data are shown from 10 subjects. Blue symbols show significant differences.

Advanced Bionics. Data on file.[27]

AutoSense OS: Streaming

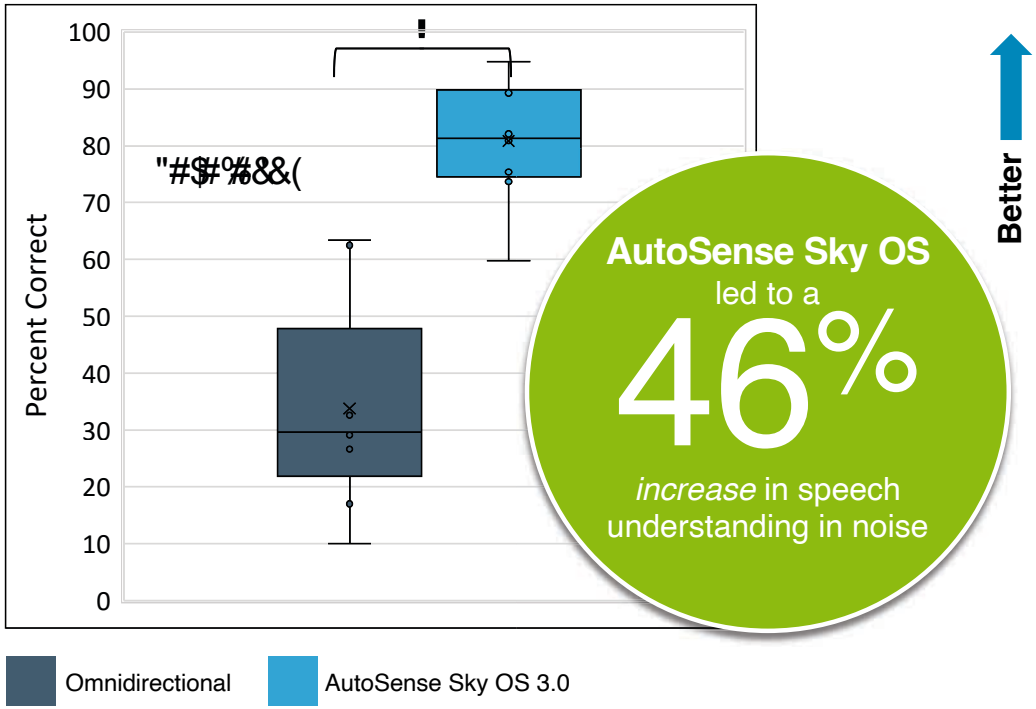
Multi-center study[29]

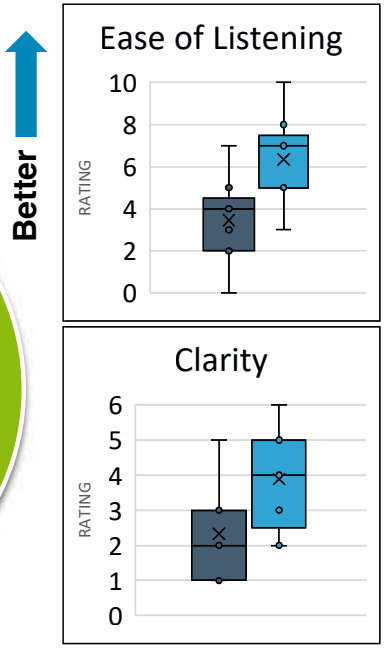


Results

Automatic Noise Management Technology and Children[28]

AzBio Pediatric Sentences at **-5 dB SNR**





AutoSense Sky OS improved ease of listening and clarity

A powerful hearing experience

Designed to deliver clear, rich sound in any listening environment

Effortless comfort and convenience

Customizes sound based on the recipient's environment

Ultimate ease of use

Provides automatic access to a variety of features

ADVANCED BIONICS
POWERFUL CONNECTIONS

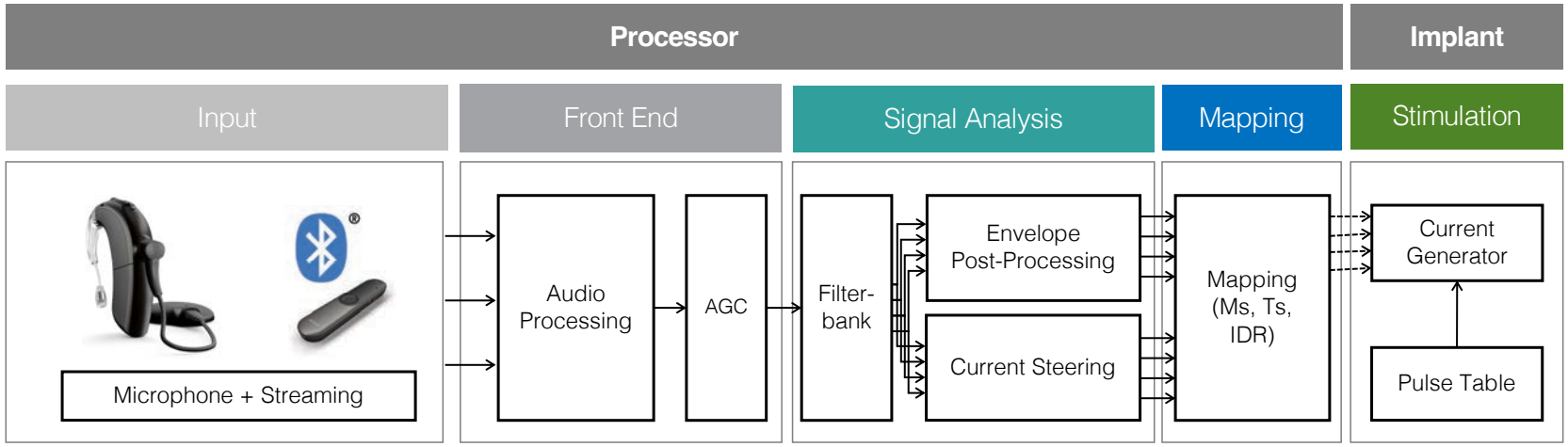
Sound Processing

*Product and service availability varies by region.

A Sonova brand

D000038202 RevA

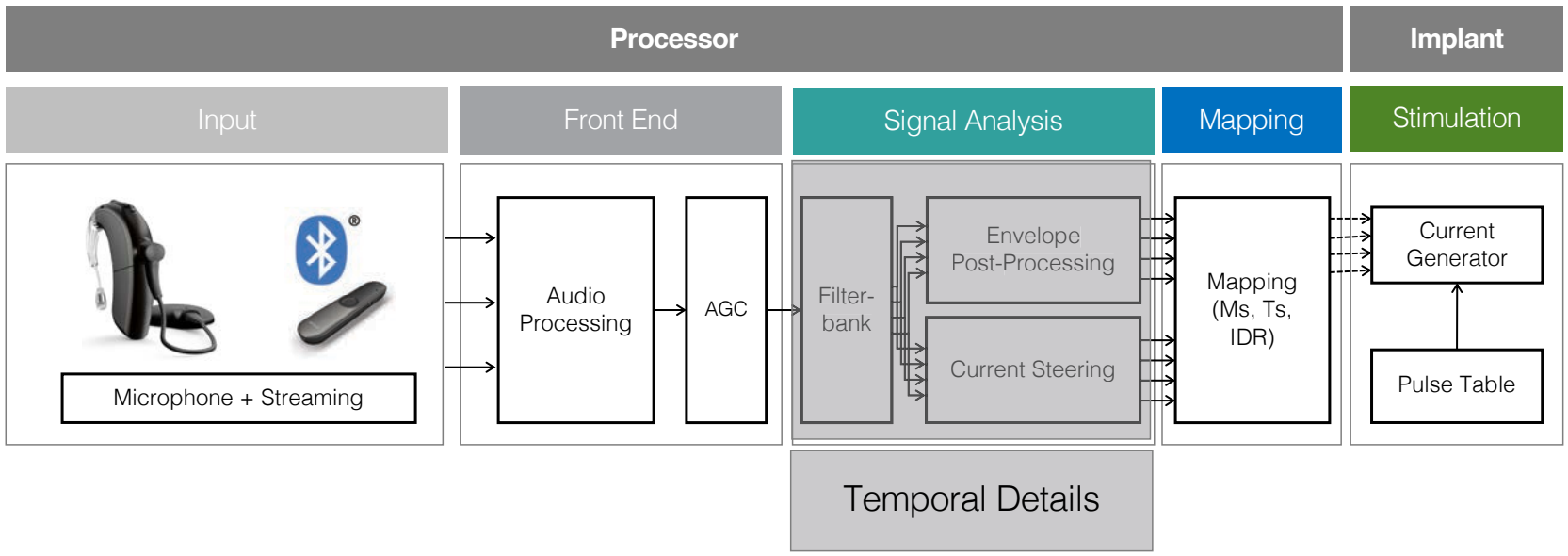
Sound Processing Pathway



Sound processing defines how acoustic signals are changed into electrical pulses and delivered by the electrode array.

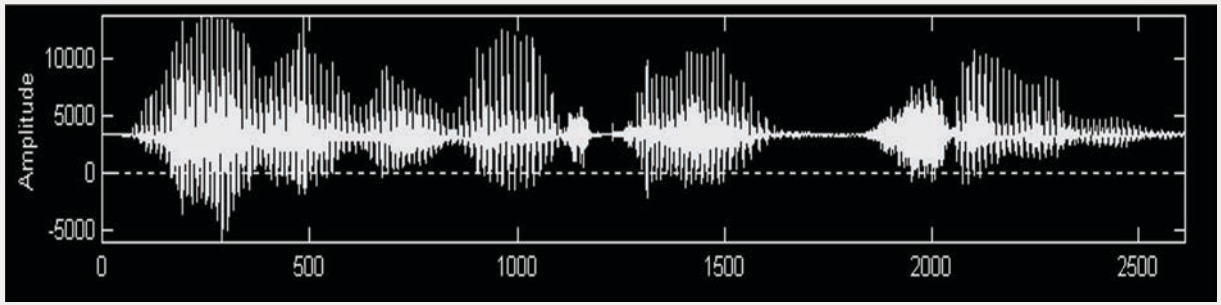
Temporal Details

Sound Processing Pathway



Temporal Characteristics of Speech

Sentence: *Where were you last year, Sam?*



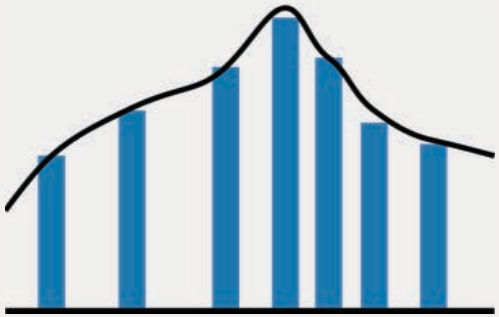
Temporal details provide information on:

- Word and syllabic structure
- Prosody/Stress
- Manner of articulation
- Stops
- Voicing (duration)
- Frication (and strength)
- Nasality

Temporal Details

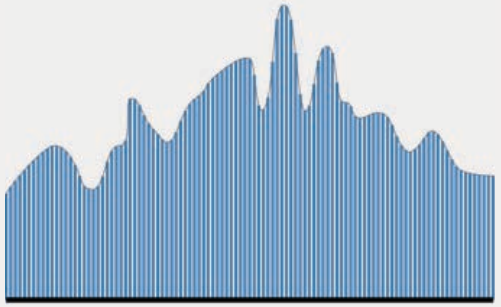
Faster stimulation rates optimize delivery of the fine timing information.

Low Rate Stimulation



Conventional

Higher Rate Stimulation

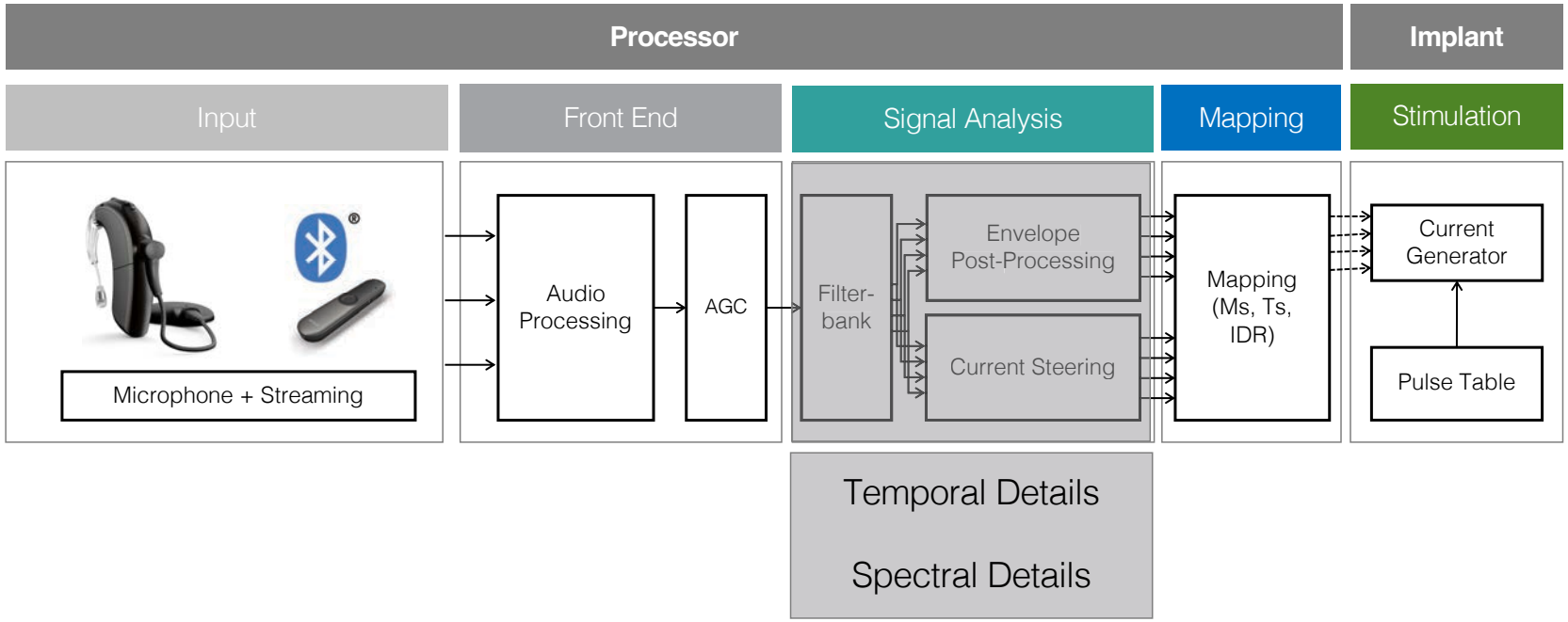


HiResolution

Temporal details provide a more accurate representation of the acoustic signal, resulting in better hearing performance.

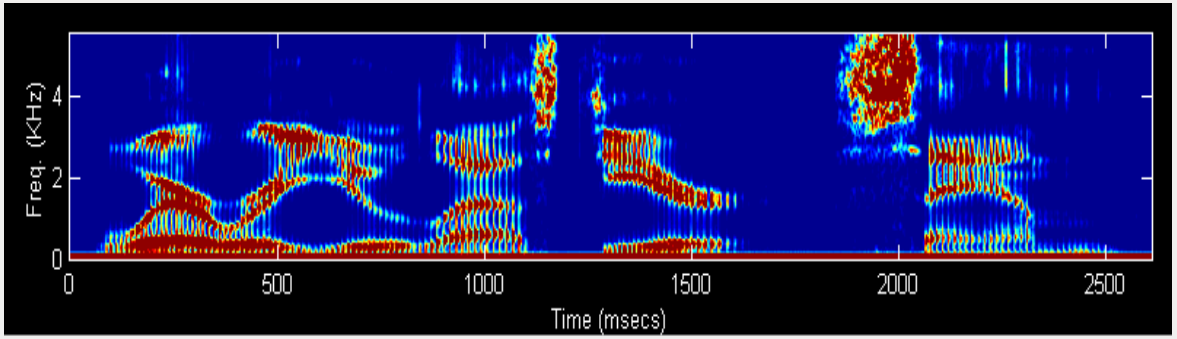
Spectral Details

Sound Processing Pathway



Spectral Characteristics of Speech

Sentence: *Where were you last year, Sam?*



Spectral details provide information on:

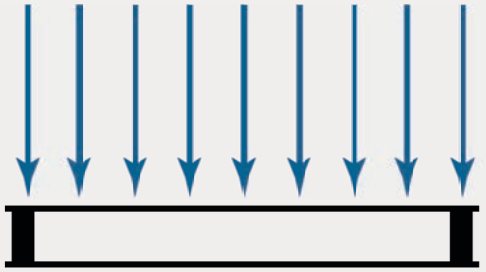
- Vowel identification
- Vowel pitch
- Intonation
- Consonant place of articulation
- Depth
- Naturalness

Current Steering

Conventional

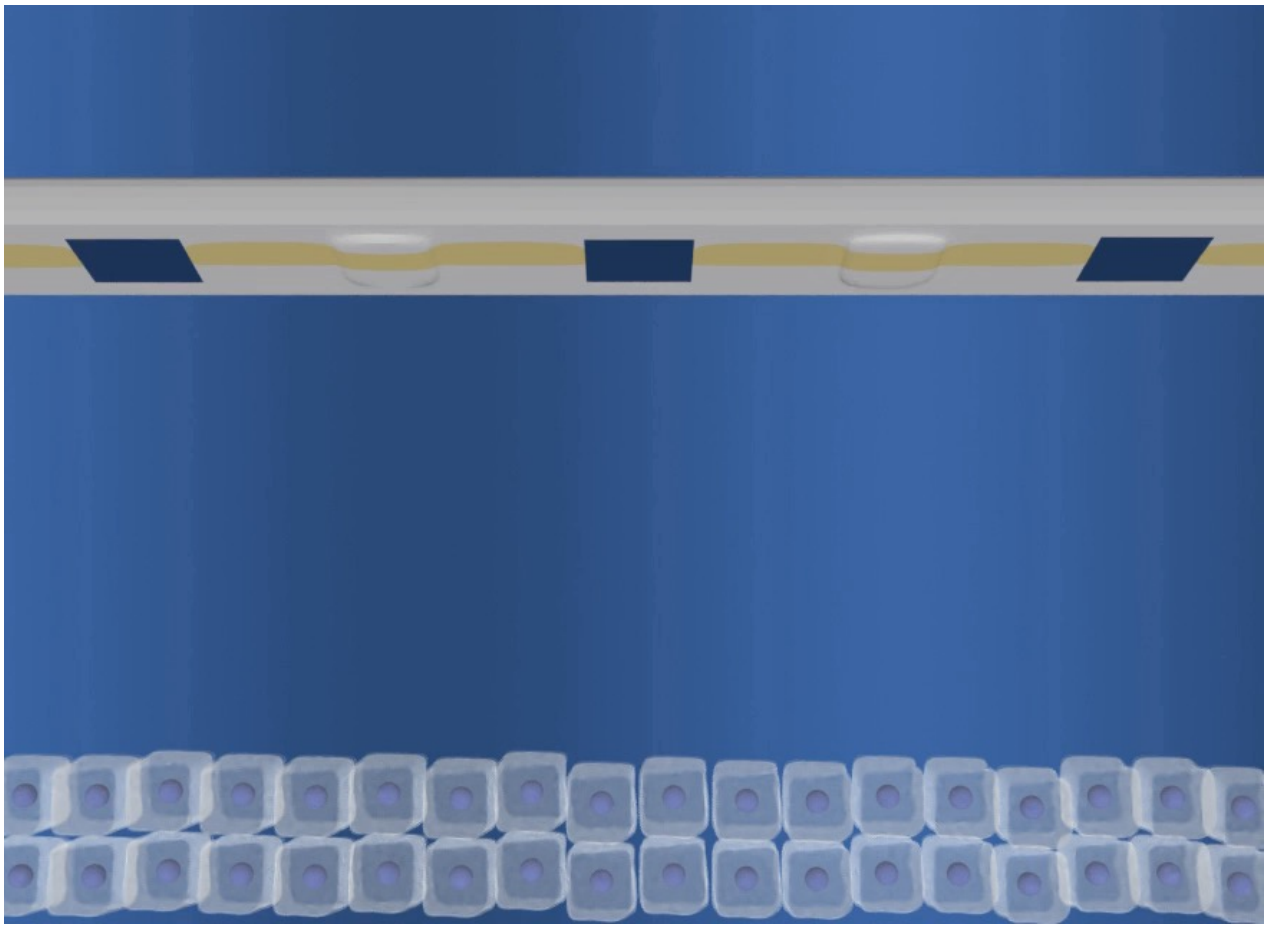
Stimulation occurs at the location of the electrode

HiRes Fidelity 120



Provides additional points of stimulation

Note: This figure represents stimulation at one site



Hear the difference for real world listening…

Hear the difference for listening to music.

Spectral details contribute to speech intelligibility and sound quality, helping recipients[1-3]:

- Hear in noise
- Appreciate music
- Hear environmental sounds
- Understand tonal languages

Knowledge Check

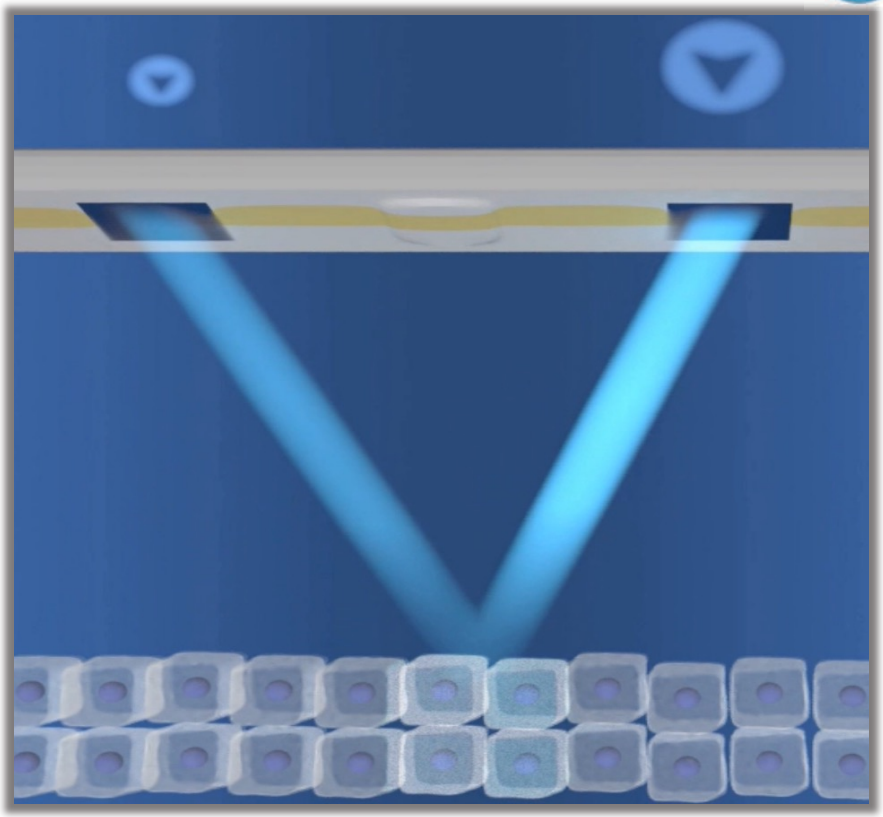
How is Advanced Bionics able to steer current between electrodes?

A. Magic

B. Independent current sources

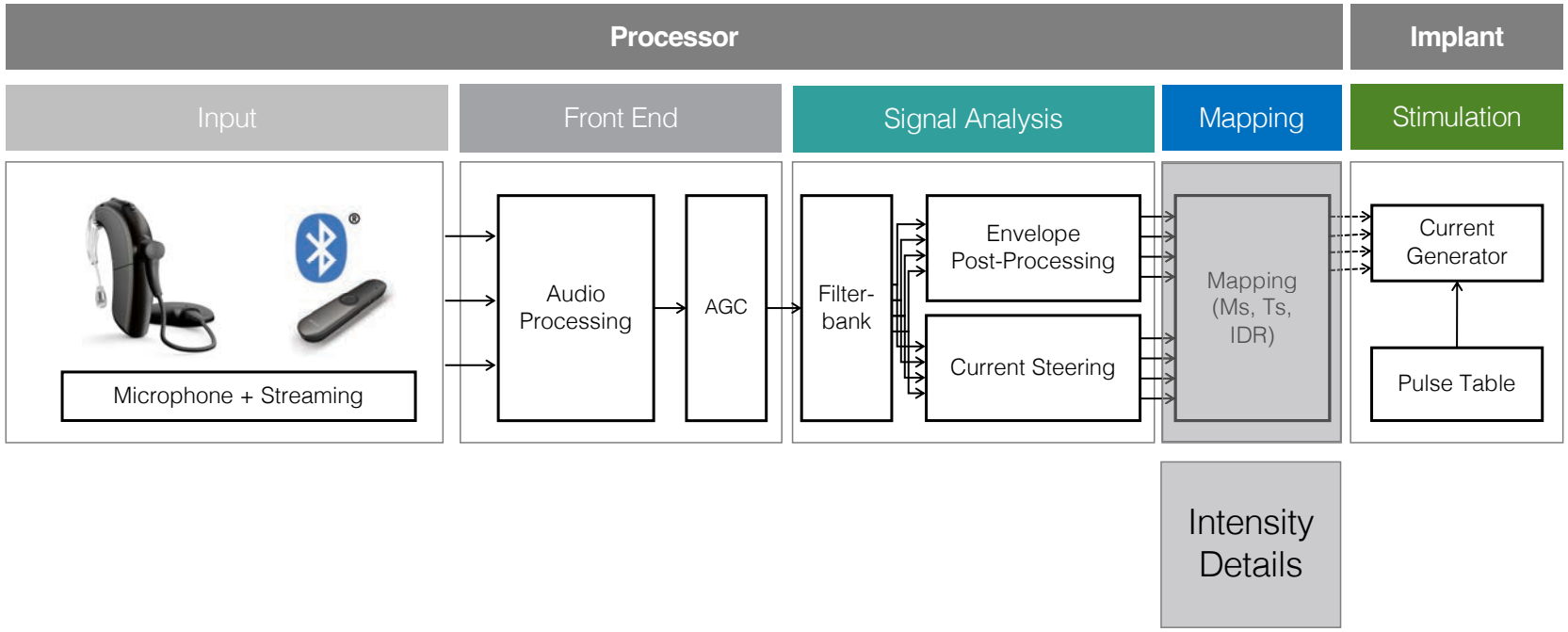
C. Wide dynamic range

D. Automatic pulse width

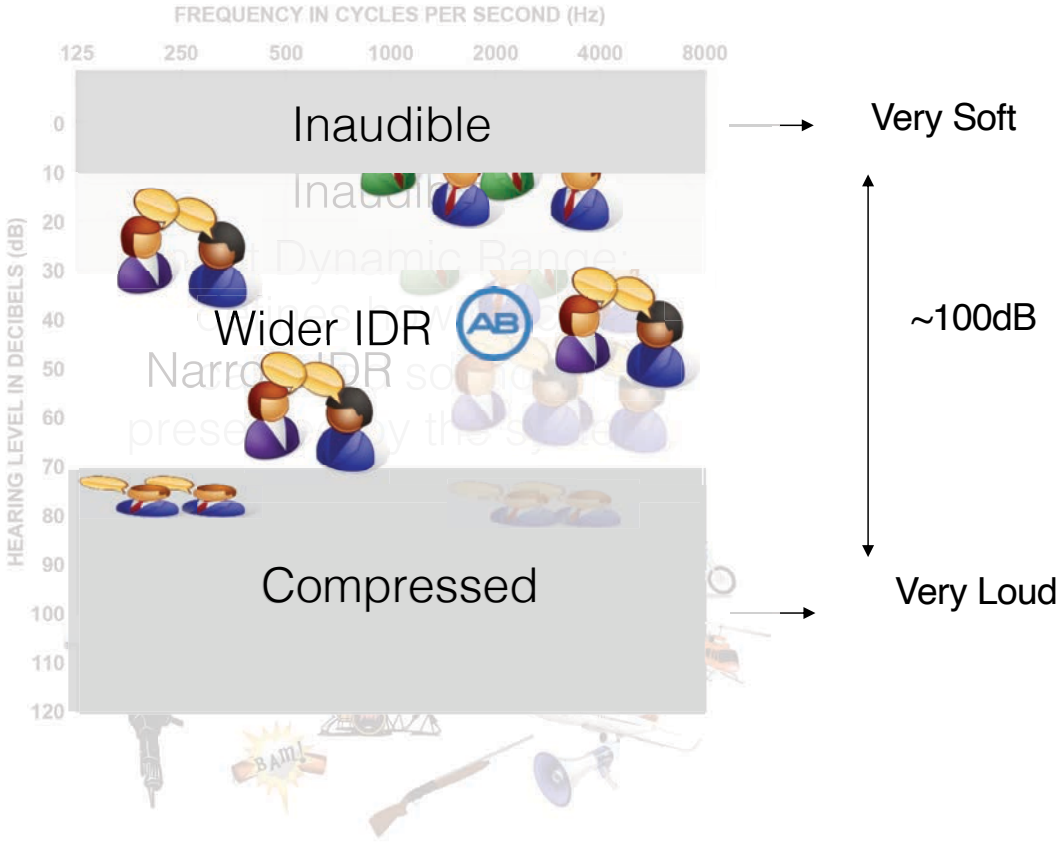


Intensity Details

Sound Processing Pathway



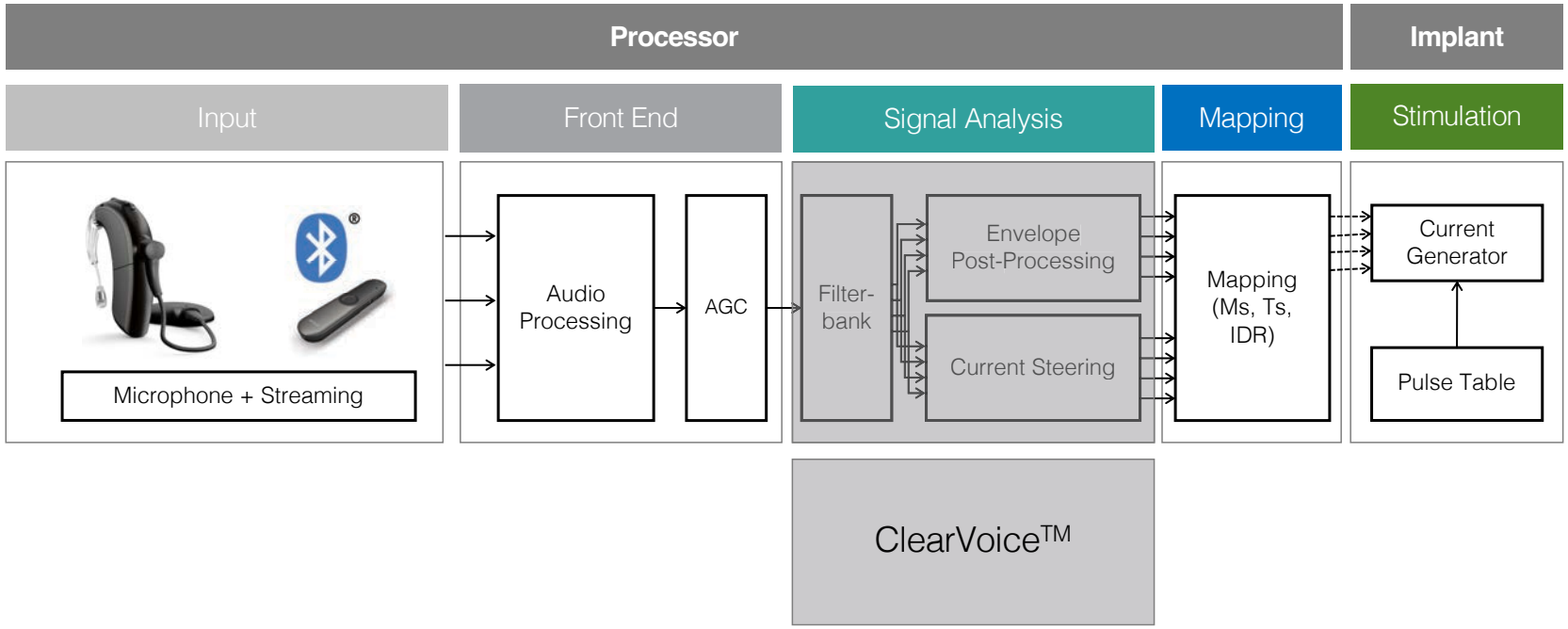
IDR


FREQUENCY IN CYCLES PER SECOND (Hz)
125
250
500
1000
2000
4000
8000
HEARING LEVEL IN DECIBELS (dB)
0
10
20
30
40
50
60
70
80
90
100
110
120
Inaudible
Wider IDR
Compressed
Very Soft
~100dB
Very Loud

With a wide IDR, soft sounds are more audible, improving perception of important speech sounds.

Signal Analysis

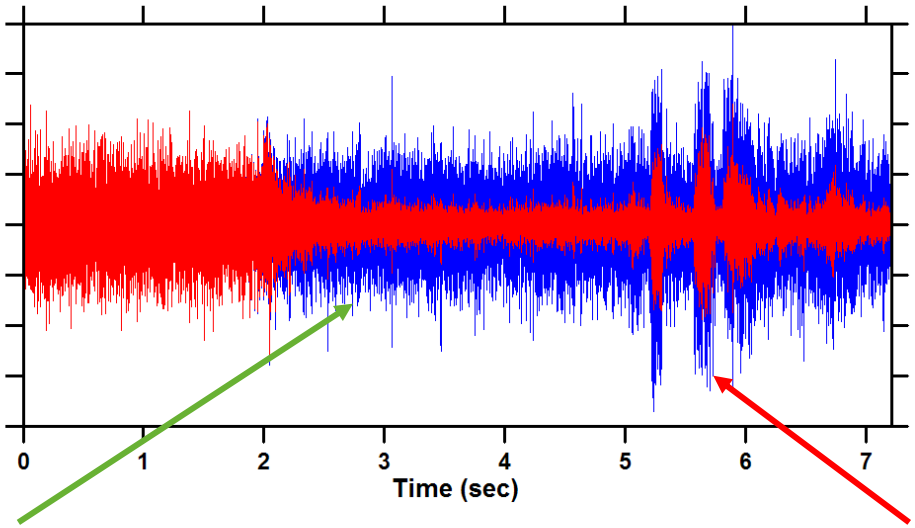
Sound Processing Pathway



ClearVoice

- Designed to automatically separate distracting noises from important speech so communication is easier in difficult listening environments
- Proven superiority in noise

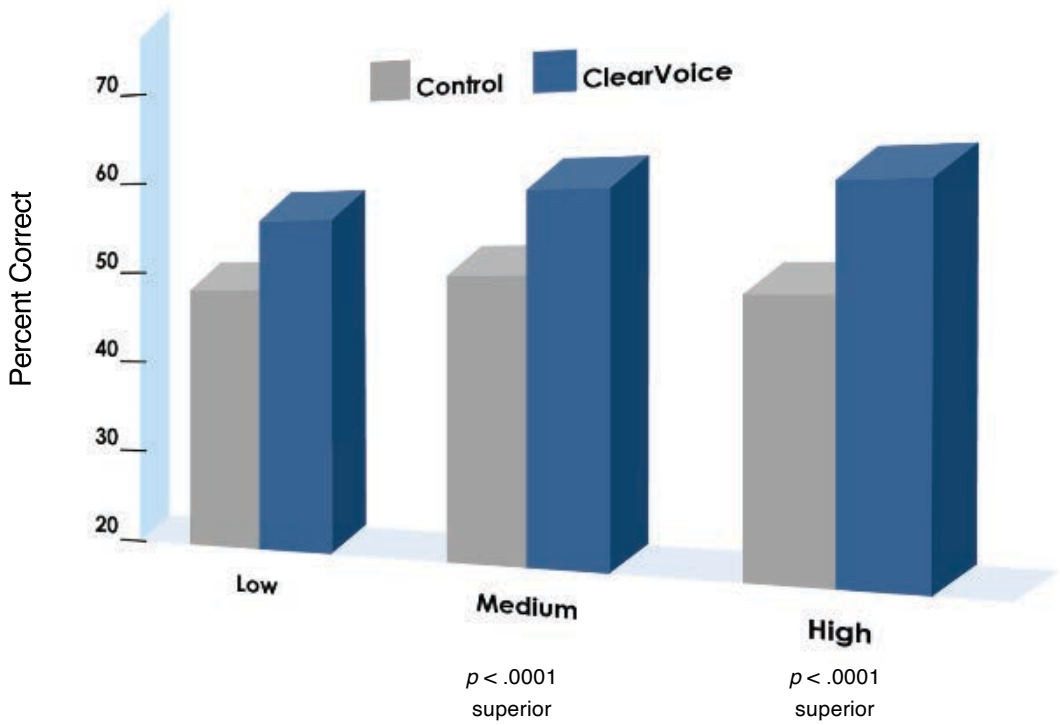
Hear the ClearVoice Difference



Without ClearVoice

With ClearVoice

! "#$%&'( )# (+ ,%- #. *. ,##) /* 012#%3$12(14*(1*. 3#$256 3$3#*1'(. #!



Koch et al., 2014

Knowledge Check

In which environments would ClearVoice be beneficial?

A. Car

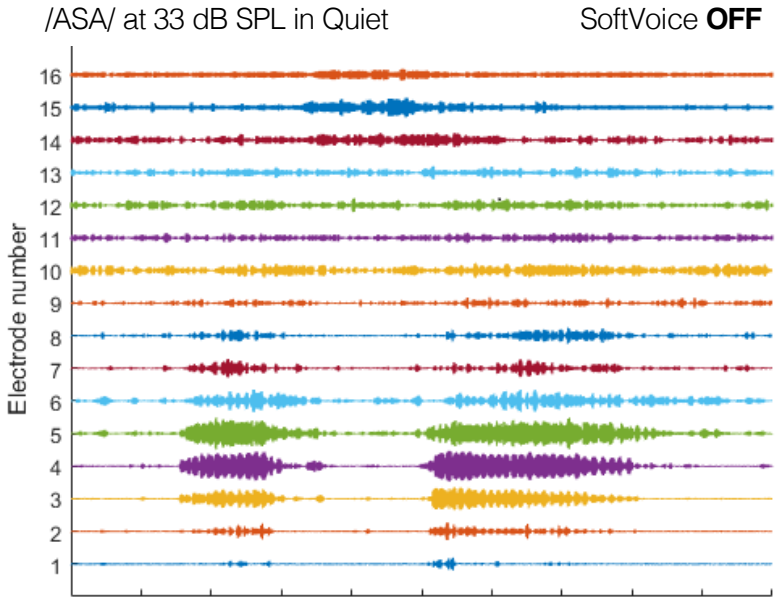
B. Wedding reception

C. Sitting near an air conditioner

D. All of the above

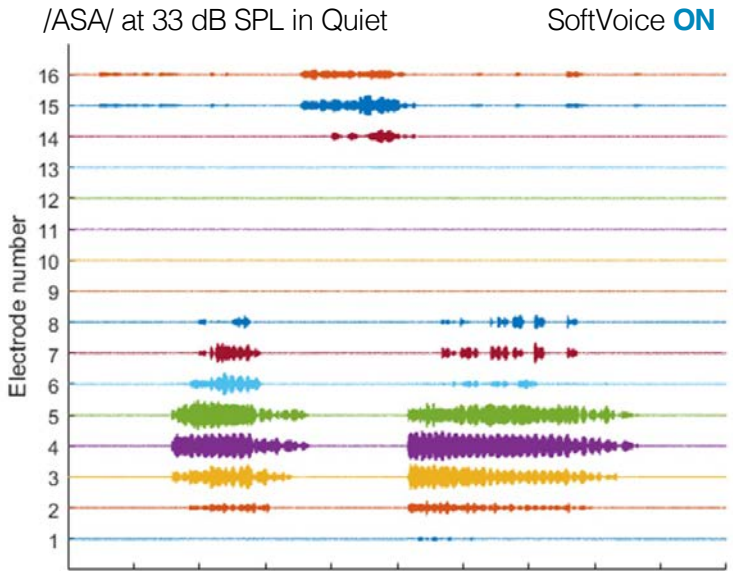
SoftVoice

- Designed to enhance audibility in quiet
- A premium enhancement to the AutoSound OS automatic processing environment
- A sound cleaning feature designed to remove unwanted noise from low intensity input



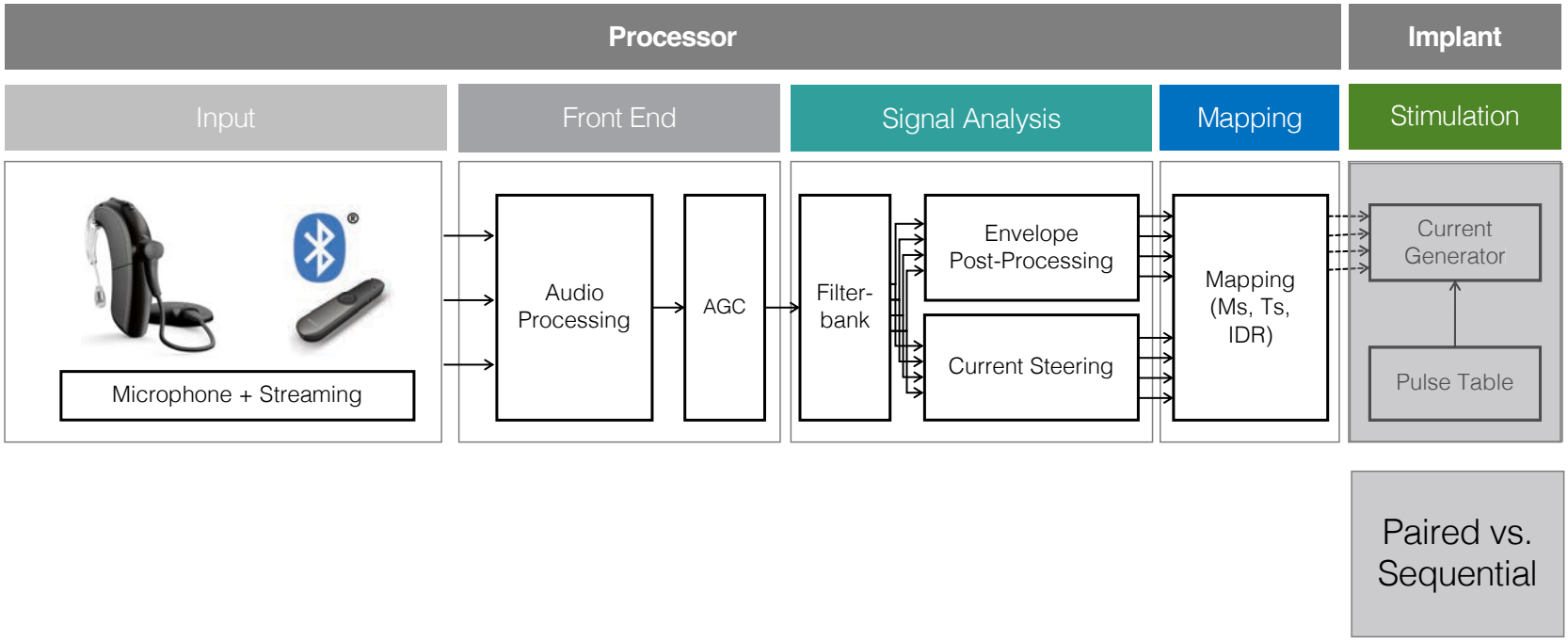
How does SoftVoice work?

- Within each channel, SoftVoice removes low level noise, making it easier to detect soft sounds.
- SoftVoice provides recipients with a greater opportunity to hear meaningful sounds and soft speech.



Stimulation

Sound Processing Pathway



Sequential and Paired Stimulation Strategies

- AB is the only company that offers both a paired and a sequential strategy.
- Both offer unique benefits to recipients.
- Recipients may have a preference.

Sequential Stimulation

- HiRes™ Optima-S*
- HiRes-S with Fidelity 120™*
- HiRes™-S
- Continuous Interleaved Sampler (CIS)

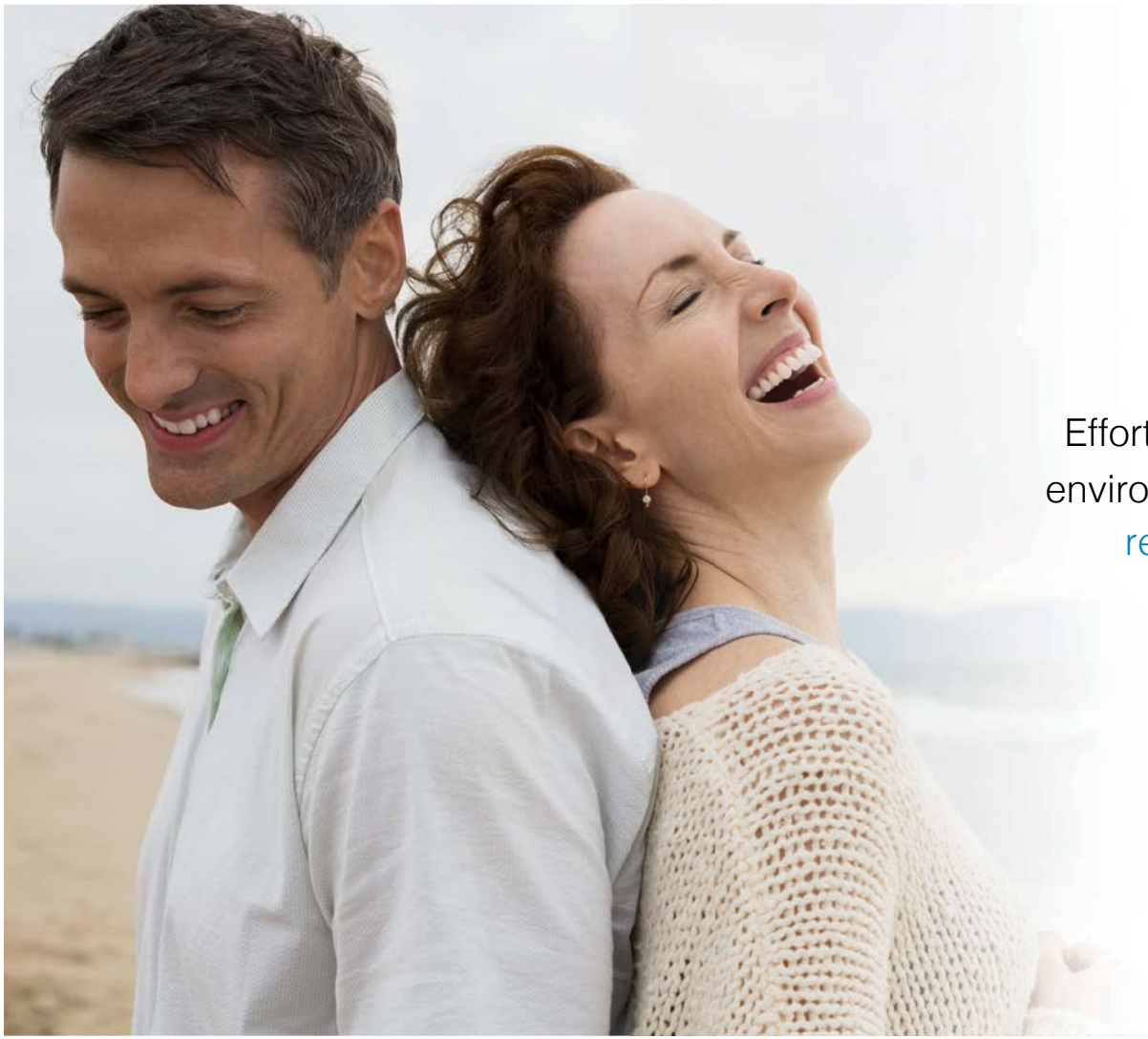
Paired Stimulation

- HiRes™ Optima-P*
- HiRes-P with Fidelity 120™*
- HiRes™-P
- Multiple Pulsatile Sampler (MPS)

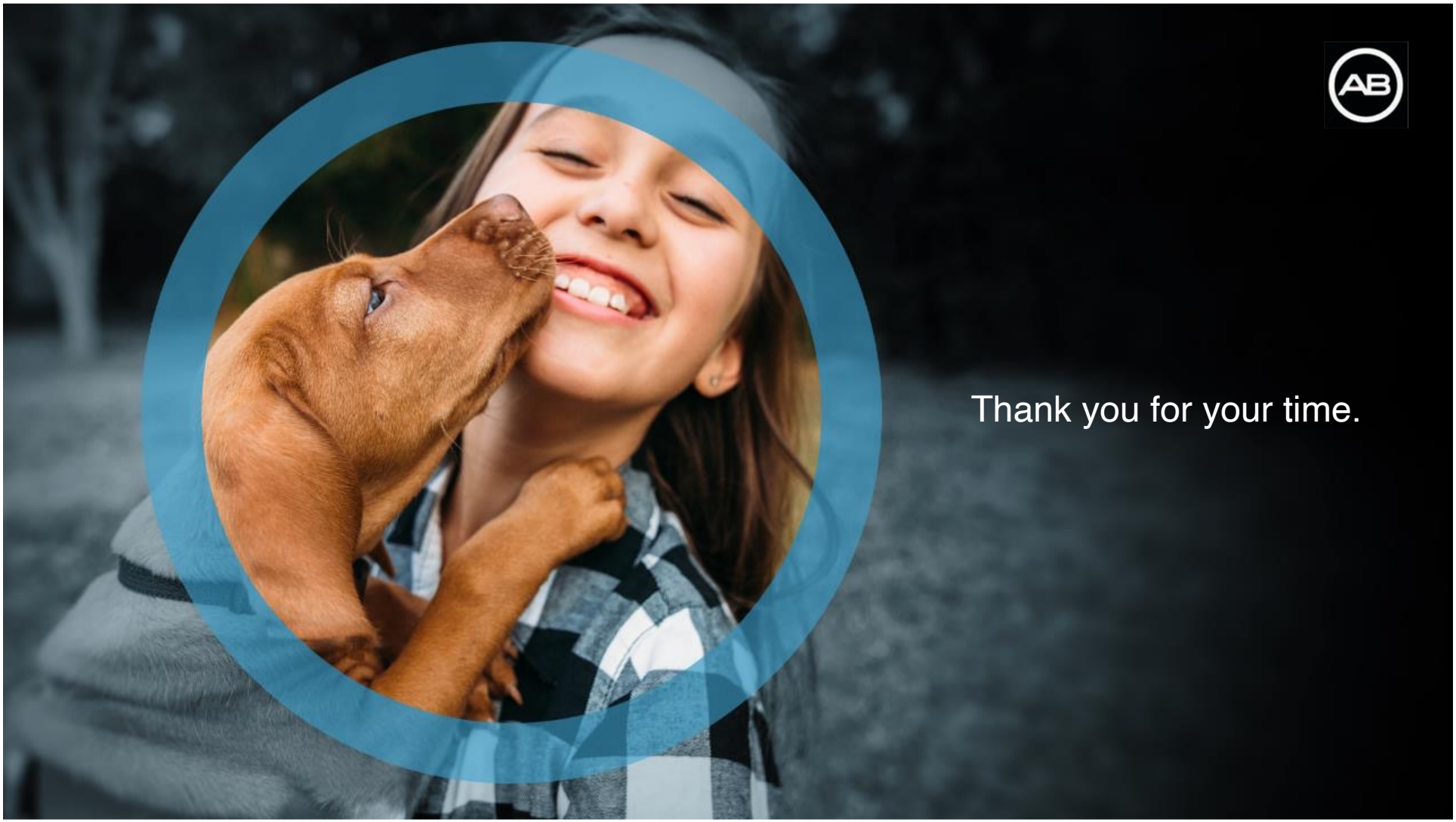
HiFocus™ SlimJ

HiFocus™ Mid Scala

*HiRes Fidelity 120 and HiRes Optima are approved for use in adults and in children over the age of 12 months



Effortless hearing in all acoustic environments with no adjustments required by the recipient


Thank you for your time.

AB Frontend Processing References

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Front-End Processing & Sound Processing

TRAINING OBJECTIVES

By the end of this session, participants will be able to:

- Identify at least three technologies (front end and/or sound processing) that are unique to AB.
- Explain how AutoSense OS benefits your patients.
- Recommend sound processing features that provide improved performance for your patients.

TRAINING TAKEAWAYS

1

2

3

SUPPORTING DATA

Independent research has shown:

- ClearVoice offers equivalent performance in quiet and superior performance in steady-state noise and multi-talker babble.

Marvel CI research has shown:

- AutoSense OS 3.0 and Sky OS 3.0 provide equivalent performance in quiet and superior performance in noise for adult and pediatric recipients.
- Patients preferred streaming quality and ease of use with Marvel CI devices compared to previous generations.

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Rodrigues, T. and Liebe, S. (2018). Phonak AutoSense OS™ 3.0. The new and enhanced automatic operating system. Phonak Insight, retrieved from www.phonakpro.com/evidence, accessed October 17, 2018.
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Marvel CI
CLINICAL TOOLS

ADVANCED BIONICS
POWERFUL CONNECTIONS

Table of Contents

Our Commitment

At Advanced Bionics, our commitment to putting patients first and providing the best possible hearing performance remains at the forefront of what we do. We are honored to have the opportunity to help those with hearing loss enjoy a life without limitations. Marvel CI offers your patients a powerful hearing experience with excellent sound quality in a variety of situations and comes with built-in connectivity solutions. Target CI fitting software is designed for easier, faster, and smarter fittings. It provides a streamlined workflow for a more efficient fitting experience. Remote Programming offers Marvel CI recipients the ability to experience complete programming sessions from a distance.

To fulfill this commitment, we have a dedicated team to support your needs. Please contact your local Advanced Bionics representative who will be glad to assist. We offer:

- CLINICAL SUPPORT: AUDIOLOGICAL, SURGICAL AND REHABILITATIVE
- CUSTOMER SERVICE

Marvel CI
SOUND PROCESSOR

HiRes™ Ultra 3D
COCHLEAR IMPLANT

Phonak Link M
HEARING AID

Phonak CROS P-13
DEVICE

For more information and online resources, please visit
AdvancedBionics.com/MarvelCI

Marvel CI
QUICK REFERENCE GUIDE

Marvel CI sound processors (Naída CI M90, Naída CI M30 and Sky CI M90) offer your patients a powerful hearing experience with excellent sound quality in a variety of situations and comes with built-in connectivity solutions. This guide provides the basic information needed to get started with the fitting, maintenance and troubleshooting.

COMPATIBILITY

Marvel CI sound processors are programmed in the Advanced Bionics Target CI fitting software and are compatible with the following implant types: HiRes Ultra 3D, HiRes Ultra, HiRes 90K Advantage, HiRes 90K and CII.

PRODUCT HIGHLIGHTS

- AutoSense OS™ 3.0 operating system automatically senses the surroundings and adjusts the signal processing to provide optimum clarity and comfort in different listening situations.
- Integrated Bluetooth® and RogerDirect technology allow recipients to stream audio and media wirelessly from their favorite devices. Recipients can stay connected with loved ones with truly hands-free phone calls.
- Unique ergonomic processor and headpiece design for a discreet, comfortable, and secure fit.
- M Waterproof Battery ideal for swimming and outdoor activities.
- Remote programming allows hearing care professionals to provide complete programming sessions in the recipient's own environment.

COMPONENTS

1. M T-Mic™ microphone with cover
2. Sound processor
3. Front microphone
4. Multi-function button with status LED
5. Back microphone
6. M Battery
7. Slim HP with integrated cable

Listening Need	Short Press (< 2 seconds)	Long Press (> 2 seconds[1])
Standard listening	Volume up or down	Program change[2]
During Audio Streaming	Streaming volume up or down	Program change
During Phone Calls	Accept phone call (while ringing) or phone call volume up or down (during call)	Reject phone call (while ringing) or end phone call (during call)

Remote Control Options

For convenient and discreet device management, the AB Remote app, myPhonak app, or myPhonak Junior app allows the recipient to make program and volume adjustments effortlessly. The AB Remote app also helps to perform a simple device check.

1. Pressing the button up or down has the same function.
2. When the multi-function button is used to change programs, whether pressing the top or the bottom part of the rocker, the programs toggle forward. To go backwards, please use the AB Remote app or toggle through the sequence.

Indicator Light (LED) Guide

The indicator light is a programmable feature that provides visual information about the sound processor status, battery life, program position, and sound processor error conditions.

Color	Behavior	Programmable	Indication
	AutoSense: 1 long green blink Program 1: 1 short green blink Program 2: 2 short green blinks Program 3: 3 short green blinks Program 4: 4 short green blinks	Yes	Program Change
	Blinks during use in response to loud input	Yes	Microphones are responding to loud sound
	3 green blinks upon command by fitting software or AB Remote app	No	Detect sound processor
	1 purple blink	Yes	Progressive level change, if enabled
	Blue blinking while streaming audio/media	Yes	Receiving streaming information
	One long orange blink at start-up after battery and program status	No	Flight mode
	Orange blinking	No	Battery status at start-up: 1 orange blink < 20% 2 orange blinks 20-49% 3 orange blinks 50-84% 4 orange blinks 85%+
	Continuous orange blinking	Yes	Low battery
	Solid red	No	Start-up issue/error
	Blinking red, faster than once per second	No	Wrong implant detected
	Blinking red, once per second after start-up	Yes	No lock to implant

CARE AND MAINTENANCE

Daily care and proper use of the sound processor and accessories will result in optimal function over time. Wipe the sound processor and components with a soft dry cloth. Do not immerse, or use solvents e.g. soap. Store the sound processor in the drying case every night. The M T-Mic covers should be replaced at regular intervals.

TROUBLESHOOTING

The checklist below and the AB Remote app will help to systematically troubleshoot the device.

- Perform a device check with the AB Remote app
- Check the indicator light
- Try a different program
- Try a different fully charged battery
- Listen to the device with the M Listening Check
- Check and change the Slim HP
- Check other equipment, e.g., charger, etc.
- Check and change the sound processor

FOR MORE INFORMATION

Refer to the Marvel CI User Guide. Refer to the AB website for wireless technology. For North America, refer to myABonline.com. Check with local AB representative for regulatory approvals and product availability in your area.

Slim Headpiece
QUICK REFERENCE GUIDE

The Slim HP offers comfort and convenience with a low profile design. This guide provides the basic information needed to get started with the fitting, counseling and maintenance of the headpiece.

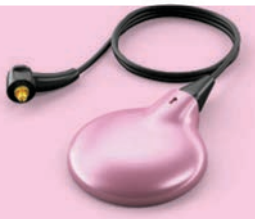
COMPATIBILITY

Implants: HiRes Ultra 3D, HiRes Ultra, HiRes 90K Advantage, HiRes 90K and CII.
Sound processors: Naída CI M90, Naída CI M30, Sky CI M90, Naída CI Q Series and Neptune (compatible with Slim HP AquaMic only).

HEADPIECE OPTIONS

SLIM HP

- No microphone.
- For sound processor on-the-ear use.



SLIM HP MIC

- Integrated microphone.
- For sound processor off-the-ear use.

SLIM HP AQUAMIC

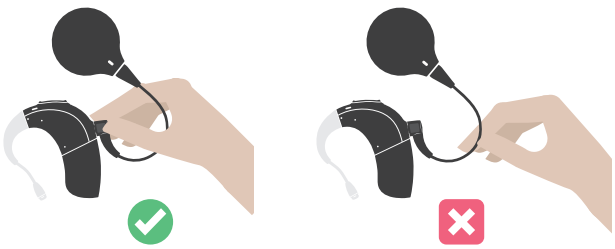
- For use with the M Waperproof Battery for complete protection against moisture, dust.
- Integrated waterproof microphone (water droplet icon on the underside).

COMPONENTS

1. Magnet well
2. 3D Magnet (**BLUE**), Standard Magnet (**BLACK**)
3. Headpiece microphone *(Only available on selected models)*
4. Headpiece cable connector with integrated cable
5. Processor cable connector
6. Color cap
7. Color cap removal tool

OPERATING INSTRUCTIONS

Always hold the cable's strain relief when attaching and removing the headpiece cable from the sound processor.

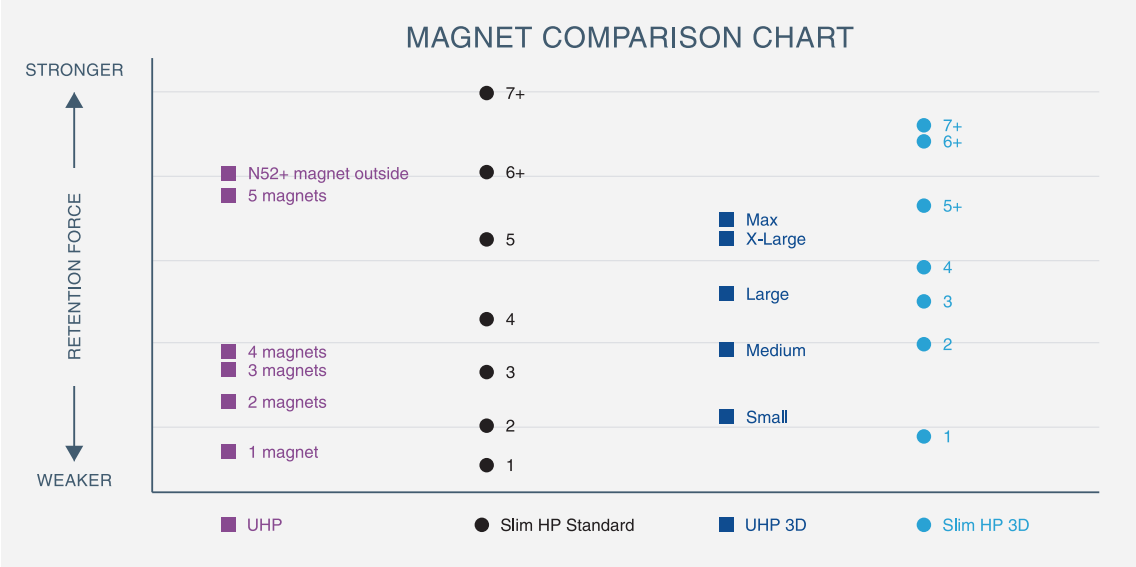


The arrow on the underside indicates the inlet where the removal tool should be inserted to remove the color cap.

MAGNET SELECTION GUIDE

The CI professional is responsible for evaluating the headpiece magnet strength. It is important to use the appropriate magnet strength to avoid discomfort or retention issues. If magnet strength is insufficient, the headpiece may fall off. If magnet strength is excessive, the user may experience irritation or discomfort.

- Slim HP 3D Magnets are **BLUE** for HiRes Ultra 3D implants. The arrow on top of the 3D magnet indicates the direction for alignment: ensure the arrow points up when the Slim HP with 3D magnet is on the recipient's head.
- Slim HP Standard Magnets are **BLACK** for HiRes Ultra, HiRes 90K Advantage, HiRes 90K and CII implants.
- Magnets are labeled from 1 to 7, corresponding to their magnetic strength.
- Insert the appropriate magnet into the magnet well. Ensure the magnet strength number is facing the underside of the Slim HP i.e. towards the patient's implant.



SLIM HP COLOR CAPS

There are two sizes of Color caps that can be used with the Slim HP, Slim HP Mic, and Slim HP AquaMic: **Standard** and **Large**. The Large Color caps are required for strongest magnet strengths (Standard Magnet sizes 6+ and 7+ and 3D Magnet sizes 5+, 6+ and 7+). These stronger magnets are **not recommended for children ages 3 years and younger** , as these color caps and magnets may become displaced if dropped.

CARE AND MAINTENANCE

Daily care and proper use of the sound processor and headpiece will result in optimal function over time. Wipe the sound processor and headpiece with a soft dry cloth and store the sound processor with the headpiece in the equipment case. Use the AB Remote app or M Listening check to troubleshoot and/or assess the microphone sound quality.

Following use of the Slim HP AquaMic in water, rinse the Slim HP AquaMic with clean water. Remove the color cap, wipe the headpiece upper surface with a soft cloth. Place in an appropriate drying system to dry completely overnight.

FOR MORE INFORMATION

Refer to the sound processor and headpiece instructions. For North America, refer to myABonline.com. If further support or information regarding product availability is required, please contact your local AB representative.

Marvel CI
PROGRAMMING GUIDE

Designed for easier, faster, and smarter fitting, Target CI provides an intuitive and streamlined workflow for a more efficient fitting experience.

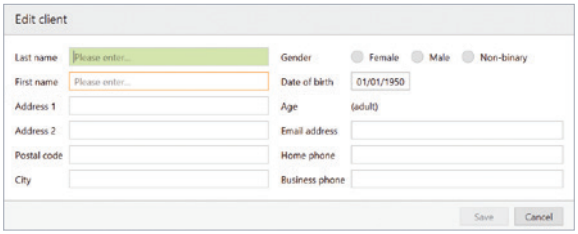
FITTING HARDWARE

Marvel CI processors are programmed in Target CI fitting software, using either the Noahlink Wireless or CPI-3 programming interface.

FITTING GUIDE

Open Target CI and follow the steps below to navigate a **unilateral CI fitting.** Work through the tabs from left to right to complete the required fitting steps.

1. CREATE THE CLIENT FILE



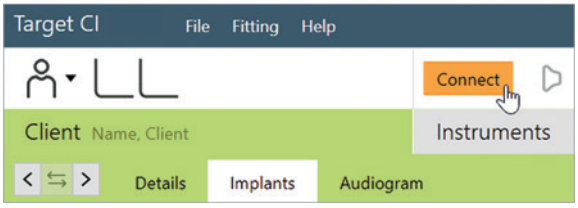
For a New client

- Select *New client*. Enter the client details and *Save*.
- Select *New session* to open a new fitting session.[1]

For an Existing client

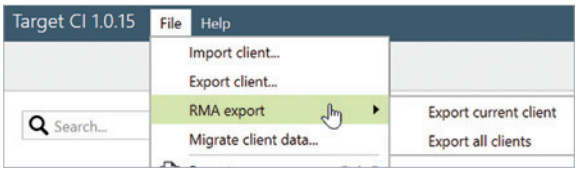
- Search and select the client's file; then, click *Open session*.[2]
- Remote Programming is available for follow-up programming sessions.

2. CONNECT TO THE HEARING INSTRUMENT



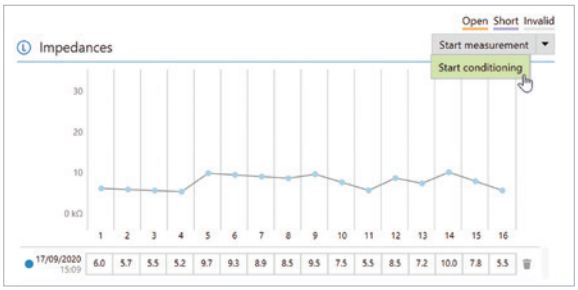
- Connect to the hearing instrument via Noahlink Wireless, CPI-3, or Remote Programming.
- When programming wirelessly, ensure that a fully charged rechargeable battery is used. Remove and re-attach the battery to put the sound processor into pairing mode. Click the *Connect* button within the 3-minute pairing window.
- Verify the side for which the device is intended to be used.
- Once device connection is successful, *Close* to proceed.

3. CONNECT TO THE INTERNAL DEVICE



- Place the headpiece on the recipient's head to achieve lock with the implant.
- For a new client, create a new implant record by clicking on the implant icon and following the prompts to add a new implant.
- Add the required implant information; then, select *Save*.

4. MEASURE IMPEDANCES AND NEURAL RESPONSE IMAGING (NRI)



- Under *Client* access the *Impedance* tab to run impedances and conditioning.
- Access the *NRI* tab to measure NRI, if desired.

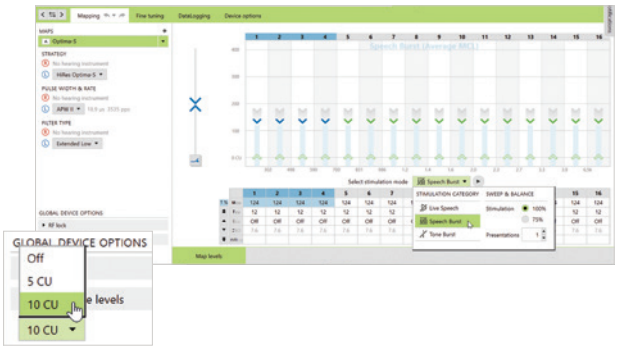
5. SELECT THE ATTACHMENTS

- Under the *Instruments* tab, go to *Acoustic parameters* and ensure that T-Mic/Standard is selected as the appropriate attachment.

1. Always enter the client's ***Date of birth*** so that the appropriate default settings can be applied.
2. Open session should be used at all follow-up visits to allow access to past impedance and NRI data.

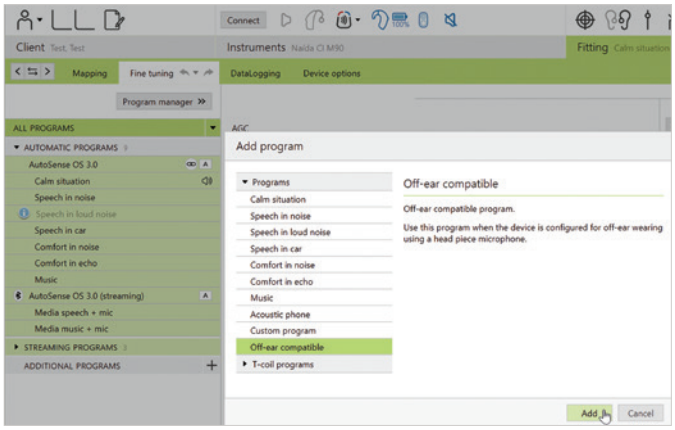
6. CREATE A MAP

- Under *Fitting*, access the *Mapping* tab to set the appropriate map parameters i.e. stimulation strategy, pulse width, etc.
- Select the *Stimulation mode* type to measure M-Levels. T-Levels will default to 10% of the set M-Levels.
- To start and stop stimulation, click the play button, or the "unmute" and "mute" control in the dashboard or press the *F-key*.
- Verify comfort using *Live Speech stimulation*.
- If desired, create progressively louder levels under *Global device options*.[3]



7. FINE TUNING

- *AutoSense OS™ 3.0* operating system offers one easy-to-use automatic program that senses the recipient's listening environment and adjusts the device automatically.
- Confirm settings for the *AutoSense OS* program, as desired.
- Add any *Additional programs [+]*, if required, based on the recipient's unique listening needs. For example, select *Off-ear compatible* for off-ear device usage with the headpiece microphone active.
- Confirm settings in the *Map options* tab, as desired.[4]
- Access the *Program options* tab to fine tune individual programs further, if desired.[5]



8. MANAGE DEVICE OPTIONS

- Access the *Device options* tab to manage Manual controls, Bluetooth®, Signals & alerts, Indicator light, Startup and Datalogging, as needed, based on each recipient's unique preferences.
- For ease of discovering the device during Bluetooth pairing, access the *Bluetooth* tab and label each side with the recipient's name.

9. SAVE AND CLOSE THE SESSION

- Select *Save & close session* to finalize the fitting session.
- Run and review the sound processor *Battery estimation*, if desired.
- Add any notes to the fitting session, if desired.
- Follow the prompts to *Save* the fitting session to the Hearing instruments and/or the Database.
- Select *Close* to complete the fitting session.

If further support is required, please contact your local Advanced Bionics representative.

3. The recipient can adjust the progressive level using the multi-functional button or the AB Remote app.
4. IDR, ClearVoice and SoftVoice settings are applied to all automatic programs and streaming programs.
5. Microphone mode and comfort features can be adjusted in the Program options tab for each individual program, if desired.

Performing NRI in Target CI
PROGRAMMING GUIDE

Neural Response Imaging (NRI) is a valuable tool used by hearing care professionals to obtain an objective measurement of the electrically-evoked compound action potential (eCAP) which can assist with intra-operative testing and post-operative cochlear implant programming. This guide provides the basic information needed to get started with performing NRI in Target CI.

FITTING HARDWARE

NRI can be performed in Target CI fitting software using a Marvel CI sound processor and either the Noahlink Wireless or CPI-3 programming interface. NRI can be conducted during a Remote Programming session also.

PERFORMING NRI MEASUREMENTS

1. OPEN TARGET CI

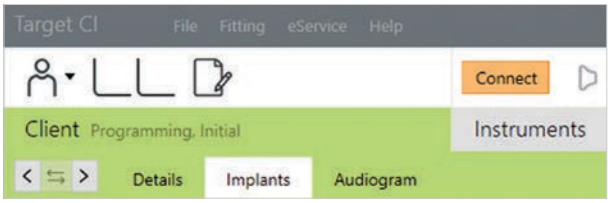
2. ACCESS THE CLIENT FILE AND OPEN A FITTING SESSION

For a New client:

- Select *New client*. Enter the client details[1] and *Save*.
- Select *New session* to open a new fitting session.

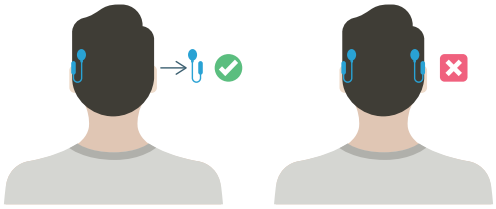
For an Existing client:

- Search and select the client's file; then, select *Open Session*[2].



3. CONNECT TO THE HEARING INSTRUMENT

- Connect to the hearing instrument via Noahlink Wireless, CPI-3, or Remote Programming.
- When programming wirelessly, ensure that a fully charged rechargeable battery is used. Remove and re-attach the battery to put the sound processor into pairing mode. Select the *Connect* button within the 3-minute pairing window.
- Verify the side for which the device is intended to be used.
- Once device connection is successful, *Close* to proceed.



4. CONNECT TO THE INTERNAL DEVICE

- Place the headpiece on the recipient's head to achieve lock with the implant.
- For a new client, create a new implant record.
- Remove the contralateral sound processor[3] prior to running NRI (if applicable). Otherwise, excessive noise will be observed in the NRI tracing.

5. REVIEW IMPEDANCES

- Under *Client*, access the *Impedance* tab to review impedances and run conditioning, if desired.
- Only run NRI on electrodes with normal impedances[4].

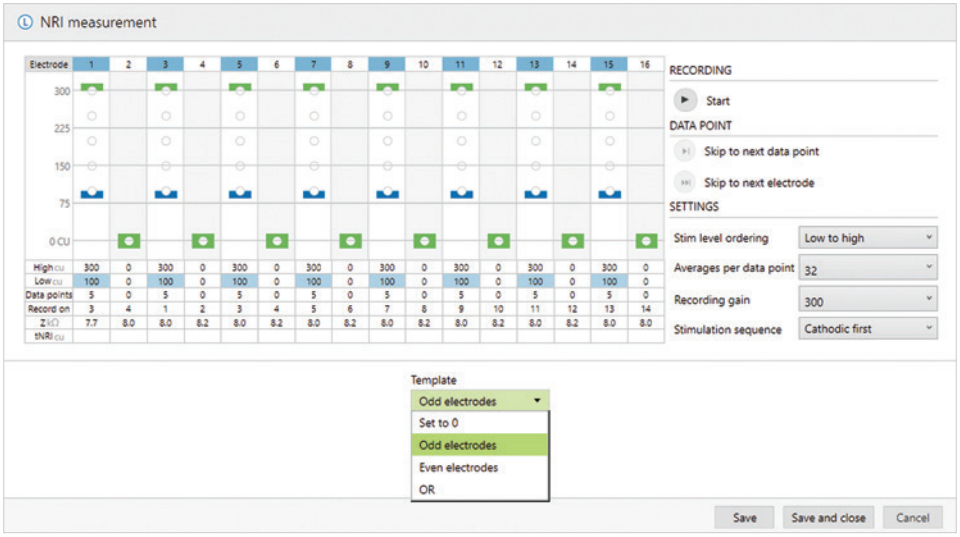
6. ACCESS NEURAL RESPONSE IMAGING (NRI)

- Under *Client*, access the *NRI* tab to measure NRI[5].
- Select *New measurement* to open the NRI measurement window.

1. Always enter the client's Date of birth so that the appropriate default settings can be applied.
2. Open session should be used at all follow-up visits to allow access to past impedance and NRI data.
3. It is okay for the recipient to wear contralateral hearing aid during NRI measurements.
4. Do not perform NRI on extra-cochlear, shorted, open, or out of compliance electrodes.
5. Due to probable impedance changes after surgery, it is best to re-run NRI in the clinic prior to creating new maps for the recipient instead of using NRI data collected in the OR.

7. DETERMINE ELECTRODES TO MEASURE

- Select a template, if desired.



- NRI template settings are automatically applied based on the recipient's age.

Adult NRI Templates

ODD ELECTRODES	EVEN ELECTRODES	OR	SET TO 0
Electrodes: 1, 3, 5, 7, 9, 11, 13, & 15 Low CU = 100 High CU = 300 Data points = 5 Stim Level Ordering = Low to high	Electrodes: 2, 4, 6, 8, 10, 12, 14, & 16 Low CU = 100 High CU = 300 Data points = 5 Stim Level Ordering = Low to high	Electrodes: 3, 7, 11, & 15 Low CU = 150 High CU = 400 Data points = 5 Stim Level Ordering = High to low	Electrodes: 1 – 16 Low CU = 0 High CU = 0 Data points = 0 Stim Level Ordering = Low to high

Pediatric NRI Templates

ODD ELECTRODES	EVEN ELECTRODES	OR	SET TO 0
Electrodes: 1, 3, 5, 7, 9, 11, 13, & 15 Low CU = 50 High CU = 250 Data points = 5 Stim Level Ordering = Low to high	Electrodes: 2, 4, 6, 8, 10, 12, 14, & 16 Low CU = 50 High CU = 250 Data points = 5 Stim Level Ordering = Low to high	Electrodes: 3, 7, 11, & 15 Low CU = 150 High CU = 400 Data points = 5 Stim Level Ordering = High to low	Electrodes: 1 – 16 Low CU = 0 High CU = 0 Data points = 0 Stim Level Ordering = Low to high

8. ADJUST NRI SETTINGS, IF DESIRED

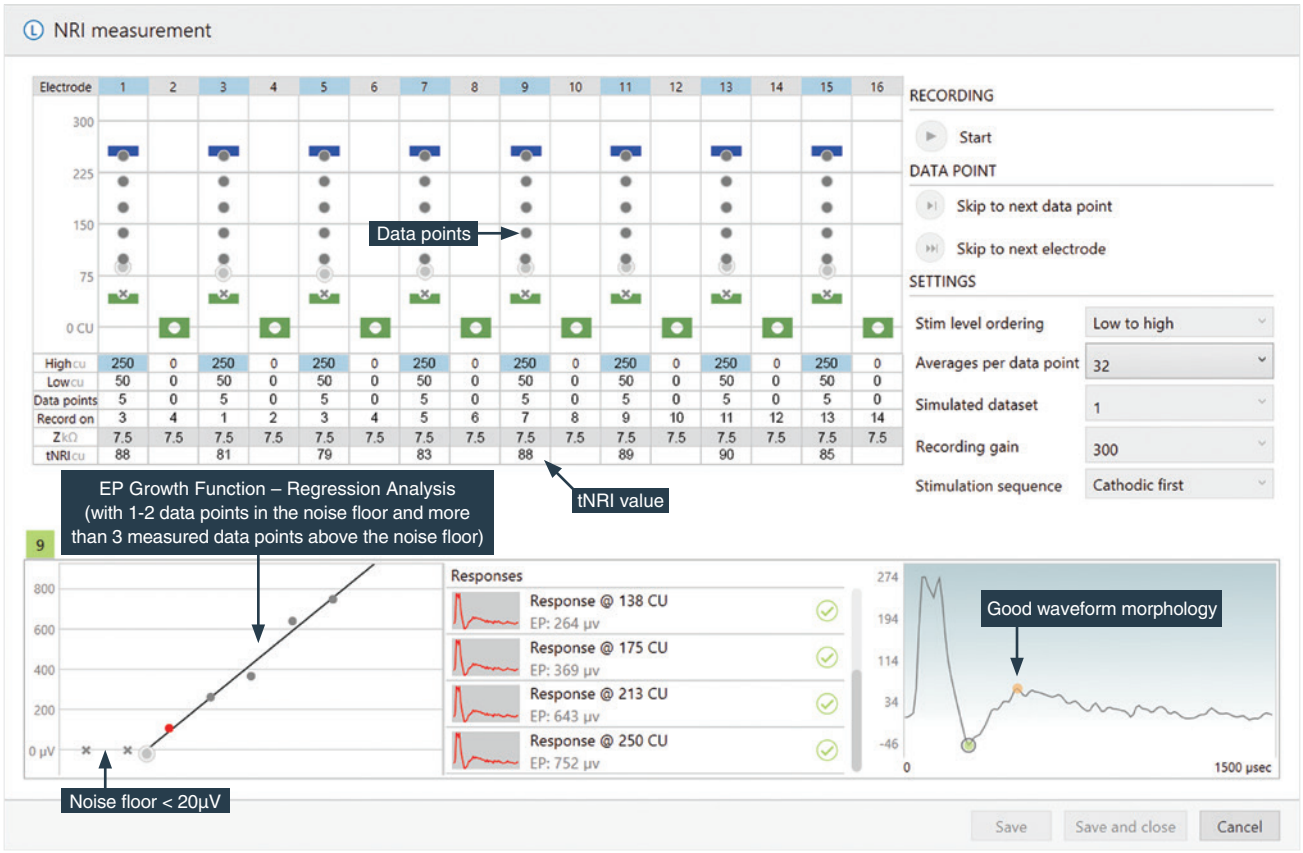
- Set High and Low CU values for electrode(s) to be measured.
  - Behavioral M-Levels can be used as a guide to establish initial low and high CU values.
  - A minimum range of 150 – 200 CU should be considered where the low CU value results in one or two responses within the noise floor.
- Choose number of *Data points*, as appropriate.
  - Target CI will populate 5 data points by default; however more can be added, as needed.
  - Unmeasured data points are indicated by an open circle. Filled data points indicate a completed measurement.
- Choose the appropriate *Stim Level Ordering*.
  - Select Low to High for use in the clinic.
  - Select High to Low for use in the operating room.

9. SELECT START

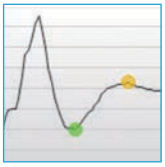
- NRI will continue to conduct measurements until all data points have been obtained.
- When measuring NRI post-operatively, monitor the recipient for signs of discomfort while NRI is running to ensure stimulus levels are not exceeding the recipient's comfort levels.
- Press *Pause* or the *F-key* to stop running a measurement at any time.

Performing NRI in Target CI
PROGRAMMING GUIDE

10. NRI ANALYSIS

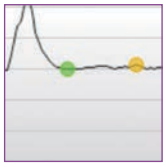


GOOD RESPONSE



- It is important to obtain 1-2 data points within the noise floor and a minimum of 3-4 data points rising from the noise floor for an accurate calculation of tNRI.
- Confirm accuracy of selected N1 and P2 peaks for each waveform. N1 and P2 latencies will remain stable with increased stimulation levels.

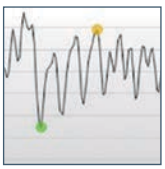
NO RESPONSE



If there is no visible response:

- Increase the stimulation level (up to levels of compliance), while monitoring recipient for comfort.
- Use a different recording electrode to measure the NRI response.

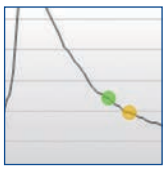
NOISY RESPONSE



If waveform tracing appears noisy:

- For bilateral recipients, confirm that the contralateral processor is removed.
- Increase the number of Averages per data point.

RESPONSE WITH ARTIFACT



If artifact is present, use a different recording electrode to measure the NRI response.

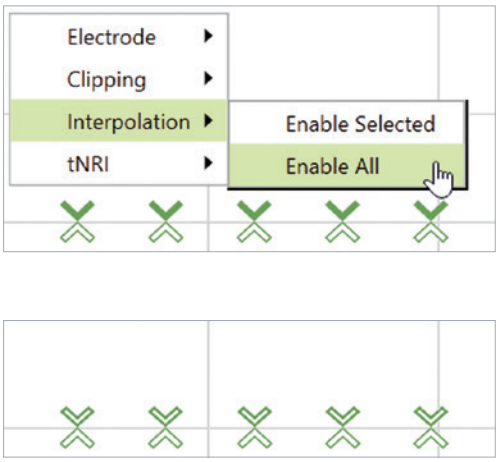
- Verifying correct tNRI values prior to saving and closing the session will ensure correct tNRI values are calculated.
- To repeat measurements in future sessions, use the copy setting function, as shown below.

11. SAVE NRI MEASUREMENT

- *Save and close* the NRI measurement.

FITTING GUIDE

1. CREATE A MAP USING NRI DATA



tNRI markers are displayed in the Mapping tab by default.

- Access the *Fitting* tab to begin the fitting process.
- In the *Mapping* tab, right-click on any channel and select *Interpolation*; then, *Enable all*. All markers will change to unfilled or open arrows.
- On channels with measured tNRI, set M-Levels to tNRI values.
- Confirm *Live Speech* as the stimulation mode.
- Globally reduce the M-Levels slightly to ensure recipient comfort and *Start stimulation*.
- Gradually increase M-Levels to find recipient's most comfortable level (level 6 on the loudness scale).
- Consider loudness balancing across each electrode.
- Verify settings (i.e. Ling Sounds, soundfield detection, etc.).

2. FINALIZE THE FITTING SESSION

- Continue with fitting process by managing program settings in *Fine Tuning Tab*.
- *Save and close* the fitting session.

NEURAL RESPONSE IMAGING (NRI) RESOURCES

- Koch, D. B., Overstreet, E.H. (2003). Neural Response Imaging: Measuring Auditory-Nerve Responses from the Cochlear with the HiResolution™ Bionics Ear System. Advanced Bionics White Paper.
- He, S., Teagle, H., Buchman, C. (2017). The Electrically Evoked Compound Action Potential: From Laboratory to Clinic. *Frontiers in Neuroscience*, Volume 11, Article 339.
- Hughes, M., Audiology Online. *Fundamentals of Clinical ECAP Measures in Cochlear Implants Part 2: Measurement Techniques and Tips.*

Marvel CI Upgrade
PROGRAMMING GUIDE

This guide provides the fitting steps needed to upgrade an existing recipient to Marvel CI.

FITTING HARDWARE

Marvel CI sound processors are programmed in the Target CI fitting software, using either the Noahlink Wireless or CPI-3 programming interface.

FITTING GUIDE

When migrating client data from SoundWave 3.2 to Target CI, it is recommended that individual client files be migrated at the time that each recipient chooses to upgrade to Marvel CI. This ensures that the most recent recipient information is transferred to Target CI at the time of the upgrade.

1. VERIFY SETTINGS IN SOUNDWAVE 3.2

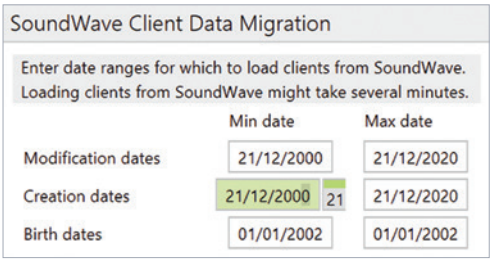
- Ensure that the recipient has a visit history for a Naída CI Q sound processor. Migration will not occur for sound processors prior to Naída CI Q. Only the most recent visit history will be migrated. If there is no Naída CI Q visit history for a given side, that side will not be migrated.
- Ensure the recipient's preferred program is saved to Program Slot 1, as information from Program Slot 1 in the most recent SoundWave 3.2 Visit History will be migrated to Target CI[1].
- Note the client's date of birth in SoundWave 3.2. Close SoundWave 3.2 fitting software[2].

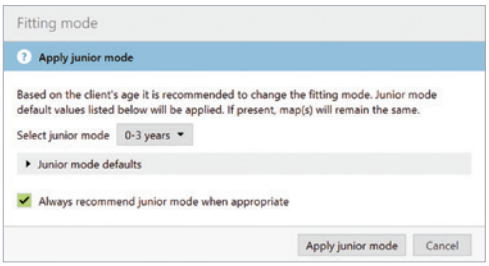
2. OPEN TARGET CI AND MIGRATE CLIENT DATA

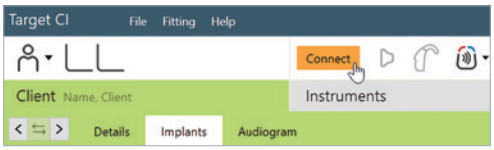
If Target CI is used as standalone software, migrating client data will add a new client to the database.

If Target CI is installed as a Noah module, it's necessary to first enter the recipient demographic information into Noah, select the client, and open a new fitting session.

- In Target CI access the *File* menu and select *Migrate client data*[3].
- Enter the required information in the *SoundWave Client Data Migration* window (Modification dates, Creation dates, Birth dates).
  - Enter the date of birth accurately.
  - Enter a wide Modification[4] and Creation date under the Min date e.g. dd/mm/2000; then, click Start.
- Verify the client's name. Confirm that the appropriate sound processor is chosen for the upgrade.
- Click *Start* and follow any prompts.
- The session is now available in the client file. The *Notes* section of the client details will indicate the session was migrated[5,6].







For pediatric Marvel CI upgrades:

- Target CI will ask if the hearing care professional wants to apply *Junior mode* default settings (based on the client's age) to the map.
- Target CI will prompt the hearing care professional to choose between *Create new fitting* or *Keep current mapping parameters and match Junior mode defaults*.
- Select *Keep current mapping parameters and match Junior mode defaults* to maintain the recipient's current map parameters.
- Select *Create new fitting* to reset the recipient's map parameters.

3. CONNECT TO THE HEARING INSTRUMENT

- Connect to the hearing instrument via Noahlink Wireless, CPI-3, or Remote Programming.
- When programming wirelessly, ensure that a fully charged rechargeable battery is used. Remove and re-attach the battery to put the sound processor into pairing mode. Click the *Connect* button within the 3-minute pairing window.
- Verify the side for which the device is intended to be used.
- Once device connection is successful, *Close* to proceed.

1. The SoundWave 3.2 file must have a Visit History and Intellilink™ enabled in order to migrate the recipient information.
2. It is important to close both SoundWave 3.2 and Target CI between migration. This ensures that the most current data is migrated from SoundWave 3.2 to Target CI.
3. Migrate one patient file at a time.
4. Modification date is the date the most recent visit history was created.
5. Client files will not be migrated if the recipient has no active implants or is identified as a test patient.
6. If the SoundWave file contains a C1 implant, the C1 data will not be migrated. If the recipient is bilateral, only data for a non-C1 implant will be migrated.

4. CONNECT TO THE INTERNAL DEVICE

- Place the headpiece on the recipient's head to achieve lock with the implant. Lock must be achieved prior to making any changes to the *Implants* tab. If lock is not achieved, the sound processor will not stimulate the implant and the fast blinking red LED will be observed.

5. SELECT THE APPROPRIATE ATTACHMENT

- Under the *Instruments* tab, go to *Acoustic parameters* and ensure that *T-Mic/Standard* is selected as the appropriate attachment.

6. MEASURE IMPEDANCES AND NEURAL RESPONSE IMAGING (NRI)

- Impedances will run automatically. Under *Client*, access the *Impedance* tab to run impedances.

7. VERIFY THE MAP SETTINGS AND COMFORT

- Under the *Fitting* tab, access *Mapping* to verify the electrical parameters like M-Levels and T-Levels, Strategy, Pulse Width, IDR, etc.The settings in the table below should be considered.
- Verify comfort using *Live Speech stimulation*.

The following settings from the SoundWave 3.2 data migration should be considered:

SETTINGS PRESERVED FROM SOUNDWAVE

- M-Levels / T-Levels
- ClearVoice – If Enabled in SoundWave 3.2, will be set to Medium in Target CI.
- SoftVoice
- IDR
- Disabled / Spanned / Clipped electrodes
- Strategy
- Filter type
- RF (Set to AutoVoltage or Manual)
- Electrical gain settings

RE-EVALUATE IN TARGET CI

- **Acoustic parameters** – The audiogram must be manually entered in Target CI.
- **Pulse Width** – May be impacted by New Impedance Measurement.

SETTINGS DIFFERENT IN TARGET CI

- **Program structure** – AutoSense OS now available
- **T-Mic + Processor Mic** – This microphone option is not available for Marvel CI

CANNOT BE MODIFIED IN TARGET CI

- QuickSync is always enabled
- Volume Min/Max (±20%)

8. FINE TUNING

- Access the *Fine tuning* tab to verify the program settings. Confirm settings in the *Map options* tab, as desired.
- Access the *Program options* tab to fine tune individual programs further, if desired.

9. MANAGE DEVICE OPTIONS

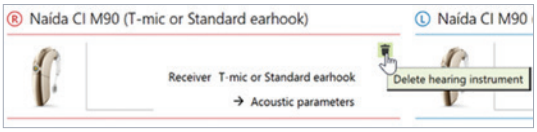
- Access the *Device options* tab to manage Manual controls, Bluetooth®, Signals & alerts, Indicator light, Startup and Datalogging, as needed, based on each recipient's unique preferences.
- For ease of discovering the device during Bluetooth pairing, access the *Bluetooth* tab and label each side with the recipient's name.

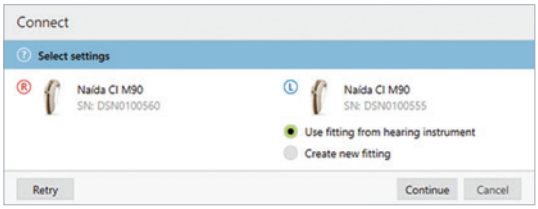
10. SAVE AND CLOSE THE SESSION

- Select *Save & close* to finalize the fitting session.
- Run and review the sound processor *Battery estimation*, if desired.
- Add any notes to the fitting session, if desired.
- Follow the prompts to *Save* the fitting session to the Hearing instruments and/or the Database . Select *Close* to complete the session.

BILATERAL RECIPIENTS UPGRADING ONLY ONE SIDE TO MARVEL CI

- When migrating a recipient's SoundWave 3.2 file into Target CI, data from both sides are migrated over. For a simpler fitting experience, it may be helpful to delete the hearing instrument on the side that you do not intend to upgrade, in the *Hearing Instruments* tab.
- Access the *Fine Tuning* tab. Under *Automatic programs*, ensure *Speech in loud noise* is not enabled (this program requires a compatible hearing instrument on the contralateral ear).





When upgrading the second side to Marvel CI:

- Simply repeat the migration of the recipient's SoundWave 3.2 file into Target CI.
- When connecting to the hearing instruments, select *Use fitting from hearing instrument* on the side that was previously upgraded. Select *Continue* to proceed with the fitting.

Phonak CROS-13
QUICK START GUIDE

MARVEL FROM EAR TO EAR!

Advanced Bionics and Phonak work together to provide every recipient with a two-ear hearing solution. Phonak CROS P-13 is available for Marvel CI recipients with unaidable hearing in the non-implanted ear.

1 CROS 2 MARVEL CI

1. CROS wirelessly transmits the microphone input signal from the non-implanted ear to the Marvel CI sound processor.
2. Marvel CI receives the signal and delivers it to the implanted ear.

Marvel CI + CROS provides recipients with access to sound from both sides and allows them to hear their best in all environments.

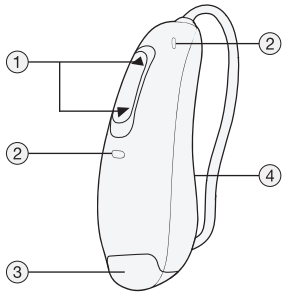
COMPATIBILITY

CROS is compatible with the Naída CI M90/30 and Sky CI M90. CROS can be programmed with Target CI v1.5 or later, and Noahlink Wireless.

OVERVIEW

PRODUCT COMPONENTS

1. Multifunction Button
2. Microphones
3. Battery Compartment
4. Right or Left Indicator

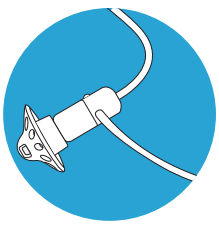


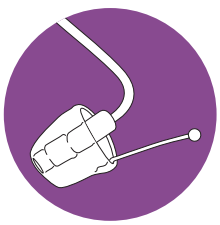
EARPIECE OPTIONS

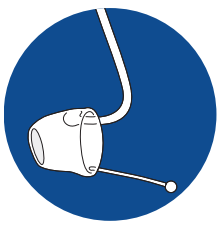
Standard Dome (CROS Tube)
- Dome available in three sizes (S, M, L)
- Right and Left
- Available in four lengths (0, 1, 2, 3)

SlimTip (CROS Tube)
- Custom-made earpiece
- Right and Left
- Available in four lengths (0, 1, 2, 3)

CROS Tip
- Fully custom-made earpiece
- Available in four lengths (0, 1, 2, 3)







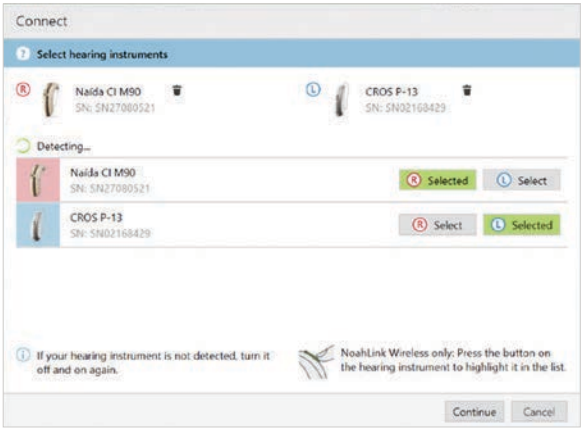
WIRELESS COMMUNICATION

When using wireless accessories or smartphones, both will stream directly to Marvel CI. When the signal from a wireless accessory or smartphone is present, the CROS signal will pause. When the signal from the wireless accessory or smartphone has stopped, the CROS signal will resume.

FITTING GUIDE

PROGRAMMING PHONAK CROS P-13

- Connect hearing instruments.
  - Open Target CI v1.5 or later.
  - Select the orange Connect button at the top of the screen.
  - Assign sides for each hearing instrument, select Continue.
    NOTE: Target CI will identify if a firmware update is required. Follow steps to perform update as indicated in Target CI.
- Proceed with programming.
- Complete the programming session.
  - Select Save & Close at the top right corner of the screen.
    NOTE: During the saving process, CROS cannot be unchecked.
    NOTE: The wireless connection between CROS transmitter and Marvel CI starts automatically once both instruments are disconnected from the software and turned on.

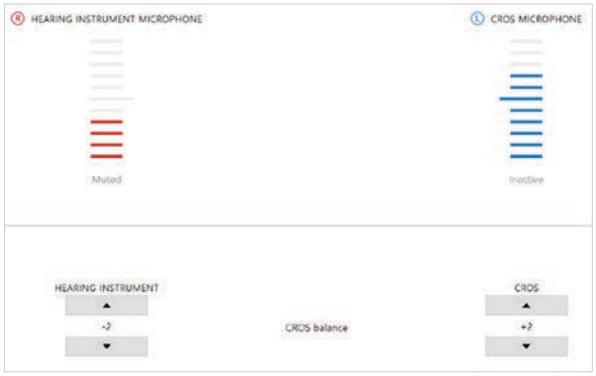


OPTIONAL CROS PROGRAMMING CONSIDERATIONS

- Select Acoustic Parameters in the Instruments tab to choose an earpiece, as needed.
- Choose Program Options within the Fitting tab to adjust or confirm CROS microphone mode, as needed.
- Adjust CROS Balance within the Fitting tab, as needed, per the directions below.

CROS BALANCE

- Select *CROS Balance*.
  NOTE: Adjustment to CROS balance is applied across all programs.
- Confirm CROS has been unmuted at the top of the dashboard.
  NOTE: When CROS is initially unmuted, a notification to enable Binaural VoiceStream Technology™ will appear.
- Adjust the loudness balance between CROS and Marvel CI sound processor by manipulating the up and down arrow keys beneath the hearing instruments.
  NOTE: A change to one hearing instrument will result in a change to both sides simultaneously.



REMOTE PROGRAMMING CONSIDERATIONS FOR CROS

PROGRAMMING PHONAK CROS P-13

- Open Target CI and select *Start Remote Support*.
  NOTE: During Remote Programming, CROS is not connected but remains active throughout the session. A new CROS instrument cannot be added during a Remote Programming session.
- Connect Marvel CI sound processor.
- Proceed with programming.
  NOTE: All adjustments made to CROS programming during a Remote Programming session will save to the Marvel CI sound processor.
- Select *Save and Close* before ending the remote session.

If you require more information about programming CROS, please contact your local AB support.

Marvel CI Bimodal Solution
PROGRAMMING GUIDE

Target CI is designed for easier, faster, and smarter fitting. Target CI is the first hearing care software to allow the fitting of a sound processor and compatible hearing aid at the same time in one fitting software. It provides a streamlined workflow for an efficient bimodal fitting experience.

COMPATIBILITY

- The Naída Link M hearing aid is compatible with the Naída CI M90 sound processor.
- The Sky Link M hearing aid is compatible with the Sky CI M90 sound processor.

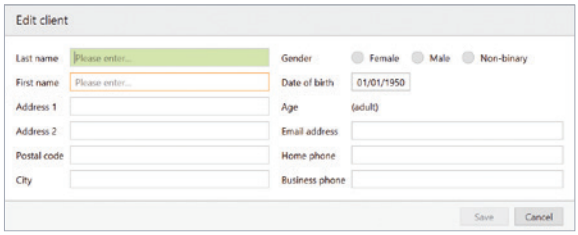
FITTING HARDWARE

Marvel CI sound processors and hearing aids can be programmed in the Target CI fitting software, using the Noahlink Wireless.

FITTING GUIDE

Open Target CI and follow the steps below to navigate the fitting of both Marvel devices in one session. Work through the tabs from left to right to complete the required fitting steps.

1. CREATE THE CLIENT FILE



For a New client:

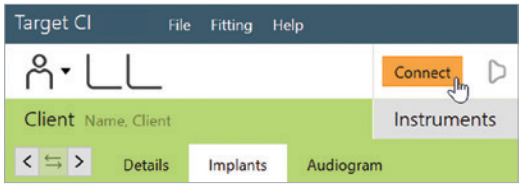
- Select *New client*. Enter the client details[1] and *Save*.
- Select *New session* to open a new fitting session.

For an Existing client:

- Search and select the client's file; then, select *Open Session*[2].

2. CONNECT TO THE HEARING INSTRUMENTS

- Connect to both hearing instruments via Noahlink Wireless or Remote Programming.
- When programming wirelessly, ensure that fully charged batteries are used for both devices. Remove and re-attach the battery to put the devices into pairing mode. Click the *Connect* button within the 3-minute pairing window.
- Verify the sides for which each device is intended to be used.
- Once the device connections are successful, *Close* to proceed.

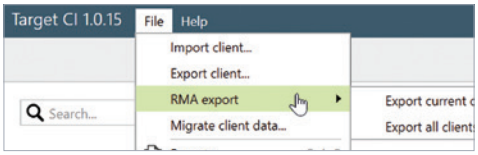


3. CONNECT TO THE INTERNAL DEVICE

- Place the headpiece on the recipient's head to achieve lock with the implant.
- For a new client, create a new implant record by clicking on the implant icon and follow the prompts to add a new implant.
- Add the required implant information; then, select *Save*.

4. MEASURE IMPEDANCES AND NEURAL RESPONSE IMAGING (NRI)

- Under *Client* access the *Impedance* tab to run impedances and conditioning.
- Access the *NRI* tab to measure NRI, if desired.



5. ENTER THE AUDIOGRAM

- Access the *Audiogram* tab to enter the client's latest audiogram[3]. Select the transducer type used.
- Optional: AudiogramDirect allows the measurement of an audiogram via the hearing aid and acoustic coupling. To access it, click *AudiogramDirect* > *Start* and follow the prompts.

6. SELECT THE APPROPRIATE ATTACHMENTS

- Under the *Instruments* tab, access the *Acoustic Parameters*, select the *Attachment* for the sound processor.
- For the hearing aid, select the appropriate earpiece option.

1. Always enter the client's Date of birth so that the appropriate default settings can be applied.
2. Open session should be used at all follow-up visits to allow access to past impedance and NRI data.
3. If using Noah, enter client details and audiogram in Noah, prior to accessing Target CI.

7. PERFORM THE FEEDBACK AND REAL EAR TEST

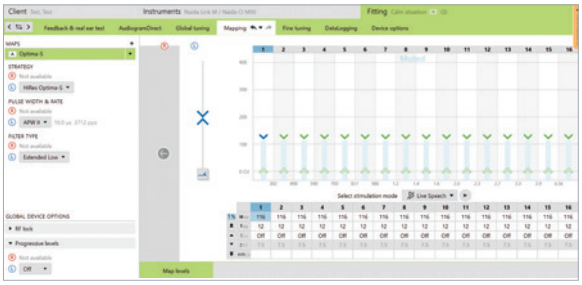
- Under the *Fitting* tab, access *Feedback & real ear test*.
- Instruct the patient to remain quiet for the duration of the measurement.
- Select *Start* to run the feedback management test.

8. PERFORM GLOBAL TUNING AND SELECT FITTING FORMULA

- Access the *Global tuning* tab to confirm the fitting formula and to view acoustic gain[4].
- Consider using the *Adaptive Phonak Digital Bimodal fitting formula*, as appropriate.

9. CREATE A MAP AND VERIFY SOUND QUALITY OF THE SOUND PROCESSOR

- Under *Fitting*, access the *Mapping* tab to set the appropriate map parameters (i.e. stimulation strategy, pulse width, etc.).
- Select the *Stimulation mode* type to measure M-Levels. T-Levels will default to 10% of the set M-Levels.
- To start and stop stimulation, click the play button, or the "unmute" and "mute" control in the dashboard, or press the F-key on the keyboard.
- Verify comfort using *Live Speech stimulation*.
- If desired, create progressively louder levels under *Global device options*.
- If desired, create additional Maps under *Mapping*.



10. FINE TUNE THE HEARING AID SETTINGS

- Access the *Fine tuning* tab. Then, select the *Gain & MPO* tab to manage acoustic settings for the hearing aid.

11. FINE TUNE BOTH DEVICES IN PROGRAM OPTIONS

- Access the *Program options* tab to fine tune individual programs further, if desired[5].
- Microphone mode and comfort features can be adjusted for each individual program, if desired.
- Add any *Additional programs [+]*, if needed, based on the client's unique listening needs.

12. MANAGE DEVICE OPTIONS

- Access the *Device options* tab to manage Manual controls, Bluetooth®, Signals & alerts, Indicator light, Startup and Datalogging, as needed, based on each recipient's unique preferences.
- For ease of discovering the device during Bluetooth pairing, access the *Bluetooth* tab and label each side with the recipient's name.
- Consider assigning the Bluetooth Side to the side with better hearing and/or longer battery life.

13. SAVE & CLOSE THE SESSION

- Select *Save & close* to finalize the fitting session.
- Run and review the sound processor *Battery estimation*, if desired.
- Add any notes to the fitting session, if desired.
- Follow the prompts to *Save* the fitting session to the Hearing instruments and/or the Database.
- Select *Close* to complete the fitting session.

If further support or information regarding product availability is required, please contact your local AB representative.

4. The gain level and compression settings are based on the user's experience.
5. By default, the settings are applied to both the CI and HA; however, settings for each device can be customized by unlinking the devices.

M Acoustic Earhook
QUICK REFERENCE GUIDE

The M Acoustic Earhook coupled with the Marvel CI sound processor is designed for CI candidates and recipients who have aidable low frequency hearing in the implanted ear. This solution provides acoustic amplification of the low frequencies via hearing aid technology, in combination with electrical stimulation of the high frequencies in the same ear via cochlear implant technology. M Acoustic Earhook takes advantage of natural acoustic hearing to provide the benefits of combined stimulation to recipients with unilateral or bilateral Marvel CI(s).

COMPATIBILITY

The M Acoustic Earhook is compatible with the Naída™ CI M90 and Sky CI™ M90 sound processors.

COMPONENTS

1. M Acoustic Earhook
2. Receiver
3. Sound processor
4. M Battery
5. Front microphone
6. Back microphone
7. Multi-function button with status LED
8. CeruShield™ Disk
9. Pin removal tool
10. Connector pin

EARPIECE OPTIONS

Custom SlimTip[1]

Custom fit recommended for moderate or greater hearing loss for better retention, comfort and protection of the receiver.

Power dome

Suitable for moderate hearing loss. Offers a tighter fit than the Vented dome.

Vented dome

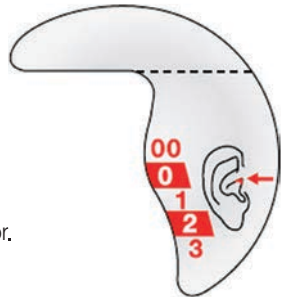
Suitable for mild-to-moderate hearing loss. Beneficial if occlusion is a concern.

1. Ordered from Phonak. Availability varies by region.

ASSEMBLING THE M ACOUSTIC EARHOOK

Follow the steps below to setup the device appropriately:

- The M Acoustic Earhook is available in 5 different lengths (00, 0, 1, 2, 3) for either the left or right ear.
- The Measurement Tool helps to determine the appropriate length of the Acoustic Earhook to accommodate different ear shapes and sizes.
- The Pin Removal Tool is used for attaching the M Acoustic Earhook to and from the sound processor.
- Confirm that a CeruShield wax filter is inside the receiver. The receiver ships with a wax filter already inserted.
- Select a suitable earpiece option to attach to the receiver of the M Acoustic Earhook. Ensure a comfortable fit and seal in the ear canal for good retention. When mounting the earpiece on to the receiver, there is a tactile click upon attachment.



Measurement Tool

CARE AND MAINTENANCE

Earwax Protection

- The M Acoustic Earhook is equipped with a CeruShield wax filter to protect the receiver from earwax damage.
- Check the earwax protection regularly and exchange it if it looks dirty or if sound quality is reduced.
- The CeruShield earwax filter should be replaced at least every four to eight weeks.

CeruShield Disk

General Care

- When not in use, store the sound processor and M Acoustic Earhook in the equipment case provided.
- Ensure the M Acoustic Earhook is not placed within proximity of the headpiece magnet, as the magnet may damage the receiver.
- Visually inspect the device daily for earwax and moisture deposits in the M Acoustic Earhook.
- Wipe the earpiece daily with a dry tissue.
- If a dome is used, it should be replaced every three months, or when it becomes brittle.
- To clean the M Acoustic Earhook:
  - Remove the dome from the receiver.
  - Using a lint-free cloth or moist cleansing wipe, gently clean the dome and receiver unit. Never use cleaning agents such as household detergents.
  - Prior to reattaching the dome to the receiver, ensure that all parts are completely dry.

FOR MORE INFORMATION

Refer to the M Acoustic Earhook Instruction For Use. If further support is required, please contact your local AB representative. They will provide information regarding regulatory approval and product availability in your region.

M Acoustic Earhook
PROGRAMMING GUIDE

The M Acoustic Earhook allows recipients to take advantage of any usable acoustic hearing in the implanted ear.

FITTING HARDWARE

Marvel CI sound processors with M Acoustic Earhook are programmed in the Target CI fitting software, using either the Noahlink Wireless or CPI-3 programming interface.

FITTING GUIDE

Open Target CI and follow the steps below to navigate fitting of Naída™ CI M90 or Sky CI™ M90 sound processors with the M Acoustic Earhook. Work through the tabs from left to right to complete the required fitting steps.

1. CREATE THE CLIENT FILE

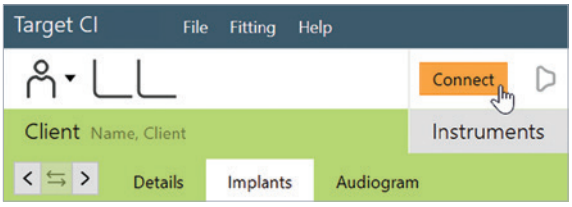
For a New client:

- Select *New client*. Enter the client's details[1] and *Save*.
- Select *New session* to open a new fitting session.

For an Existing client:

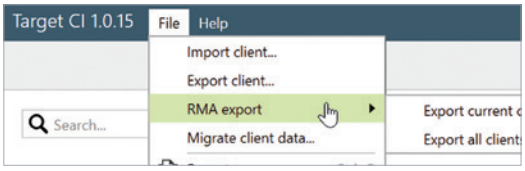
- Search and select the client's file; then, select *Open Session*[2].

2. CONNECT TO THE HEARING INSTRUMENTS



- Connect to the hearing instrument(s) via Noahlink Wireless, CPI-3, or Remote Programming.
- When programming wirelessly, ensure that a fully charged rechargeable battery is used. Remove and reattach the battery to put the sound processor into pairing mode. Click the *Connect* button within the 3-minute pairing window.
- Verify the sides for which each device is intended to be used.
- Once the device connection is successful, *Close* to proceed.

3. CONNECT TO THE INTERNAL DEVICE



- Place the headpiece on the recipient's head to achieve lock with the implant.
- For a new client, create a new implant record by clicking on the implant icon and follow the prompts to add a new implant.
- Add the required implant information; then, select *Save*.

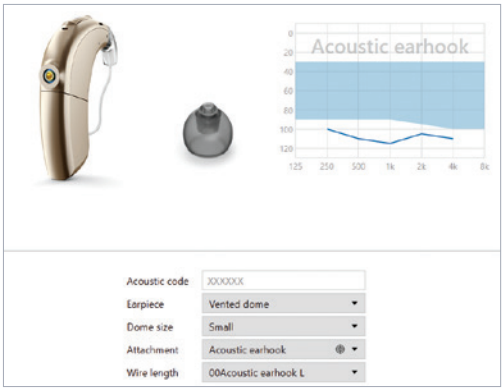
4. MEASURE IMPEDANCES AND NEURAL RESPONSE IMAGING (NRI)

- Under *Client*, access the *Impedance* tab to run impedances and conditioning.
- Access the *NRI* tab to measure NRI, if desired.

5. ENTER THE RECIPIENT'S LATEST AUDIOGRAM

- Access the *Audiogram* tab to enter the client's latest audiogram[3]. Select the transducer type used.
- AudiogramDirect allows the measurement of an audiogram via the M Acoustic Earhook . To access it, click *AudiogramDirect > Start* and follow the prompts.

6. SELECT THE APPROPRIATE ATTACHMENTS



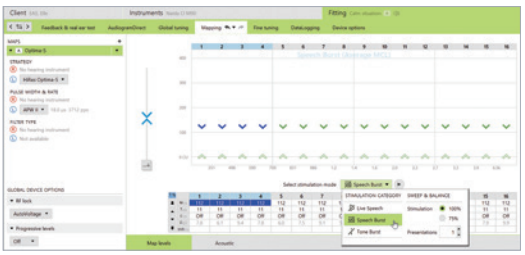
- Under the *Instruments* tab, access the *Acoustic Parameters*, select *Acoustic Earhook,* the appropriate earpiece, dome size, and wire length.
- For optimal fitting, *SlimTip* is recommended (order from Phonak).

7. PERFORM THE FEEDBACK AND REAL EAR TEST

- Under the *Fitting* tab, access *Feedback & real ear test*.
- Instruct the patient to remain quiet for the duration of the measurement.
- Select *Start* to run the feedback management test.

1. Always enter the client's Date of birth so that the appropriate default settings can be applied.
2. Open session should be used at all follow-up visits to allow access to past impedance and NRI data.
3. If using Noah, enter the client's details and audiogram in Noah, prior to accessing Target CI.

8. PERFORM GLOBAL TUNING AND SELECT FITTING FORMULA



- Access the *Global tuning* tab to confirm the fitting formula and to view acoustic gain.
- Consider using the *Adaptive Phonak Digital Bimodal fitting formula*, as appropriate.

9. CREATE A MAP FOR THE ELECTRIC MODE

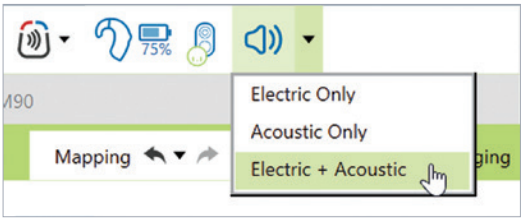
- Under *Fitting*, access the *Mapping* tab, set the appropriate electric parameters (i.e. stimulation strategy, pulse width, etc.).
- Select the *Stimulation mode* type to measure M-Levels. T-Levels will default to 10% of the set M-Levels.

If electrodes are extra-cochlear:

- Disable electrodes which are suspected to be located outside the cochlea.
- Disable the first electrode located inside the cochlea (e.g. if electrodes 15 and 16 are outside the cochlea, disable electrodes 14 -16 in the map).
- Check M-Level on remaining active electrodes using tone burst stimulation. If the recipient reports sound as uncomfortably loud or unpleasant (e.g. tinny, shrill), reduce M-Level to a comfortable level[4].

10. SET ACOUSTIC AND ELECTRIC CUTOFF FREQUENCIES

- Select the *Acoustic* tab to access acoustic and electric cutoffs.
- The electric cutoff will default to the point at which r ecipient's unaided threshold exceeds 70 dB HL. The acoustic cutoff will default to the point at which the unaided threshold exceeds 90 dB HL.



11. VERIFY SOUND QUALITY AND COMFORT

- Click the dropdown next to the *Mute/Unmute* icon, to stimulate *Electric only*, *Acoustic only*, or *Electric + Acoustic* together.
- Verify sound quality and comfort using live speech stimulation.

12. FINE TUNING

- Access *Fine tuning* to confirm settings, as desired.
- Access the *Gain & MPO tab* to set acoustic gains and maximum acoustic earhook output.

13. MANAGE DEVICE OPTIONS

- Access the *Device options* tab to set controls and alerts according to the recipient's preference.
- For ease of discovering the device during Bluetooth® pairing, access the*Bluetooth* tab and label each side with the recipient's name.

14. SAVE & CLOSE THE SESSION

- Select *Save & close* to complete the fitting session.
- Run and review the sound processor *Battery estimation*, if desired.
- Add any notes to the fitting session, if desired.
- Follow the prompts to *Save* the fitting session to the Hearing instruments and the Database.
- Select *Close* to complete the fitting session.

FOR MORE INFORMATION

If further support or information regarding product availability is required, please contact your local AB representative.

4. Additional electrodes should be disabled if any of the following are noted with individual electrode stimulation: non-auditory percept, abnormal or absent loudness growth, or atonal or abnormal stimulus sound quality.

AutoSense OS 3.0
QUICK START GUIDE

Marvel CI sound processors (Naída CI M90, Naída CI M30 and Sky CI M90) are designed to help you stay connected with your family and friends, by providing a powerful hearing experience in any listening situation. This guide provides the basic information needed to help build confidence with your new device.

WHAT IS AUTOSENSE OS?

AutoSense OS™ 3.0 operating system is a sophisticated, **easy to use automatic program** in the Marvel CI sound processors and Phonak Link M hearing aids. It automatically senses your surroundings and adapts to provide optimum clarity and comfort in the different listening situations, without requiring manual program changes.

TIPS FOR SUCCESS

STARTUP PROGRAM

When your device is powered on, you will hear a melody[1] as the device goes into the automatic startup program.

AUTOMATICALLY ADAPTS TO CHANGING ENVIRONMENTS

The device will seamlessly adapt to your surroundings and adjust automatically from quiet, to noise and while streaming music or media.

BE PATIENT

It may take a few days or weeks to get used to the new sound quality, just like with all new technologies. Allow the brain time to adapt to the new sound. Try out the following listening exercises to build your confidence.

ALWAYS FACE THE PERSON YOU WISH TO HEAR

When in noisy environments, the directional microphones will activate. It is designed to focus to the front, while making sounds from the back and sides to be perceived as softer. Hence, it is important to always face the person you wish to hear, especially in group conversations.

AB REMOTE APP

You can adjust the volume on the device or the AB Remote app, if desired. You can customize the balance of the streamed signal versus the environmental sounds also.

WIRELESS SOLUTIONS

If you are still struggling to hear in noise, consider using a wireless solution like Roger devices to improve hearing in challenging listening situations like meetings and restaurants.

1. The startup melody will only be audible if enabled in the fitting software by the hearing care professional.

EXPERIENCE THE BENEFIT

Try the following activities with a family member or friend to help you adjust to the sound quality.

Listening Activity	Rate your experience and add a comment regarding the experience 1 = Poor ; 2 = Fair ; 3 = Good ; 4 = Very Good ; 5 = Excellent
Conversation with one person in a quiet situation. E.g. in the clinic or at home. Observe the speakers voice and the sounds around you.	1 2 3 4 5
Group conversation in a quiet situation. Always face the person you wish to hear.	1 2 3 4 5
Conversation with one person in a noisy restaurant. When in noise, the directional microphones will activate. It is designed to focus to the front, while making sounds from the back and sides to be perceived as softer. Always face the person you wish to hear.	1 2 3 4 5
Group conversation in a noisy situation. When in noise, the directional microphones will activate and focus to the front while reducing background noise. Always face the person you wish to hear in the group.	1 2 3 4 5
Go for a walk outdoors. Observe the environmental sounds around you like birds, traffic, etc.	1 2 3 4 5
Conversation in the car. Listen to the driver or other passengers.	1 2 3 4 5
Listen to music via speaker and/or Bluetooth® streaming. Start with your favorite songs, and follow the lyrics.	1 2 3 4 5
Listen to a podcast via Bluetooth streaming. Find an interesting podcast or audio book to stream directly to your device using Bluetooth.	1 2 3 4 5

We want you to get the most out of your Marvel CI device and enjoy a powerful hearing experience in any listening situation. If you are still struggling to adapt to the new sound quality after a few weeks, please inform your audiologist. You may require additional programming. You can rate the listening activities in the table above and take it along to the clinic, so the hearing care professional is informed about your experiences in the various listening situations.

For more information, please visit AdvancedBionics.com/MarvelCI

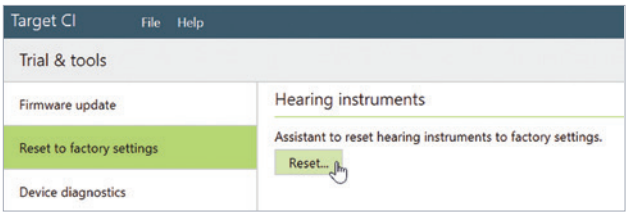
Target CI
PROGRAMMING REPLACEMENT MARVEL DEVICES

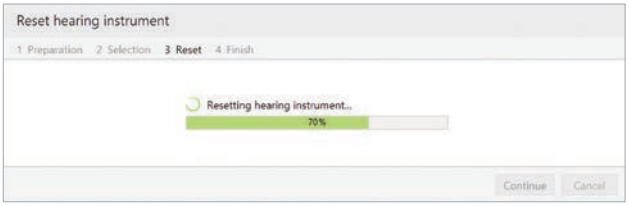
This guide provides the hearing care professional with the steps to program a replacement Marvel CI sound processor or hearing aid in Target CI.

RESET TO FACTORY SETTINGS IF USING A LOANER MARVEL DEVICE

If using a Marvel device that was previously programmed for a different recipient, it is advisable to reset to factory settings first. This step will clear all patient and program information previously stored on the device. Reset one hearing instrument at a time. If you are using a new hearing instrument, you can skip this step.

- Open Target CI and select *Trial & tools*.
- Select *Reset to factory settings > Reset* under Hearing instruments.
- Select the preferred programming interface – *Noahlink Wireless* or *CPI-3*.
- Turn the hearing instrument off and on again (i.e. remove and re-attach the battery to the device). Click *Continue*.
  Note: Any data previously saved on the device will be lost. However, selecting *Reset to factory settings* will not remove any previous Roger license installations.
- Select the detected hearing instrument, click *Continue*.
- The reset may take several minutes. Be patient and do not disconnect the device or close the software. The progress bar is a visual indicator to monitor progress. Click *Continue*.
- Once the Hearing instrument is successfully reset, click *Close*. The device has now been reset to factory settings.





PROGRAMMING THE REPLACEMENT MARVEL DEVICE

OPEN TARGET CI AND SELECT THE CLIENT FILE

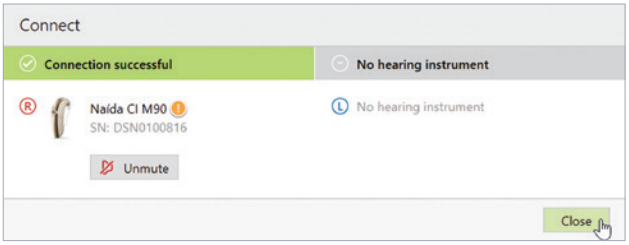
- Open the most recent fitting session.
  Note: If the *Apply Junior mode* message pops up when programming a replacement Sky CI M, select *Keep current mapping parameters and match "Junior mode" defaults* to maintain the recipient's current map parameters.

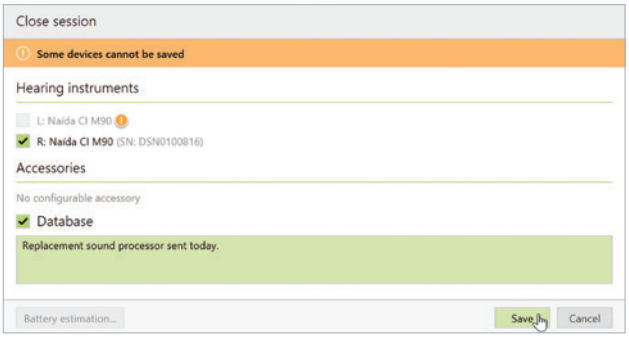
CONNECT TO THE HEARING INSTRUMENT

- Connect to the hearing instrument via Noahlink Wireless, CPI-3, or Remote Programming.
- When programming wirelessly, ensure that a fully charged rechargeable battery is used. Remove and re-attach the battery to put the sound processor into pairing mode. Select the *Connect* button within the 3-minute pairing window.
- Verify the side for which the device is intended to be used.
- Once device connection is successful, *Close* to proceed.

SAVE AND CLOSE THE SESSION

- Select *Save & close* to finalize the fitting session.
- Add any notes to the fitting session, if desired.
- *Save* the fitting session to the Hearing instruments and/or the Database.
- Select *Close* to complete the fitting session.

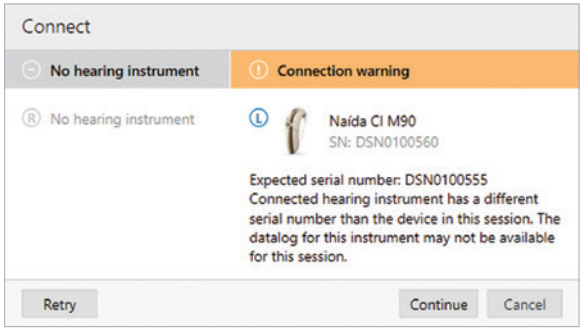




PROGRAMMING A BACK-UP MARVEL CI SOUND PROCESSOR DURING IN-PERSON CLINIC VISIT

Follow the steps below to program a back-up Marvel CI sound processor.

- Program the primary Marvel CI sound processor; then, *Save & close* session.
- Open the session that was just created with the primary Marvel CI.
- Put the back-up Marvel CI into pairing mode by attaching a fully charged rechargeable battery to this back-up device.
- Connect to the hearing instrument via Noahlink Wireless, CPI-3, or Remote Programming.
- Verify the side for which the device is intended to be programmed.
- A *Connection warning* notification will pop-up indicating that the connected device has a different serial number than the device in this session (see below for more details) . Select *Continue* to proceed.
- Be sure to select *Use fitting from session*; then, follow the prompts to proceed.
- Once device connection is successful, select *Close* to proceed
- Select *Save & close session* to save the same settings and programs to the back-up Marvel CI sound processor and database.



Target CI Connection Warning Notification

If the serial number of the device connected to the session does not match the serial number of the device stored in the session, the datalog report in Target CI will not be available.

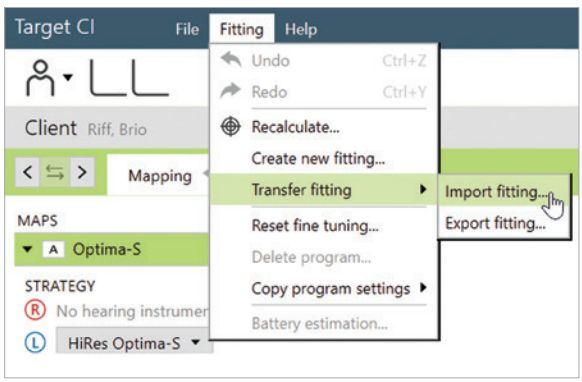
- In the case of programming the back-up Marvel CI device, the hearing care professional can ignore this message and proceed with the fitting session to program the back-up device.
- This notification will also be displayed at return visits when a Marvel CI device that has a different serial number than the one used in the previous fitting session is connected. In this case, there are two resolutions:
  a. Disconnect the device and connect the device with matching serial number to session, if available.
  b. Instead of starting by opening the existing session, rather start a new session and choose to read settings from the hearing instrument.

  Note: The most recent impedance data, but no historical impedance or NRI data, will be available when starting a new session.

IF THE REPLACEMENT MARVEL CI DEVICE IS A DIFFERENT TYPE

If programming a replacement Marvel CI sound processor that is different from the original device type issued to the recipient (e.g. programming Naída CI M90 to replace the Sky CI M90, or vice versa), use the *Transfer fitting* function within Target CI.

- Open Target CI, select the client whose device is to be programmed from the client list.
- Select *Open session* to open the client's most recent fitting session.
- Connect to the device via Noahlink Wireless or CPI-3.
- Go to the *Fitting* menu. Select *Transfer fitting > Import fitting*.
- The transfer fitting assistant transfers fitting data between different hearing instrument types. Select *Continue* to proceed.
- Import the fitting session that should be loaded onto the replacement processor. Select the fitting session from the list; then, select *Continue* to proceed.
- Confirm transferable programs and settings; select *Continue* to proceed.
- Select *Close* to complete the transfer fitting process.



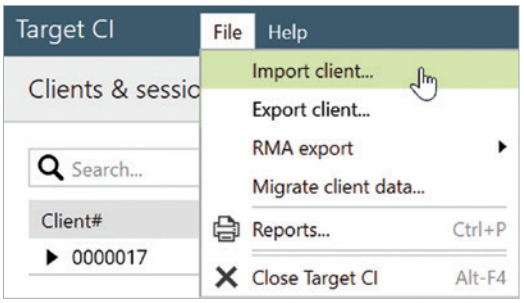
If further support is required, please contact your local AB representative.

Target CI
IMPORTING AND EXPORTING CLIENT FILES

This guide provides the hearing care professional with the steps to import and export the client file from Target CI.

HOW TO IMPORT THE CLIENT FILE INTO TARGET CI

If a Marvel CI user transfers from one clinic to another, the hearing care professional can obtain and import the client's Target CI file into their own Target CI database. The imported file will provide the client's full fitting history.

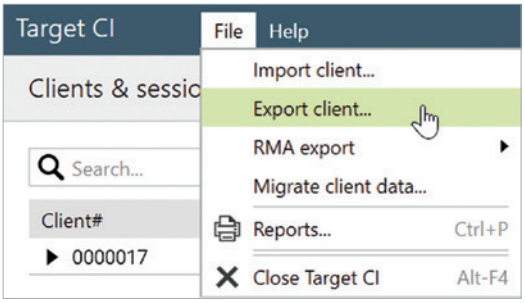


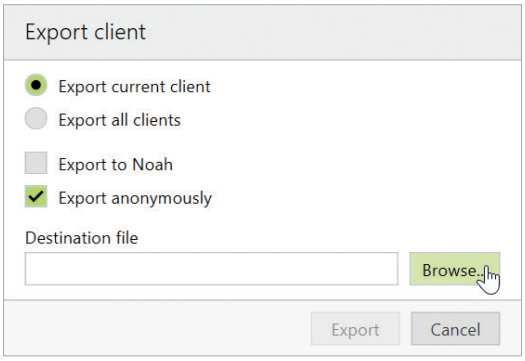
- Go to *File > Import clients*.
- Click *Browse*, select the file you wish to import; then, click *Import Client*.
- If the client file was anonymized, it will appear in Target CI as an anonymized number. For example: *Anonymized19600101*. The client name may be edited after the anonymized file is imported into Target CI.

Note: If the Target CI client file is not available to import when seeing a transfer client, then the current device settings can still be accessed by connecting to the patient's hearing instrument and selecting *Use fitting from hearing instrument*.

HOW TO EXPORT A CLIENT FILE FROM TARGET CI

If a Marvel CI user transfers from one clinic to another, the hearing care professional can export the client's Target CI file and send it to the new clinic. **It is recommended that client data be exported from within Target CI, rather than Noah, in order to maintain data privacy.**





- Select the *Client file* to be exported. Do not open the client file.
- Go to *File > Export client*.
- Select the preferred export client file option:
  - Export current client (default) to only export the individual client file.
  - Export all clients if you want to move all clients to another installation (and don't want to use a database back-up). This option only appears in stand-alone mode.
  - Export to Noah to make this file a .nha file, in order to import into Noah. It can be used together with the above Export all option if you wish to move the stand-alone patients to Noah.
  - Export anonymously (default) will remove the client's name from the file and replace it with an anonymized number. Consider whether the person receiving the file will need the name within the file or not.
- Click *Browse* to select the *Destination file* location to be saved; then, click *Export*.
- Once the export is complete, simply open the folder to locate the file to be sent.

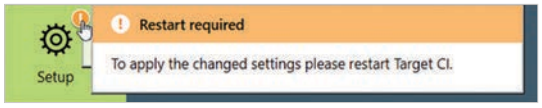
Note: Consider creating a shortcut from the desktop to the *C:\ProgramData\Advanced Bionics\Target CI\Target CI\RMAExports* file for easy file location in future.

HOW TO IMPORT A CLIENT FILE FROM THE AIM SYSTEM

Data from the AIM™ System can be imported into Target CI v1.5 or later. Data that can be imported from AIM includes IntelliLink ID, Implant type, Electrode type, Impedance measurements, and NRI measurements.

Enable the AIM system data transfer feature in Target CI by conducting the following steps:

- Open Target CI; then, select *Setup > Support*.
- Type *A1miable* into the *Support number* text box to enable AIM imports.
- Restart Target CI to apply the change.



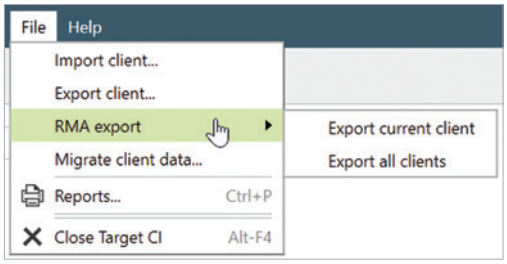
To import a file from AIM

- Open Target CI.
- Access the client file in one of the following ways:
  - If the recipient is in the Target CI database, select the client file; then, select Open session.
  - If the recipient is not in the Target CI database, create the client file; then, select New session.
- Select *Fitting > Import AIM*.
- Select *Browse*; then, select the .json file to be imported from the saved location.
- Select *Import*.

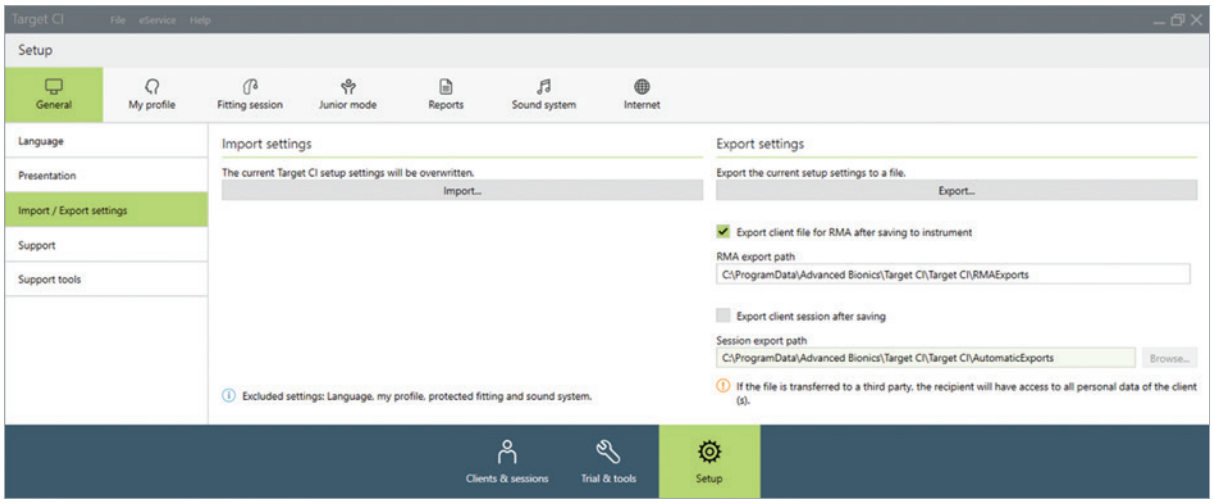
Measurements imported from AIM are identified with this symbol:

FOR REGIONS WITH AB EXPRESS AND AB PRO PORTAL RMA SERVICES

AB Express and the AB Pro Portal allow health care professionals to send fitting information to AB to support repairs and exchanges. These services may not be available in all regions. Check with your local AB representative.



- Select the *Client file* to be exported. Do not open the client file.
- Go to *File > RMA export*.
- Select the appropriate export option and follow the prompts:
  - Export current client (default) to only export the individual client file when using the Processor Direct Service.
  - Export all clients if you want to export all clients.
- The files are exported to the file path in *Setup* (Note: this file path is fixed).
- To access the RMA export file, go to *Setup*; then, under *General* select *Import/Export settings*.
- In *Setup*, the checkbox indicates that a file is exported automatically after saving to the hearing instrument.
- Once in the RMAExpor ts folder, the hearing care professional can either upload the selected client file manually to AB (in Europe this may be called AB4You, in North America it is called Processor Direct) or the AB Express will automatically pull the file from this RMAExports folder.



- This data export is fully encrypted and saved to the following location:
  C:\ProgramData\Advanced Bionics\Target CI\Target CI\RMAExports
  - No identifying infor mation will be available in the file name, so it will be important to retrieve the file immediately after exporting it.
  - Important: Although the file can be renamed as long as the .rma extension is preserved, renaming the file may breach cybersecurity compliance of anonymizing patient data.
- For AB Express users, all files in the RMAExports folder will be automatically sent to AB . You will be able to select the latest programming file while completing an RMA on the ProPortal. For AB ProPortal users, you can start your RMA on the ProPortal and upload the RMA export file directly on the web during the RMA process.

Target CI Remote Programming
QUICK START GUIDE

Remote Programming[1], available in Target CI, is designed to support the care of Marvel CI recipients by providing complete programming sessions with greater convenience. For follow-up appointments, a programming session can be conducted in real time in the recipient's own environment, rather than traveling to the clinic.

This guide provides information on how to successfully conduct a follow-up programming session using Remote Programming in Target CI for all AB recipients with Marvel CI, including bimodal recipients.

REMOTE PROGRAMMING REQUIREMENTS

Remote Programming is available for follow-up programming sessions for all Marvel CI recipients, including those with Link M, M Acoustic Earhook, and CROS. To activate Remote Programming, the programming computer must be connected to the internet and the hearing instrument(s) must be connected to Target CI v1.5 or later in the clinic. The recipient must pair to their hearing instrument(s) in the AB Remote Support app.

Additional requirements include:

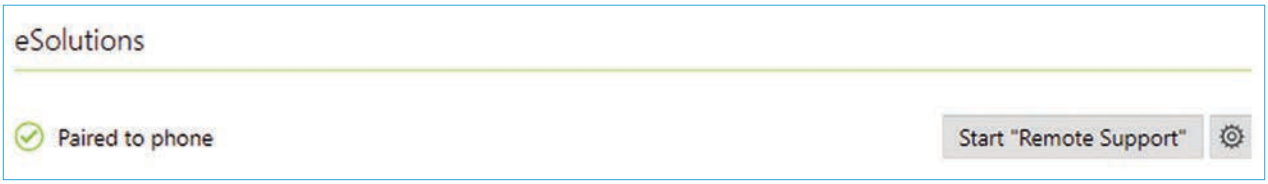
- Computer with an integrated webcam or microphone, or an external webcam and microphone connected to the computer.
  NOTE: For better sound quality, use headphones with a microphone connection for the Remote Programming session.
- Stable internet connection (Wi-Fi, LAN or 4G) with at least 5 Mbit/s of data transfer connection for uploads and downloads. Internet connection can be checked within Target CI.

REMOTE PROGRAMMING STEPS

OPEN TARGET CI V1.5 OR LATER

SELECT THE CLIENT FILE AND CHOOSE START REMOTE SUPPORT

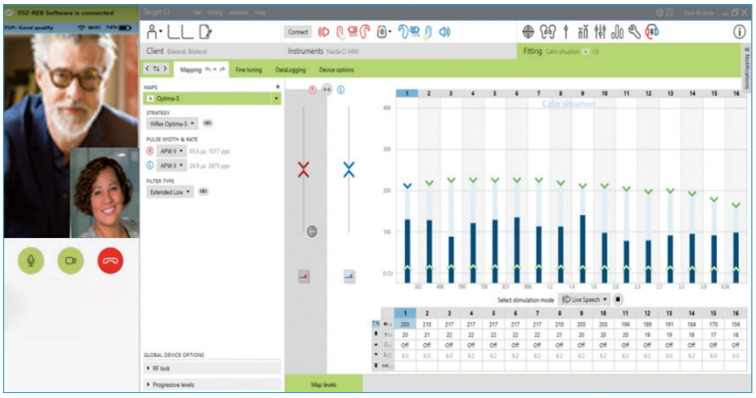
- Confirm the programming computer is connected to the internet.
- The hearing care professional (HCP) can select *Start Remote Support* to begin the Remote Programming session.
  NOTE: *Start Remote Support* is available after the recipient pairs to their phone and the recipient joins the programming session in the AB Remote Support app. *Paired to phone* will display in Target CI after the recipient's hearing instruments have been paired to their phone and will remain visible for subsequent programming sessions.



1. For adults and children aged 13 years and older

SELECT THE DESIRED VISIT HISTORY AND CHOOSE *OPEN SESSION* TO BEGIN PROGRAMMING

- The Remote Support window will appear on the left side of the Target CI screen.



- Conduct the Remote Programming. The same cochlear implant programming steps that can be performed during in-person programming sessions are available during the Remote Programming session.

SELECT ***SAVE AND CLOSE*** TO COMPLETE PROGRAMMING

NOTE: Target CI will not allow the hearing care professional to close the Remote Support video call before saving and closing the session.

END THE REMOTE PROGRAMMING SESSION

- Selecting will end the video call for the hearing care professional and the recipient.
- Close the Remote Support video window to end the Remote Programming session in Target CI.

PRO TIPS

During the in-person fitting session, assist the recipient with downloading the AB Remote Support app and pairing their hearing instrument(s). Going through these simple steps prepares the recipient for future remote programming sessions.

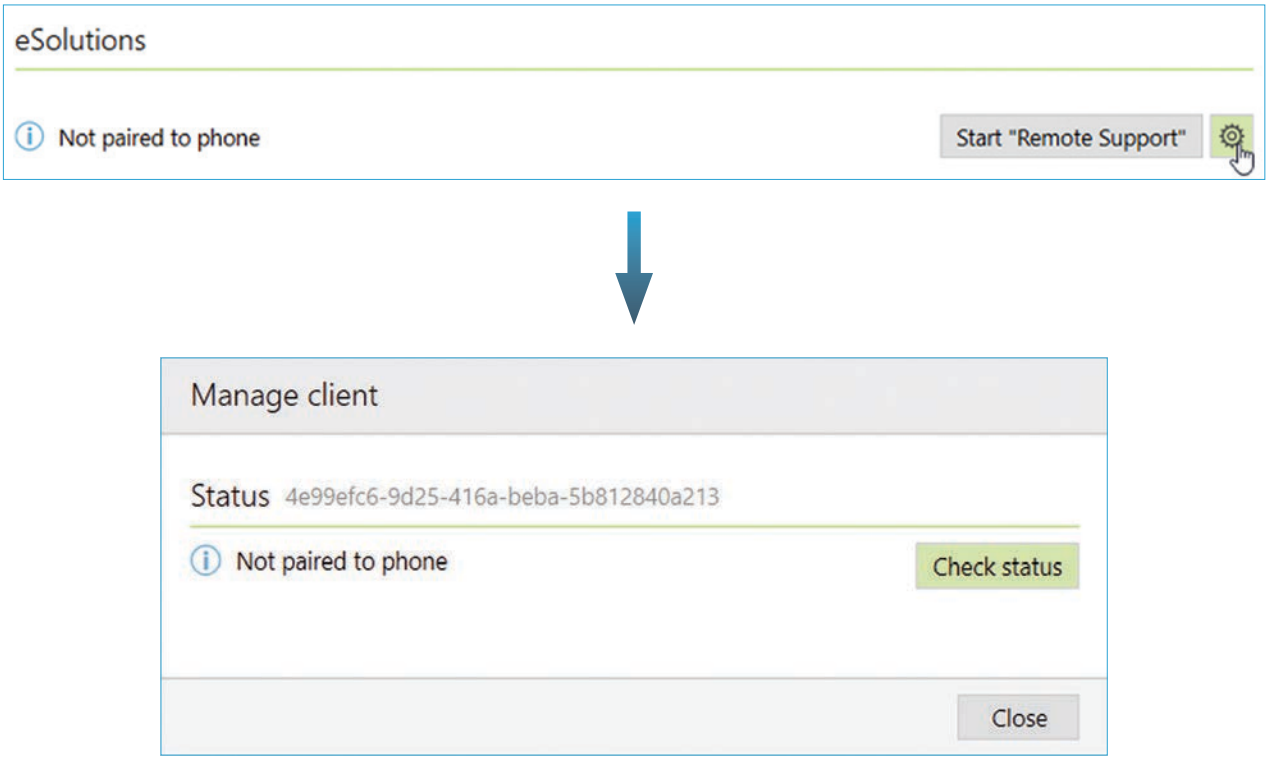
During a Remote Programming session:

- When a recipient joins the Remote Programming session, ensure good visibility in the Remote Support video window for the hearing care provider and the recipient. Adjust camera angle or body position as needed.
- Ensure audio quality is adequate. Adjust the microphone or volume settings, if needed.
- To ensure good visibility within Target CI during Remote Programming, undock the Remote Support window (option found in menu in top left of the Remote Support window) and move to another location on the screen, if needed.
- Encourage recipients to set their phone to *Do not disturb* prior to the remote programming session.
- Encourage recipients to remain in the AB Remote Support app for the entire programming session and communicate with their HCP if they must navigate away from the app (e.g., changing phone settings) to minimize disruptions during programming and prevent ending the session prematurely.
- Notify the recipient when sound will be muted (e.g., when connecting, saving, etc.) so they do not think the wireless connection has been lost.
- Provide access to a loudness scaling chart for the recipients to utilize during the remote programming session.

TROUBLESHOOTING

Not paired to the phone displayed in Target CI after the recipient has paired to the AB Remote Support app and initiated a Remote Programming session by selecting *Join waiting room*.

- Select *Manage client* and then select *Check status*.



- Select *Close* after pairing has been recognized in Target CI.

If sound quality is poor, try the following:

- Adjust the microphone and/or volume settings
- End the call and establish a new video connection

If video quality is poor, check that:

- There is a high quality internet connection
- Computer manufacturer updates have been installed

Recipient loses connection during the programming session.

The Remote Programming session is still open for the hearing care professional. To reconnect, the recipient needs to:

- Reopen the AB Remote Support app.
- Join the Remote Programming session.
- Resume participation in the Remote Programming session.

No Remote Support ID available is displayed under eSolutions in Target CI

Remote Programming is not available because the initial fitting in Target CI v1.5 or later has not been saved or because the client file was imported from Target CI v1.0 and the recipient has not been programmed in Target CI v1.5 or later. To enable Remote Programming, the recipient needs to be programmed in-person in Target CI v1.5 or later. on a programming computer that is connected to the internet.

Supporting the Recipient with Connection or Pairing Issues in the AB Remote Support app

- Ensure Bluetooth® is enabled and that all pairing requests are accepted when pairing devices within the AB Remote Support app.
- Forget Bluetooth® pairings on the phone/tablet and in the AB Remote Support app for devices no longer in use (e.g., sound processors that have been replaced).
- Ensure that the hearing instrument battery is fully engaged and adequately charged.
- Forget Bluetooth® pairing on the phone/tablet for the curr ent instrument(s) and re-pair instrument(s) to the AB Remote Support app.
  - This will require re-pairing device with phone for Bluetooth® streaming function and potentially connection with other apps in use on phone (e.g., AB Remote app).

    NOTE: If the wireless network connection status is poor, encourage recipient to see whether a better connection may be established (e.g., move to another location, turn off video camera or power down/remove possible interfering devices).
- If the recipient is using more than one set of hearing instruments with the AB Remote Mobile app, the recipient may need to switch between devices. The recipient can go to *Settings > Manage Devices* to see which hearing instrument is paired. If the incorrect hearing instrument is paired, the recipient can go to *Settings > Pair hearing devices* to connect to a different hearing instrument.

If you require more information about Remote Programming in Target CI, please contact your local AB support.

AB Remote Support app
QUICK START GUIDE

The AB Remote Support app[1] allows you to virtually meet with your hearing care professional in a video appointment and to conveniently program your Marvel devices. First, contact your clinic to arrange a virtual appointment. Then, follow the simple steps below to prepare for the remote session.

STEP 1: DOWNLOAD THE AB REMOTE SUPPORT APP

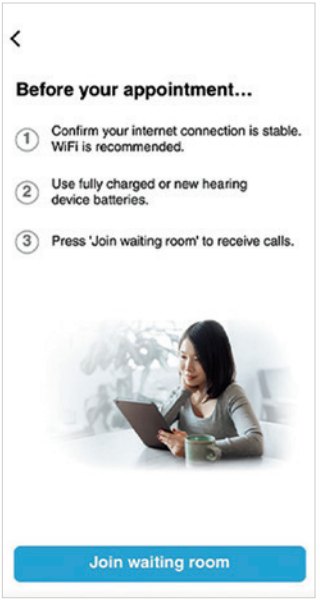
- From the app store, download the AB Remote Support app.
  Note: The AB Remote Support app is compatible with Apple iOS 14 and Android OS 6 or higher.

STEP 2: PAIR MARVEL DEVICE(S) TO AB REMOTE SUPPORT APP

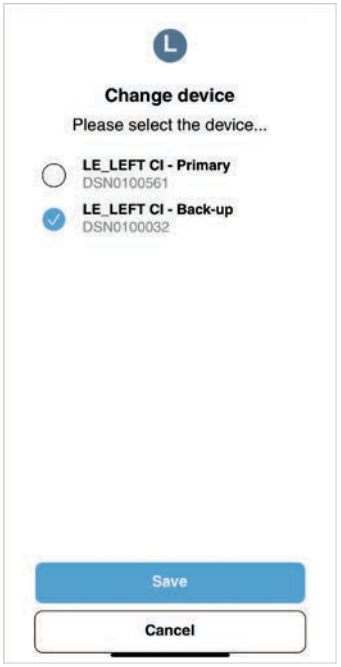
- Turn on Bluetooth® on your phone.
- Open the AB Remote Support app, and tap *Let's Get Started*.
- Remove and reattach the battery for each hearing device to enable Bluetooth pairing mode. Then, tap *Continue* in the AB Remote Support app.
- Select the device(s) found in the app; then, select *Done*.
  Note: Navigate to *Settings > Pair new devices*; then follow the above instructions to pair any back-up devices.
  Note: The CROS device does not pair to the Remote Support app for Remote Programming.
- Once pairing is complete, you are ready for the Remote Programming session.

STEP 3: PARTICIPATE IN THE REMOTE PROGRAMMING SESSION

- When joining the remote session at the pre-determined appointment time, select the *Appointment* icon, then select *Continue* > *Join waiting room*.
  NOTE: The first time you join, the AB Remote Support app will prompt you to allow access to your phone's camera and microphone. Select *OK*, when prompted; then allow access to your camera in the phone settings.
- When your hearing care professional joins, select *Join* to start the session.
- You and your hearing care professional will be able to see each other through the video. You will hear your hearing care professional through the phone speaker.
- Participate in the remote session to program and adjust your device settings, just as you would in an in-person programming session.
  NOTE: When loudness measurements are conducted, you will not hear sounds in the environment. Use the AB Loudness Rating Chart to provide feedback about the loudness levels.
- Select *Done* after your hearing care professional ends the session.



REMOTE PROGRAMMING FOR BACK-UP DEVICES



Complete the following steps after your hearing care professional indicates that it is time to program your back-up processor.

- Select to end the video call.
- Select *Leave* appointment; then, select *Done*.
- Select the < at the top of the screen.
- Select *Devices* at the bottom of the screen.
- Remove the battery from the primary processor and place the battery on the back-up processor.
- Select the blue *Change* button beneath the processor(s).
  NOTE: All devices must be paired in order to see the blue *Change* button. See Step 2 above.
- From the menu, select the back-up device.
- Select *Save*; then, rejoin the appointment by navigating to the Appointment tab and selecting *Continue*.
- Follow the steps in the AB Remote Support app to rejoin the Remote Programming session.
- The hearing care professional may proceed with programming at this time.

Considerations for a successful remote programming session

- Choose a quiet room to reduce distractions and background noise.
- Ensure that your cell phone connection is stable. Wi-Fi is recommended.
- Use a fully-charged battery for your hearing device(s).
- Charge your cell phone before the appointment.
- Turn on the *Do Not Disturb* function on your phone prior to the appointment. Accepting an incoming call or clicking on a notification will put the virtual appointment on hold.
- For Troubleshooting Tips, select *See device instructions* in the app.

Scan the QR code to watch a short video on the AB Remote Support app. If you require more information about the AB Remote Support app, please contact your hearing care professional or local AB support.

DOWNLOAD THE AB REMOTE SUPPORT APP

The AB Remote Support app is available for free for both iOS and Android devices.

Download on the App Store

GET IT ON Google Play

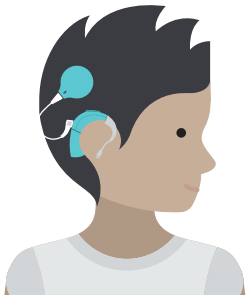
Marvel CI Connectivity
QUICK REFERENCE GUIDE

Marvel CI provides numerous ways for recipients to stream audio from their favorite devices and connect with the ones they love With Marvel CI, recipients can stream using Bluetooth®, Roger™, and AirStream technologies. This clinical resource is designed to identify which streaming options are available for the recipient based on which hearing instrument the recipient is using with Marvel CI.

NAÍDA CI M90 on one side

		BLUETOOTH	ROGER	AIRSTREAM
RECOMMENDED ON OTHER SIDE	Naída CI M90 Phonak Naída Link M	**Bilateral/Bimodal streaming** via integrated Bluetooth	**Bilateral/Bimodal streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into each device via Roger iN microphone or via Roger X + Roger installer	**Bilateral/Bimodal streaming** with Phonak TV Connector and Phonak PartnerMic
OTHER HEARING INSTRUMENTS	Sky CI M90 Phonak Paradise or Phonak Marvel HI	**Unilateral streaming** to the selected hearing instrument via integrated Bluetooth	**Bilateral/Bimodal streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into each device via Roger iN microphone or via Roger X + Roger installer	**Bilateral/Bimodal streaming** with Phonak TV Connector. **Unilateral streaming** to the paired hearing instrument with Phonak PartnerMic
	Naída CI Q90	**Unilateral streaming** to Naída CI M90 via integrated Bluetooth **OR** to Naída CI Q90 via Naída CI Connect, Roger 17[2], or Phonak ComPilot	**Bilateral streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into Naída CI M90 via Roger iN microphone or via Roger X + Roger installer and Roger 17 for Naída CI Q90	**Bilateral streaming** with Phonak TV Connector when Naída CI Connect is attached to Naída CI Q90. **Unilateral streaming** to Naída CI M90 with Phonak PartnerMic
	Phonak Naída Link Q	**Unilateral streaming** to Naída CI M90 via integrated Bluetooth **OR** to Phonak Naída Link Q via Roger 10 (Link UP)[2], Roger 15 (Link RIC)[2] or Phonak ComPilot	**Bilateral streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into Naída CI M90 via Roger iN microphone or via Roger X + Roger installer and Roger 10 (Link UP), Roger 15 (Link RIC) attached to Naída Link Q	**Unilateral streaming** to Naída CI M90 via Phonak TV Connector and Phonak PartnerMic
	Chorus	**Unilateral streaming** to Naída CI M90 via integrated Bluetooth **OR** to Chorus via integrated Roger[2]	**Bilateral streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into Naída CI M90 via Roger iN microphone or via Roger X + Roger Installer. Roger 02 is integrated into Chorus.	**Unilateral streaming** to Naída CI M90 via Phonak TV Connector and Phonak PartnerMic

1. Bluetooth on Roger microphone should be disabled because Phonak Marvel and Phonak Paradise technologies have integrated Bluetooth.
2. Requires a Roger microphone with Bluetooth



SKY CI M90 on one side

		BLUETOOTH	ROGER	AIRSTREAM
RECOMMENDED ON OTHER SIDE	Sky CI M90 Phonak Sky Link M	**Bilateral/Bimodal streaming** via integrated Bluetooth	**Bilateral/Bimodal streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into each device via Roger iN microphone or via Roger X + Roger installer	**Bilateral/Bimodal streaming** with Phonak TV Connector and Phonak PartnerMic
OTHER HEARING INSTRUMENTS	Naída CI M90 Phonak Paradise or Phonak Marvel HI	**Unilateral streaming** to the selected hearing instrument via integrated Bluetooth	**Bilateral/Bimodal streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into each device via Roger iN microphone or via Roger X + Roger installer	**Bilateral/Bimodal streaming** with Phonak TV Connector. **Unilateral streaming** to the paired hearing instrument with Phonak PartnerMic
	Naída CI Q90	**Unilateral streaming** to Sky CI M90 via integrated Bluetooth **OR** To Naída CI Q90 via Naída CI Connect, Roger 17[2], or Phonak ComPilot	**Bilateral streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into Sky CI M90 via Roger iN microphone or via Roger X + Roger installer and Roger 17 for Naída CI Q90	**Bilateral streaming** with Phonak TV Connector when Naída CI Connect is attached to Naída CI Q90. **Unilateral streaming** to Sky CI M90 with Phonak PartnerMic
	Phonak Naída Link Q	**Unilateral streaming** to Sky CI M90 via integrated Bluetooth **OR** To Phonak Naída Link Q via Roger 10 (Link UP)[2], Roger 15 (Link RIC)[2] or Phonak ComPilot	**Bilateral streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into Sky CI M90 via Roger iN microphone or via Roger X + Roger installer and Roger 10 (Link UP), or Roger 15 (Link RIC) attached to Naída Link Q	**Unilateral streaming** to Sky CI M90 via Phonak TV Connector and Phonak PartnerMic
	Chorus	**Unilateral streaming** to Sky CI M90 via integrated Bluetooth **OR** To Chorus via integrated Roger[2]	**Bilateral streaming** (Roger mic input only)[1] Microphones: any Roger iN or Roger microphone[1] Receivers: Roger installed into Sky CI M90. Roger 02 is integrated into Chorus.	**Unilateral streaming** to Sky CI M90 via Phonak TV Connector and Phonak PartnerMic

1. Bluetooth on Roger microphone should be disabled because Phonak Marvel and Phonak Paradise technologies have integrated Bluetooth.
2. Requires a Roger microphone with Bluetooth

MAPPING KEYBOARD BINDINGS

KEY	ACTION
F	Stop All Stimulation
Page Down	Adjust All Markers Down
Page Up	Adjust All Markers Up
Down Arrow	Adjust Selected Markers Down (M, T, Clipping)
Up Arrow	Adjust Selected Markers Up (M, T, Clipping)
L or Ctrl + Left Arrow	Bilateral Window: Focus Left Side
R or Ctrl + Right Arrow	Bilateral Window: Focus Right Side
0-9	Data Entry
Alt + Left Arrow	Move Entire Channel Selection to the Left
Alt + Right Arrow	Move Entire Channel Selection to the Right
Left Arrow	Move Selection Left
Right Arrow	Move Selection Right
Ctrl + A	Select All Markers
C	Select Clipping Marker
G (goes to Map Input Gain tab)	Select Gain Marker
M	Select M Marker
T	Select T Marker
Shift + Left Arrow	Select Multiple Channels to the Left
Shift + Right Arrow	Select Multiple Channels to the Right
S	Toggle Stimulation On/Off
Ctrl + Z	Undo
Ctrl + Y	Redo
Shift + Tab *(must press Enter to confirm electrode selection)*	Move Numerical Data Entry Selection Left
Tab *(must press Enter to confirm electrode selection)*	Move Numerical Data Entry Selection Left

NRI KEYBOARD BINDINGS

KEY	ACTION
F	Stop All Stimulation
Page Down	Adjust All Markers Down
Page Up	Adjust All Markers Up
Down Arrow	Adjust Selected Markers Down
Up Arrow	Adjust Selected Markers Up
0-9	Data Entry
Alt + Left Arrow	Move Entire Channel Selection to the Left
Alt + Right Arrow	Move Entire Channel Selection to the Right
Left Arrow	Move Selection Left
Right Arrow	Move Selection Right
Ctrl + A	Select All Markers
H	Select High Marker
L	Select Low Marker
Shift + Left Arrow	Select Multiple Channels to the Left
Shift + Right Arrow	Select Multiple Channels to the Right
S	Toggle Measurement On/Off

Notes

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ADVANCED BIONICS
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028-Q069-02 Rev D

ADVANCED BIONICS
POWERFUL CONNECTIONS

CLINICAL RESEARCH

AutoSense OS™ 3.0 Operating System

Allowing Marvel CI users to seamlessly connect with the moments they love

INTRODUCTION

As cochlear implant (CI) recipients move through their day, they encounter a variety of acoustic environments, each of which places unique listening demands upon them. AutoSense OS 3.0, first introduced in Phonak hearing aids, is an operating system designed to automatically steer sound processing, optimizing hearing performance and recipient comfort while minimizing the need for manual changes.[1, 2] In the Advanced Bionics Naída™ CI M Sound processor and Sky CI™ M sound processor, AutoSense OS 3.0 and AutoSense Sky OS 3.0 have been adapted and optimized for CI users.

HOW DOES AUTOSENSE OS 3.0 WORK?

AutoSense OS 3.0 leverages artificial intelligence that was trained using modern machine learning methods. Training this system for classification of listening environments involved analysis of thousands of sound scenes that reflect the broad range of acoustic experiences that are encountered during daily life. The result is a system that monitors acoustic parameters, including level differences, estimated signal-to-noise ratios, synchrony of temporal onsets across frequency bands, amplitude, and spectral information. Every 0.4 seconds, the algorithm calculates the statistical probability that the listening environment matches one of seven pre-defined sound classes. Based on these probabilities, AutoSense OS 3.0 determines a combination or blend of sound classes that best matches the listener's environment. The appropriate blend of sound classes, features, and settings for that environment is then automatically activated. This optimizes sound quality and speech intelligibility by applying sound processing intelligently based on real-time analysis of the listening environment.

Acoustic environments are classified into seven different sound classes: Calm situation, Speech in noise, Speech in loud noise, Speech in car, Comfort in noise, Comfort in echo, and Music (see Figure 1). Of these, Speech in loud noise, Music, and Speech in car are exclusive classes, meaning that these classes cannot be blended with other sound classes. The other four sound classes can be activated either exclusively or as a blend, with the possibility for up to three sound classes to be blended at once. For example, Comfort in echo, Comfort in noise, and Speech in noise may be blended when the listener is having a conversation in a moderately noisy environment with high ceilings. This advanced technology allows AutoSense OS 3.0 to create over 200 possible settings that are designed to optimize listening based on the CI user's dynamic sound environment and the settings programmed by the professional. In addition to classifying acoustic environments, AutoSense OS 3.0 is the first in the industry to classify streamed audio signals. Streamed input is classified as Media speech or Media music, and the appropriate parameters are adjusted to optimize the listener's audio streaming experience, whether they are watching TV, listening to music, or streaming podcasts.

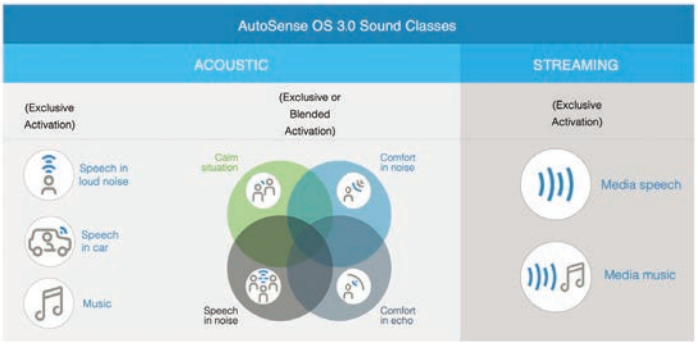

Figure 1: Acoustic and streaming classification in AutoSense OS 3.0.

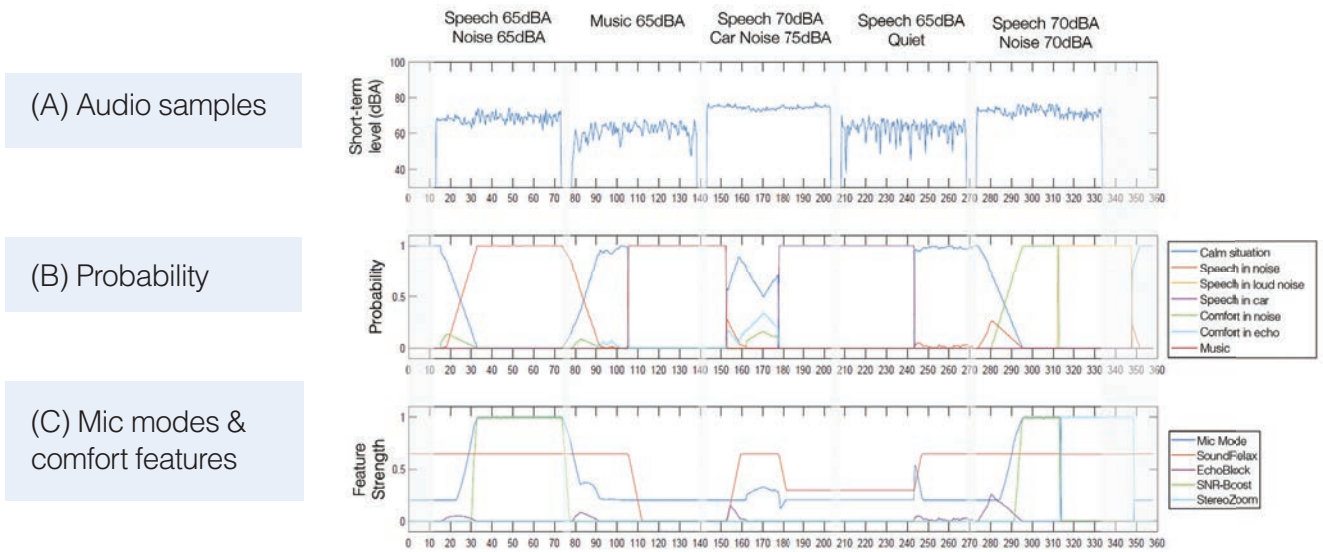

Figure 2: The classification of acoustic input by AutoSense OS 3.0. Panel A depicts audio samples from five sound environments — speech and noise at 65 dBA (Speech in noise), music at 65 dBA (Music), speech at 70 dBA in 75 dBA car noise (Speech in car), speech in quiet at 65 dBA, and speech and noise at 70 dBA each. Each audio sample is 60 seconds in duration. Panel B shows the corresponding statistical probabilities calculated by AutoSense OS 3.0 for the acoustic input matching the seven sound classes either exclusively (i.e., 100%) or in a blended manner. Panel C depicts how the strengths and the blend of the microphone modes as well as front-end processing features automatically change accordingly over time. Microphone (mic) mode varies from omnidirectional (T-Mic/RES) to more directional (UltraZoom) to maximum directionality (StereoZoom). The strength of SNR-Boost is varied depending on the presence of noise. Depending on the probability match with Comfort in echo, EchoBlock strength is varied. The microphone modes and comfort features named here and in Figure 3 are defined in Table 1.

Clinicians can review the proportion of time each sound class (acoustic and streaming) is active via the datalog section of the Target CI programming software. Figure 3 shows sample data from a Marvel CI processor fit on the left ear of a recipient.

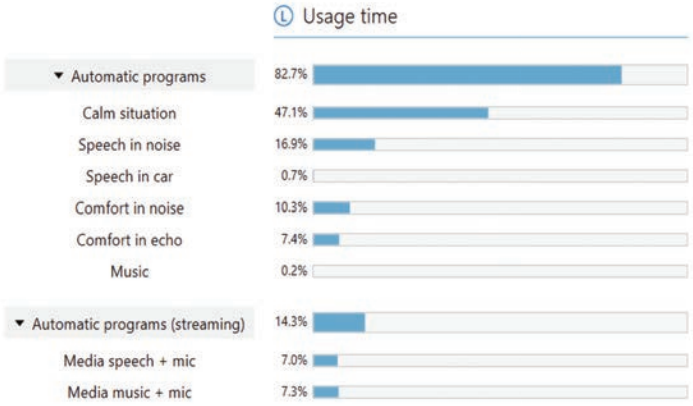

Figure 3: Example of information regarding AutoSense OS 3.0 activity from a unilateral CI recipient's datalog, as displayed in Target CI fitting software.

MARVEL CI MICROPHONE MODES AND FRONT-END SOUND CLEANING FEATURES

Once finished with classifying the recipient's listening environment, AutoSense OS 3.0 activates the microphone mode and front-end processing feature(s) that are appropriate for that environment (Table 1). These features are complemented by AB sound processing technologies and proven noise reduction features like ClearVoice™ sound processing,[3-7] SoftVoice,[8,9] industry-leading wide Input Dynamic Range (IDR),[10,11] dual-loop Automatic Gain Control (AGC),[12,13] and Span.[14]

	FEATURE	PURPOSE
Microphone Modes	**Real Ear Sound (RES)**	Mimic response and benefit of the T-Mic[15-18] by mildly attenuating sounds from behind the listener[19]
	UltraZoom	Adaptively attenuate noise sources located on the sides and back to improve face-to-face speech understanding in noise[20-25]
	UltraZoom & SNR-Boost	UltraZoom plus application of additional noise cancellation based on location of noise[26]
	StereoZoom	Create narrow focus for front-facing communication in extreme noise for bilateral or bimodal recipients[21, 24]
Front-end Processing Features (FEPs)	**NoiseBlock**	Reduce bothersome background noise (for M Acoustic Earhook users)
	WindBlock	Reduce bothersome impact of wind noise
	SoundRelax	Reduce bothersome impact of sudden impulse sounds
	EchoBlock	Reduce bothersome impact of reverberation

Table 1: Automatic microphone modes and front-end processing features available in the Marvel CI sound processor system.

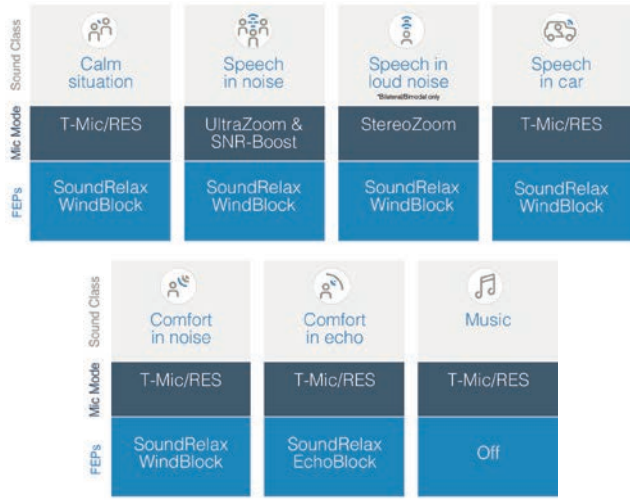

Figure 4: AutoSense OS 3.0 sound classes and associated microphone modes and front-end processing features (FEPs). Note that default strength settings for FEPs may vary by sound class.

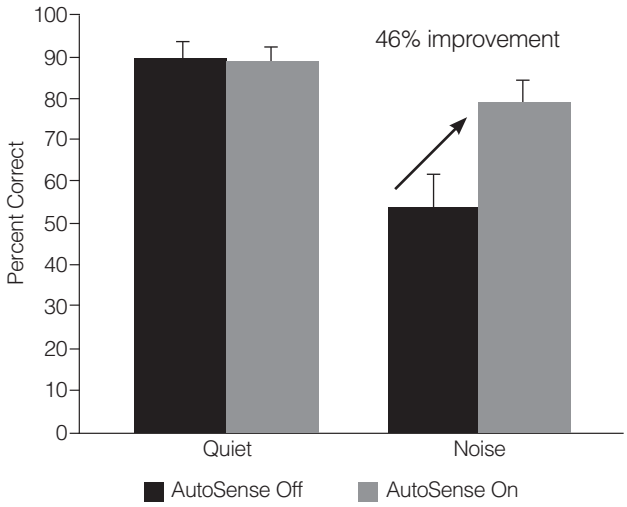

Figure 5: Speech recognition scores with the Marvel CI sound processor as a function of listening environment and AutoSense OS activity.

Figure 4 displays a simplified overview of the microphone modes and front-end processing features that are activated within each acoustic sound class of AutoSense OS 3.0. The strength and the blend of the microphone modes and front-end processing features will change depending on the environment, which allows for optimized listening all day, every day. The seamless and automatic activation of these features is designed to allow CI users to move from one listening environment to the next without the need to manually adjust their sound processor settings as they go. Recipients do not need to manage various programs for different listening environments.

CLINICAL RESULTS WITH AUTOSENSE OS 3.0

Studies with Phonak Marvel hearing aid users have demonstrated better speech perception in real-world listening conditions when using a program with AutoSense OS 3.0 technology.[1, 2] Participants in these studies preferred the AutoSense OS 3.0 program to their manually selected program in all listening conditions. As a part of the Marvel CI development, multiple clinical studies provided evidence for an improved listening experience with AutoSense OS 3.0 in Advanced Bionics CI recipients.[27-29]

In one study completed at the labs of Advanced Bionics, LLC,[30] ten adult CI recipients underwent speech recognition tests in quiet and in noise. Target stimuli (AzBio sentences at 65 dBA) were presented from a loudspeaker at 0 degrees azimuth. Noise (multi-talker babble at +5 dB SNR) was presented from a loudspeaker positioned at 180 degrees.

Figure 5 shows speech recognition scores in quiet and in noise with AutoSense OS 3.0 set to OFF and ON. As hypothesized, performance was equivalent in quiet, and an improvement (46%) was observed in noise with AutoSense OS 3.0 set to ON, demonstrating the benefit provided when AutoSense OS 3.0 adapts to the user's listening environment.

AUTOSENSE SKY OS 3.0

AutoSense Sky OS 3.0 is the world's first operating system for a CI sound processor designed for children, Sky CI M.[31, 32] AutoSense Sky OS 3.0 was developed specifically for the listening environments children experience to ensure that kids and teens have the optimal listening experience in their unique listening situations, including classrooms, libraries, the playground, and when listening to music. AutoSense Sky OS 3.0 applies customized settings without the need for manual adjustments, so kids and their parents can focus on more of life's great adventures and let the sound processor do the work.

SUMMARY

AutoSense OS 3.0 and AutoSense Sky OS 3.0 combine innovations from AB and Phonak that are designed to provide adult and pediatric recipients with a powerful hearing experience and the ultimate ease of use throughout the day, reducing the need to manually switch programs. AutoSense OS 3.0 provides improved speech recognition in noisy listening environments by seamlessly activating the microphone modes and processing features that are appropriate for the environment in real time. The automatic adaptation to the listening environment enabled by AutoSense OS 3.0 allows Marvel CI users to stay fully connected to the world, rather than focusing on how their CI sound processor is functioning.

REFERENCES

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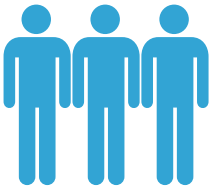
MARVEL CI'S AUTOSENSE OS 3.0 MAKES BETTER HEARING EASY

The study



Two groups* of 22 adults with cochlear implants from 6 clinics in the US participated in the study.

Speech-in-noise testing and questionnaires were administered.

The study compared benefit of Marvel CI with previous generation AB sound processor.

The results

AutoSense OS 3.0 automatically steered CI sound processing to significantly improve speech understanding in noise by 78% and 65% across the two study groups.

Participants clearly preferred hearing with Marvel CI in a variety of daily situations, including noisy environments and listening to music.

*Group 1 consists of 10 adults with electric hearing only in their CI ear. Group 2 consists of 12 adults with aidable hearing present in their CI ear.

Strong D, Anderson M, Blanchard M, Dwyer N. Dwyer R. Firszt J, Gifford R, Holden L, Iannuzzi K, Morton S, Nelson M, Zlomke S, Thode S, Passmore C, Galster J. (2021, April 28 -May 1). Clinical Outcomes with a Next-generation Sound Processor. CI2021 Cochlear Implants in Children and Adults, Orlando, FL, USA. ePoster: 2349.

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Investigation of Automatic Scene Classification and Wireless Streaming Technology in the Naída Marvel Hearing System

Martina Brendel, Anne Michels, Smita Agrawal, Jason Galster, Laure Arnold
Advanced Bionics GmbH, SARL and LLC

INTRODUCTION

Latest generation cochlear implant (CI) sound processors feature directional microphones and sound-cleaning algorithms that can significantly improve CI users' ability to communicate in challenging surroundings. To alleviate the CI users' burden and difficulty of selecting an optimal program when entering a new listening situation, an automatic scene classification system, named AutoSense OS, has been developed. This system also includes an automatic directional beamformer named Speech in 360° that focuses the sound processor microphones to the front, back and sides, following the dominant sound source. Direct Bluetooth streaming allows for wireless audio streaming from any Bluetooth capable streaming device and proprietary accessories like remote microphones. Each of these features are part of the Marvel CI M90 sound processor.

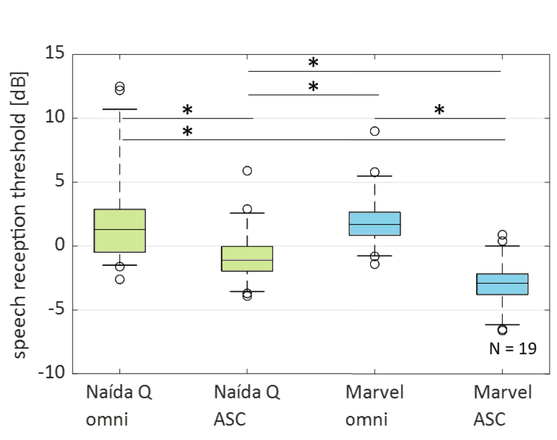
AUTOSENSE OS™

AutoSense OS is continuously analyzing incoming sounds and activating one out of seven classes, including different microphone and noise reduction settings. In a clinical study in Hanover, speech perception was tested with adult CI users, in India children were asked to rate their experience with the new hearing devices in everyday life.

Clinical Study - Hanover

Medizinische Hochschule Hannover

- N = 19 adults (bimodal, bilateral)
- German matrix test (50% correct SRT)
- Multi-talker babble noise (70dB)
- S_0 $N_{0,\pm45,\pm90,\pm135,180}$
- Naída Q omni/automatic vs. Marvel omni/automatic



Outcomes

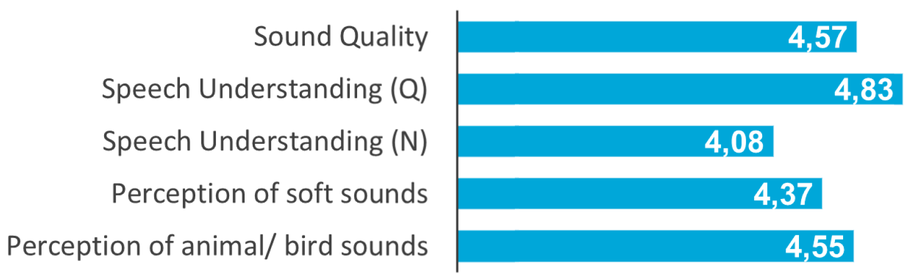
- Significant improvement with automatic features compared to omni-directional microphone on the same device
- Significant improvement with Marvel automatic vs. Naída Q automatic

Clinical Study – Mumbai and Calicut

Dr. MANOJ'S ENT SUPER SPECIALITY INSTITUTE & RESEARCH CENTRE Redefining ENT Care

Shaba Speech and Hearing Centre

- N = 15 children and young adults
- Hearing performance questionnaire
- Rating scale: 1 (very poor) to 5 (very good)
- Marvel hearing system with automatic program
- Rating one month after upgrading



Outcomes

- Very positive feedback in general
- Sound quality, audibility and speech perception were rated highly (above 4 out of 5) after one month of device use

SPEECH IN 360°

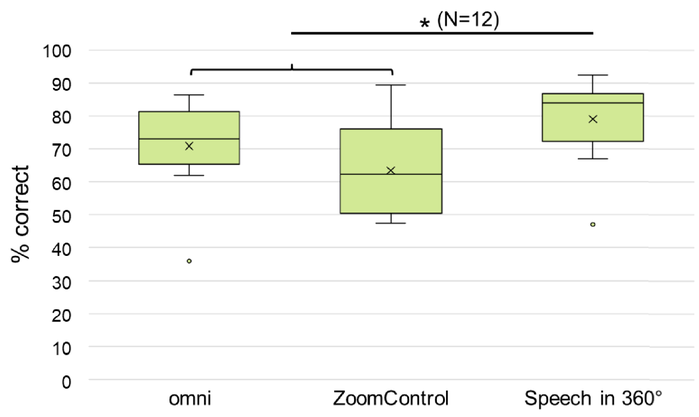
Speech in 360° enables the beamformer into four directions: front, back, left right, either via manual switching (ZoomControl, comparable with Naída Q) or automatically when detecting a signal (autoZoomControl, new on Marvel). In a clinical study in Geneva, speech perception was tested with adult CI users.

April 26 - 27, 2022 • Cardiff, Wales
British Cochlear Implant Group

Clinical Study - Geneva

Hôpitaux Universitaires Genève

- N = 12 adults (bimodal, bilateral)
- French matrix test (individual SNR)
- Speech shaped noise (65dB)
- $S_{0,\pm90,180}$ (random), $N_{0,\pm90,180}$
- Marvel omni, ZoomControl (manual), autoZoomControl (automatic)



Outcomes

- Similar speech perception with omni-directional microphone and ZoomControl (manual switching)
- Significant improvement with Marvel automatic ZoomControl compared to omni and ZoomControl

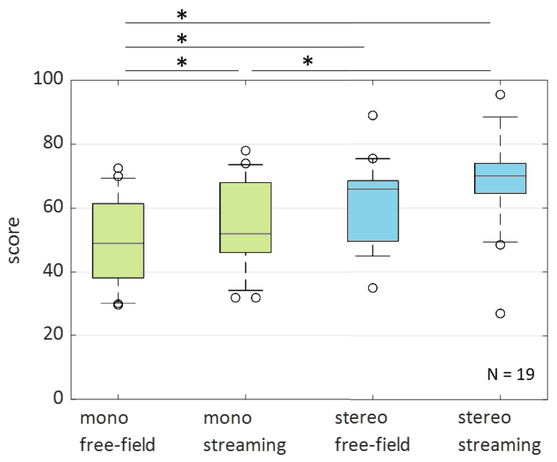
STREAMING

The Marvel hearing system offers direct Bluetooth (BT) streaming for all common audio sources or phones as well as streaming via AirStream™ technology (e.g. Phonak TV connector). Via the AB remote app the mixing ratio of omni-directional microphone and streaming signal can be individually set. In clinical studies in Hanover and Geneva, music enjoyment as well as speech understanding via streaming were tested in adult CI users.

Clinical Study - Hanover

Medizinische Hochschule Hannover

- N = 19 adults (bimodal, bilateral)
- Rating of music enjoyment for 20 music samples
- Free-field presentation 0° or ±30°, streaming via TV connector
- Mono / stereo signal in free-field / via streaming



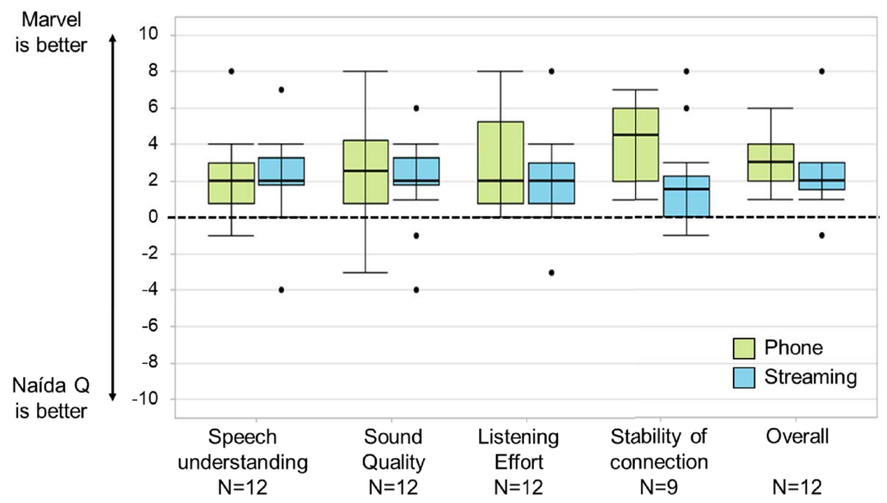
Outcomes

- Significantly better music enjoyment scores for stereo presentation compared to mono, while streaming
- Highest rating for music enjoyment when streaming a stereo signal

Clinical Study - Geneva

Hôpitaux Universitaires Genève

- N = 12 adults (bimodal, bilateral)
- Rating scale: -10 (Naída Q much better) to 10 (Marvel much better)



Outcomes

- Very positive feedback in general for streaming
- Group results show preference for Marvel in all aspects

SUMMARY

AutoSense OS and Speech in 360° both switch automatically into the optimal program and increase speech understanding. Streaming options allow for improved music enjoyment and speech understanding on the phone.

Advanced Bionics GmbH • European Research Center
Feodor-Lynen-Str. 35 • 30625 Hanover • Germany

Music Perception and Enjoyment with the Harmony® HiResolution® Bionic Ear

HiRes Fidelity 120® Uses Current Steering to Deliver up to 120 Spectral Bands for Increased Potential to Improve Music Appreciation in Harmony HiResolution Bionic Ear Users

Music Perception

Today's cochlear implant users typically can understand speech remarkably well in quiet. Speech information is conveyed using redundant temporal and spectral cues. In ideal conditions, speech understanding may be accomplished with limited spectral resolution (Shannon et al. 2004). On the other hand, the ability to understand speech in noise and to enjoy music remains poor (Mirza et al. 2003, McDermott 2004). This outcome is not surprising, given the limited spectral resolution delivered by previous generation implant technology. Music perception requires as many as 100 channels of spectral (frequency) resolution even in subjects with normal hearing (Shannon 2005). With the introduction of the HiRes Fidelity 120® (HiRes 120) sound-processing option, Harmony recipients now have access to greater spectral resolution and the potential to improve their music appreciation and perception.*

HiRes 120 is intended to allow implant users to take advantage of their residual place-pitch perception capabilities by delivering spectral information in higher resolution compared to conventional processing. HiRes 120 uses current steering to deliver up to 120 spectral bands. Through simultaneous delivery of current to pairs of adjacent electrodes, the locus of stimulation can be steered to sites between the electrode contacts by varying the proportion of current delivered to each electrode of a pair. There are eight spectral bands implemented for each pair. When all 16 electrodes are enabled, 120 total spectral bands are created (15 pairs times eight spectral bands). The increased spectral resolution, in combination with the fine temporal resolution already implemented in HiRes 120, may lead to better speech perception in noise and improved music appreciation.

Study Design and Subjects

Clinical trial results showed that HiRes 120 increased the frequency, pleasantness, and enjoyment of listening to music when compared to standard HiRes® sound processing (Advanced Bionics 2007, Oleson et al. 2008). Therefore, a multicenter study was designed to further explore music benefits that adults derive from HiRes 120. The study explores the relationships among a range of music perception abilities, ratings of everyday music listening and enjoyment, speech recognition, and demographic variables.

Subjects to date are 43 adults implanted with an Advanced Bionics' implant (CII Bionic Ear®/HiRes 90K®) who use the Harmony processor programmed with HiRes 120. Demographic information is in Table 1 on page 2.

CONTENTS

*HiRes Fidelity 120 is not approved for pediatric patients in the United States.

Table 1. Demographics of study participants.

Variable	Mean	Range
Age at Implant	51 years	19 to 83 years
Duration of Severe-to-Profound Hearing Loss	12 years	1 to 48 years
Duration of Implant Use	5 years	1 to 23 years
Duration of HiRes 120 Use	11 months	3 to 23 months

Everyday Music Listening

A questionnaire adapted from Mirza et al. (2003) was used to evaluate everyday music listening experience. Figure 1 shows the individual ratings for music enjoyment with HiRes 120 (0 = not at all, 10 = very much). Of the 43 adults, 36 report enjoying music to some extent (rating of 3 or higher). Mean ratings of music enjoyment and frequency of music listening (0 = never, 10 = very often) are shown in Figure 2 along with the corresponding mean results reported by Mirza and colleagues for users of other technologies. The comparisons show that HiRes 120 users listen to and enjoy music more than users of older devices. In addition, comparison of the HiRes 120 results to demographic data indicate that music enjoyment is greater for individuals implanted at a younger age, and for individuals who have used their devices longer.

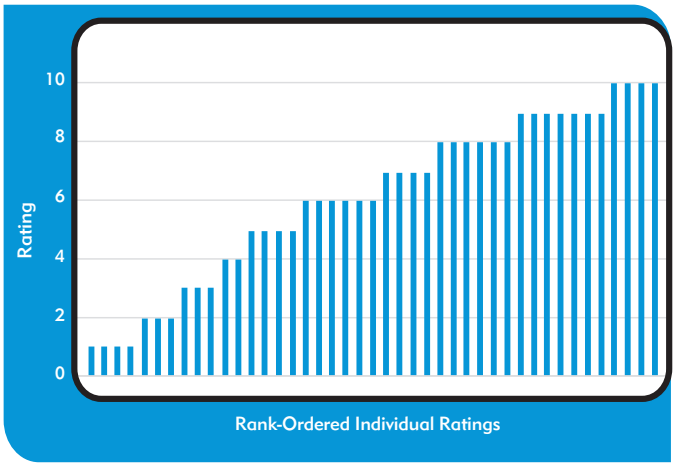


Figure 1. Individual ratings for music enjoyment (0 = not at all, 10 = very much). Eighty-four percent of adults (36 of 43) enjoy music to some extent with HiRes 120 (rating of 3 or higher).

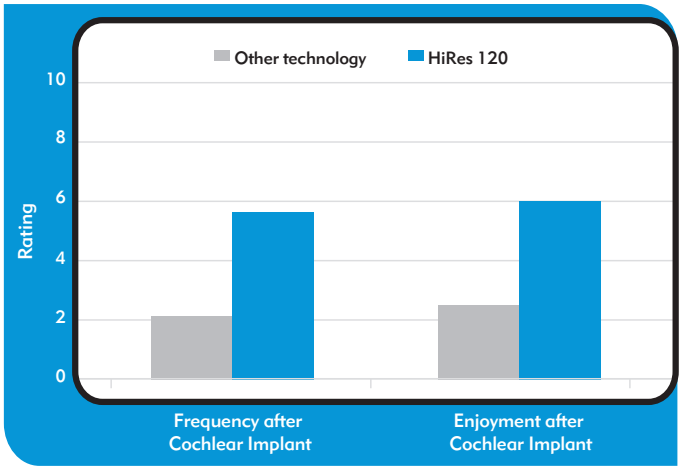


Figure 2. Mean ratings for frequency of listening to music and enjoyment of music for users of other technology (n =35) and for users of HiRes 120 (n = 43).

Appreciation of Music in Cochlear Implantees (AMICI)

The AMICI test battery developed by Spitzer et al. (2008) also was administered. The AMICI stimuli consist of short musical pieces selected from commercial recordings. The Instrument Identification subtest requires subjects to identify a target instrument or male/female vocalist from a closed set of 10 options. The Musical Styles subtest requires listeners to identify the genre of a musical selection from a closed set (rock/pop, classical, country/western, jazz, Latin). The Musical Pieces subtest consists of selections (instruments only or instruments with lyrics) that are considered to be part of the American cultural mainstream. In an open-set task, the target piece can be identified by naming the song, composer, or performer; naming an associated movie or TV show; or singing/humming the melody.

Results for the Instrument Identification test show a mean score of 71% with 25 of 43 subjects scoring 70% or better (Figure 3). On the Musical Styles test, the mean score was 69% and all subjects scored above chance (Figure 4). On the difficult open-set Musical Pieces test, the mean score was 45% and 11 subjects scored 70% or greater (Figure 5). These mean scores compare favorably to results reported by Spitzer and colleagues (2008). On all three subtests, the mean scores of the HiRes 120 listeners were higher than the mean scores for 11 implanted adults tested during the development of the AMICI (Figure 6).

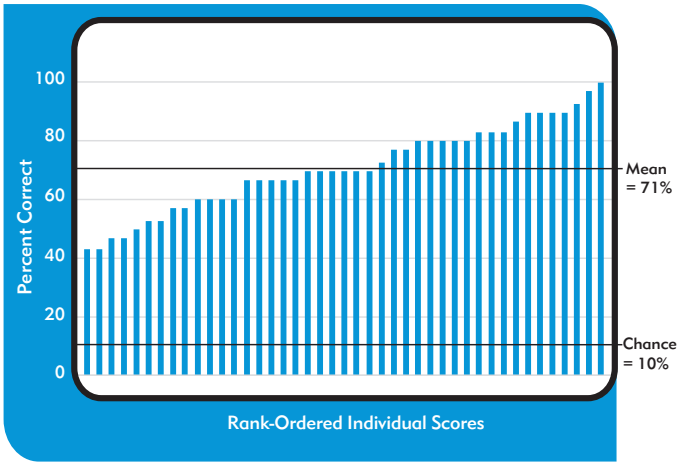


Figure 3. Individual scores for the AMICI Instrument Identification test. Fifty eight percent of subjects (25 of 43) scored 70% or better.

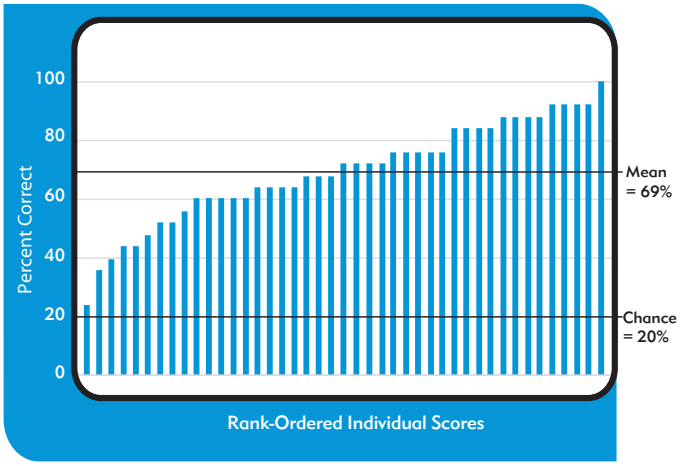


Figure 4. Individual scores for the AMICI Musical Styles test. All subjects scored above chance.

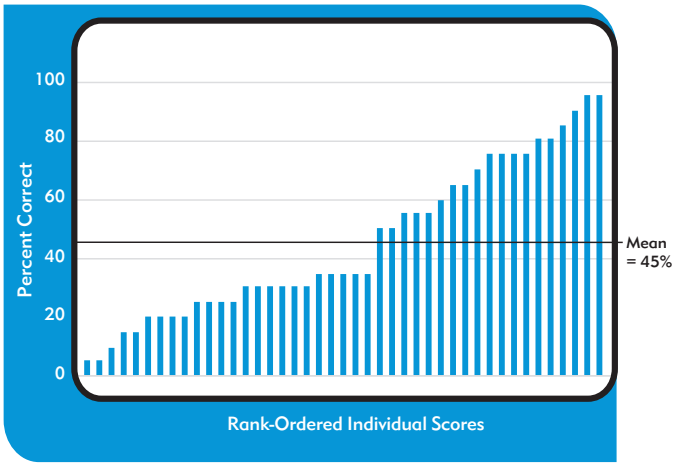


Figure 5. Individual scores for the AMICI Musical Pieces test. Eleven subjects scored 70% or better.

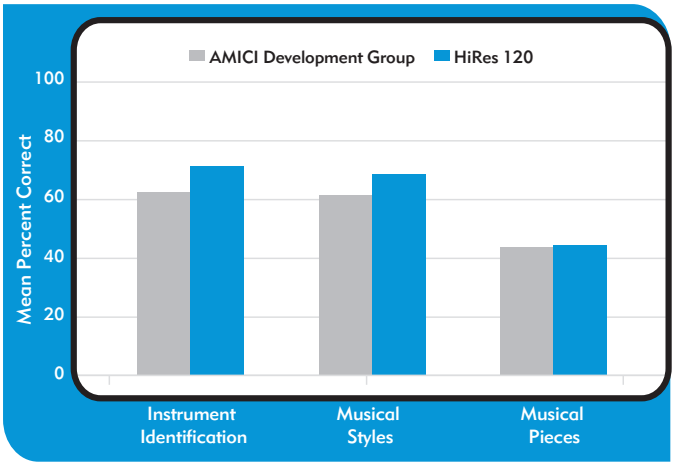


Figure 6. Mean scores for the AMICI Instrument Identification, Musical Styles, and Musical Pieces subtests for 11 implant recipients tested during development of the AMICI (5 HiRes users, 3 ACE users, 2 CIS users, 1 SPEAK user) (Spitzer et al. 2008) and 43 HiRes 120 users.

Notably, AMICI scores were not correlated with ratings of music enjoyment. Scores on the AMICI subtests also were unrelated to any of the demographic variables.

Music Scores and Speech Perception

Speech perception was evaluated using CNC words (Petersen and Lehiste 1962) and the BKB-SIN test (Etymotic Research 2005). Scores on these two tests showed modest correlations with scores on the AMICI subtests, with the exception of Musical Styles and CNC words (see Table 2). That is, individuals who had high scores on the speech tests tended to perform better on the music tests, and vice versa.

Table 2. Correlations between speech and music results.

	CNC Words	BKB-SIN
AMICI Instrument Identification	r = 0.42, p < .01	r = - 0.53, p < .001
AMICI Musical Styles	r = 0.38, p = .014	r = - 0.55, p < .001
AMICI Musical Pieces	r = 0.46, p < .01	r = - 0.79, p < .001

Summary and Implications

Music perception and enjoyment are greater in users of HiRes 120 than in users of other technologies. The fact that music enjoyment is higher in individuals who are implanted younger and who have used their devices longer suggests that music listening skills and appreciation may improve as users gain more experience with their Harmony Sound Processor. Notably, scores on tests of

music perception are not related significantly to users' self report of music enjoyment. That is, even cochlear implant recipients who do not score well on clinical music tests may derive considerable everyday pleasure from listening to music.

With HiRes 120, Harmony recipients have the opportunity to hear and to enjoy music better than ever before. The results from this ongoing study indicate that HiRes 120 is delivering the acoustic information required to be successful in hearing both speech ***and*** music. Clinicians who work with implant recipients might consider incorporating tests of music perception into their post-implant test batteries to explore the additional music benefit offered by HiRes 120.

Participating Study Sites

Advanced Bionics, *Sylmar, CA*
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Columbia University Medical Center, *New York, NY*
House Ear Clinic, *Los Angeles, CA*
Houston Ear Research Foundation, *Houston, TX*
Mayo Clinic, *Rochester, Minnesota*
Medical University of South Carolina, *Charleston, SC*
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HiRes with Fidelity 120™* Clinical Results

Clinical Studies Summary

HiRes with Fidelity 120 Overview

In 2003, Advanced Bionics released HiResolution® Sound (HiRes®), a family of strategies that doubled the number of spectral bands and increased temporal rates tenfold over conventional sound processing strategies. Clinical trial results revealed that adult subjects demonstrated significant improvement on all speech recognition tests with HiRes compared to their performance with conventional strategies (Koch et al, 2004). Moreover, 96% of the subjects expressed a strong preference for HiRes strategies.

The flexibility of the Bionic Ear's electronics platform (CII Bionic Ear® and HiRes 90K® implants) allows for the continued evolution of HiRes processing. HiRes with the Fidelity 120 option (HiRes 120) is designed to build on the strengths of standard HiRes and to create electrical stimulation patterns that more faithfully represent the frequency spectrum of the acoustic input signal. In the initial stage, HiRes 120 analyzes the incoming sound signal by applying a 256-bin Fast Fourier Transform (FFT). The algorithm then processes the temporal and spectral detail in parallel. Temporal detail is extracted using a Hilbert transform while a navigator determines the energy maximum for each electrode pair. The estimated frequencies of the spectral maxima are used to select an optimal "steered" spectral band for each electrode pair. These "steered" spectral bands are created through simultaneous delivery of current to a pair of adjacent electrodes. Conceptually, the effective locus of stimulation can be steered to locations between the electrodes by varying the proportion of current delivered to each electrode of the pair. HiRes 120 is designed to provide eight spectral bands for each of the 15 electrode pairs, thereby creating 120 separate spectral bands.

HiRes 120 is intended to allow implant users to take advantage of their residual place-pitch perception capabilities by delivering spectral information in higher resolution compared to conventional processing. The increased spectral resolution, in combination with the fine temporal resolution already implemented in HiRes, may lead to better speech perception in noise and improved music appreciation.

CONTENTS

* *In the United States, an optional feature for adults only. See package insert for details.*

Clinical Study Design

An ongoing clinical study is documenting the listening benefits of HiRes 120 sound processing in adult CII and HiRes 90K users. Performance with standard HiRes is assessed at the baseline visit and compared with HiRes 120 performance after three months of listening experience. Subsequently, subjects are refit and retested with standard HiRes. Outcome measures include speech perception in quiet and noise, music and sound quality ratings, self-reported benefits, and a preference questionnaire.

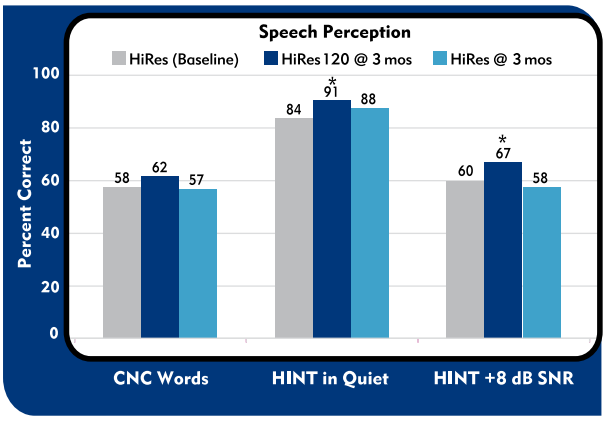

Figure 1. Mean scores for three speech tests at baseline with HiRes, at three months with HiRes 120, and after being refit with HiRes. Asterisk indicates significant difference between HiRes 120 and baseline HiRes ($p < .05$).

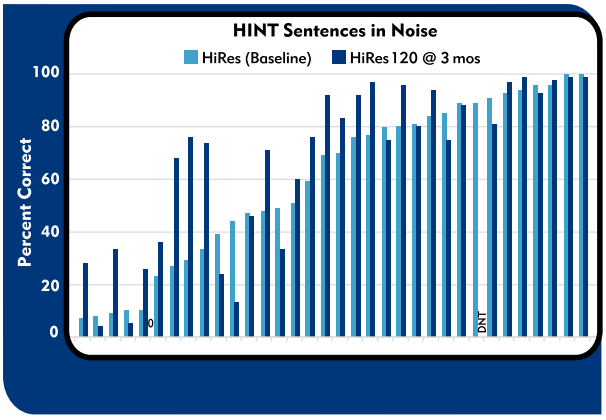

Figure 2. Individual baseline HiRes and three-month HiRes 120 HINT-in-noise scores for 34 subjects. Score-pairs are rank-ordered by baseline HiRes results.

A unique aspect of the study is use of a direct-connect system for the speech tests. The system, developed in collaboration with Sigfrid Soli and colleagues at the House Ear Institute (Soli et al, 2005), eliminates the need for a sound booth or speaker array. The direct-connect system uses a family of head-related transfer functions (HRTFs) measured with KEMAR at source locations corresponding to loudspeaker positions appropriate for unilateral or bilateral testing. HRTFs appropriate to the selected source location are applied to the selected signal and presented via direct connection to the auxiliary input of the Auria® or Harmony® sound processor at the specified level in dB(A). The HRTFs also incorporate a mapping function that specifies the relationship between electrical inputs provided via direct connection to the sound processors and acoustic inputs received via the T-Mic®. The speech stimulus at a selected location and a noise signal at the same or different specified location can be presented simultaneously at independently specified levels in dB(A) in order to simulate sound field testing.

Speech Perception Results

In the present study, a battery of speech perception tests is used to compare implant benefit between standard HiRes and HiRes 120. The speech perception tests include CNC words, HINT sentences in quiet, and HINT sentences in noise (using a fixed signal-to-noise ratio). For 34 subjects who have reached the three-month test interval to date, mean sentence perception scores were significantly higher for HiRes 120 compared to baseline with HiRes and to scores after subjects were refit with HiRes (Figure 1). As shown in the individual data (Figure 2), subjects who showed the lowest scores at baseline (and therefore had the greatest headroom for improvement on the test measure) appeared to exhibit the greatest gains when using HiRes 120—particularly for the HINT sentences in quiet and noise.

Sound Quality and Music Ratings

In addition to speech testing, study participants rate the clarity of female voices, male voices, child voices, and environmental sounds (from the Iowa Sound Quality Test) (Tyler, 2005) on a proportional scale from 0 (unclear) to 100 (clear). Subjects also rate the pleasantness and distinctness of recorded instrumental music passages on a scale from 0 (extremely unpleasant/indistinct) to 10 (extremely pleasant/distinct). The music samples consist of a variety of styles including classical, easy listening, and solo instrument passages. Finally, subjects rate their everyday frequency of listening to music (1 = never to 5 = very often) and satisfaction with listening to music (1 = very dissatisfied to 5 = very satisfied).

Subjects listen to and rate sound and music quality with standard HiRes and after using HiRes 120 for three months. For the 34 subjects with three-month data, clarity of voices and environmental sounds were significantly higher for HiRes 120 compared to baseline with HiRes. Moreover, mean ratings for pleasantness and distinctness of music were higher with HiRes 120 than with standard HiRes (Figure 3). After three months using HiRes 120, there was over a 15% shift in the proportion of adults reporting that they listen to music "often" or "very often" and that they are "satisfied" or "very satisfied" when listening to music compared to their baseline ratings with standard HiRes (Figure 4).

These results (particularly ratings of music pleasantness) for subjects using either standard HiRes or HiRes 120 show markedly higher values compared to ratings reported in an earlier study (Mirza et al, 2003) of music enjoyment with other cochlear implant technologies (Figure 5). It should be noted that the Mirza study asked subjects to rate general music listening enjoyment, whereas the present HiRes 120 study asked subjects to rate music pleasantness (and distinctness) after listening to specific musical passages.

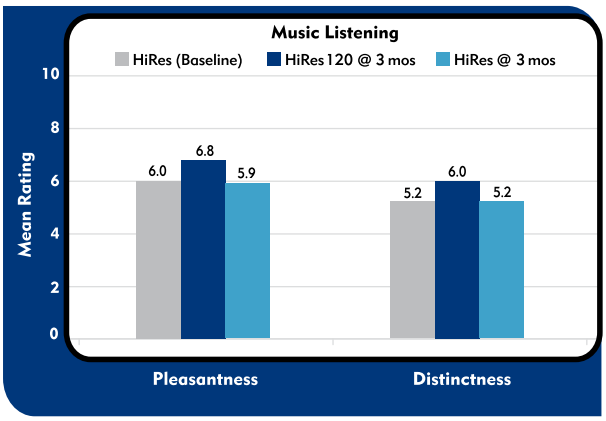

Figure 3. Mean ratings for music pleasantness and distinctness (scale: 1–10) at baseline with HiRes, after three months with HiRes 120, and at three months with HiRes.

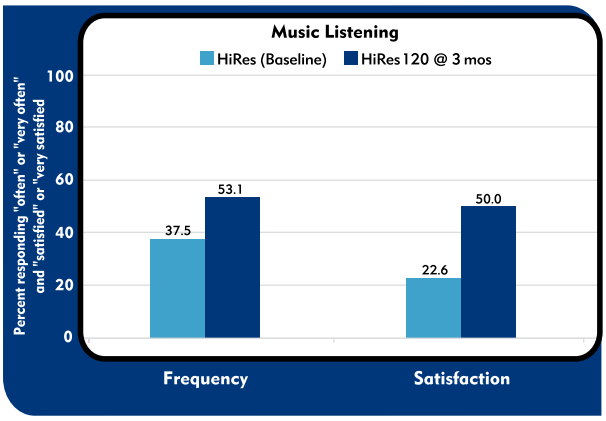

Figure 4. Percent of subjects reporting that they listen to music "often" or "very often" (left) and percent of subjects reporting their satisfaction with listening to music as "satisfied" or "very satisfied" (right) at baseline with HiRes and after three months with HiRes 120.

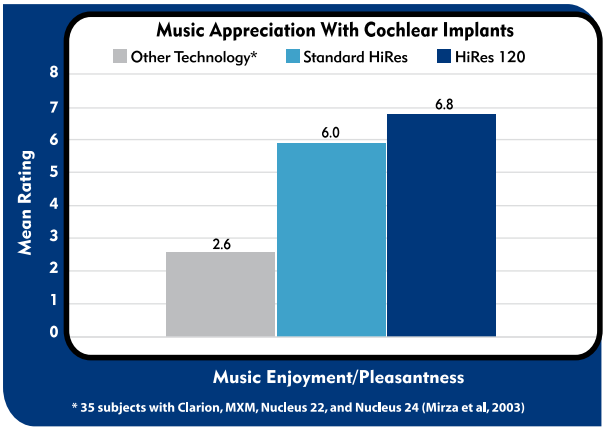

Figure 5. Mean ratings of music appreciation/pleasantness with at least nine months of use with other cochlear implant technologies (from Mirza et al, 2003) compared to at least three months of use with standard HiRes and at the three-month test interval with HiRes 120.

Everyday Listening Benefits

Study subjects also rate the sound clarity and ease of listening in everyday situations using a 5-point Likert scale, with 5 being best (clearest or easiest). Ratings are made at baseline with standard HiRes and after using HiRes 120 for three months.

After three months of HiRes 120 use, a greater proportion of the 34 subjects rated their experience as "clear" or "very clear" for all but one listening situation (at home). There was over a 15% shift in the proportion of adults reporting "clear" or "very clear" for 6 of 13 situations (Figure 6). Similarly, a greater proportion of subjects rated their experience as "easy" or "very easy" for all situations after using HiRes 120. There was over a 15% shift in the percent of subjects rating their experience as "easy" or "very easy" for 5 of 11 listening situations (Figure 7).

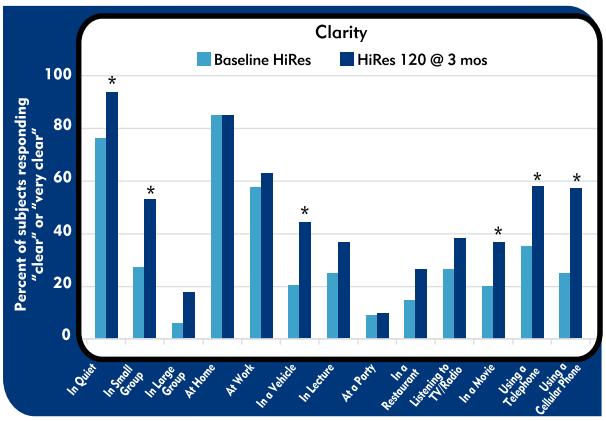

Figure 6. Percent of subjects reporting sounds as "clear" or "very clear" in 13 listening situations at baseline with HiRes and at three months with HiRes 120. Asterisk indicates a shift of 15% or more in the percent of subjects responding "clear" or "very clear."

Preference Ratings

Twenty-eight of 34 subjects (82%) reported a preference for the HiRes 120 over standard HiRes. Subjects also rated strength of preference for the two strategies on a scale from 1 (weak preference) to 10 (strong preference). The mean strength of preference for the 28 subjects who preferred HiRes 120 was 8.3 (range: 1-10). The strength of preference was rated as 8 or higher by 19 of the 28 subjects. Indeed, 14 of the 28 subjects rated their preference as 10 (strong preference). For the six subjects who preferred standard HiRes, the mean strength of preference was 5.2 (range: 1-9). The strong preference for HiRes 120 suggests that standard objective test batteries are not able to measure quantitatively some of the important qualitative benefits reported by recipients.

Participants also indicated those aspects of sound that were better with their preferred processing mode using the scale: strongly disagree, disagree, neutral, agree, or strongly agree. As seen in Table 1, over three-quarters of the subjects agreed or strongly agreed that HiRes 120 resulted in better overall sound quality and more natural sounding speech—and that environmental

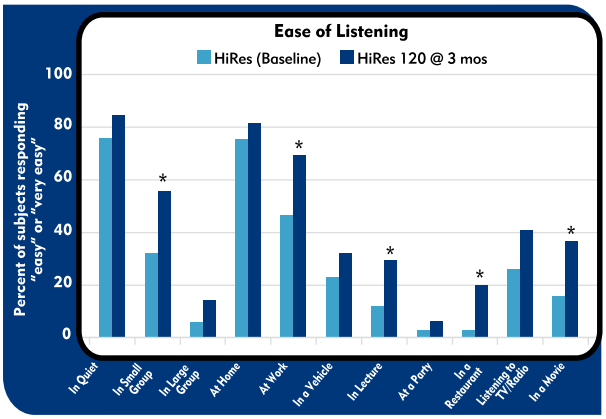

Figure 7. Percent of subjects reporting listening as "easy" or "very easy" for 11 listening situations at baseline with HiRes and at three months with HiRes 120. Asterisk indicates a shift of 15% or more in the percentage of subjects responding "easy" or "very easy."

sounds were easier to distinguish and sounded more distinct compared with standard HiRes. Table 2 shows that approximately one-half to two-thirds of the subjects who preferred HiRes 120 reported improvement in listening to various aspects of music.

Table 1. Distribution of Preference Ratings on Speech and Environmental Sounds Items‡

Preference Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Quality is better.	0%	0%	14.3%	39.3%	46.4%
Speech is more natural.	0%	3.6%	14.3%	39.3%	42.9%
Speech is easier to understand.	0%	10.7%	25.0%	32.1%	32.1%
Environmental sounds are easier to distinguish.	0%	0%	14.3%	35.7%	50.0%
Environmental sounds are more distinct.	0%	3.6%	7.1%	46.4%	42.9%

‡ For 28 (of 34) subjects who preferred HiRes 120.

Table 2. Distribution of Preference Ratings on Music Items‡

Preference Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Music sounds better.	0%	3.6%	25.0%	28.6%	42.9%
Music sounds more natural.	0%	0%	33.3%	22.2%	44.4%
Music sounds richer.	0%	3.6%	25.0%	28.6%	42.9%
Melody is more enjoyable.	0%	3.6%	25.0%	39.3%	32.1%
Rhythm is more noticeable.	0%	0%	28.6%	32.1%	39.3%
Singers' voices are more distinguishable from instruments.	0%	3.6%	25.0%	46.4%	25.0%
Singers' voices sound more distinct.	0%	7.1%	39.3%	28.6%	25.0%
Lyrics are recognizable.	0%	14.3%	39.3%	28.6%	17.9%
Individual instruments are distinguishable.	0%	10.7%	21.4%	53.6%	14.3%
Individual instruments sound more distinct.	0%	7.1%	21.4%	50.0%	21.4%

‡ For 28 (of 34) subjects who preferred HiRes 120.

Participating Centers (North America)

House Ear Clinic, Los Angeles, California
Houston Ear Research Foundation, Houston, Texas
Johns Hopkins University, Baltimore, Maryland
Ottawa Hospital (Civic Campus), Ottawa, Ontario
Midwest Ear Institute, Kansas City, Missouri
Northwestern University, Evanston, Illinois
Washington University, St. Louis, Missouri

Summary

These clinical results indicate that HiRes 120 is a viable sound processing option that may offer additional hearing advantages for some CII and HiRes 90K recipients in a variety of listening environments. The reported benefits extend beyond speech perception and may encompass everyday sounds and music appreciation—outcomes once thought to be beyond expectations for cochlear implant recipients.

References

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Mirza S, Douglas SA, Lindsey P, Hildrech T. (2003) Appreciation of music in adult patients with cochlear implants: a patient questionnaire. Coch Impl Intl 4 (2): 85-95.

Soli S, Chan J, Vermiglio A, Freed D, Kessler DK. (2005) Assessment of spatial unmasking and sound localization in bilateral implants using direct input. Poster presented at the Conference on Implantable Auditory Prostheses, Pacific Grove, CA. 30 July–4 August, 2005.

Tyler RS. (2005) Personal communication.

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