ADVANCED BIONICS
POWERFUL CONNECTIONS

Neural Response Imaging (NRI) and Remote Programming

TRAINING OBJECTIVES

At the end of this course, participants will be able to:

- Explain the value of NRI and how to conduct the measurement.
- Demonstrate how to apply NRI results to maps in Target CI.
- Describe the steps to programming a patient remotely using Target CI and the AB Remote Support app.

TRAINING TAKEAWAYS

1

2

3

SUPPORTING DATA

Independent research has shown:

- 37% of adults in the United States used telehealth in 2021, and telehealth utilization increases with age.
- Patients reported high levels of satisfaction with remote programming from AB.

Marvel CI research has shown:

- Outcomes with remote programming are no different from in-person programming. Attitudes towards remote programming are positive from both professionals and recipients.

1.CDC (2022). Telemedicine use among adults: United States, 2021. Retrieved from: Products - Data Briefs - Number 445 - October 2022

2.Advanced Bionics. (2023). Remote programming from AB: clinical care without limits. Clinical Research Department.

3.Andreoli, J. H., Delano, P. H., Morris, A. M., Stott, C., Martinho de Carvalho, A. C., Diaz, R. C., & Agrawal, S. (2024, February 13-15). Remote programming outcomes with CI recipients in Chile. [Poster session]. American Auditory Society Annual Conference, Scottsdale, AZ.

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- Click File
- Click Print
- Click dropdown menu on the right "preview"
- Click layout
- Choose # of pages per sheet from dropdown menu
- Checkmark Black & White if wanted.

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- Open PDF
- Click Print
- Choose # of pages per sheet from dropdown menu
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ADVANCED BIONICS
POWERFUL CONNECTIONS

Target CI

Neural Response Imaging Introduction

A Sonova brand

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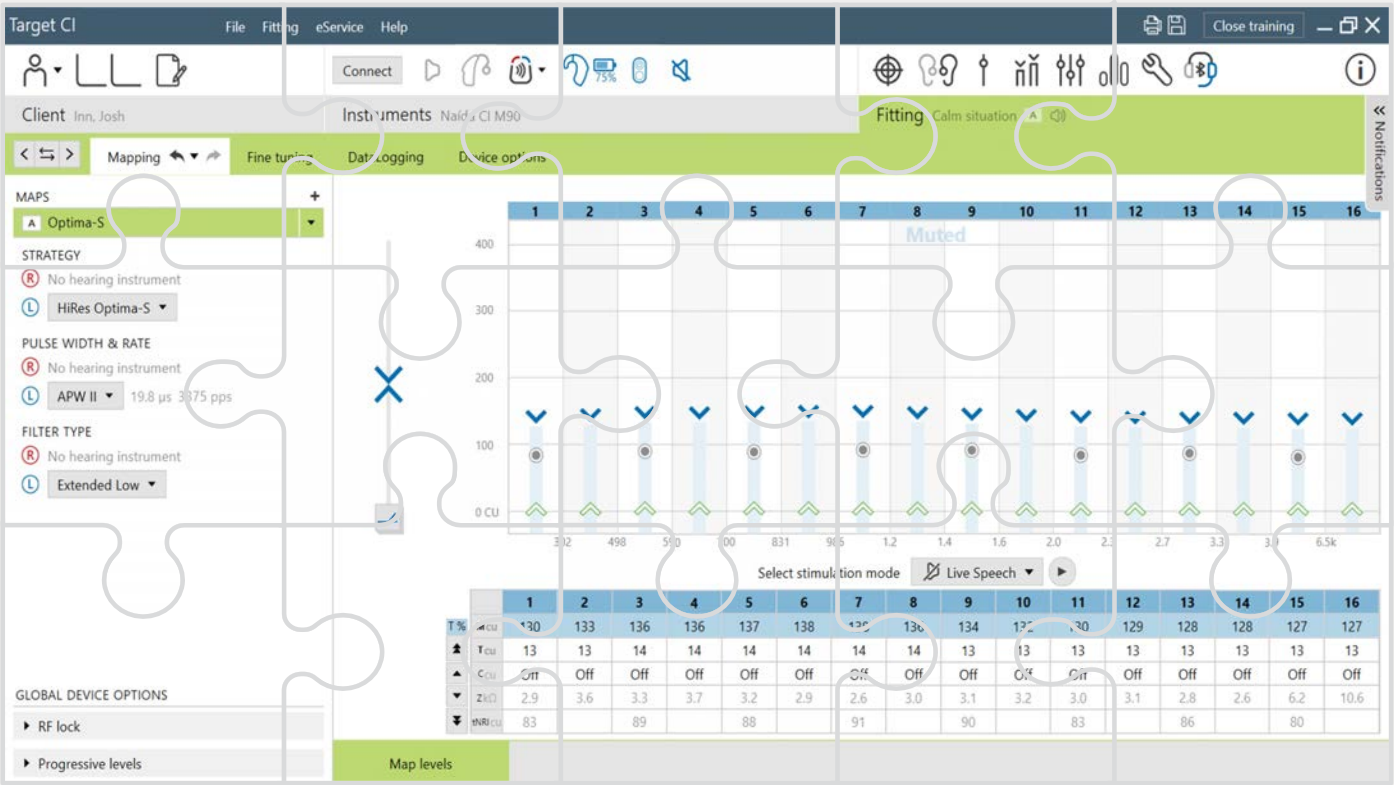
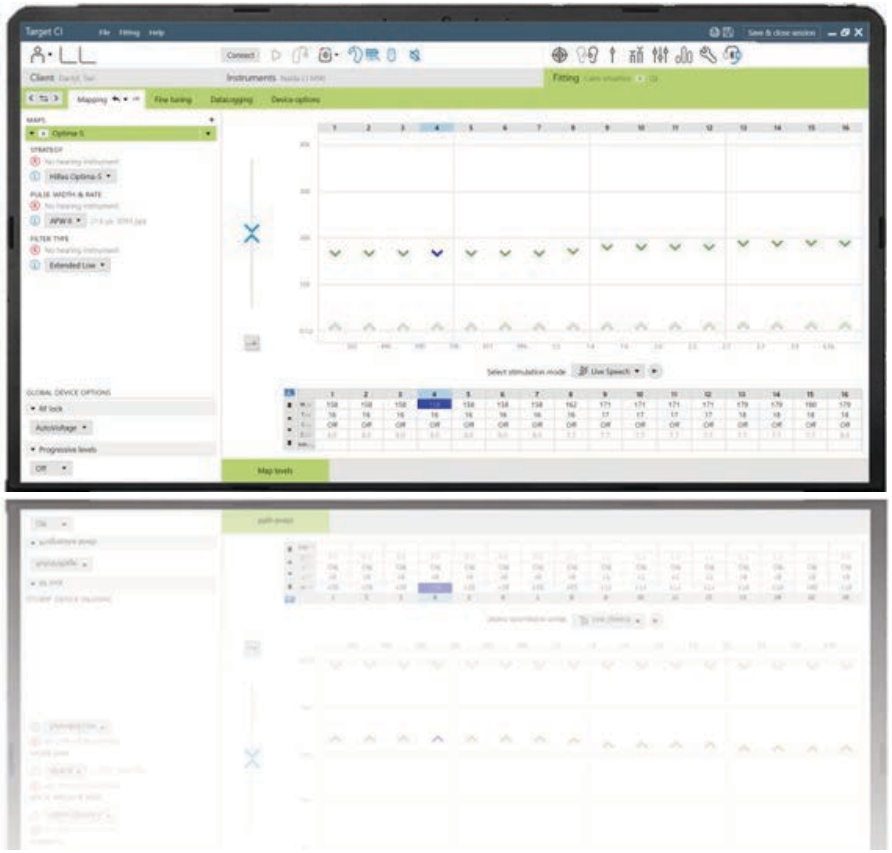
Utilizing NRI



Utilizing NRI

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

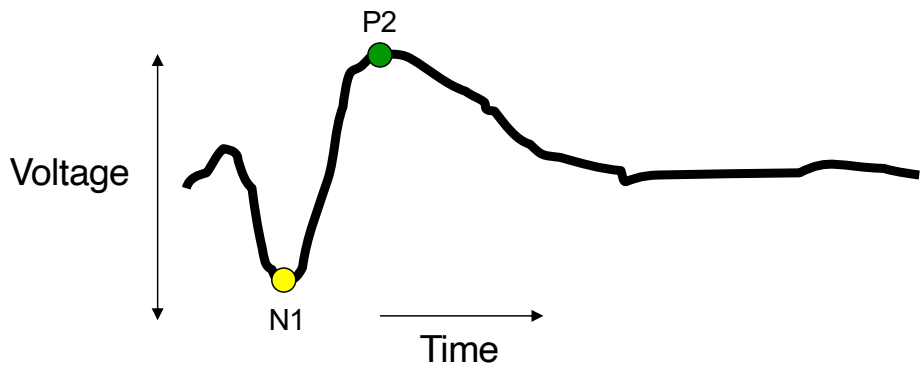
- Explain the value of NRI.
- Describe how to conduct NRI.
- Demonstrate how to apply NRI results to maps in Target CI



Neural Response Imaging

NRI

- Measurement of the neural response (ECAP–Electrically Evoked Compound Action Potential)
- Measured using the intracochlear electrodes & Target CI programming software
- NRI is dependent upon adequate neural survival and synchronous neural activity.



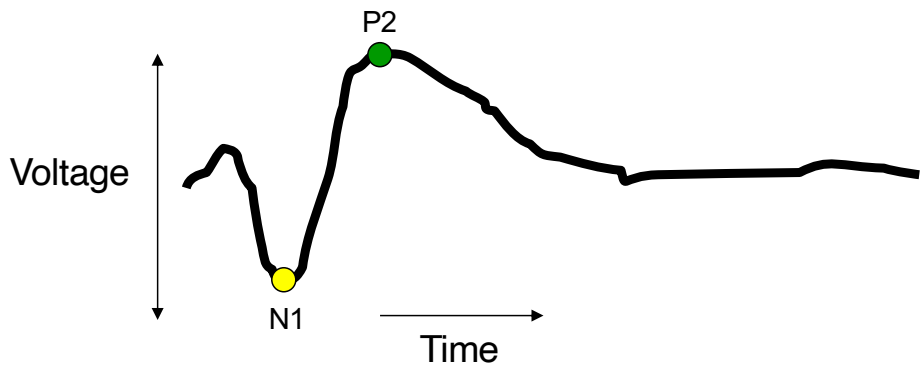
Compound Action Potential

CAP

Action Potential – a small change in voltage resulting from the firing of neurons

The synchronous firing of neurons creates a Compound Action Potential (CAP).

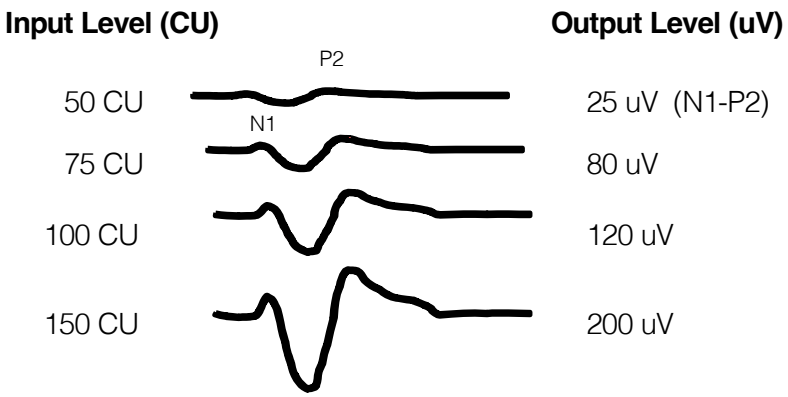
- The CAP can be recorded in the Advanced Bionics Cochlear Implant using the system's telemetry and the intracochlear electrodes.
- The resulting waveform is Wave I noted during ABR.



What is an Electrically Evoked Compound Action Potential (ECAP)?

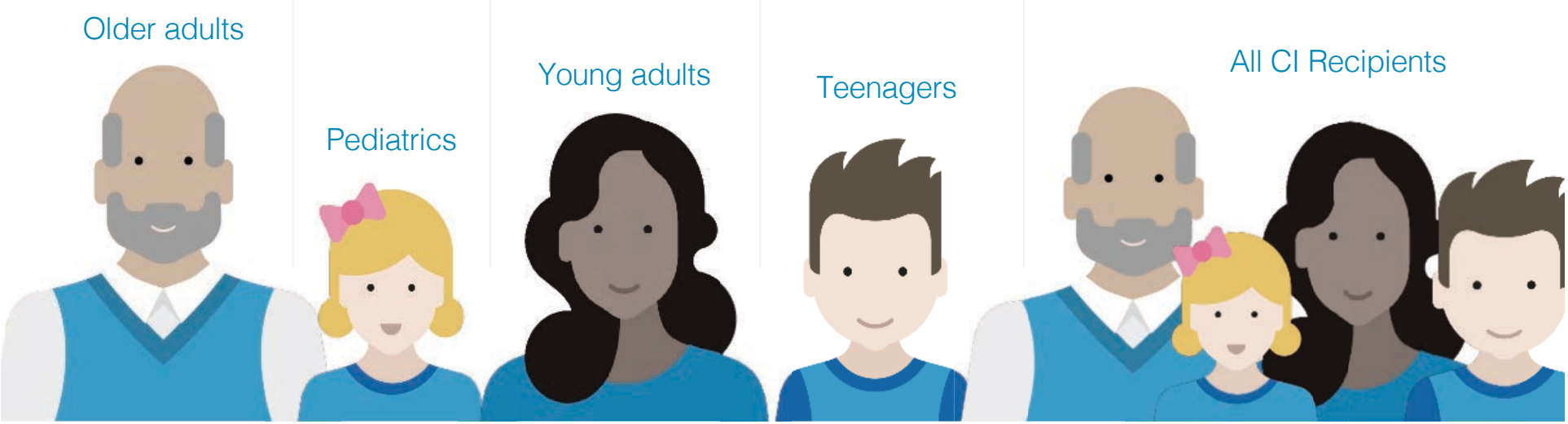
An ECAP is the response obtained when an electrical stimulus is used to record compound action potentials.

Example:



Knowledge Check

With whom should we use NRI?



TRUE

OR

FALSE

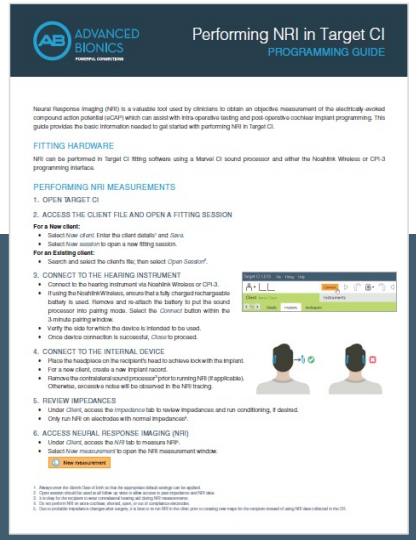
Knowledge Check: True or False

The ability to measure an ECAP is highly influenced by neural survival, synchronous neural activity, ~~and the level of environmental sounds.~~

Performing NRI in Target CI

Performing NRI in Target CI

Quick reference guide



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Performing NRI in Target CI

PROGRAMMING GUIDE

Neural Response Imaging (NRI) is a valuable tool used by clinicians 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.

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.

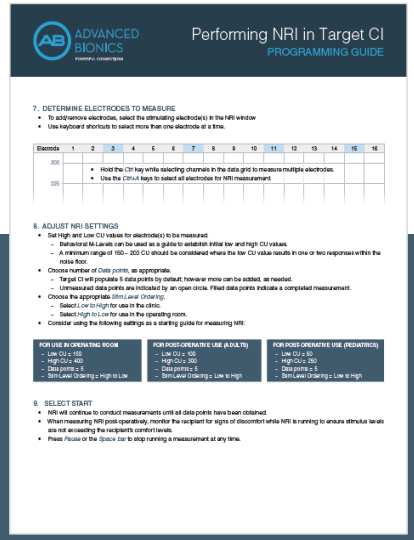
For an Existing client:

- 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 or CPI-3.
   - If using the Noahlink Wireless, 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 impedance[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.

New measurement

1. Always ensure the client's Date of birth so that the appropriate default settings can be applied.
2. Ensure the correct processor is selected in the client file to avoid inaccurate or missing NRI data.
3. It is ideal for the recipient to wear contralateral hearing aid during NRI measurements.
4. Do not perform NRI on ears cochlear, stented, open, or out of compliance electrodes.
5. Due to probable impedance changes after surgery, it is best to run NRI in the clinic prior to creating new maps for the recipient instead of using NRI data collected in the OR.



ADVANCED BIONICS

Performing NRI in Target CI

PROGRAMMING GUIDE

7. DETERMINE ELECTRODES TO MEASURE
   - To add/remove electrodes, select the stimulating electrode(s) in the NRI window
   - Use keyboard shortcuts to select more than one electrode at a time.

Electrode	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
300																
225																

- Hold the *Ctrl* key while selecting channels in the data grid to measure multiple electrodes.
- Use the *Ctrl+A* keys to select all electrodes for NRI measurement.

8. ADJUST NRI SETTINGS
   - 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.
   - Consider using the following settings as a starting guide for measuring NRI:

FOR USE IN OPERATING ROOM	FOR POST-OPERATIVE USE (ADULTS)	FOR POST-OPERATIVE USE (PEDIATRICS)
– Low CU ≥ 150 – High CU ≥ 400 – Data points ≥ 5 – Stim Level Ordering ≥ High to Low	– Low CU ≥ 100 – High CU ≥ 350 – Data points ≥ 5 – Stim Level Ordering ≥ Low to High	– Low CU ≥ 50 – High CU ≥ 250 – Data points ≥ 5 – Stim Level Ordering ≥ Low to High

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 *Space bar* to stop running a measurement at any time.

ADVANCED BIONICS

Performing NRI in Target CI

PROGRAMMING GUIDE

10. NRI ANALYSIS

NRI measurement

Data points

RECORDING

Start

DATA POINT

Stop to next data point

Stop to next electrode

SETTINGS

Stim level ordering: Low to high

Averages per data point: 10

Simulated dataset: 1

Recording gain: 300

Stimulation sequence: Cathode first

SP Smooth Function - Regression Analysis with 10 data points in the plot. First and more than 3 measured data points above the noise floor.

NRI value

Noise floor ≈ 20µV

Good waveform morphology

Save | Save and close | Cancel

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 NRI.
- 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:
- Pause the NRI measurement, confirm that the contralateral hearing aid is removed.
- Increase the number of Averages per data point.

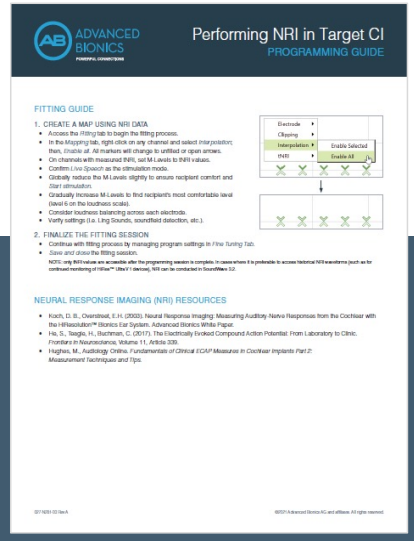
RESPONSE WITH A ARTIFACT

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

- NRI waveforms are not accessible after the programming session is complete. Verifying correct NRI values prior to saving and closing the session will ensure correct NRI values are calculated.
- To repeat measurements in future sessions, use the copy setting function, as shown below.

1/20/2021 11:43 AM | 84 | 88 | 89 | 85 | 88 | 84 | 85 | 74 | Copy

11. SAVE NRI MEASUREMENT
    - *Save and close* the NRI measurement.



ADVANCED BIONICS

Performing NRI in Target CI

PROGRAMMING GUIDE

FITTING GUIDE

1. CREATE A MAP USING NRI DATA
   - 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 NRI, set M Levels to NRI 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.).

Electrode | Clipping | Interpolation | NRI | Enable Selected | Enable All

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

NOTE: only NRI values are accessible after the programming session is complete. In cases where it is preferable to access historical NRI waveforms (such as for continued monitoring of HiRes™ Ultra 3 devices), NRI can be conducted in SoundWave 3.2.

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.
- Hu, S., Saege, H., Buchman, C. (2017). The Electrically Evoked Compound Action Potential: From Laboratory to Clinic. *Frontiers in Neuroscience*, Volume 11, Article 339.
- Hughes, M., Auditology Online. *Fundamentals of Clinical ECAP Measures in Cochlear Implants Part 2: Measurement Techniques and Tips.*

SV NRI-03 Rev A

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Case Study

Neural Response Imaging

Josh has an Advanced Bionics cochlear implant. His hearing healthcare team knows that Neural Response Imaging (NRI) is a valuable tool that can be used to obtain objective measurements which can assist with both intra-operative testing and post-operative CI programming.

The cochlear implant protocol at Josh's center includes obtaining baseline NRI results within the first three months of implantation. Today, we will focus on running NRI for Josh's left cochlear implant.

Let's go through the steps to conduct NRI on Josh.

Target CI

Open fitting software

Target CI File Help

Clients & sessions

Inn Search Show all

Client#	Last name	First name
0000021	Inn	Josh
Session 1	2/15/2021	
Session 2	3/15/2021	
Session 3	5/15/2021	

Access the client file and open a fitting session.

Inn, Josh 4/1/1985

Session 3 4/19/2021 5:40 AM

R No audiogram

No hearing instrument

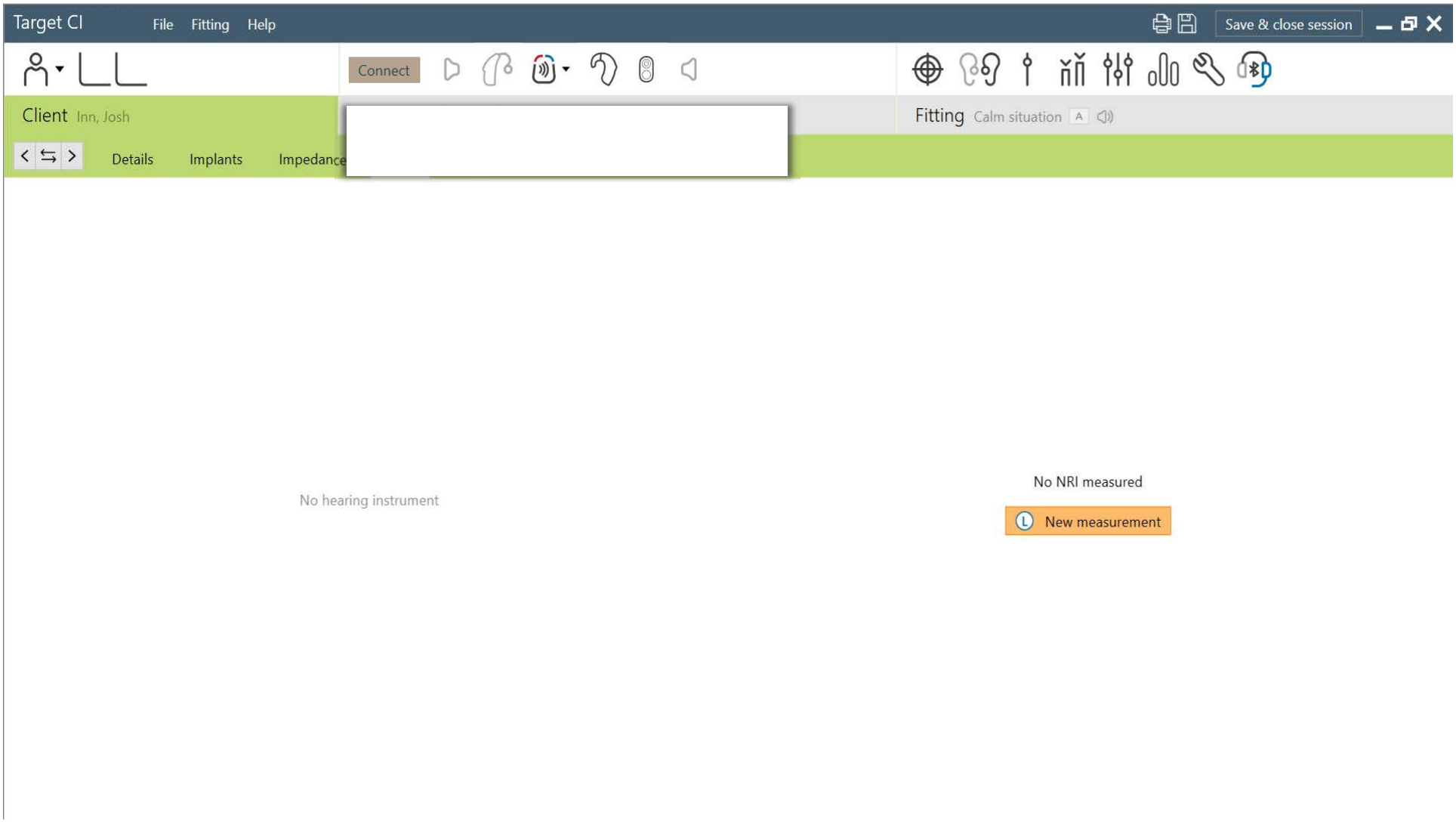
L No audiogram

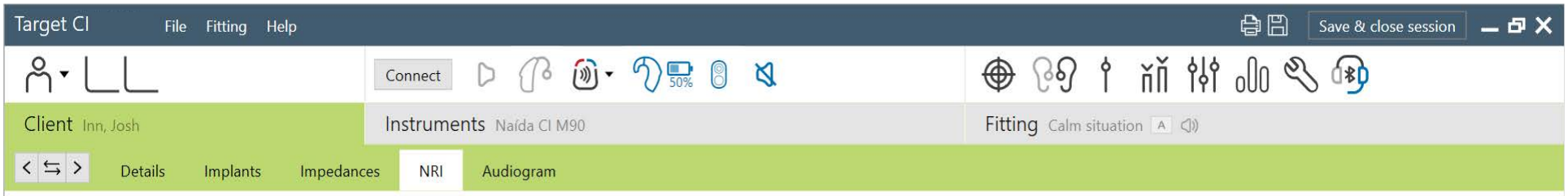
Naída CI M90
SN: DSN0101004

Select *Open session* to begin the fitting session.

New client... Open session New session Reports...

Clients & sessions Trial & tools Setup

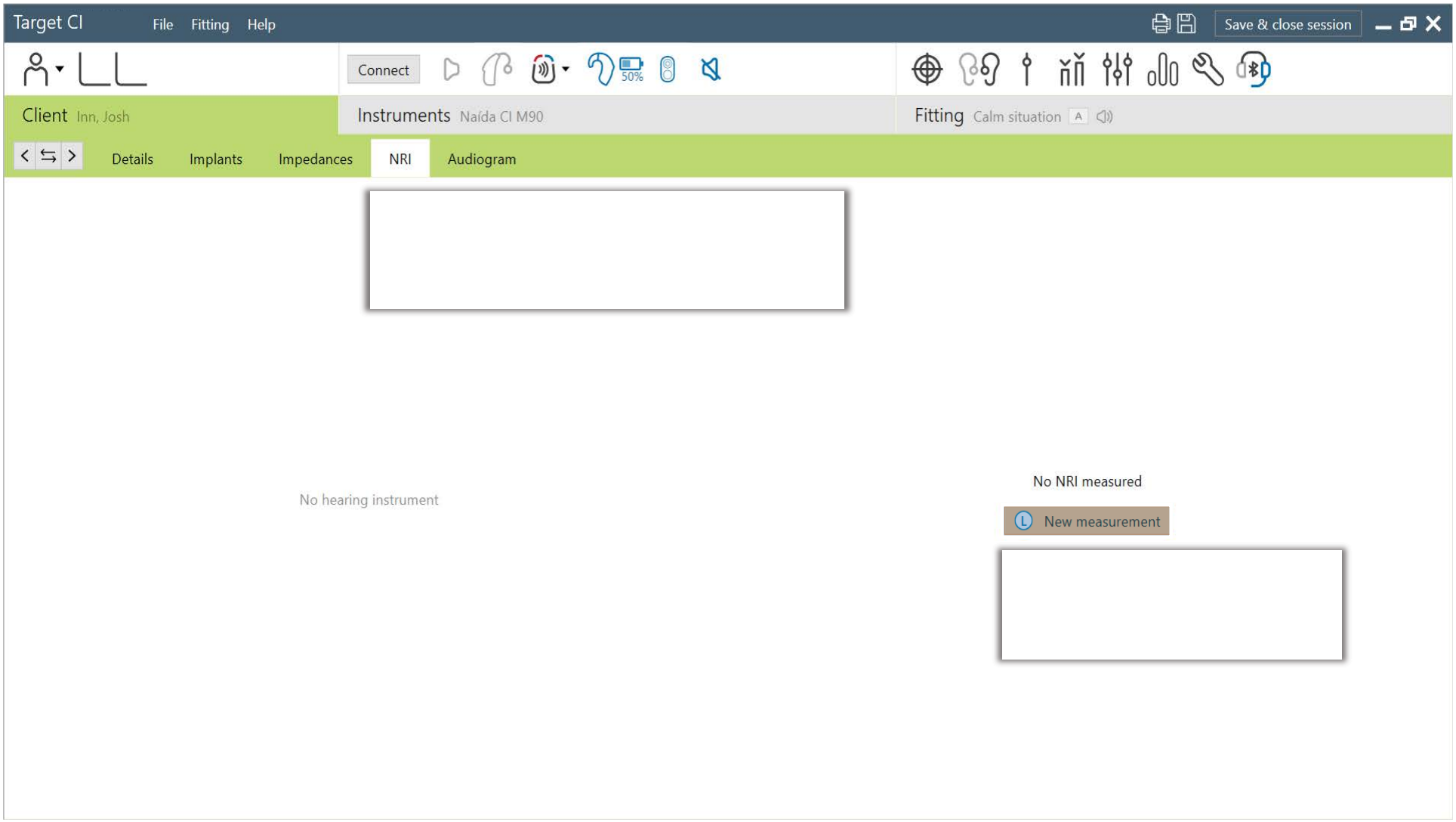

Target CI
File
Fitting
Help
Save & close session
Connect
Client
Inn, Josh
Fitting
Calm situation
A
Details
Implants
Impedance
No hearing instrument
No NRI measured
New measurement

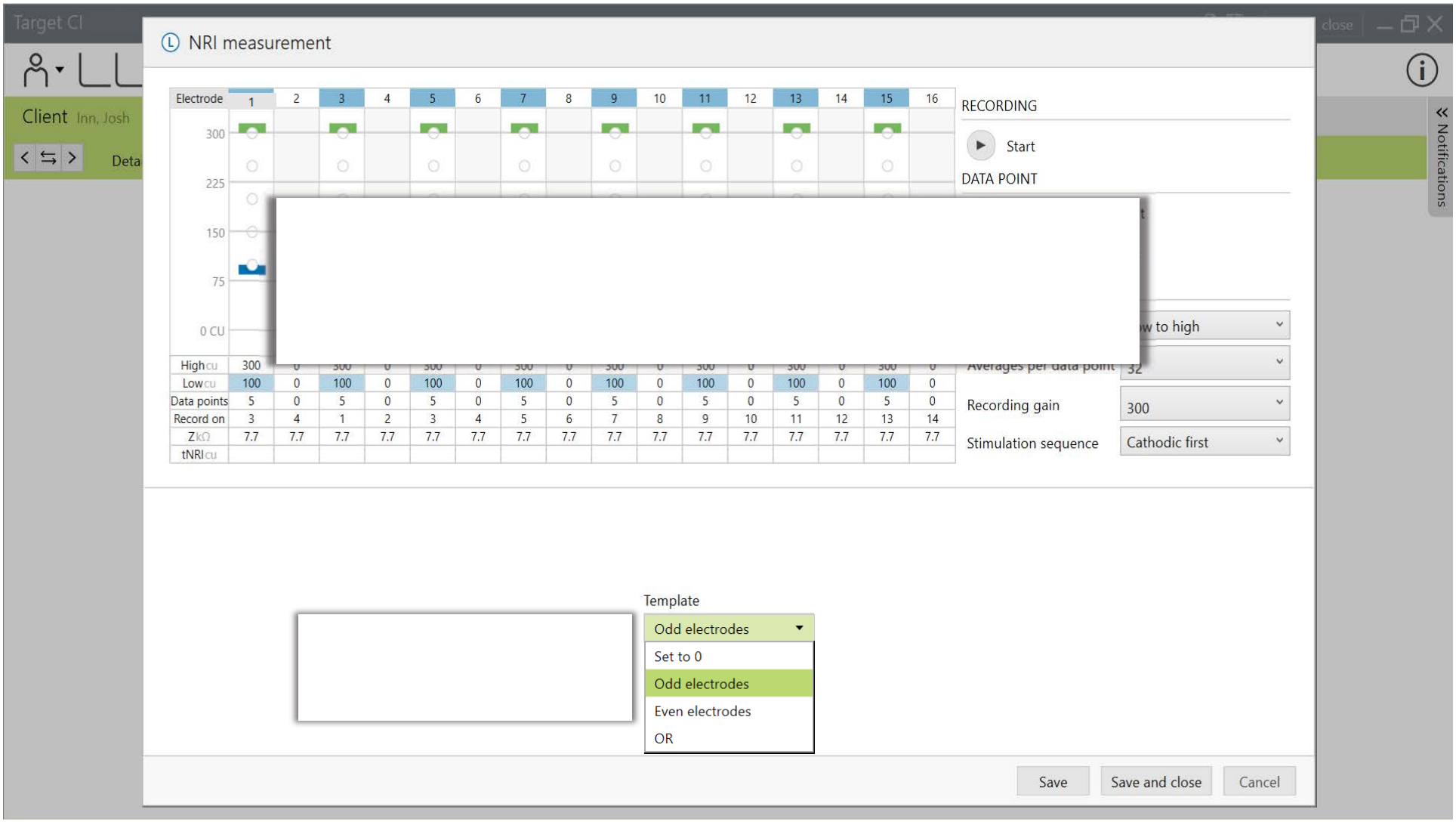


Connect to the internal device.

- Place the headpiece on the recipient's head to achieve lock with the implant.
- Remove the contralateral sound processor prior to running NRI (if applicable). Otherwise, excessive noise will be observed in the NRI tracing.

NOTE: It is okay for the recipient to wear a contralateral hearing aid during NRI measurements.


Target CI
File
Fitting
Help
Save & close session
Connect
50%
Client Inn, Josh
Instruments Naída CI M90
Fitting Calm situation
Details
Implants
Impedances
NRI
Audiogram
No hearing instrument
No NRI measured
New measurement


Target CI
close
Client Inn, Josh
Deta
NRI measurement
Electrode 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
300
225
150
75
0 CU
High cu 300
Low cu 100 0 100 0 100 0 100 0 100 0 100 0 100 0 100 0
Data points 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0
Record on 3 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Z kΩ 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7
tNRI cu
RECORDING
Start
DATA POINT
w to high
Averages per data point 32
Recording gain 300
Stimulation sequence Cathodic first
Template
Odd electrodes
Set to 0
Odd electrodes
Even electrodes
OR
Save
Save and close
Cancel
Notifications

Target CI

NRI measurement

Adult NRI Templates

ODD ELECTRODES	EVEN ELECTRODES	OR	SET TO 0
Electrodes: 1, 3, 5, 7, 9, 11, 13, & 15	Electrodes: 2, 4, 6, 8, 10, 12, 14, & 16	Electrodes: 3, 7, 11, & 15	Electrodes: 1 – 16
Low CU = 100	Low CU = 100	Low CU = 150	Low CU = 0
High CU = 300	High CU = 300	High CU = 400	High CU = 0
Data points = 5	Data points = 5	Data points = 5	Data points = 0
Stim Level Ordering = Low to high	Stim Level Ordering = Low to high	Stim Level Ordering = High to low	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	Electrodes: 2, 4, 6, 8, 10, 12, 14, & 16	Electrodes: 3, 7, 11, & 15	Electrodes: 1 – 16
Low CU = 50	Low CU = 50	Low CU = 150	Low CU = 0
High CU = 250	High CU = 250	High CU = 400	High CU = 0
Data points = 5	Data points = 5	Data points = 5	Data points = 0
Stim Level Ordering = Low to high	Stim Level Ordering = Low to high	Stim Level Ordering = High to low	Stim Level Ordering = Low to high

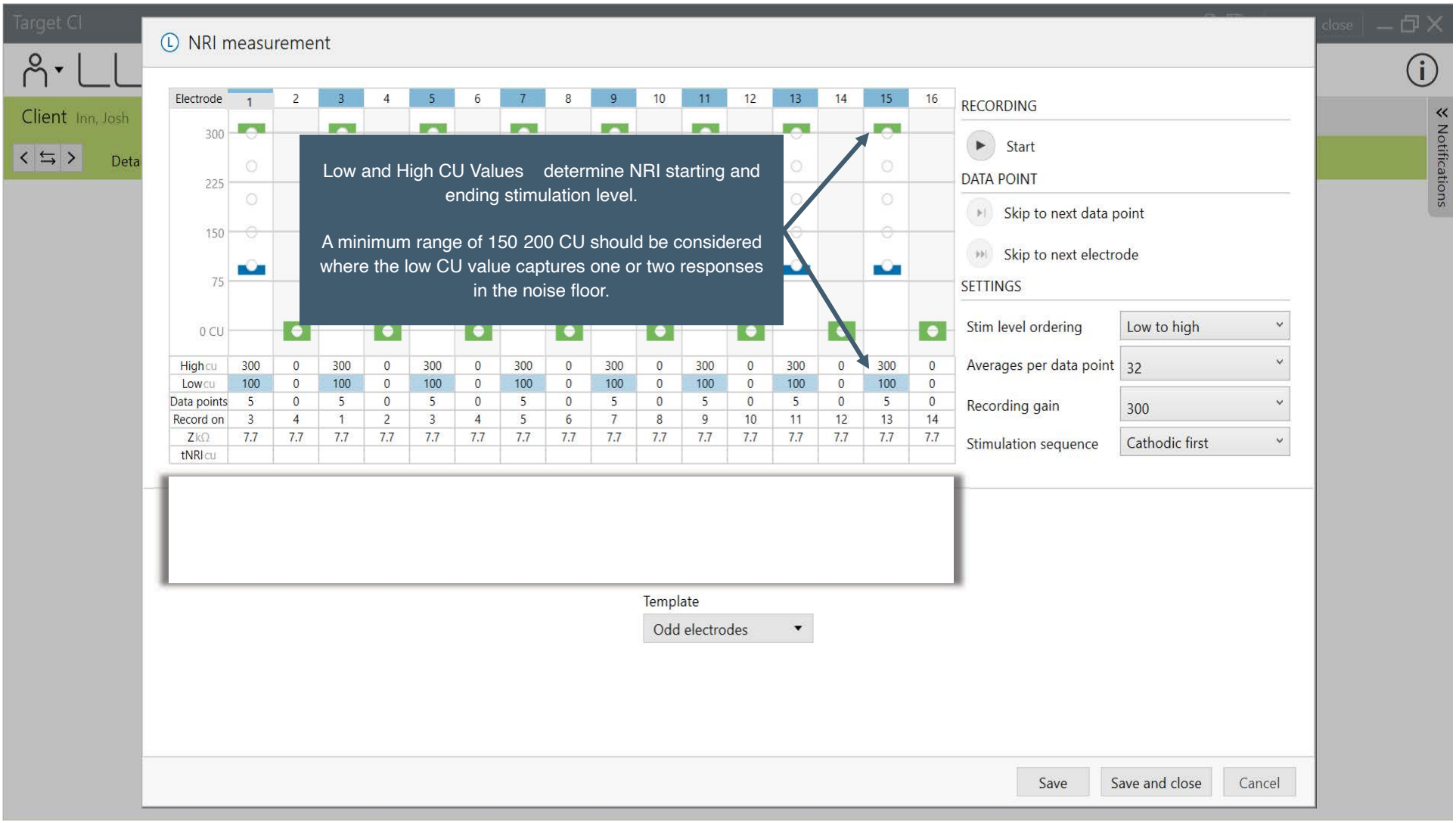
Template

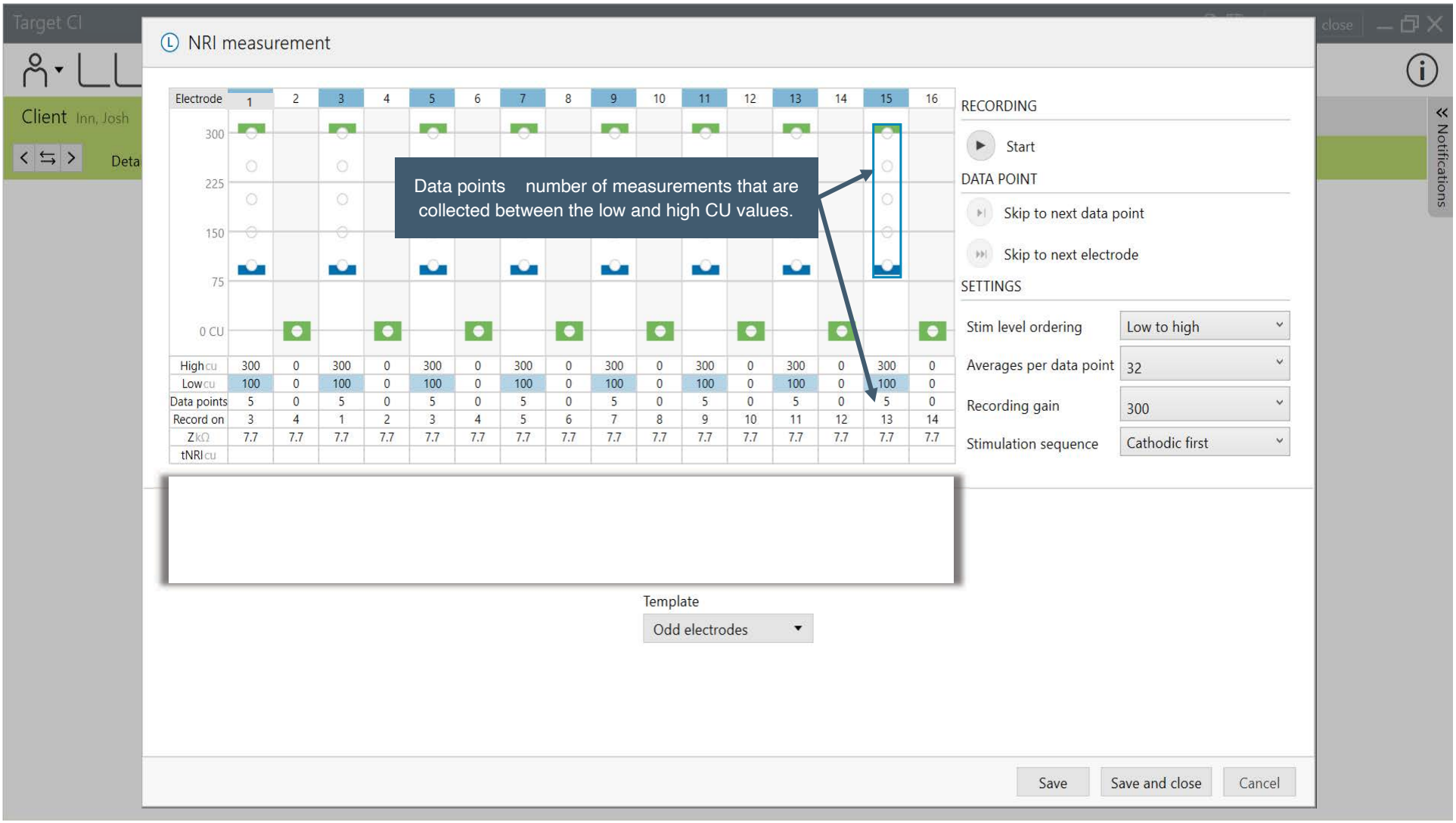
Odd electrodes

- Set to 0
- Odd electrodes
- Even electrodes
- OR

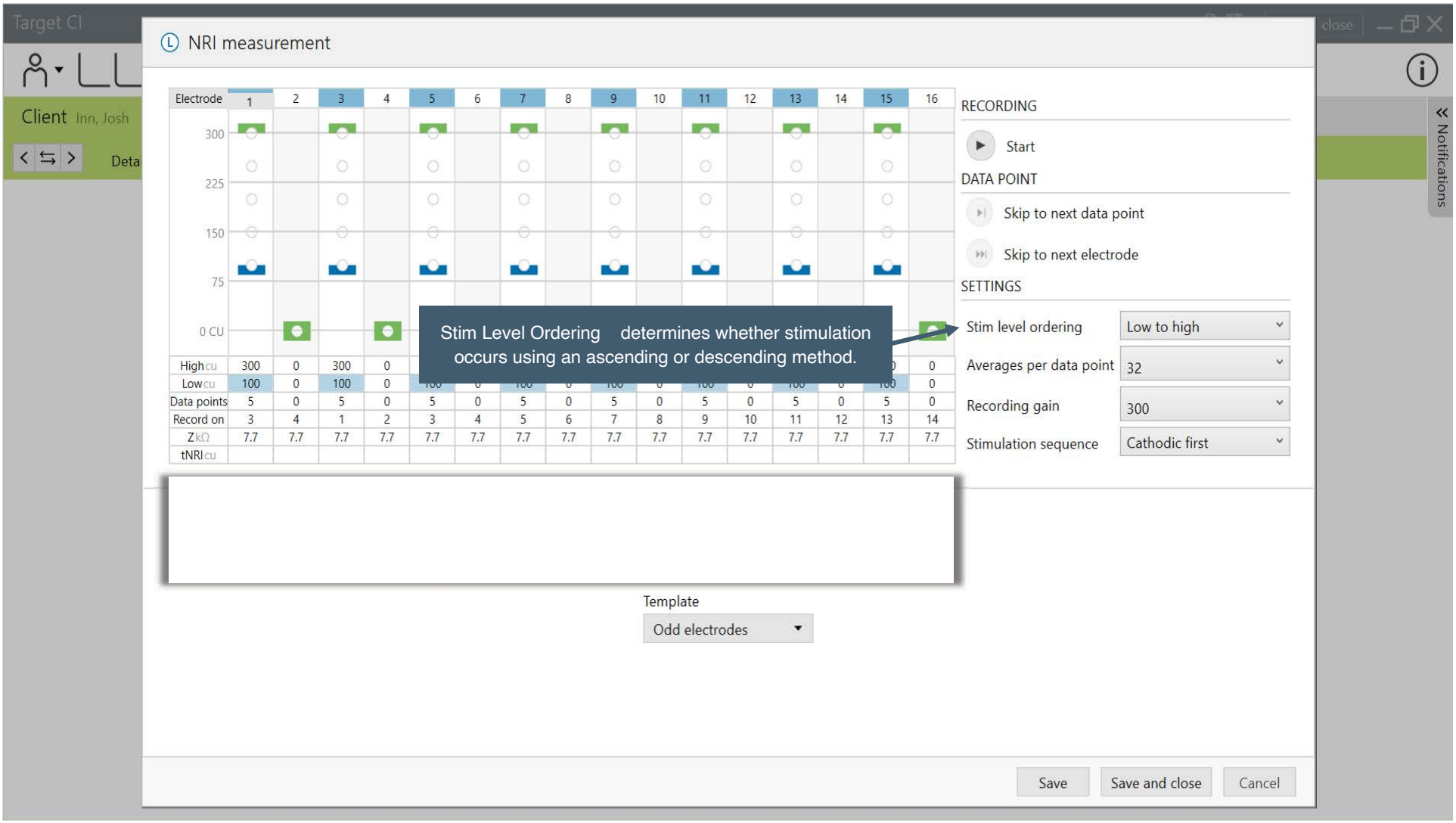
Save | Save and close | Cancel

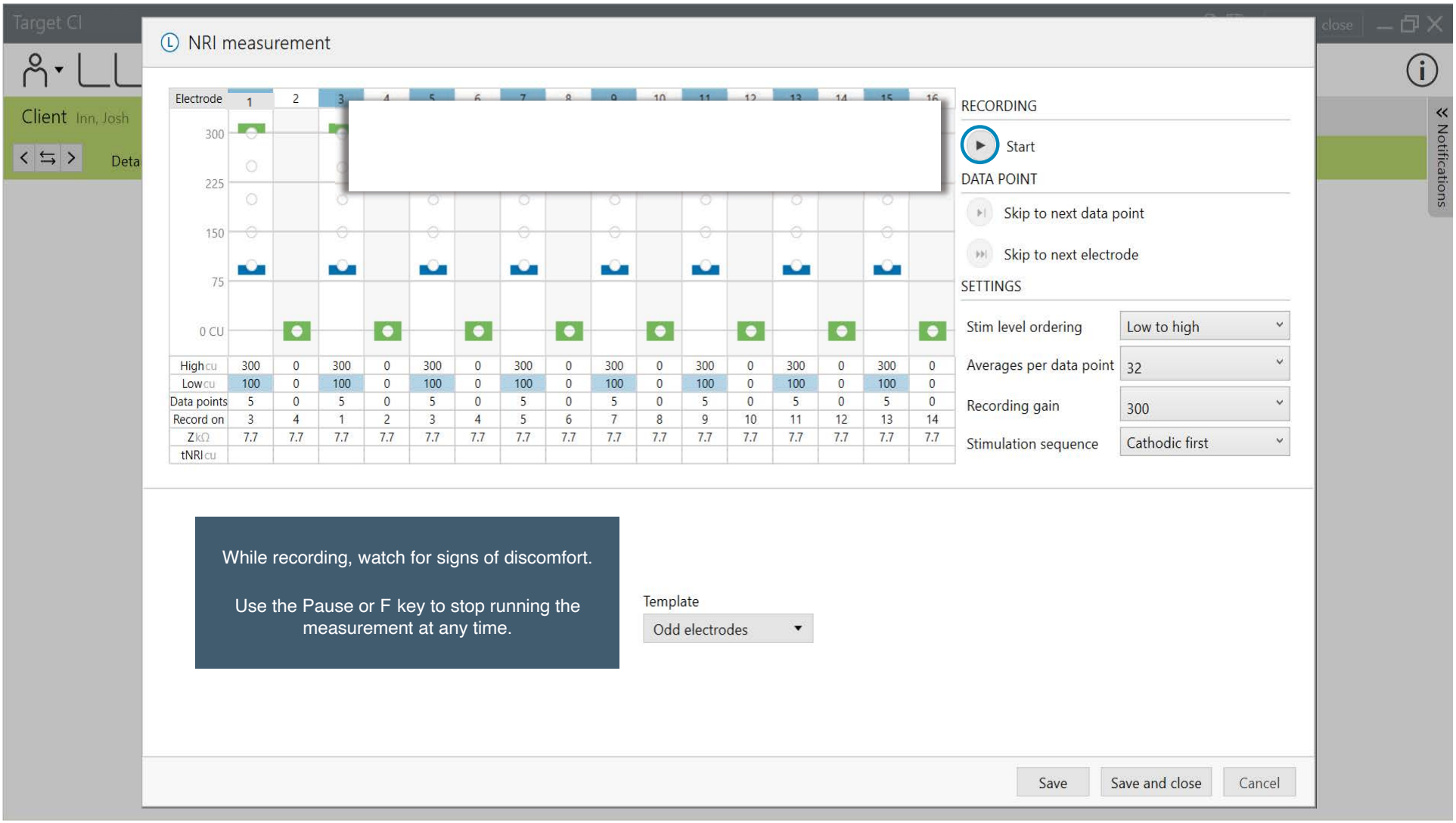
Notifications

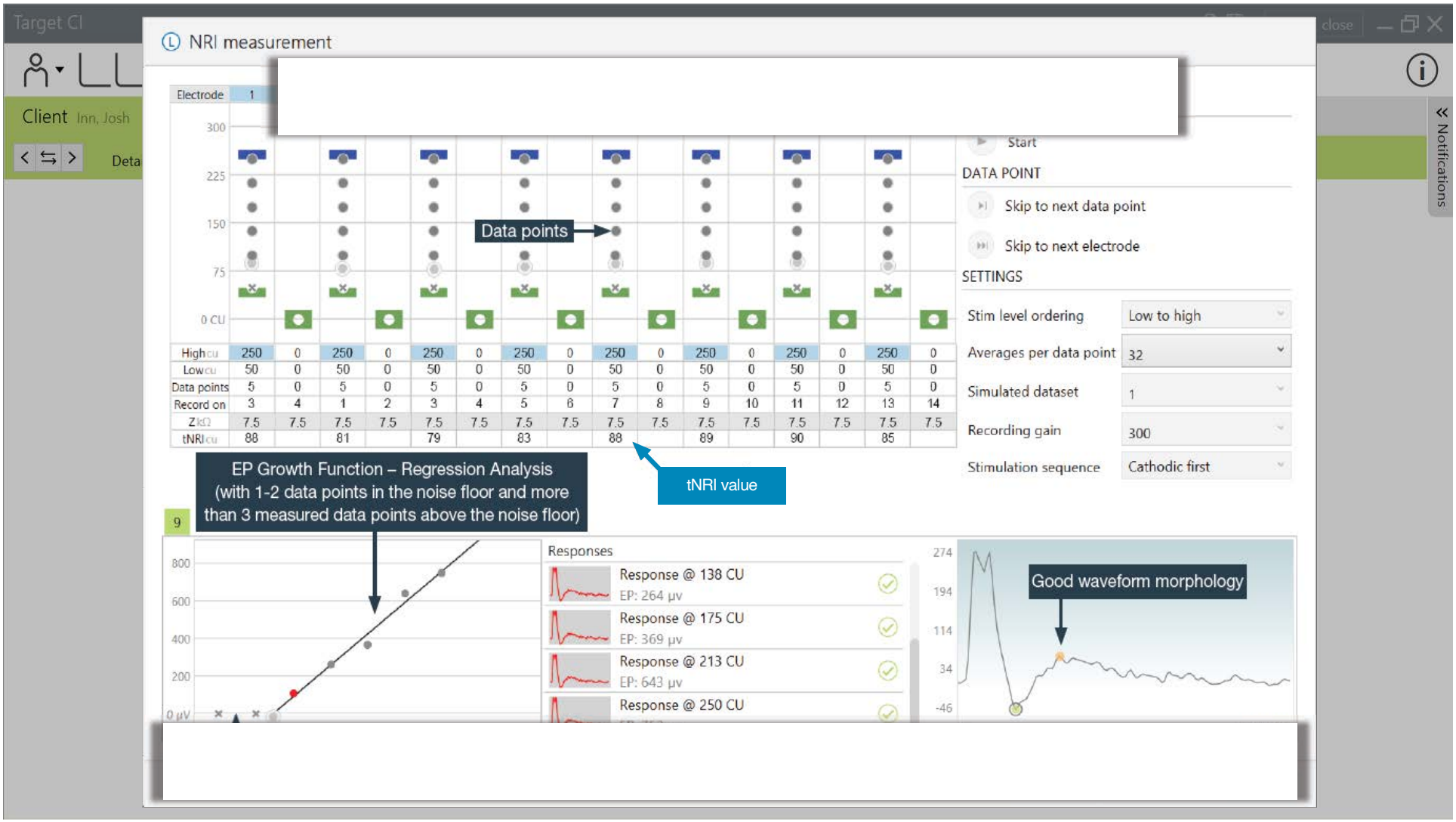

Target CI
Client Inn, Josh
NRI measurement
Low and High CU Values determine NRI starting and ending stimulation level.
A minimum range of 150 200 CU should be considered where the low CU value captures one or two responses in the noise floor.
Electrode 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
300
225
150
75
0 CU
High cu 300 0 300 0 300 0 300 0 300 0 300 0 300 0 300 0
Low cu 100 0 100 0 100 0 100 0 100 0 100 0 100 0 100 0
Data points 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0
Record on 3 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14
ZkΩ 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7
tNRI cu
RECORDING
Start
DATA POINT
Skip to next data point
Skip to next electrode
SETTINGS
Stim level ordering Low to high
Averages per data point 32
Recording gain 300
Stimulation sequence Cathodic first
Template
Odd electrodes
Save
Save and close
Cancel
Notifications

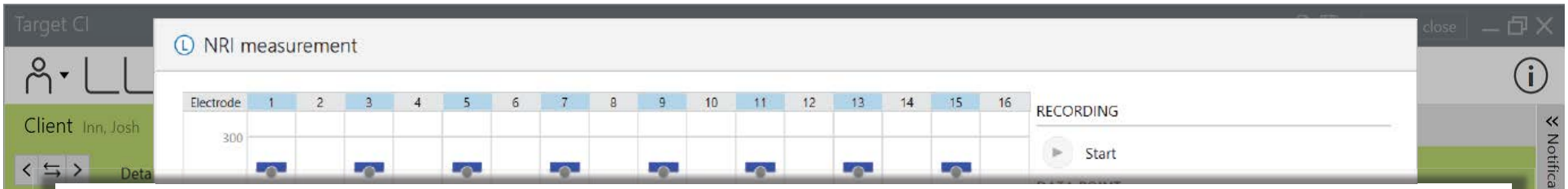


Electrode	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
High cu	300	0	300	0	300	0	300	0	300	0	300	0	300	0	300	0
Low cu	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
Data points	5	0	5	0	5	0	5	0	5	0	5	0	5	0	5	0
Record on	3	4	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Z kΩ	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
tNRI cu																


Target CI
Client Inn, Josh
NRI measurement
Electrode 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
300
225
150
75
0 CU
High cu 300 0 300 0 0
Low cu 100 0 100 0 100 0
Data points 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0
Record on 3 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14
ZkΩ 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7
tNRI cu
Stim Level Ordering determines whether stimulation occurs using an ascending or descending method.
RECORDING
Start
DATA POINT
Skip to next data point
Skip to next electrode
SETTINGS
Stim level ordering
Low to high
Averages per data point
32
Recording gain
300
Stimulation sequence
Cathodic first
Template
Odd electrodes
Save
Save and close
Cancel
Notifications


Target CI
close
Client Inn, Josh
Deta
NRI measurement
Electrode 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
300
225
150
75
0 CU
High cu 300 0 300 0 300 0 300 0 300 0 300 0 300 0 300 0
Low cu 100 0 100 0 100 0 100 0 100 0 100 0 100 0 100 0
Data points 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0
Record on 3 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14
ZkΩ 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7
tNRI cu
RECORDING
Start
DATA POINT
Skip to next data point
Skip to next electrode
SETTINGS
Stim level ordering
Low to high
Averages per data point
32
Recording gain
300
Stimulation sequence
Cathodic first
While recording, watch for signs of discomfort.
Use the Pause or F key to stop running the measurement at any time.
Template
Odd electrodes
Save
Save and close
Cancel
Notifications

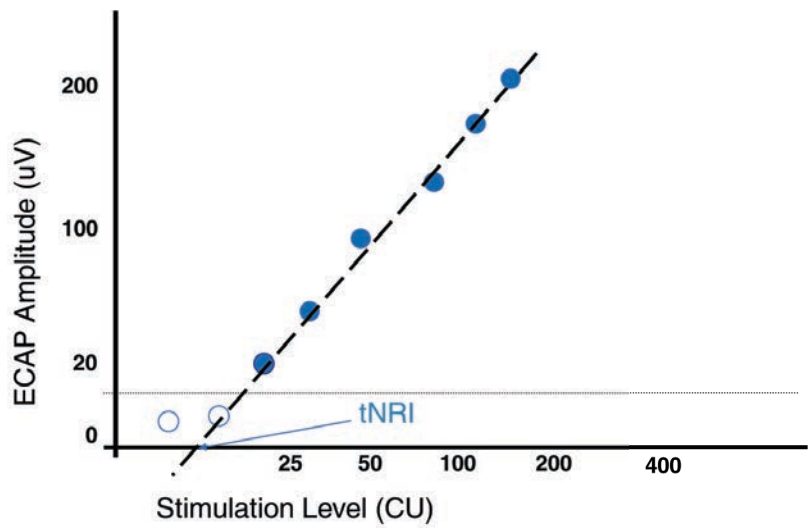

Target CI
Client Inn, Josh
NRI measurement
Electrode 1
Data points
Start
DATA POINT
Skip to next data point
Skip to next electrode
SETTINGS
Stim level ordering Low to high
Averages per data point 32
Simulated dataset 1
Recording gain 300
Stimulation sequence Cathodic first
High cu 250 0 250 0 250 0 250 0 250 0 250 0 250 0 250 0
Low cu 50 0 50 0 50 0 50 0 50 0 50 0 50 0 50 0
Data points 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0
Record on 3 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Z kΩ 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5 7.5
tNRI cu 88 81 79 83 88 89 90 85
tNRI value
EP Growth Function – Regression Analysis
(with 1-2 data points in the noise floor and more than 3 measured data points above the noise floor)
Responses
Response @ 138 CU
EP: 264 µv
Response @ 175 CU
EP: 369 µv
Response @ 213 CU
EP: 643 µv
Response @ 250 CU
Good waveform morphology



NRI

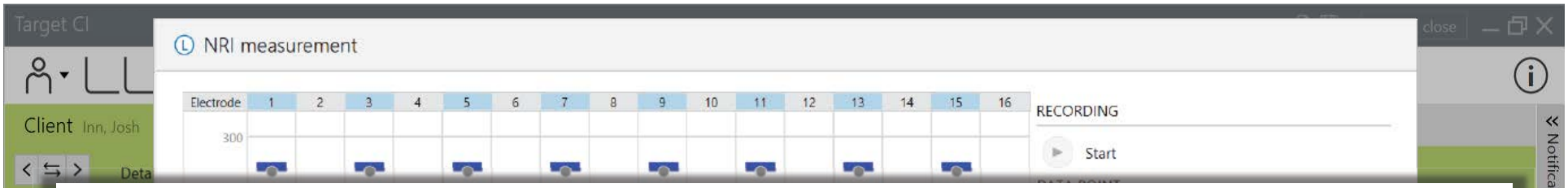
EP Growth Function

NRI recordings ("output") are plotted as a function of stimulus amplitude ("input").



A regression line is extended to the point where N1-P2 = 0 (the x-intercept).

The x-intercept point is called **"tNRI,"** or NRI threshold

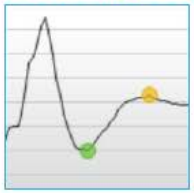


NRI

Waveform morphology

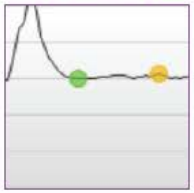
NRI waveforms are accessible and editable after the programming session is complete.

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:

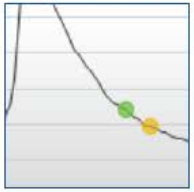
- Increase the stimulation level (up to levels of compliance), while monitoring recipient for comfort.
- Use a different recording electrode to measure the NRI response.

NOISY RESPONSE

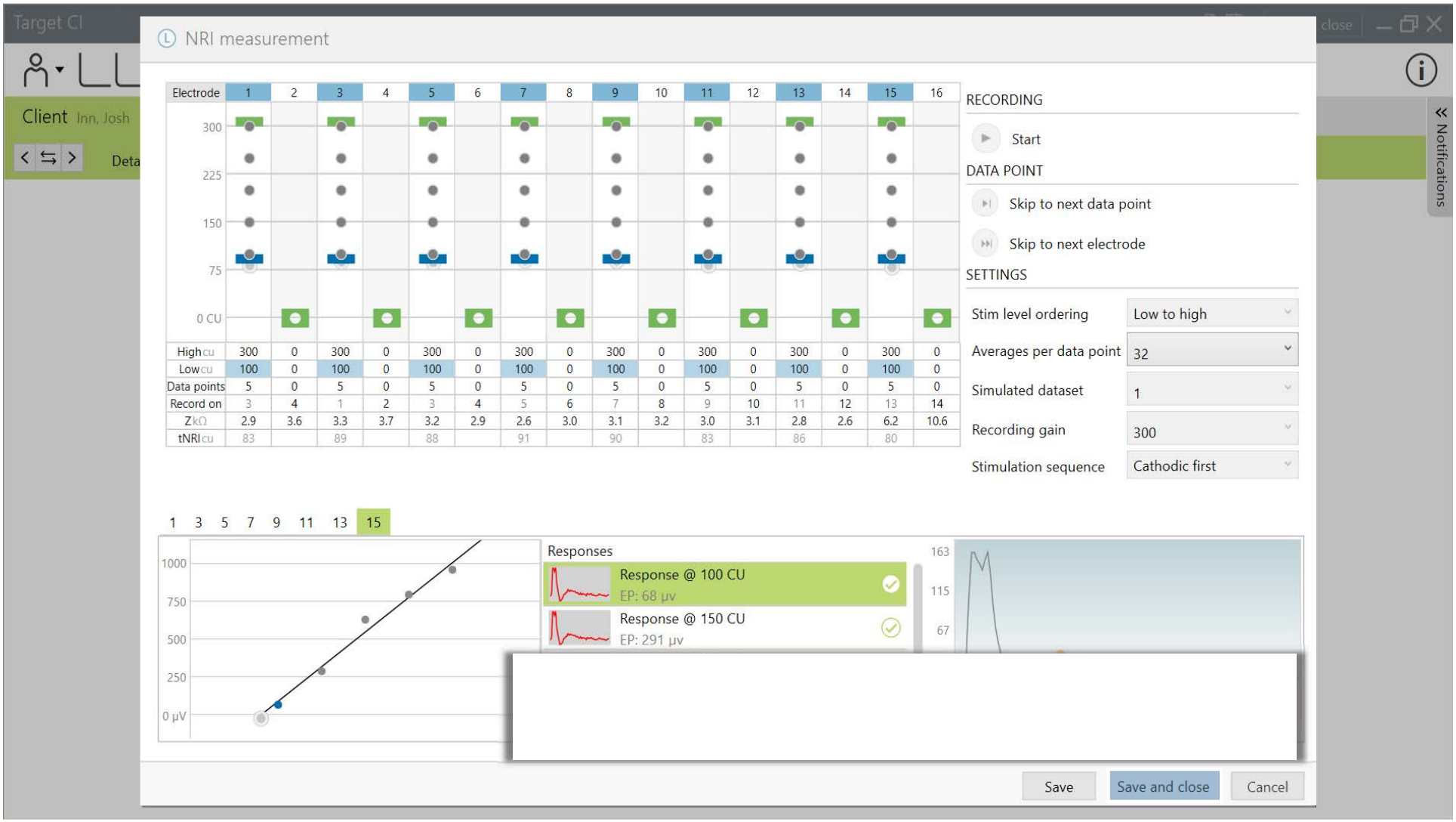
If waveform tracing appears noisy:

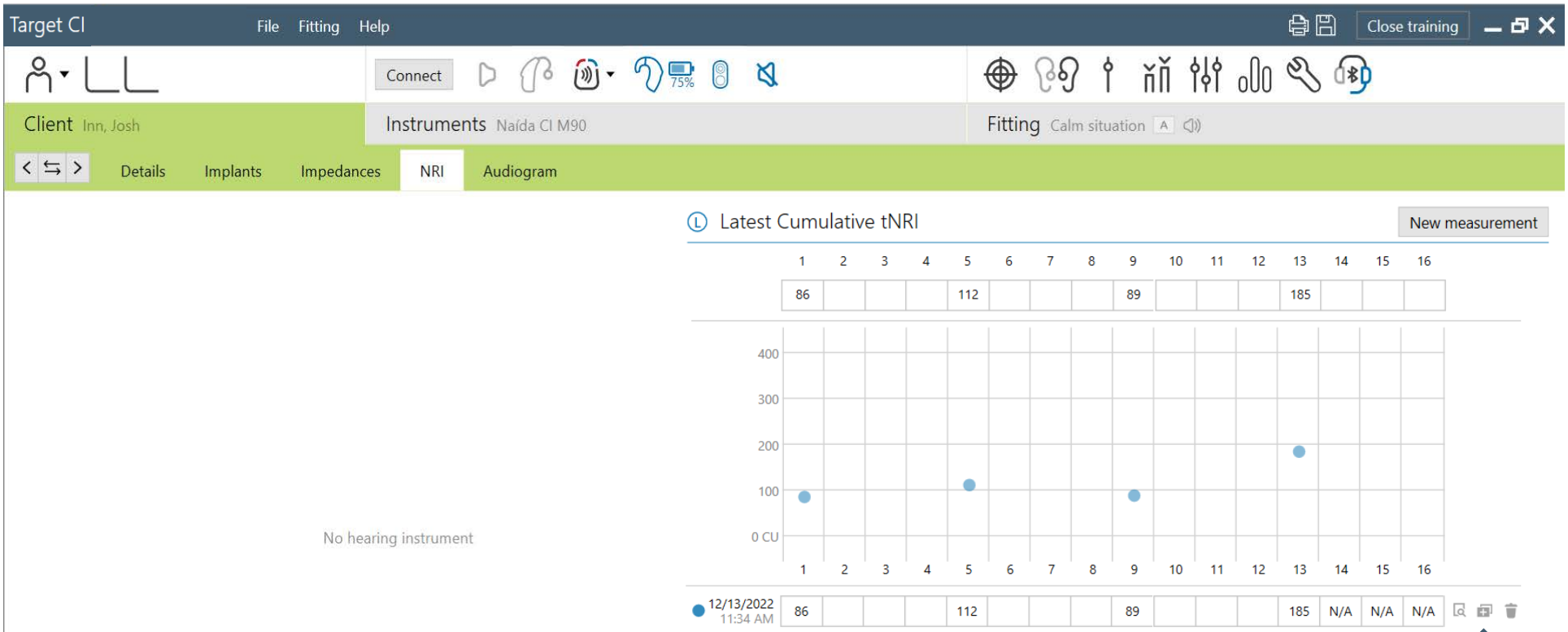
- For bilateral recipients, confirm that the contralateral processor is removed.
- Increase the number of Averages per data point.

RESPONSE WITH ARTIFACT



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


Target CI
Client Inn, Josh
NRI measurement
Electrode 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
300
225
150
75
0 CU
High cu 300 0 300 0 300 0 300 0 300 0 300 0 300 0 300 0
Low cu 100 0 100 0 100 0 100 0 100 0 100 0 100 0 100 0
Data points 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0
Record on 3 4 1 2 3 4 5 6 7 8 9 10 11 12 13 14
ZkΩ 2.9 3.6 3.3 3.7 3.2 2.9 2.6 3.0 3.1 3.2 3.0 3.1 2.8 2.6 6.2 10.6
tNRI cu 83 89 88 91 90 83 86 80
RECORDING
Start
DATA POINT
Skip to next data point
Skip to next electrode
SETTINGS
Stim level ordering Low to high
Averages per data point 32
Simulated dataset 1
Recording gain 300
Stimulation sequence Cathodic first
1 3 5 7 9 11 13 15
1000
750
500
250
0 µV
Responses
Response @ 100 CU
EP: 68 µv
Response @ 150 CU
EP: 291 µv
163
115
67
Save
Save and close
Cancel
Notifications



- Target CI keeps a record of tNRI values from each session.
- Open session should be used at all follow-up visits to allow access to past impedance and NRI data.
- To repeat measurements in future sessions, use the copy function, shown with the arrow.

View, Copy, or Delete

Knowledge Check: True or False

NRI is a measurement of the Electrically Evoked Compound Action Potential (ECAP) and requires the use of ~~extracochlear~~ electrodes.

ADVANCED BIONICS
POWERFUL CONNECTIONS

Target CI

Clinical Application of NRI

A Sonova brand

D000038334 RevA

NRI

Clinical Use

AIM tablet

Target CI fitting software

TRUE

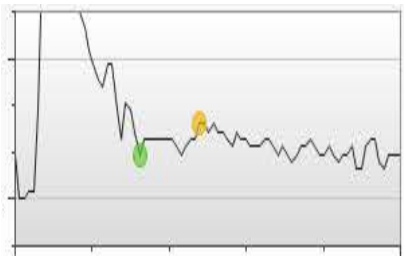
OR

FALSE

True or False?

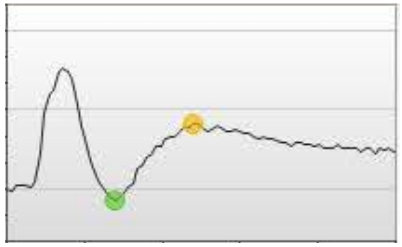
This NRI waveform indicates a good response.

OPTION 1



Option 1 is not a good NRI response. The waveform is noisy and has no clear negative and positive peak.

OPTION 2



Correct! Option 2 is an example of a good NRI response.

True or False?

During post-operative appointments, it is recommended that NRI is run ~~"High to Low"~~ stim level ordering.

SETTINGS

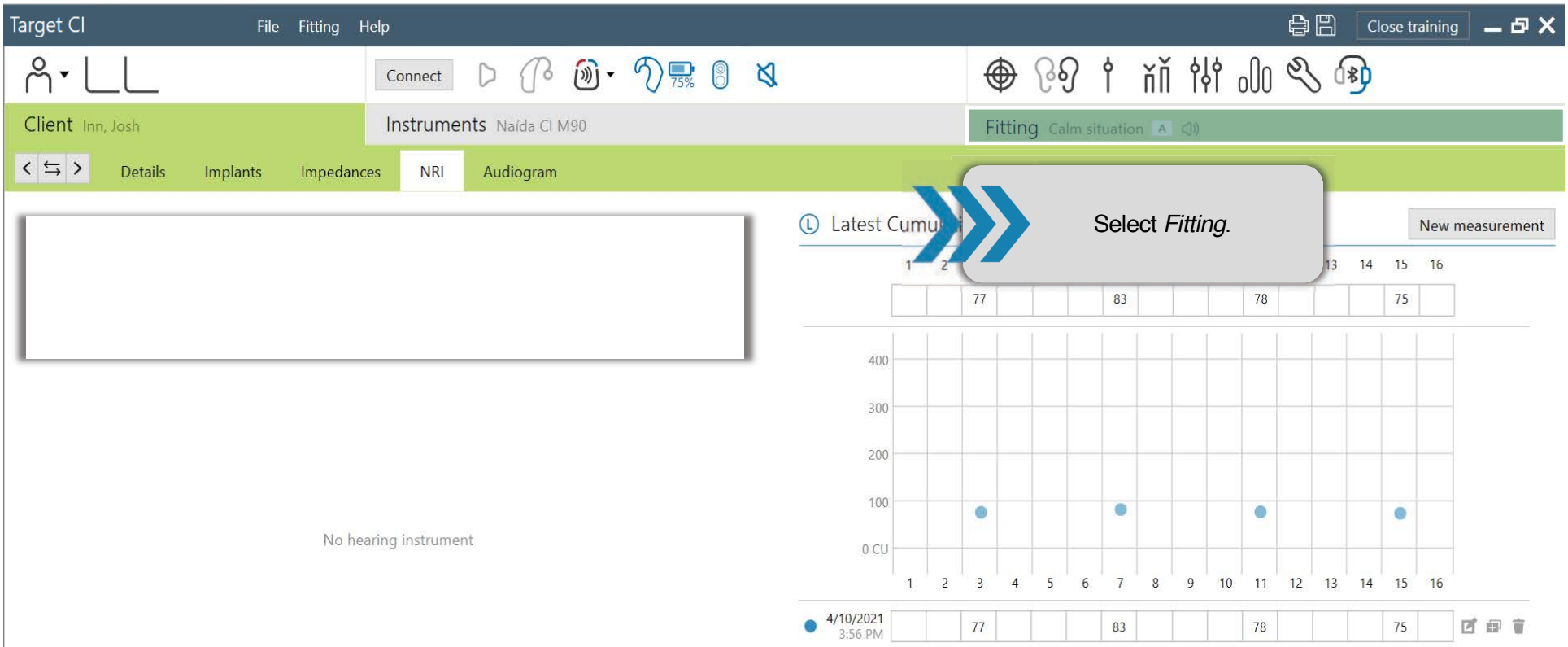
Stim level ordering	High to low
Averages per data point	32
Simulated dataset	1
Recording gain	300
Stimulation sequence	Cathodic first

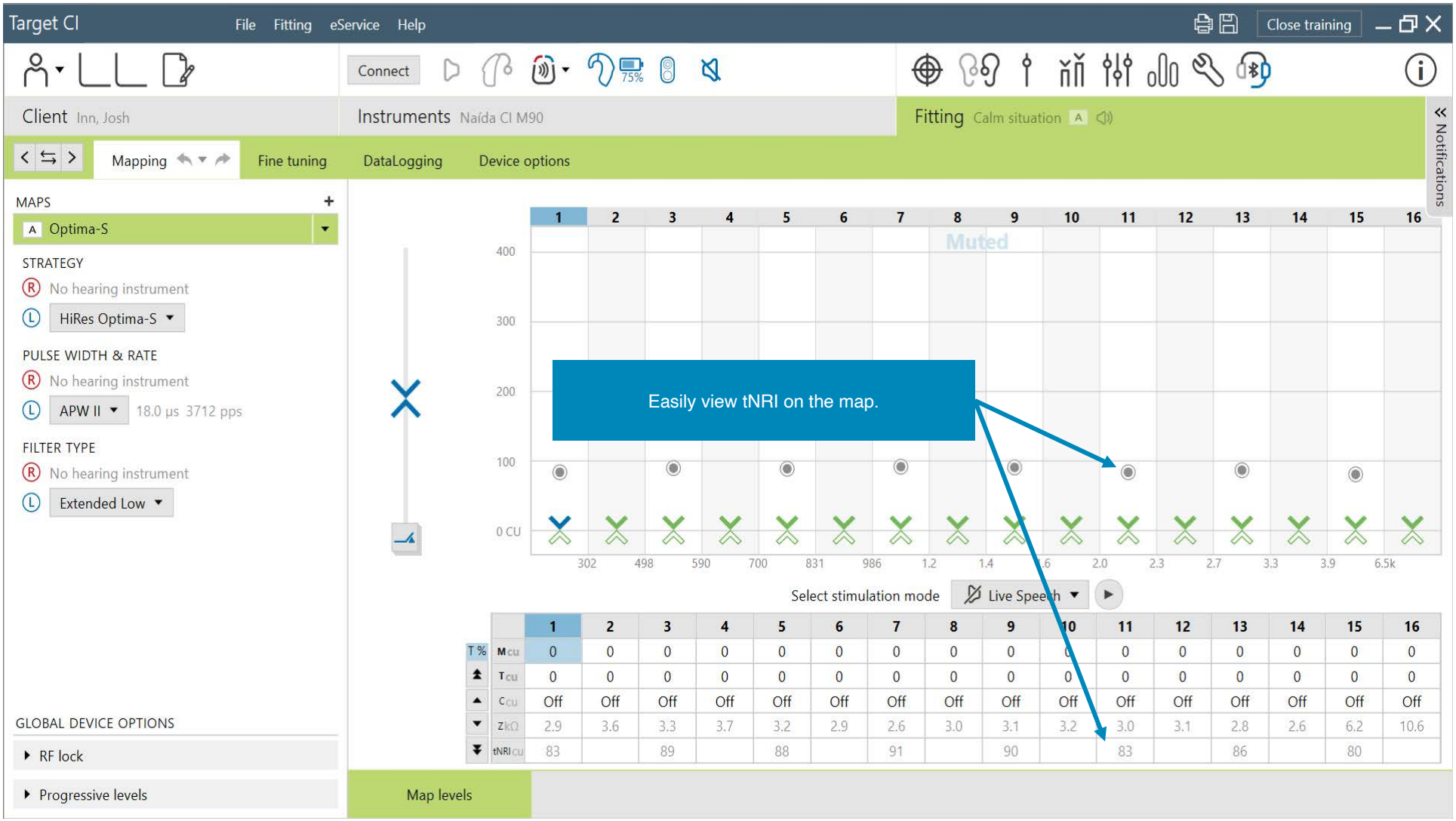
NRI

Clinical Use

- Verify that the auditory nerve is responsive
- Verify subjective responses (M-Levels)
- Estimate psychophysical (M-Levels) when a patient is not able to respond consistently
- Use as a counseling tool to provide reassurance to the family and/or recipient

ECAP results **DO NOT** indicate potential
for patient performance or device integrity.


Target CI
File
Fitting
Help
Close training
Connect
75%
Client Inn, Josh
Instruments Naída CI M90
Fitting Calm situation
Details
Implants
Impedances
NRI
Audiogram
Select *Fitting*.
Latest Cumul
New measurement
No hearing instrument
400
300
200
100
0 CU
4/10/2021
3:56 PM


Target CI
File
Fitting
eService
Help
Close training
Connect
75%
Client Inn, Josh
Instruments Naída CI M90
Fitting Calm situation
Notifications
Mapping
Fine tuning
DataLogging
Device options
MAPS
Optima-S
STRATEGY
No hearing instrument
HiRes Optima-S
PULSE WIDTH & RATE
No hearing instrument
APW II
18.0 µs 3712 pps
FILTER TYPE
No hearing instrument
Extended Low
GLOBAL DEVICE OPTIONS
RF lock
Progressive levels
Muted
400
300
200
100
0 CU
302
498
590
700
831
986
1.2
1.4
2.0
2.3
2.7
3.3
3.9
6.5k
Easily view tNRI on the map.
Select stimulation mode
Live Speech
T %
Mcu
Tcu
Ccu
ZkΩ
tNRIcu
Map levels

Target CI File Fitting eService Help Close training

Connect 75%

Client Inn, Josh | Instruments Naída CI M90 | Fitting Calm situation A

Mapping | Fine tuning | DataLogging | Device options

MAPS

A Optima-S

STRATEGY

R No hearing instrument

L HiRes Optima-S

PULSE WIDTH & RATE

R No hearing instrument

L APW II 18.0 µs 3712 pps

FILTER TYPE

R No hearing instrument

L Extended Low

GLOBAL DEVICE OPTIONS

RF lock

Progressive levels

Josh's audiologist wants to use NRI measures to support device mapping.

It is important to remember:

- NRI responses can provide guidelines for programming levels.
- There is no exact correlation between tNRI and M-Levels.
- On average, tNRI value is below M-Level for most recipients.
- tNRI value should be audible for recipient, but not uncomfortable.

Map levels

Notifications

Target CI File Fitting eService Help Close training

Connect

Client Inn, Josh | Instruments Naída CI M90 | Fitting Calm situation

Mapping | Fine tuning | DataLogging | Device options

MAPS

A Optima-S

STRATEGY

R No hearing instrument

L HiRes Optima-S

PULSE WIDTH & RATE

R No hearing instrument

L APW II 18.0 µs 3712 pps

FILTER TYPE

R No hearing instrument

L Extended Low

GLOBAL DEVICE OPTIONS

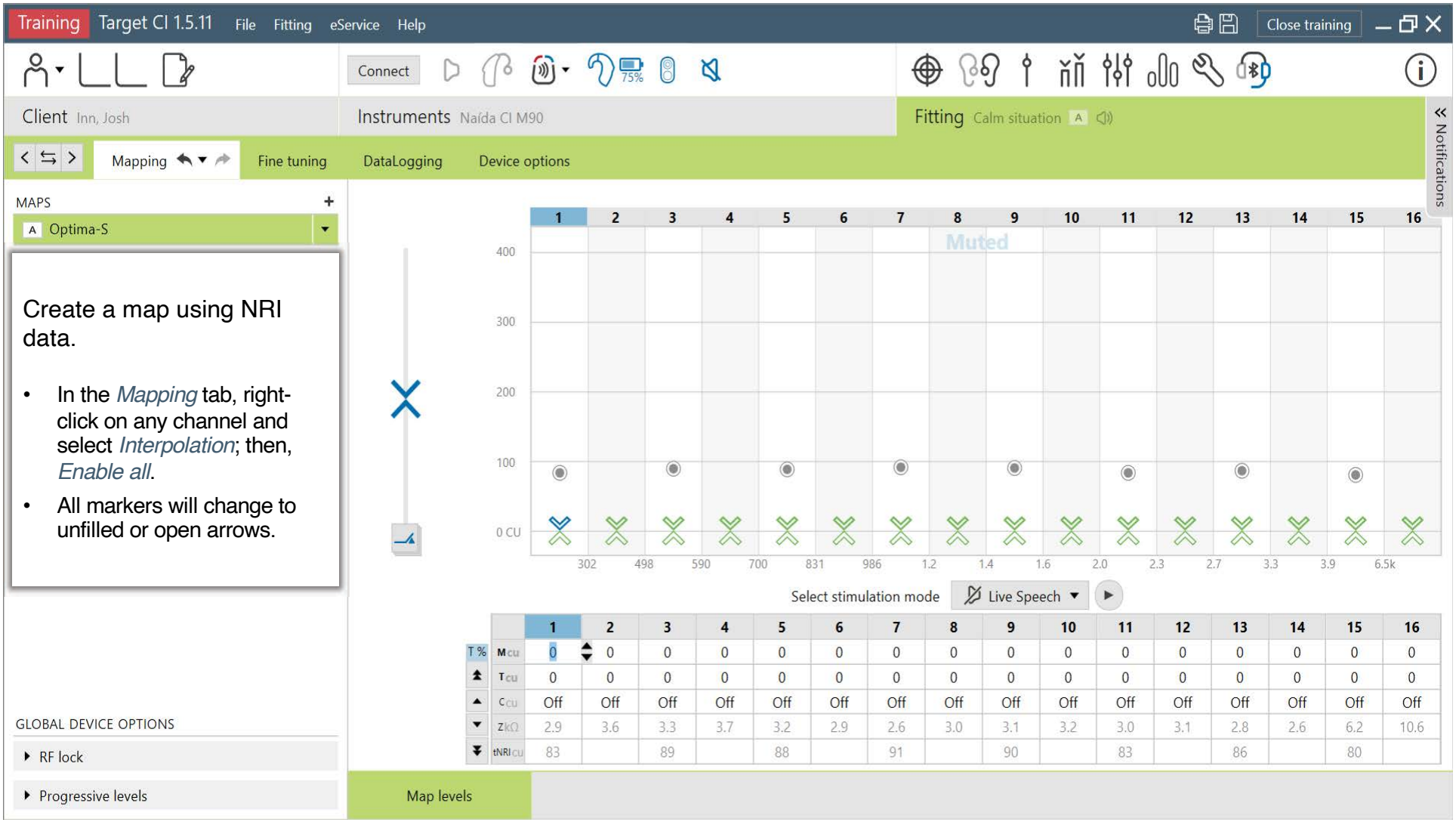
RF lock

Progressive levels

Map levels

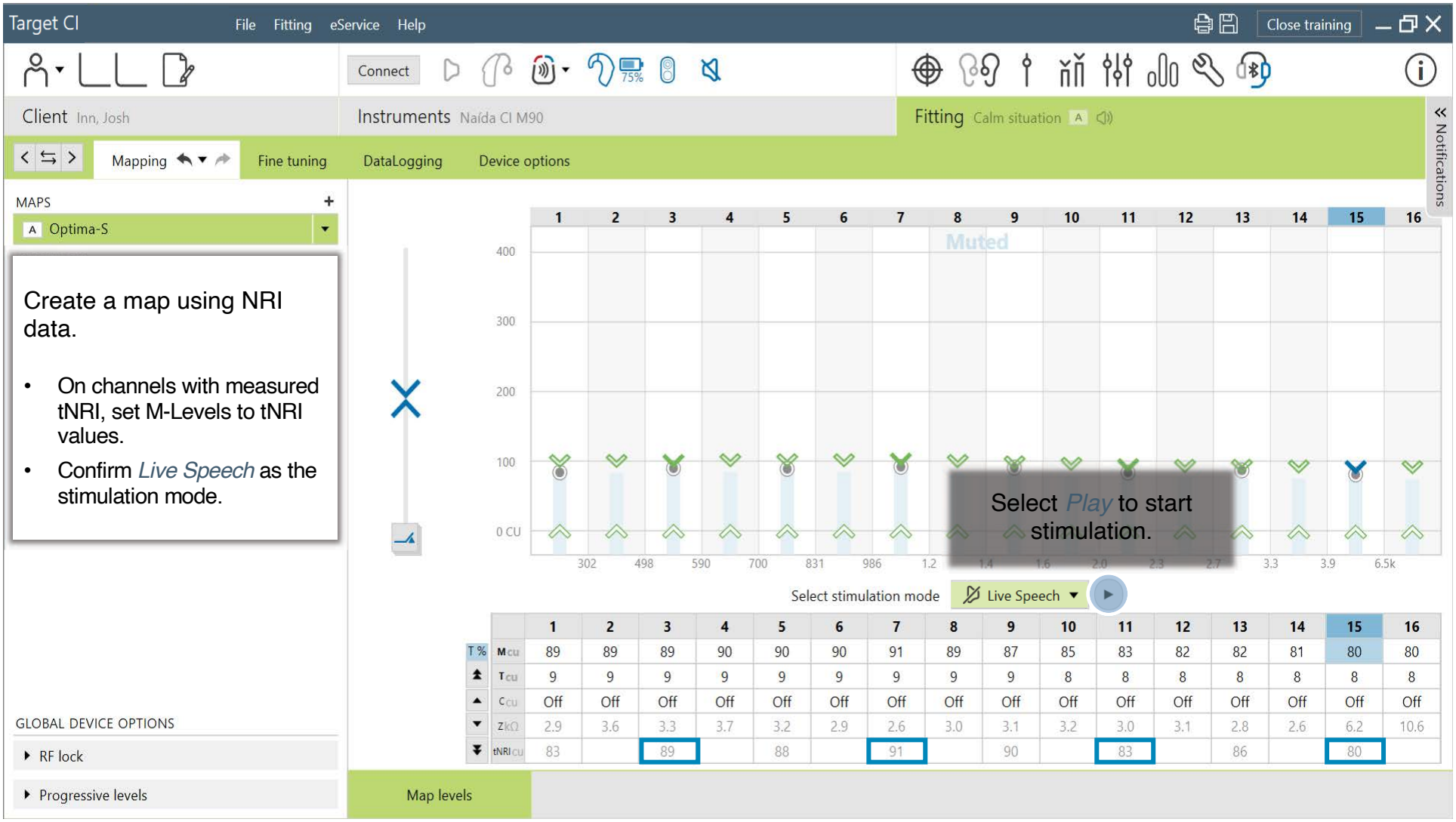
Other important tips to consider:

- Intra-operative NRI responses should <u>not</u> be used to estimate behavioral M-Levels (only post-operative results should be used as a guide).
- Post-operative NRI responses can aid with establishing contour of the CI map.
- NRI responses should correlate with audibility for the recipient.
- Behavioral measures and report by the recipient, family and therapist/educator (if applicable) are the most valuable tool for establishing CI map settings.



Create a map using NRI data.

- In the *Mapping* tab, right-click on any channel and select *Interpolation*; then, *Enable all*.
- All markers will change to unfilled or open arrows.



Create a map using NRI data.

- On channels with measured tNRI, set M-Levels to tNRI values.
- Confirm *Live Speech* as the stimulation mode.

Target CI File Fitting eService Help Close training

Connect

Client Inn, Josh | Instruments Naída CI M90 | Fitting Calm situation

Mapping | Fine tuning | DataLogging | Device options

Notifications

MAPS

A Optima-S

Create a map using NRI data.

- Verify settings (i.e. Ling Sounds, soundfield detection, etc.).

comfortable level (level 6 on the loudness scale).

Muted

400
300
200
100
0 CU

302 498 590 700 831 986 1.2 1.4 1.6 2.0 2.3 2.7 3.3 3.9 6.5k

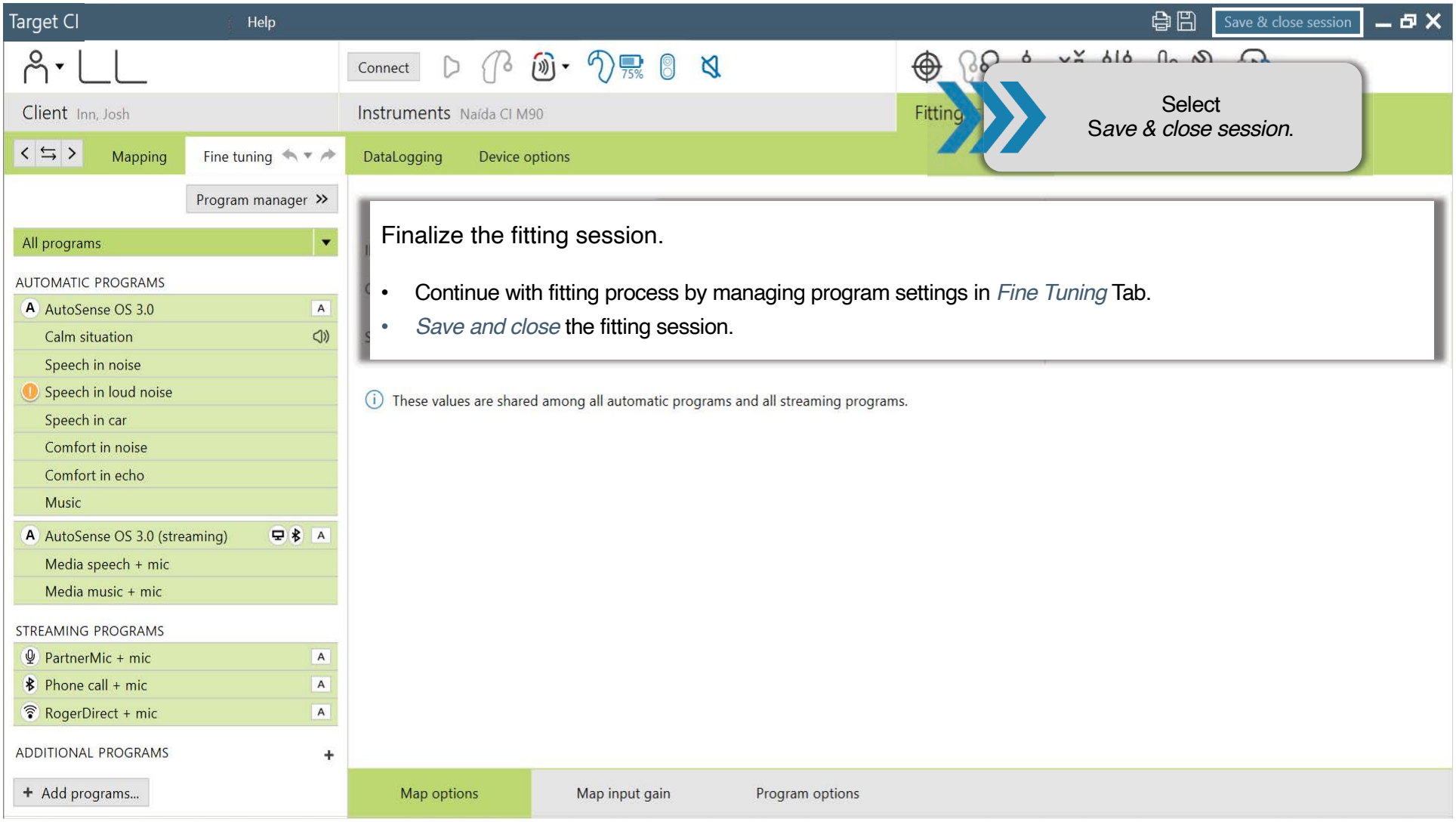
Select stimulation mode: Live Speech

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
T %	M cu	130	133	136	136	137	138	138	136	134	132	130	129	128	128	127	127
	T cu	13	13	14	14	14	14	14	14	13	13	13	13	13	13	13	13
	C cu	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off
	Z kΩ	2.9	3.6	3.3	3.7	3.2	2.9	2.6	3.0	3.1	3.2	3.0	3.1	2.8	2.6	6.2	10.6
	tNRI cu	83		89		88		91		90		83		86		80	

GLOBAL DEVICE OPTIONS

- RF lock
- Progressive levels

Map levels



Select
Save & close session.

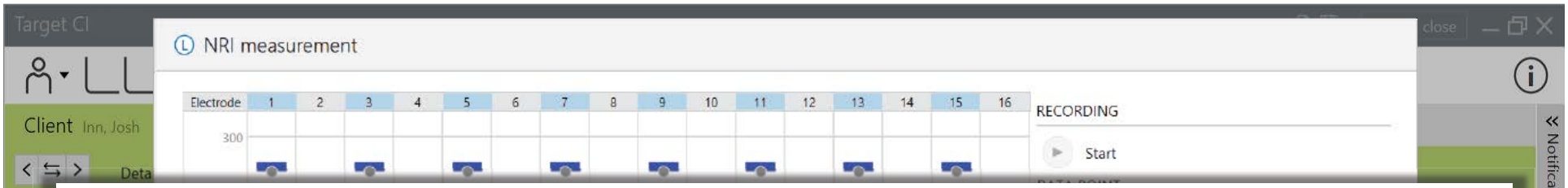
Finalize the fitting session.

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

Target CI

NRI is complete!

Final Considerations



NRI

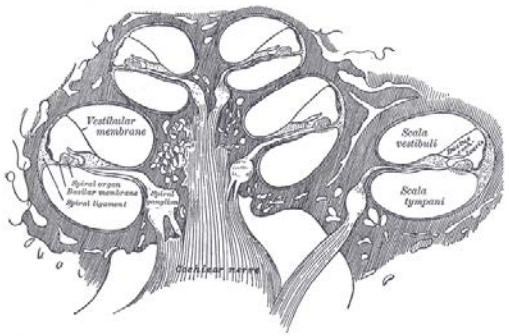
Waveform morphology

If NRI waveforms cannot be obtained, consider the following:

- Recording parameters may need to be optimized.

SETTINGS

Stim level ordering	Low to high
Averages per data point	32
Recording gain	300
Stimulation sequence	Cathodic first

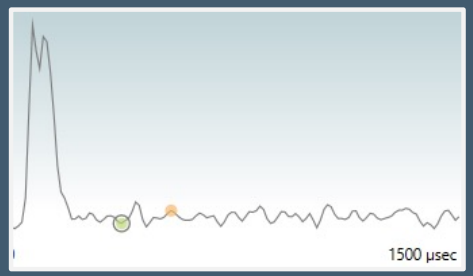


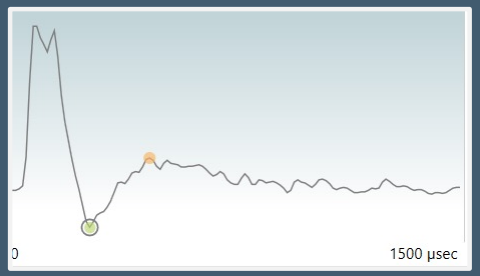
- There may be poor neural survival.

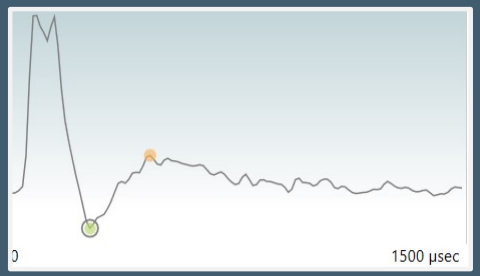
Can NRI Results Change Over Time?
NRI variability

NRI responses can vary over time due to:

- Changes in impedances
- Changes in tissue or a status of the cochlea
- Changes in noise (biologic) levels
- Changes in physiologic status, especially during the first 6-months post implantation





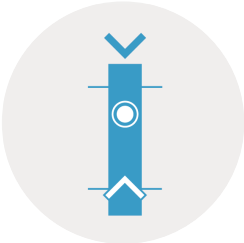


Neural Response Imaging (NRI)

Benefits

NRI is an objective measure and is a valuable tool to assist with programming.

Provides an indication of audibility



Provides a guideline for setting levels

Provides a method of verification and monitoring

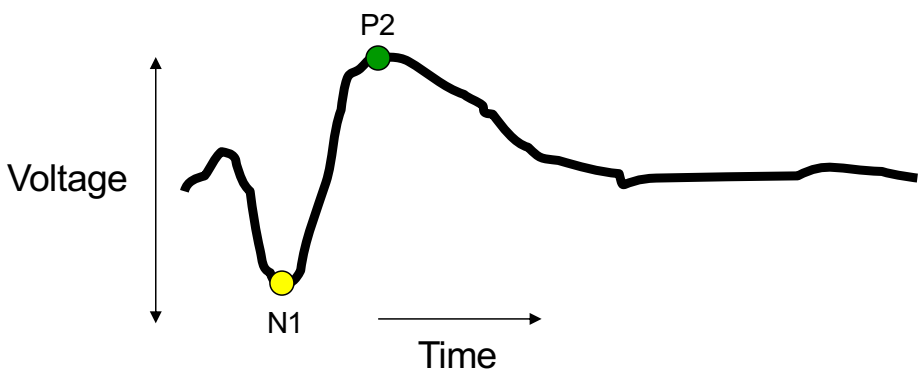
Provides professionals with an important counseling tool

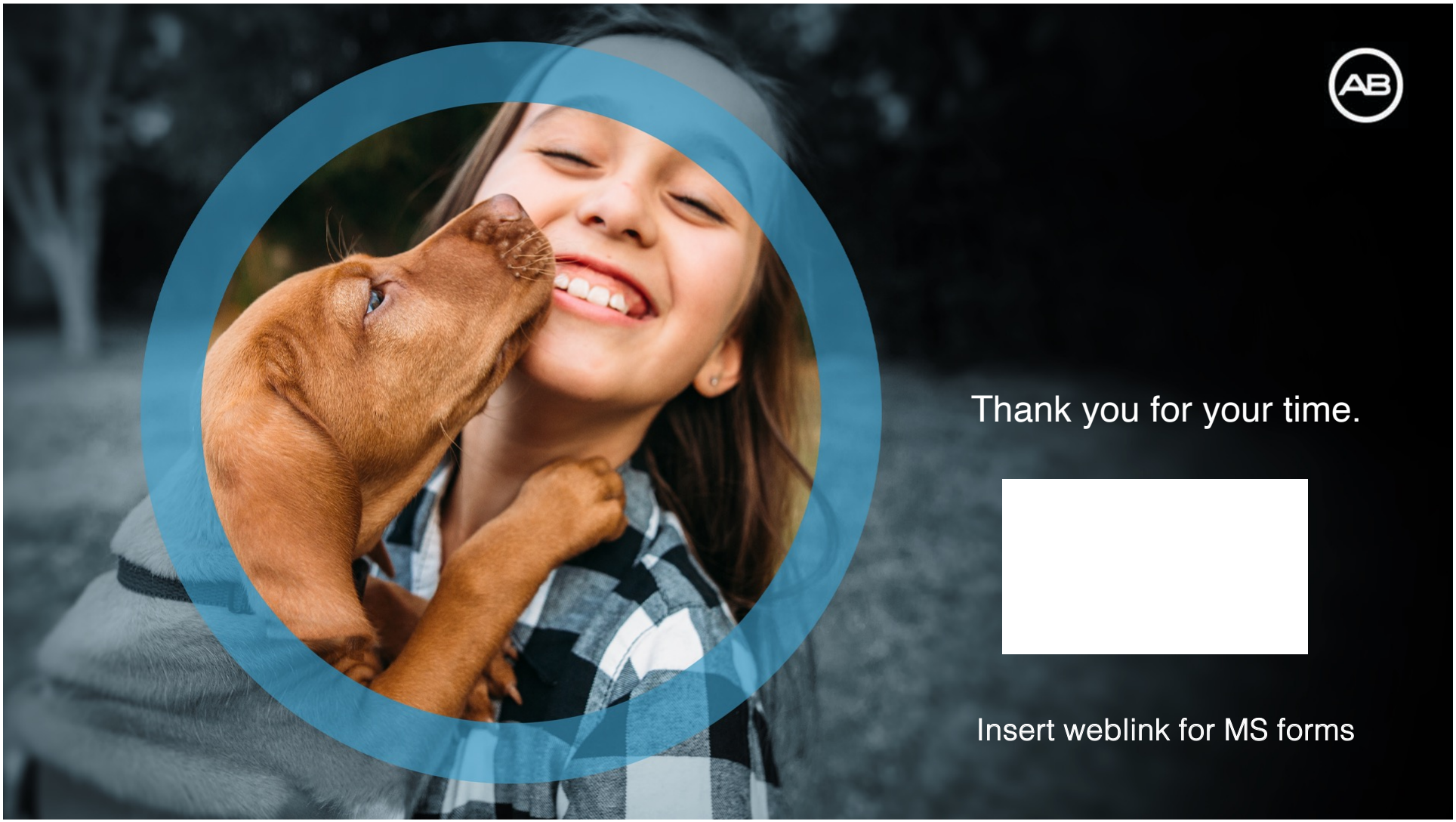
True or False?

~~Intraoperative~~ tNRI values should be used as guidelines for setting M levels.

True or False?

NRI results can be utilized to assist with programming, determine that the auditory nerve is responsive, and provide reassurance to the patient and family.





Thank you for your time.

Insert weblink for MS forms

References

1. Advanced Bionics. (2023). Remote programming from AB: clinical care without limits. Clinical Research Department.
2. America Counts. (2017, August 9). One in Five Americans Live in Rural Areas. United States Census Bureau. https://www.census.gov/library/stories/2017/08/rural-america.html
3. Andreoli, J. H., Delano, P. H., Morris, A. M., Stott, C., Martinho de Carvalho, A. C., Diaz, R. C., & Agrawal, S. (2024, February 13-15). Remote programming outcomes with CI recipients in Chile. [Poster session]. American Auditory Society Annual Conference, Scottsdale, AZ.
4. CDC (2022). Telemedicine use among adults: United States, 2021. Retrieved from: Products - Data Briefs - Number 445 - October 2022
5. Dyvik., E.H. (2024, July 4). Rural population worldwide from
6. 2011 to 2022. Statista. https://www.statista.com/statistics/1328171/rural-population-worldwide/
7. United Nations Economic Commission for Europe (UNECE). (2017, March). Policy brief on aging. https://unece.org/fileadmin/DAM/pau/age/Policy_briefs/ECE-WG1-25.pdf

Marvel CI
CLINICAL TOOLS

ADVANCED BIONICS
POWERFUL CONNECTIONS

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Slim Headpiece QUICK REFERENCE GUIDE 6
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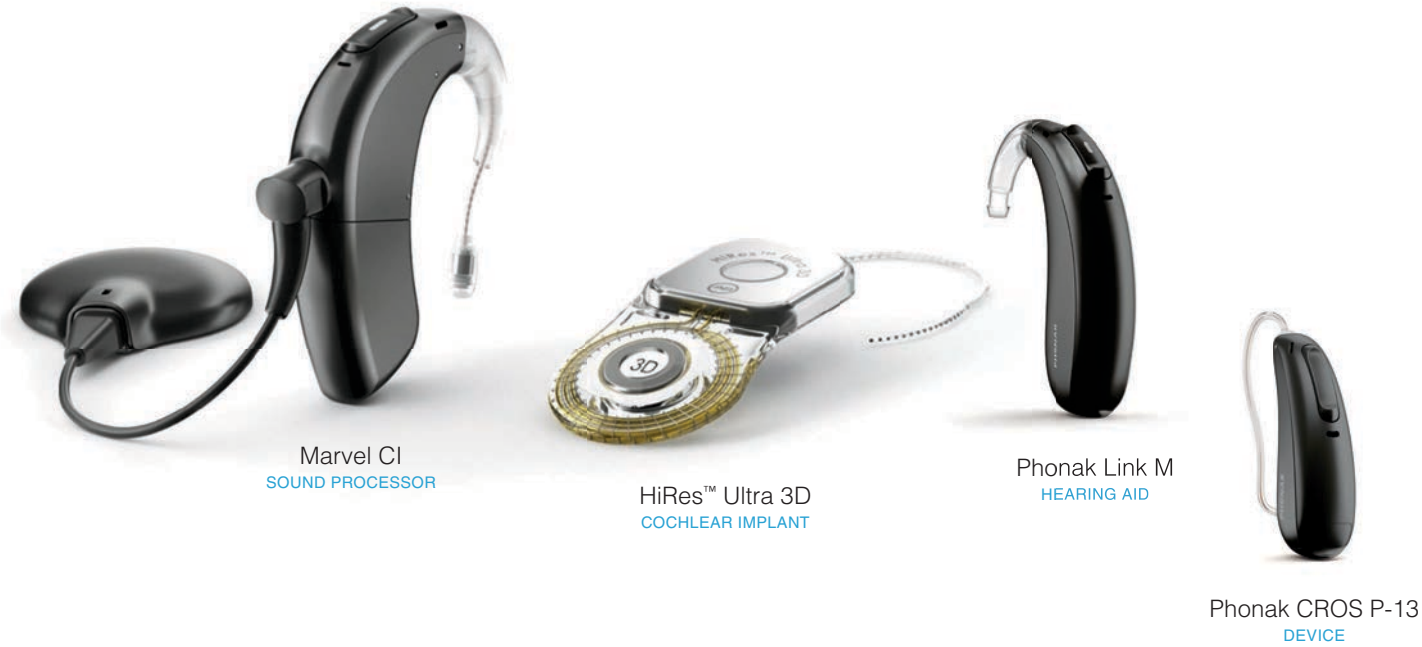
Our Commitment

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



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.

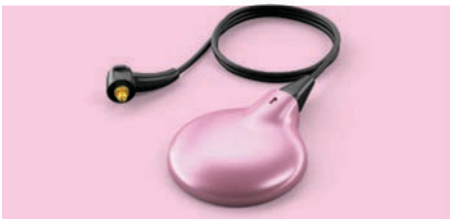
COMPATIBILITY

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

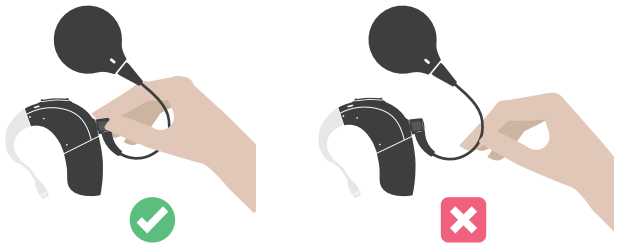
- For use with the M Waterproof Battery for complete protection against moisture, dust.
- Integrated waterproof microphone (water droplet icon on the underside).

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.

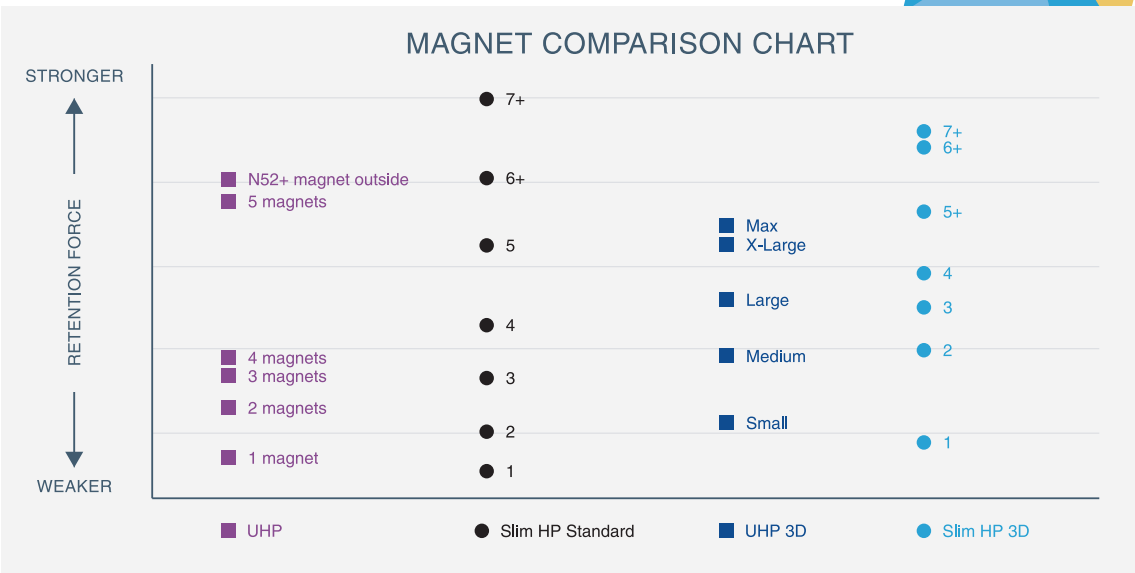


The arrow on the underside indicates the inlet where the removal tool should be inserted to remove the color cap.

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.

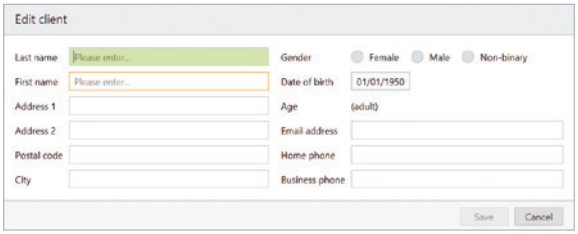
FITTING HARDWARE

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



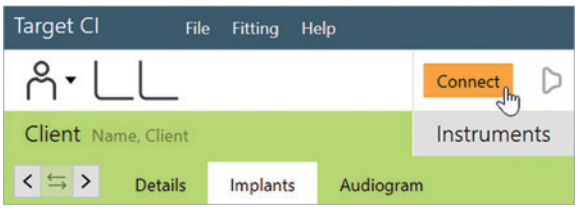
For a New client

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

For an Existing client

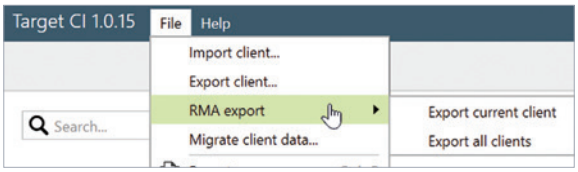
- Search and select the client's file; then, click *Open session.*[2]
- Remote Programming is available for follow-up programming sessions.

2. CONNECT TO THE HEARING INSTRUMENT



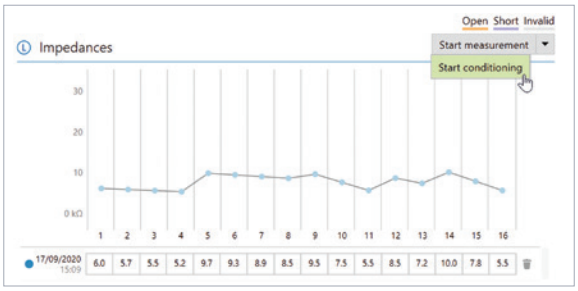
- Connect to the hearing instrument via Noahlink Wireless, CPI-3, or Remote Programming.
- When programming wirelessly, ensure that a fully charged rechargeable battery is used. Remove and re-attach the battery to put the sound processor into pairing mode. Click the *Connect* button within the 3-minute 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)



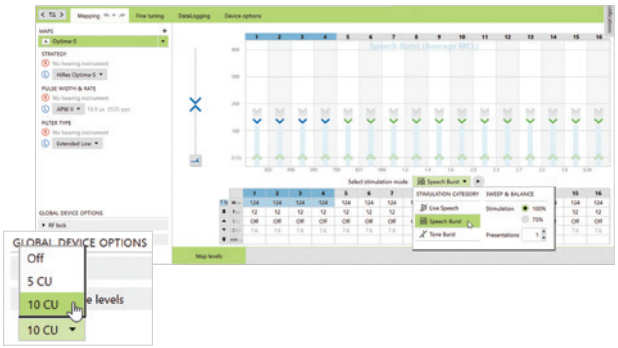
- Under *Client* access the *Impedance* tab to run impedances and conditioning.
- Access the *NRI* tab to measure NRI, if desired.

5. SELECT THE ATTACHMENTS

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

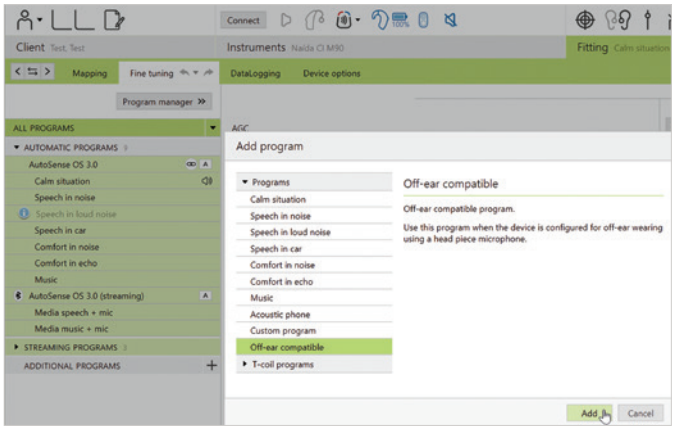
1. Always enter the client's ***Date of birth*** so that the appropriate default settings can be applied.
2. Open session should be used at all follow-up visits to allow access to past impedance and NRI data.

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

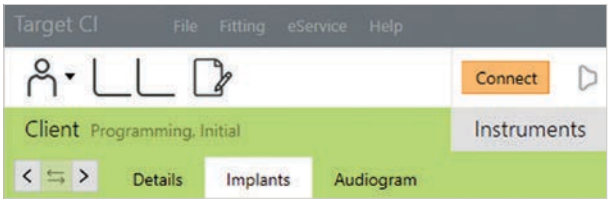
2. ACCESS THE CLIENT FILE AND OPEN A FITTING SESSION

For a New client:

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

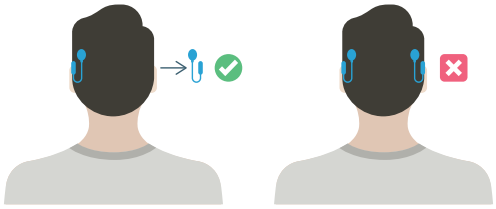
For an Existing client:

- 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

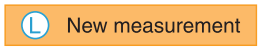
- Place the headpiece on the recipient's head to achieve lock with the implant.
- For a new client, create a new implant record.
- Remove the contralateral sound processor[3] prior to running NRI (if applicable). Otherwise, excessive noise will be observed in the NRI tracing.

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)

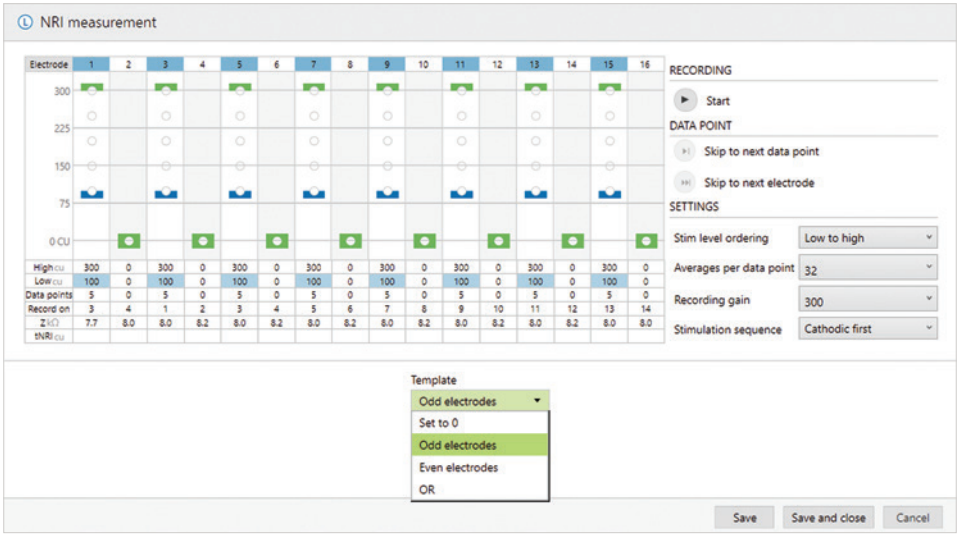
- Under *Client*, access the *NRI* tab to measure NRI[5].
- Select *New measurement* to open the NRI measurement window.



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

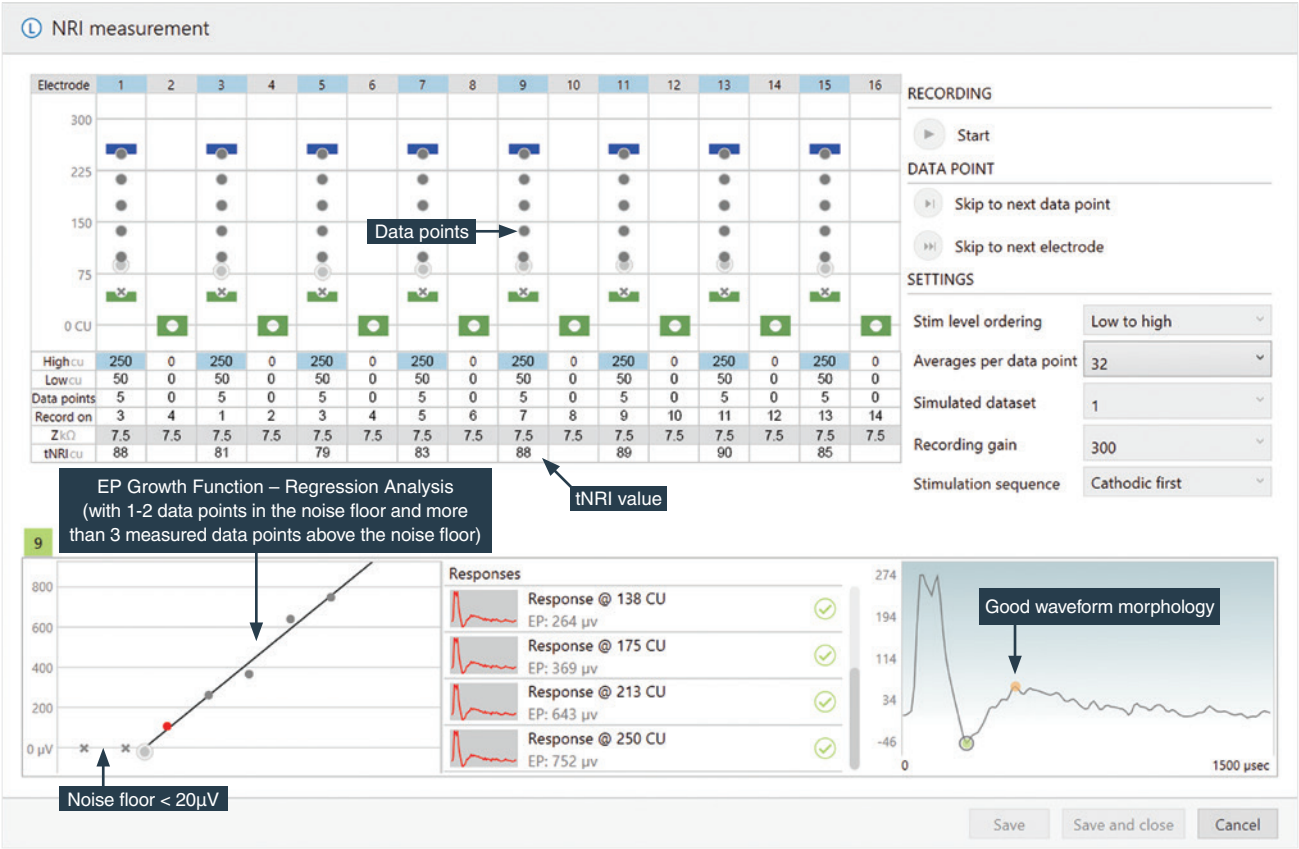
8. ADJUST NRI SETTINGS, IF DESIRED

- 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.

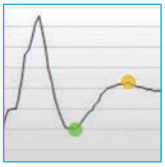
9. SELECT START

- 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.

10. NRI ANALYSIS

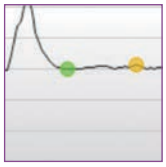


GOOD RESPONSE



- 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.

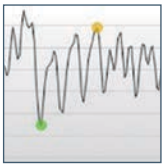
NO RESPONSE



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.

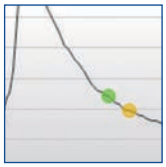
NOISY RESPONSE



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.

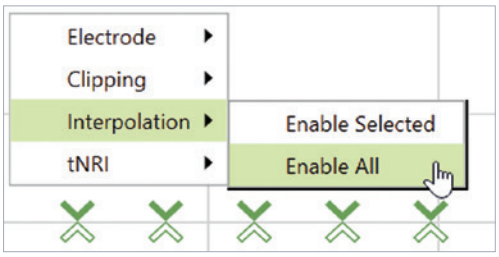
- Verifying correct tNRI values prior to saving and closing the session will ensure correct tNRI values are calculated.
- To repeat measurements in future sessions, use the copy setting function, as shown below.

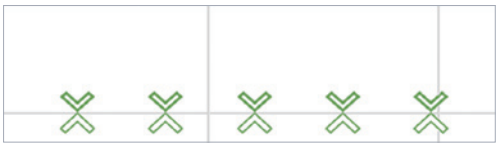
11. SAVE NRI MEASUREMENT

- *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

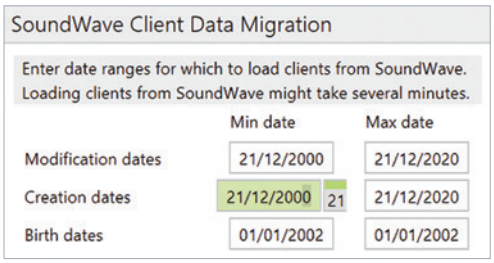
- Ensure that the recipient has a visit history for a Naída CI Q sound processor. Migration will not occur for sound processors prior to Naída CI Q. Only the most recent visit history will be migrated. If there is no Naída CI Q visit history for a given side, that side will not be migrated.
- Ensure 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].

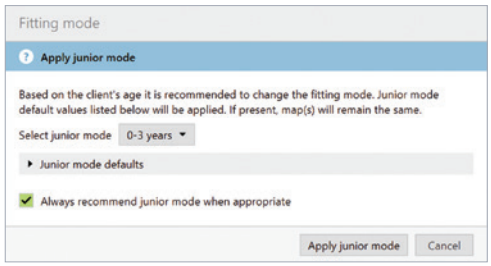
2. OPEN TARGET CI AND MIGRATE CLIENT DATA

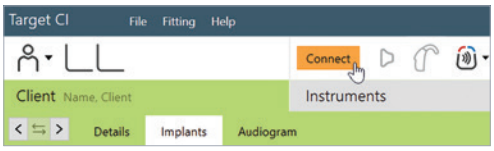
If Target CI is used as standalone software, migrating client data will add a new client to the database.

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.

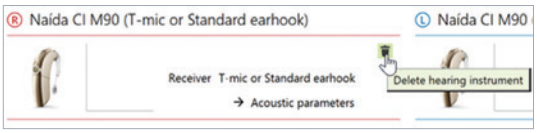
9. MANAGE DEVICE OPTIONS

- 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.

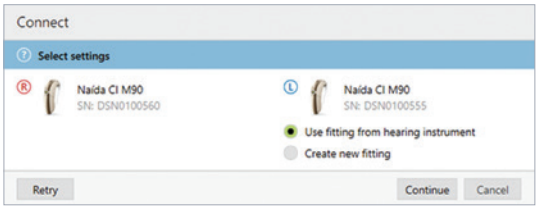
10. SAVE AND CLOSE THE SESSION

- 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.

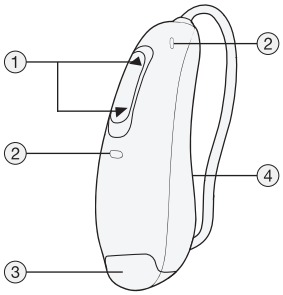
COMPATIBILITY

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

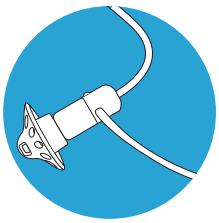


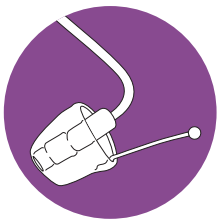
EARPIECE OPTIONS

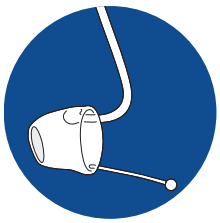
Standard Dome (CROS Tube)
- Dome available in three sizes (S, M, L)
- Right and Left
- Available in four lengths (0, 1, 2, 3)

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)







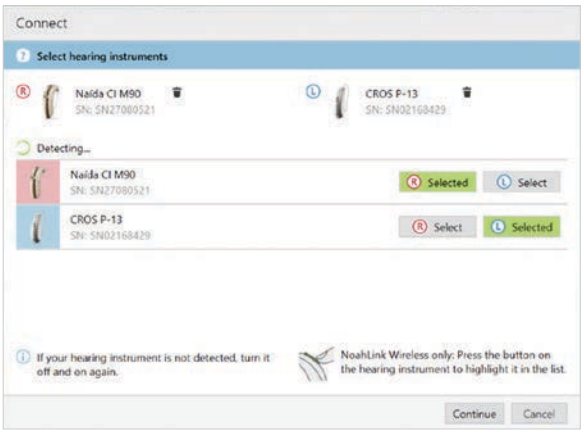
WIRELESS COMMUNICATION

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.

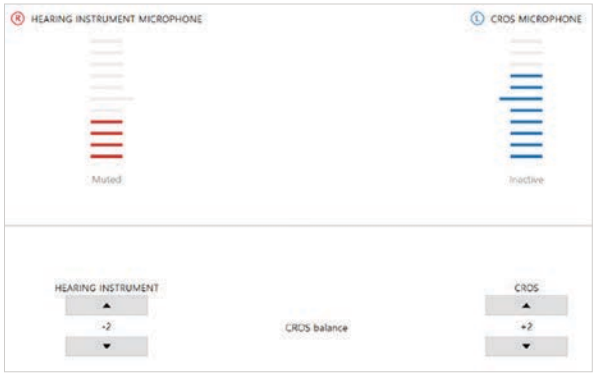


OPTIONAL CROS PROGRAMMING CONSIDERATIONS

- 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.

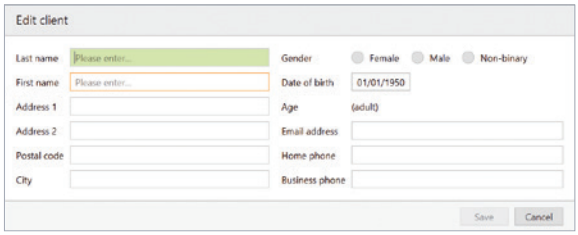
FITTING HARDWARE

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:

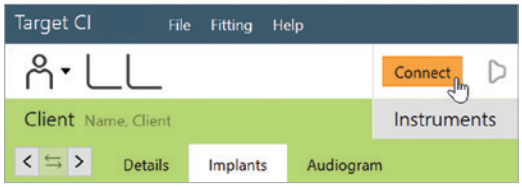
- Select *New client*. Enter the client details[1] and *Save*.
- Select *New session* to open a new fitting session.

For an Existing client:

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

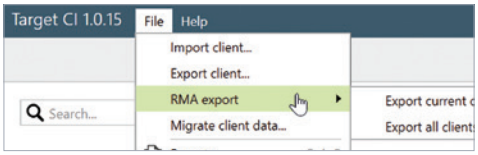
2. CONNECT TO THE HEARING INSTRUMENTS

- 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

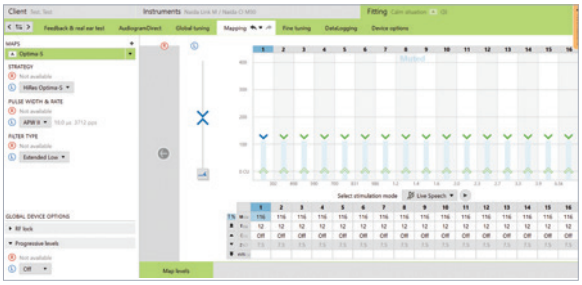
- Under the *Fitting* tab, access *Feedback & real ear test*.
- Instruct the patient to remain quiet for the duration of the measurement.
- Select *Start* to run the feedback management test.

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

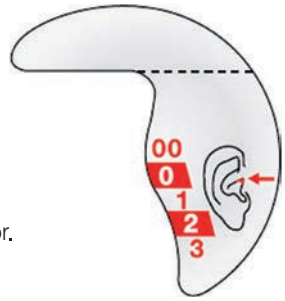
Suitable for mild-to-moderate hearing loss. Beneficial if occlusion is a concern.

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:

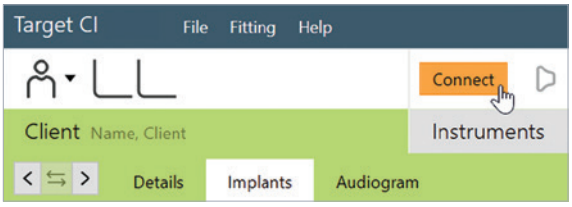
- Select *New client*. Enter the client's details[1] and *Save*.
- Select *New session* to open a new fitting session.

For an Existing client:

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

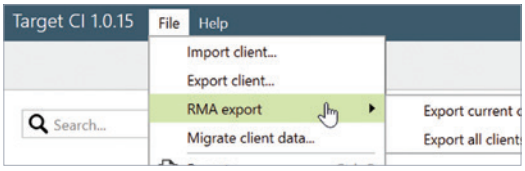
2. CONNECT TO THE HEARING INSTRUMENTS

- 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

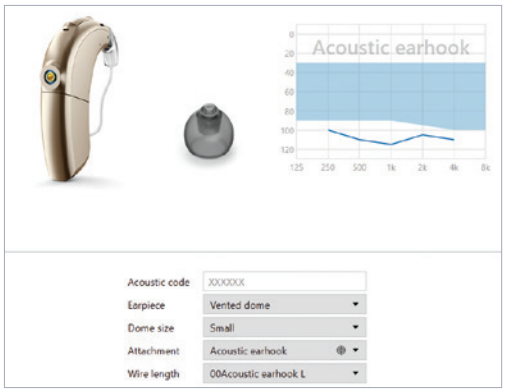
- Access the *Audiogram* tab to enter the client's latest audiogram[3]. Select the transducer type used.
- AudiogramDirect allows the measurement of an audiogram via the M Acoustic Earhook. To access it, click *AudiogramDirect > Start* and follow the prompts.

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).

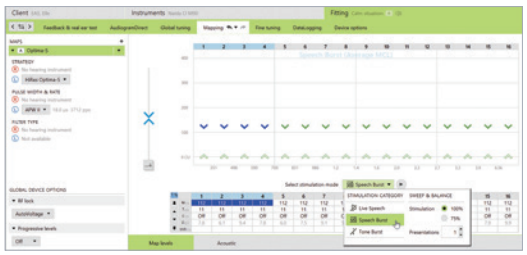
7. PERFORM THE FEEDBACK AND REAL EAR TEST

- 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

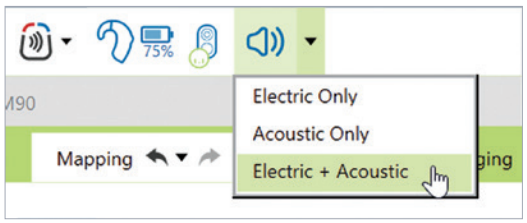
- Under *Fitting*, access the *Mapping* tab, set the appropriate electric parameters (i.e. stimulation strategy, pulse width, etc.).
- Select the *Stimulation mode* type to measure M-Levels. T-Levels will default to 10% of the set M-Levels.

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 recipient'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

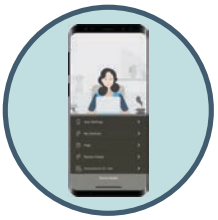
The device will seamlessly adapt to your surroundings and adjust automatically from quiet, to noise and while streaming music or media.

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

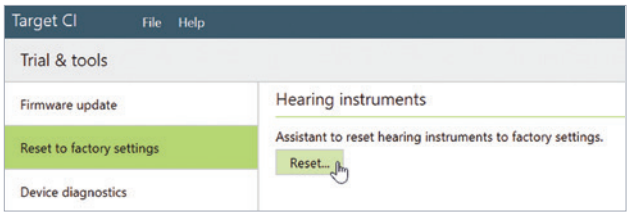
Target CI
PROGRAMMING REPLACEMENT MARVEL DEVICES

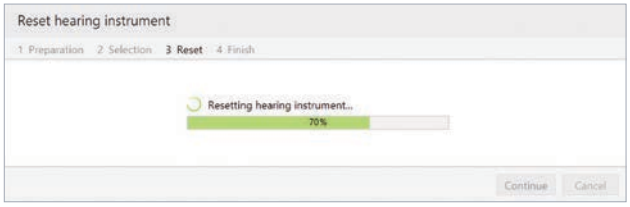
This guide provides the hearing care professional with the steps to program a replacement Marvel CI sound processor or hearing aid in Target CI.

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.





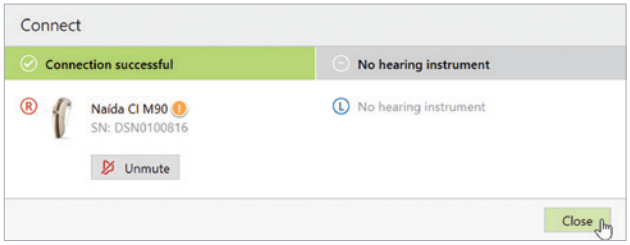
PROGRAMMING THE REPLACEMENT MARVEL DEVICE

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.

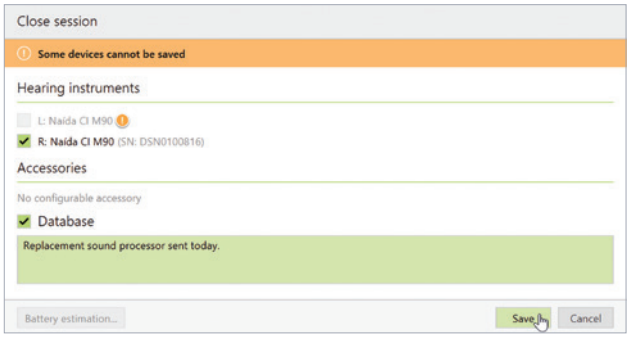
CONNECT TO THE HEARING INSTRUMENT

- 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

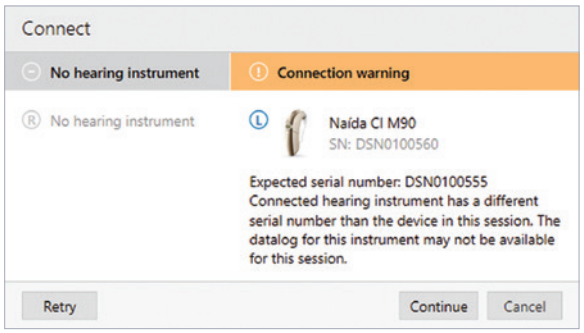
- Select *Save & close* to finalize the fitting session.
- Add any notes to the fitting session, if desired.
- *Save* the fitting session to the Hearing instruments and/or the Database.
- Select *Close* to complete the fitting session.



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.

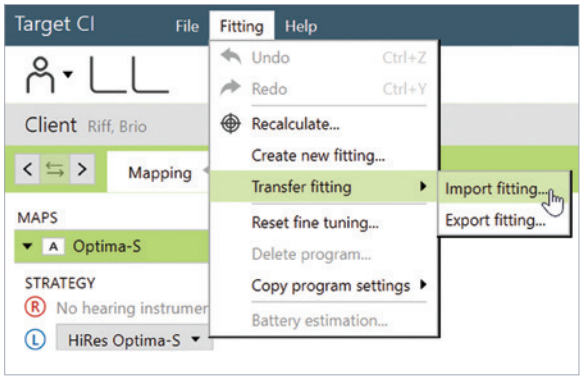
- In the case of programming the back-up Marvel CI device, the hearing care professional can ignore this message and proceed with the fitting session to program the back-up device.
- This notification will also be displayed at return visits when a Marvel CI device that has a different serial number than 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.



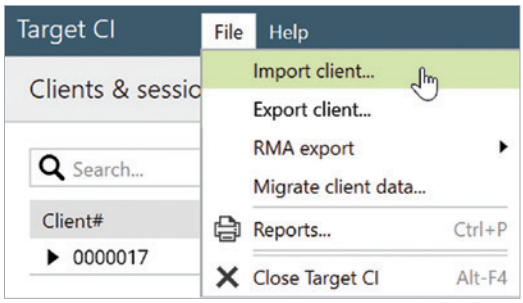
If further support is required, please contact your local AB representative.

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.

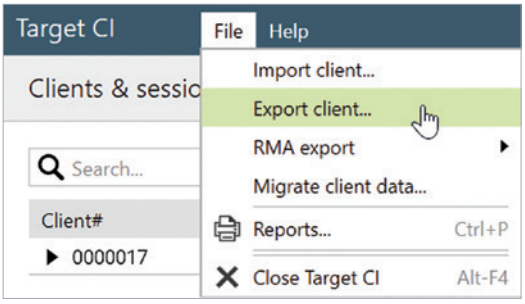


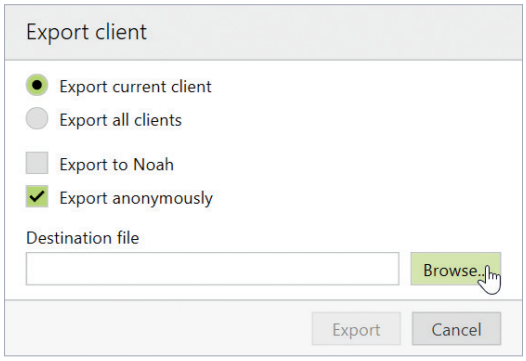
- Go to *File > Import clients*.
- Click *Browse*, select the file you wish to import; then, click *Import Client*.
- If the client file was anonymized, it will appear in Target CI as an anonymized number. For example: *Anonymized19600101*. The client name may be edited after the anonymized file is imported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

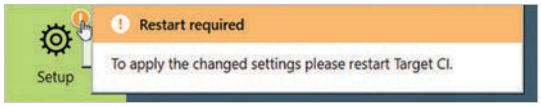
Note: Consider creating a shortcut from the desktop to the *C:\ProgramData\Advanced Bionics\Target CI\Target CI\RMAExports* file for easy file location in future.

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.



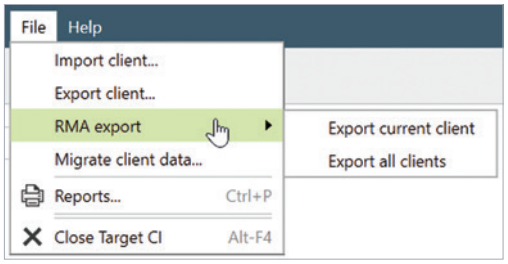
To import a file from AIM

- 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*.

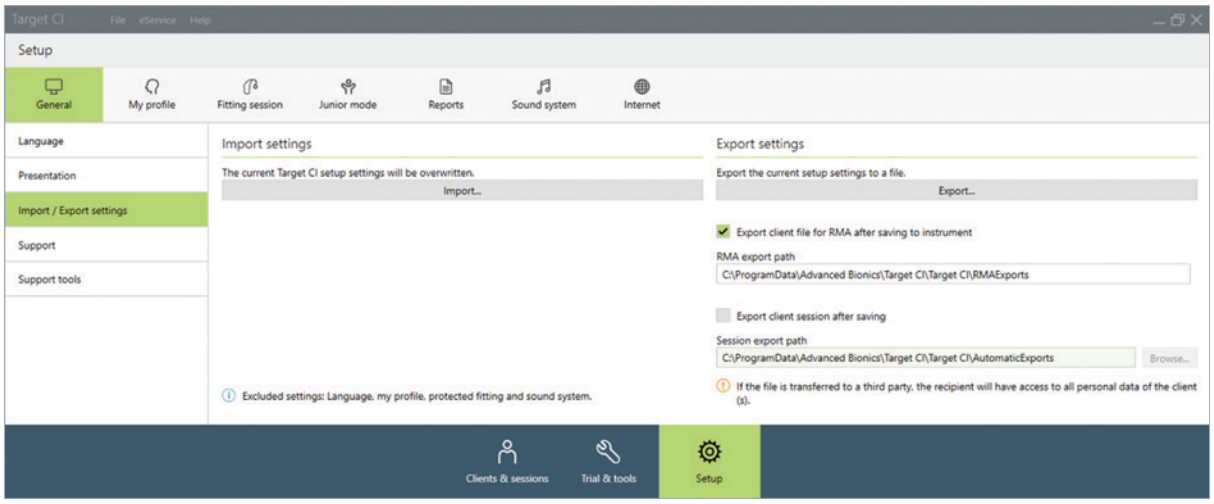
Measurements imported from AIM are identified with this symbol:

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 RMAExports 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 information 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:

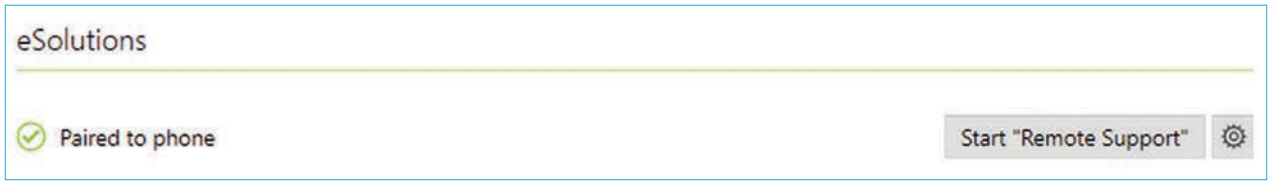
- Computer with an integrated webcam or microphone, or an external webcam and microphone connected to the computer.
  NOTE: For better sound quality, use headphones with a microphone connection for the Remote Programming session.
- Stable internet connection (Wi-Fi, LAN or 4G) with at least 5 Mbit/s 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

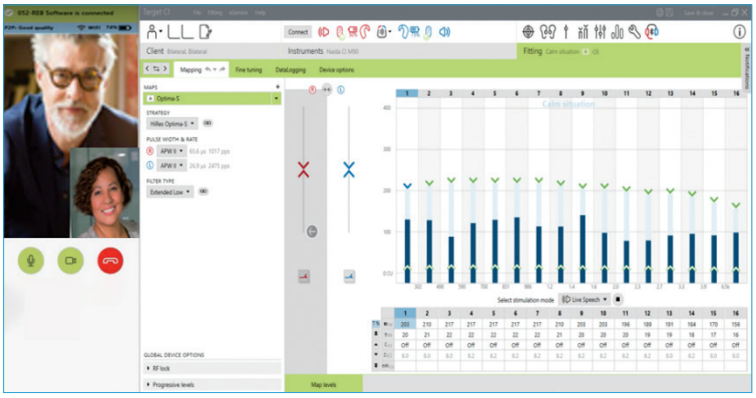
- Confirm the programming computer is connected to the internet.
- The hearing care professional (HCP) can select *Start Remote Support* to begin the Remote Programming session.
  NOTE: *Start Remote Support* is available after the recipient pairs to their phone and the recipient joins the programming 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.

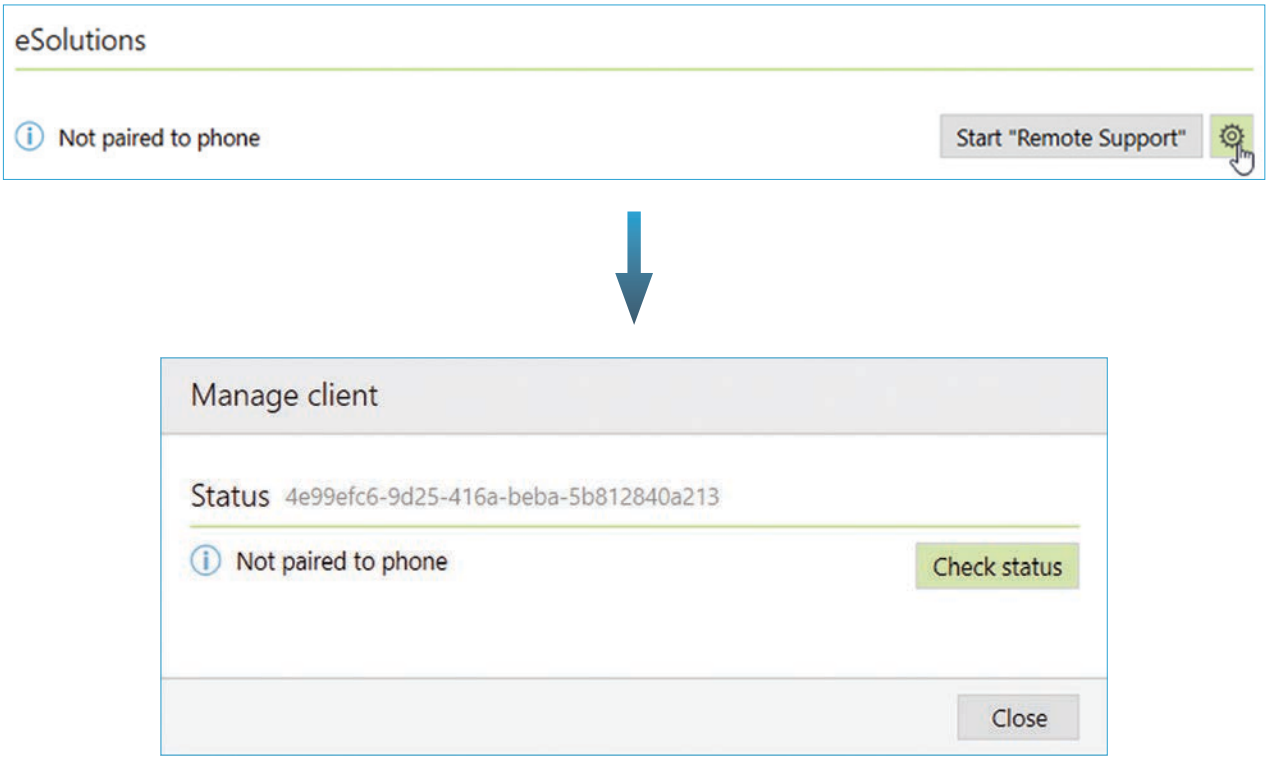
During a Remote Programming session:

- 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.

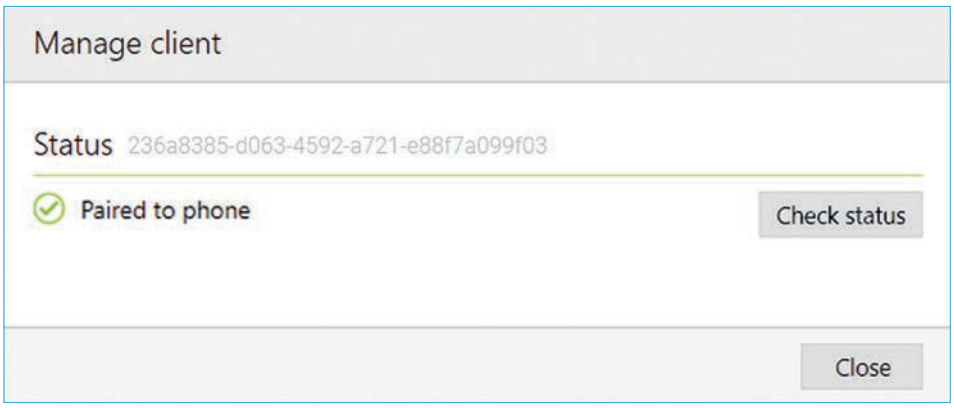
TROUBLESHOOTING

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 current 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

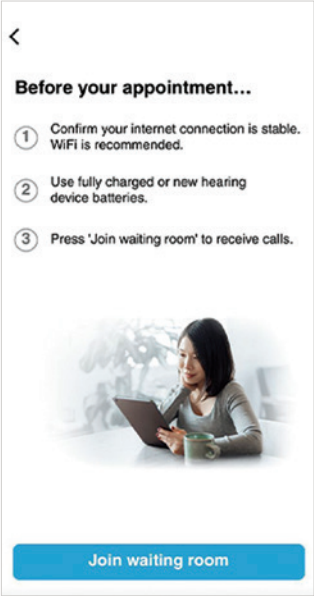
- From the app store, download the AB Remote Support app.
  Note: The AB Remote Support app is compatible with Apple iOS 14 and Android OS 6 or higher.

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

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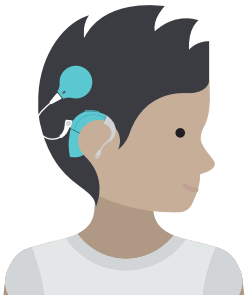
Marvel CI Connectivity
QUICK REFERENCE GUIDE

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
POWERFUL CONNECTIONS

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ADVANCED BIONICS
POWERFUL CONNECTIONS

AB Remote Support
GETTING STARTED

Your Remote Appointment	Date:	Time:
	Clinician:	

With the AB Remote Support App, you can meet with your hearing care team without making the trip to their office. Your care is now in your hands. Save your gas. Save your time. Open your schedule. From wherever you see fit, you can now hear better sooner.

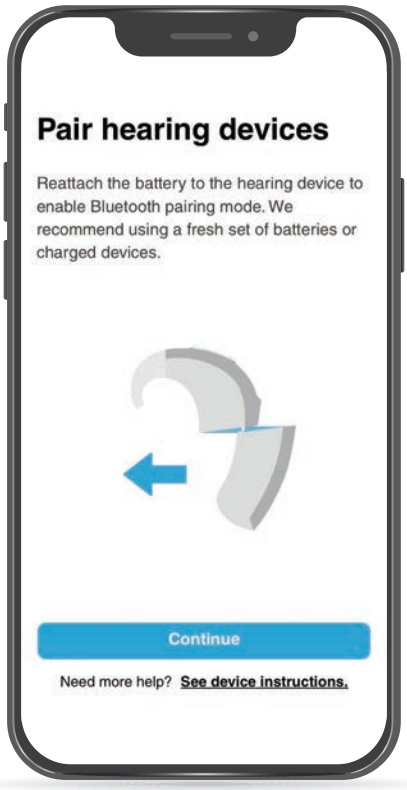
Once your Remote Appointment is booked, follow the steps below.

1. DOWNLOAD THE AB REMOTE SUPPORT APP

The AB Remote Support app works with Apple iOS 11 and Android OS 6 or higher.

Download on the App Store

GET IT ON Google Play



2. PAIR YOUR MARVEL DEVICE(S)

- 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. Then tap *Continue* in the app.
- Select the device(s) found in the app. Then select *Done*.
  - If you have more Marvel devices, such as backups, select *Settings* > *Pair New Devices*. Then follow the steps given within the app.
    Note: If you have a CROS, this device will not be connected to the app.
- Once finished here, the last steps will take place on the day of your Remote Appointment.

3. JOIN THE REMOTE PROGRAMMING SESSION

- Select the *Appointment* icon, then select *Continue* > *Join waiting room*.
  - If asked, select *OK* to allow access to your camera and microphone.
- When your hearing care professional joins, select *Join* to start the session.
  - If asked during your appointment, turn this page over to use the loudness scale, or to find the steps to have your backup devices programmed.
- Once your visit is complete, select *Done*.
  - For Troubleshooting Tips, select *See device instructions* in the app.

Scan here to watch a short video on the AB Remote Support app.

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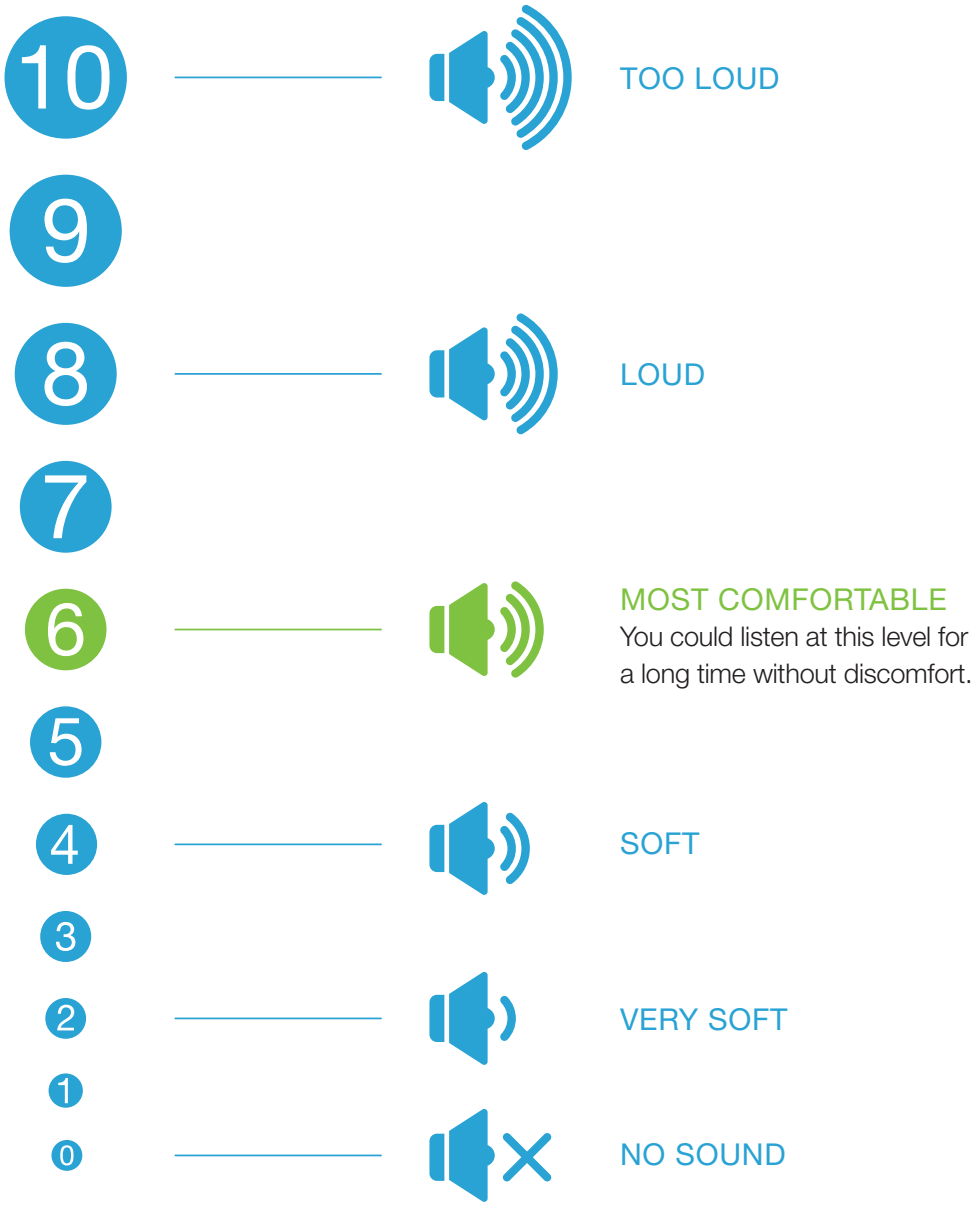

FOR BACKUP MARVEL DEVICE(S), FOLLOW THE STEPS BELOW:

- When asked, select to end the call. Then select *Leave appointment* and *Done.*
- Select the < at the top of the screen and then *Devices* at the bottom.
- Remove the batteries from all devices and then place batteries onto your backup devices. Then select the blue *Change* button to select the backup devices.
- Select *Save* and rejoin the session by going to the *Appointment* Tab and selecting *Continue*.
- From this point, follow the instructions on the app to re-join the session.

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ADVANCED BIONICS
POWERFUL CONNECTIONS

CLINICAL RESEARCH

Advanced Bionics Remote Programming

The AB Remote Programming solution comprises the clinician-facing Target CI fitting software and a recipient-facing AB Remote Support smartphone app. With Marvel CI's universal Bluetooth® connectivity that provides wireless two-way streaming from any Bluetooth audio device, the AB Remote Support app turns the recipient's Apple iOS or Android OS smartphone into a wireless programming interface for Remote Programming. For the first time, hearing care professionals (HCPs) can connect with cochlear implant (CI) recipients from the comfort and convenience of their homes (or anywhere with cellular or Internet connection) to provide complete programming services without shipping additional hardware (Cochlear Limited, 2022).

HOW DOES IT WORK?

Following an initial in-person clinic appointment, Target CI v1.5 (or later) enables real-time video and audio communication between HCPs and Marvel CI recipients using the AB Remote Support app. This allows recipients to attend subsequent programming sessions from a remote location instead of in-person at the clinic. Programming adjustments initiated by an HCP in Target CI are transmitted over the internet to a cloud service that forwards the programming command to the AB Remote Support app through a Wi-Fi or cellular connection (Figure 1). The programming command is then transmitted from the AB Remote Support app to the Marvel CI sound processor and Link M hearing aid (if applicable) through a standard Bluetooth low-energy 2.4 GHz wireless connection. This allows the HCP to make programming adjustments, counsel on device use, and discuss plans for (re)habilitation remotely, reducing the need for travel and missed time at work or school for recipients and, in some cases, their partners, relatives, or other caretakers.

WHY REMOTE PROGRAMMING MATTERS FOR IMPROVING ACCESS TO CI SERVICES

Complexities in treatment delivery have been acknowledged as part of the reason for the underutilization of cochlear implants (Nassiri et al., 2021, 2022). Globally, around 3.4 billion people, or 43% of the world's population, reside in rural areas (Ritchie & Roser, 2018). In developed nations such as the United States, about 60 million people (one in five Americans) live in rural areas (Ratcliffe et al., 2016). Older residents are more likely to live in rural areas where healthcare is often less accessible (Symens Smith & Trevelyan, 2019). In parts of the United States, access to CIs can also be challenging for veterans with more than 80% residing more than 180 miles from the nearest Veterans Health Administration facility providing CI services (Shayman et al., 2019).

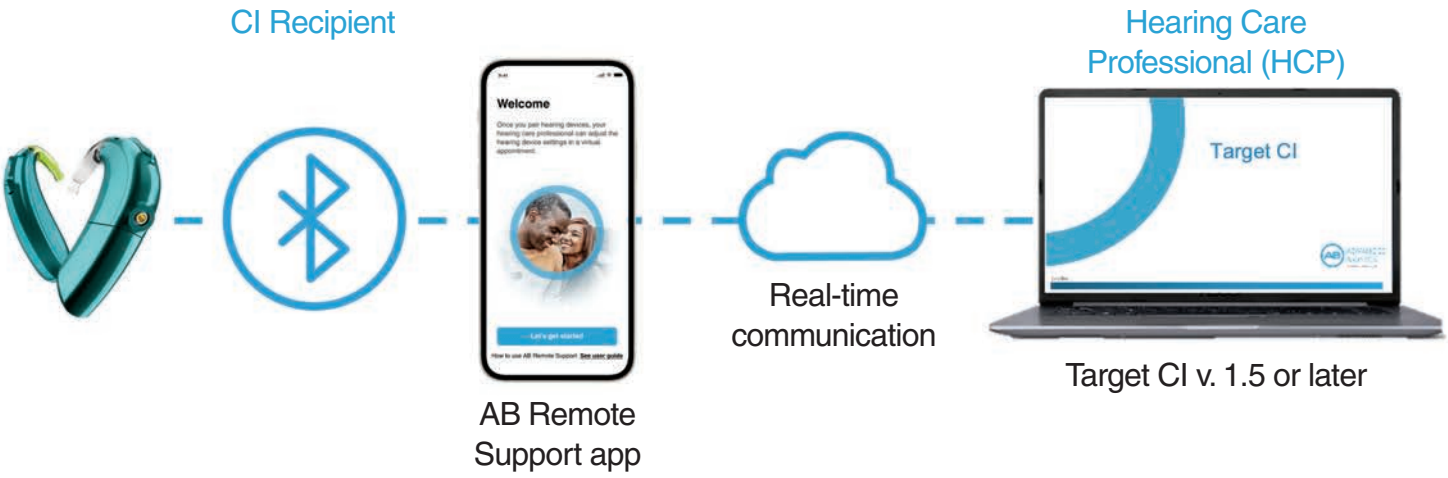

Figure 1: Participating in a Remote Programming session for unilateral, bilateral, and bimodal CI recipients is designed for simplicity. The recipient begins by connecting to the Remote Programming session via the AB Remote Support app. The HCP then connects via Target CI, allowing the systems to communicate in real-time for updates to programming.

For developing nations, insufficient access to audiological services is even more pronounced. In the World Health Organization African Region, 78% of countries have fewer than one audiologist per one million people. Similarly, in South-East Asian nations, the density is less than five audiologists per million people, with 44% of these countries having fewer than one audiologist per million people (World Report on Hearing, 2021). Extending audiology services via AB's Remote Programming solution to underserved rural and remote areas will be one step toward improving accessibility to and affordability of audiology services.

For individuals who successfully navigate the cochlear implantation process despite the geographical and economic constraints, keeping up with the numerous post-activation programming and (re) habilitation appointments can be a significant hurdle, especially during the first year. Working parents might need to find time to bring their child to a CI center or hearing care professional for programming. Teenagers might need to organize their fitting appointments around active academic and social lives, while busy professionals might be unable to leave the office for appointments. These are just some examples of obstacles in the care delivery process.

Accessibility, convenience, efficiency, and reduced costs have been drivers in telehealth uptake (Ratanjee-Vanmali et al., 2020; Swanepoel & Hall, 2020). The pandemic accelerated the adoption of telehealth as the primary means of seeing noncritical patients, with healthcare providers quickly adapting to digital care (Jacqueline & Maria, 2022). The AB Remote Programming solution is the first to enable access to all the programming parameters without the need for shipping programming hardware.

CLINICAL STUDY

Advanced Bionics (Valencia, CA, USA) conducted a multi-center pivotal clinical trial to evaluate the safety and efficacy of cochlear implant remote fitting with Marvel CI. The study employed a prospective, within-participants, repeated-measures design to determine whether hearing performance is similar in programs created via a Remote Programming session and an in-person programming visit. Participants evaluated each program chronically for two to three weeks, allowing for exposure to a variety of everyday situations. The study used a non-inferiority design to determine whether speech recognition in quiet with a program created in a Remote Programming session was no worse than speech recognition in quiet with a program created in an in-person setting. The primary efficacy endpoint was the comparison of AzBio sentence recognition in quiet after chronic use of a program fitted in-person to chronic use of a program fitted with Remote Programming. The data to follow support this primary endpoint and show that Remote Programming presents an opportunity for time and cost savings.

PARTICIPATING U.S. SITES

Austin ENT (Austin, TX, USA)

University of Colorado (Boulder, CO, USA)

Saint Luke's Hospital Midwest Ear Institute (Kansas City, MO, USA)

Vanderbilt University Medical Center (Nashville, TN, USA)

Washington University in St Louis (St. Louis, MO, USA)

MATERIALS AND METHODS

Participants: Seventeen CI recipients participated in the study, of which three were under the age of 18 years at the time of study enrollment. Participants were enrolled in either electric-only (EO) or aidable residual hearing (ARH) cohorts based on the level of unaided audiometric thresholds in their implanted ear. Additional participant demographics are shown in Table 1.

	EO COHORT	ARH COHORT
TOTAL PARTICIPANTS	12	5
Age (years)		
Mean (SD)	45.2 (22.9)	67.0 (7.2)
Median	49.5	68
Range	15*; 77	60; 78
Gender		
Male	5 (41.7%)	1 (20%)
Female	7 (58.3%)	4 (80%)
Implanted Devices		
HiRes Ultra 3D	6 (25.0%)	1 (4.2%)
HiRes Ultra	1 (4.2%)	0 (0.0%)
HiRes 90K Advantage	3 (12.5%)	4 (16.7 %)
HiRes 90K	9 (37.5%)	0 (0.0%)

Table 1: Participant demographics for electric only (EO) and aidable residual hearing (ARH) cohorts.
Note: Implanted device percentages are based on the total number of implanted devices in the study (n = 24).
*Three participants were under the age of 18.

Study hardware and software: Participants were fitted with an investigational Marvel CI sound processor in the audiologist's office using Target CI v1.5. ARH participants were fitted with an acoustic earhook, and EO participants were fitted with an M T-Mic™ microphone. The AB Remote Support app was installed on study-dedicated smartphones.

Test measures: All participants underwent standard audiometric testing to determine cohort eligibility and completed the Mobile Device Proficiency Questionnaire (MDPQ-16; Roque & Boot, 2018). The MDPQ-16 assesses the ability to perform various tasks with a mobile device. The responses are as follows: 1 (never tried), 2 (not at all), 3 (not very easily), 4 (somewhat easily), 5 (very easily). The median MDPQ-16 score was 4.70, with a range of 3.1 to 5.0. One participant was excluded from participation at visit one after scoring an average score of less than 3, which fell below the qualification threshold of ≥ 3. The study was conducted over three visits, as illustrated in Figure 2. During visit 1, fittings were performed in the investigator's office using Target CI. At visit 2, the participants were placed in a remote location in the clinic with the study smartphone, and fittings were completed through the smartphone app. After each chronic period, speech recognition was tested in quiet in an audiometric sound booth (65 dBA from speaker in front) using two lists of AzBio sentences (Spahr et al., 2012). Testing was performed unilaterally for unilaterally implanted participants and bilaterally for bilaterally implanted participants. Contralateral ear devices were removed for unilaterally implanted participants, and, if necessary, foam plugs were used to isolate the test ear.

The abbreviated Speech, Spatial, and Qualities of Hearing Scale (SSQ-12; Noble et al., 2013) was used to evaluate the chronic experience with each fitting in the participants' everyday hearing environments. Custom questionnaires were completed to assess the opinions of the participants and audiologists toward remote fitting. Supporting data including in-person fitting and remote fitting durations, psychophysical data (adjustments to the acoustic component for participants in the (ARH) cohort and M-level changes), and electrophysiological data (threshold neural response imaging (tNRI) measurements and impedance measurements) were also collected.

Statistical analyses: Non-inferiority analyses were based on paired t-tests for the mean differences in speech scores with the remotely fit program and the in-person program. Performance falling outside the 95% confidence interval (CI), established by Spahr et al. (2012) for AzBio sentences, were considered for clinically significant differences. Thus, mean paired differences of less than 10% for AzBio in quiet would support the observation that remotely fit programs are non-inferior to in-person fit programs.

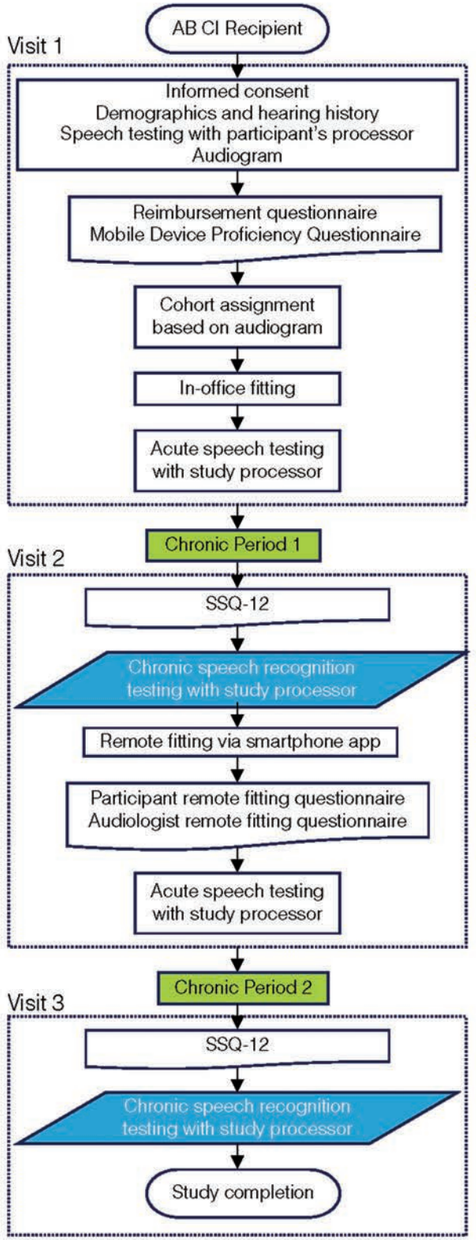

Figure 2: Study flow chart. Blue shapes indicate data for primary endpoint. Participants were experienced listeners of Marvel CI. Programming at both visits was completed with the participant's everyday listening program.

RESULTS

REMOTE PROGRAMMING IS NON-INFERIOR TO IN-PERSON FITTINGS

Figure 3a shows the mean AzBio sentence recognition scores in quiet after chronic use of the remotely fitted program and the in-person fitted program for the EO cohort (n = 12). The mean AzBio speech recognition score for the program created in-person was 89.28% (*SE* = 3.48), while the mean AzBio speech recognition for the program created via AB's Remote Programming solution was 91.94% (*SE* = 2.76). This paired difference is 2.66 (*SE* = 0.99), with a two-sided 95% CI [0.48, 4.84]. The observed *p* value was < 0.001, rejecting the null hypothesis of inferiority, confirming that sentence recognition with AB's Remote Programming solution is not significantly inferior to that with in-person fitting.

A non-inferiority evaluation was also completed with the EO and ARH cohorts pooled together (n = 17; Figure 3b). The mean speech recognition score for the program created in-person was 89.04% (*SE* = 2.66), while the mean speech recognition score for the program created via AB's Remote Programming solution was 90.99% (*SE* = 2.09). This paired difference equals 1.95 (*SE* = 1.31), with a two-sided 95% CI [-0.81, 4.72]. The observed *p* value was < 0.001, thereby rejecting the null hypothesis of inferiority, again supporting that sentence recognition with AB's remote fitting solution is non-inferior to in-person fittings.

REMOTE PROGRAMMING IS AN EFFICIENT USE OF TIME

Fitting durations were similar between in-person and Remote Programming fittings. For the purposes of the study, investigators were asked to begin timing the fitting session when they clicked "connect" in the fitting software to connect to the sound processor(s), and the session timing stopped when they clicked "save & close." Differences in overall fitting durations between in-person and Remote Programming fittings ranged from 3 to 11 minutes. For both in-person and Remote Programming fittings, the total fitting durations for bilateral and ARH fittings were longer than the respective unilateral and EO fittings, which is explained by additional time spent fitting the second ear or the acoustic earhook component.

REMOTE PROGRAMMING OFFERS COST AND TIME SAVINGS COMPARED TO A TYPICAL CLINIC VISIT

In-person clinic visits have measurable demands, including time, travel, and possibly financial expenditure. When asked about the "Approximate time spent in total during a typical CI office visit" (e.g., total spent in travel, wait, and appointment times), responses from the 17 participants ranged from less than 1 hour (11.8%), 1 – 2 hours (47.1%), 2 – 4 hours (29.4%), and more than 4 hours (11.8%). This distribution of responses indicated that the total time spent during a typical CI office visit ranged from 1 to more than 4 hours for 88.2% of study participants. When asked if office visits related to CI care were covered by insurance, 41.2% of study participants were not reimbursed for all costs associated with a CI clinic visit.

RECIPIENTS AND AUDIOLOGISTS RATE REMOTE PROGRAMMING POSITIVELY

Opinions towards Remote Programming were positive. Custom questionnaires collected information regarding the investigator's and participant's satisfaction with the Remote Programming experience (Figure 4). The results of the questionnaire, which involved rating the strength of agreement with specific statements, revealed that participant and audiologist ratings did show differences. Specifically, participants exhibited a tendency to express stronger agreement with these statements, suggesting that Remote Programming was similar to their in-person experience. Audiologists reported the remote fitting experience as positive and that they would recommend it as an alternative to some in-clinic visits.

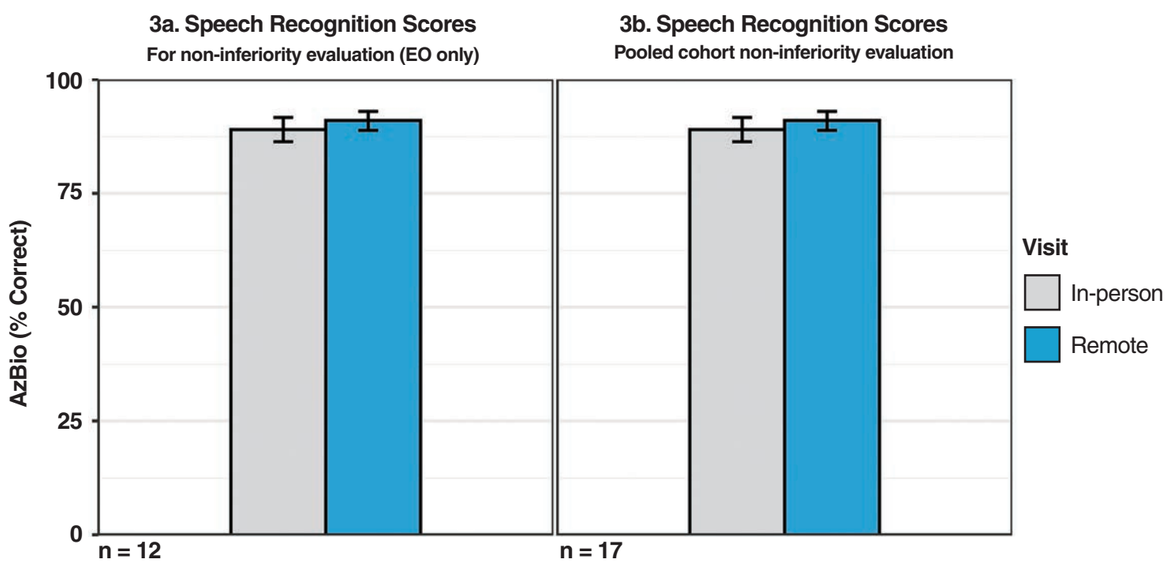

Figure 3: Speech recognition scores are shown in % correct for programs created using in-person (gray) and remote (blue) fitting methods. Error bars show the standard error of the mean. 3a. Electric only (EO) cohort (n = 12; primary efficacy endpoint) 3b. EO and aidable residual hearing (ARH) cohorts pooled together (n = 17)

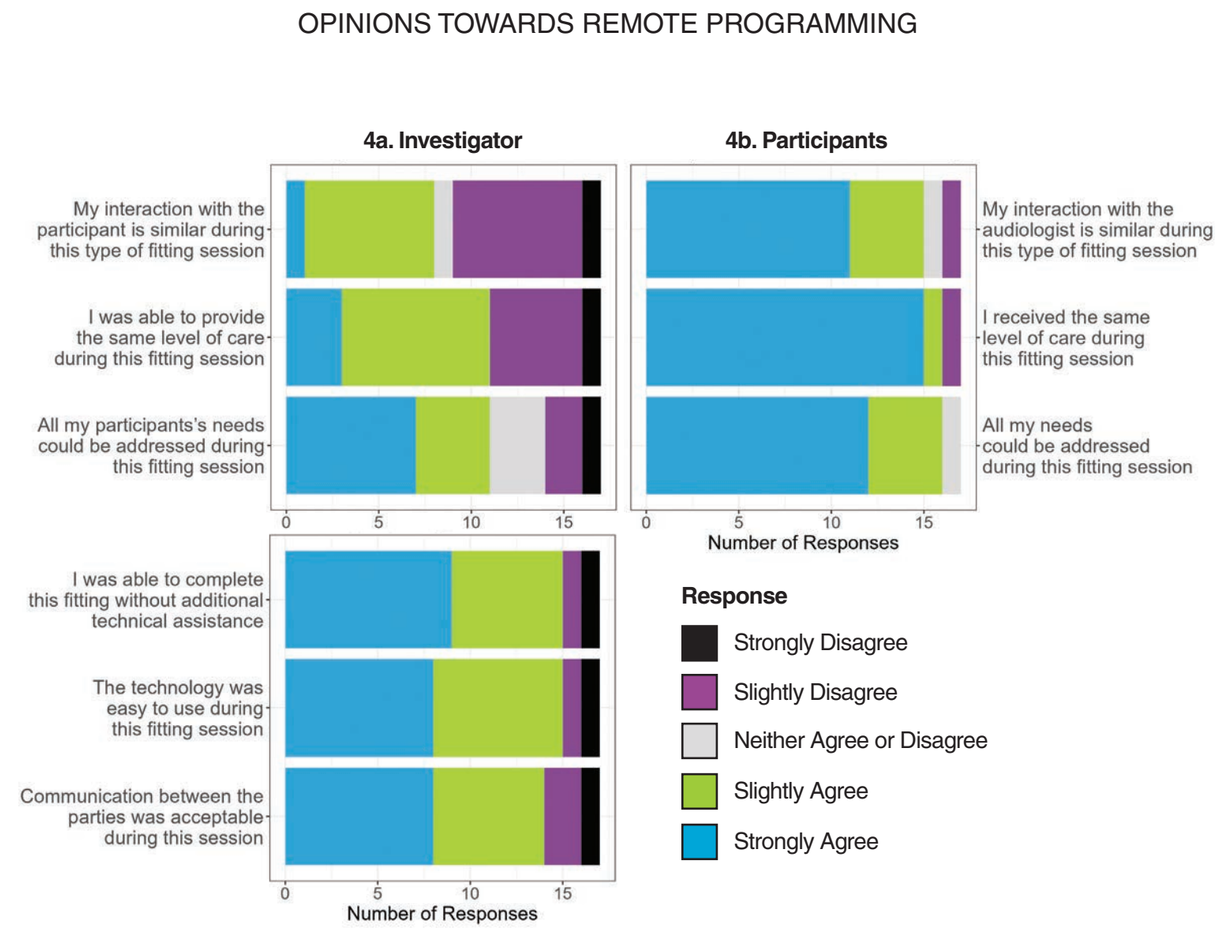

Figure 4: Investigator (4a) and participant (4b) self-reported opinions towards Remote Programming.

PSYCHOPHYSICAL AND ELECTROPHYSIOLOGICAL DATA COLLECTED DURING THE FITTING SESSIONS

Psychophysical and electrophysiological measurements as well as fitting adjustments were logged during the fitting sessions to demonstrate the completion of the programming commands made in Target CI. All measurements and adjustments were completed and accurate. Any instances of incomplete measurements or adjustments were related to clinical factors such as disabled electrodes or stimulus range for tNRI measurements.

SUMMARY

The findings from this clinical study show that Remote Programming is an effective innovation that provides recipients and audiologists with measurable benefits.

Specifically, the results demonstrate that:

- Speech recognition in quiet with remotely created programs is non-inferior to speech recognition in quiet with programs created during an in-person fitting. This finding was observed for unilateral and bilateral, electric-only CI recipients and those with acoustic residual hearing in the implanted ear.
- Overall fitting durations were similar between in-person and remote fittings.
- Remote Programming offers time and cost savings to AB CI recipients compared to routine clinic visits. The total time spent during a typical CI office visit ranged from 1 to more than 4 hours for 88.2% of study participants. Forty percent of participants in this study are not reimbursed for expenses related to a typical clinic visit.
- Research participants and audiologists rate Remote Programming positively. Participant and audiologist ratings did show differences. Specifically, participant ratings were higher on average, suggesting the remote fitting was similar to their in-person experience.

Remote Programming for Marvel CI sound processors and Link hearing aid devices enables professionals to conveniently connect, assist, and support AB recipients' needs by allowing complete CI programming – an industry first for cochlear implants.

See 2023 Target CI and AB Remote Support app Instructions for Use for complete study results. Data protection complies with the Health Insurance Portability and Accountability Act (HIPAA), General Data Protection Regulation (GDPR), and Swiss Federal Data Protection Act (FDRA) policies.

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REMOTE PROGRAMMING OUTCOMES WITH CI RECIPIENTS IN CHILE

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American Auditory Society

RED Hospital Clinico Universidad de Chile

Advanced Bionics — Powerful Connections

Poster #138

Introduction

Remote programming has the potential to lessen the burden of in-person clinical follow-up borne by CI recipients, their families, and CI audiologists. With Marvel CI sound processor's built-in universal Bluetooth capability which allows two way streaming from any Bluetooth audio device, a smartphone can be transformed into a wireless programming interface. Consequently, the patient can be programmed from anywhere with a stable internet or cellphone data connection. This presents opportunities for patients to save time and money compared to a conventional clinic visit and for clinics to improve access to CI follow-up.

Study Objectives

To evaluate the usability, effectiveness, and acceptability of a novel remote programming system from the perspective of CI recipients and their audiologists.

Methods

To date, 10 adult CI recipients (45 to 80 yrs.; median 58.6 yrs.) managed by the Hospital Clinico de la Universidad de Chile have participated in the study. CI programming was conducted in-person (face-to-face) as well as remotely, in a secondary programing room within the clinic separate from the location of the programing audiologist, using a remote programming system. In both set-ups, the clinician used a clinical CI programming software (Target CI 1.5) and a standard programming protocol. The order of in-person and remote programming sessions was randomized. Each programming session included verification of per electrode M-levels, creation and fine-tuning of an additional program, and measurement of electrode impedances and NRI. Additional procedures are listed below:

Baseline steps

- Consent
- Baseline questionnaire
- Remote programming app training

In-person programming

- Check impedances
- Verify everyday program
  - ✓ Sound quality
  - ✓ Electrode sweep for loudness (M-level)
  - ✓ Gain adjustments
- **Create additional program**
  - ✓ **Assess mic mode preference**
- Measure NRIs
- Measure ambient noise levels

Remote programming

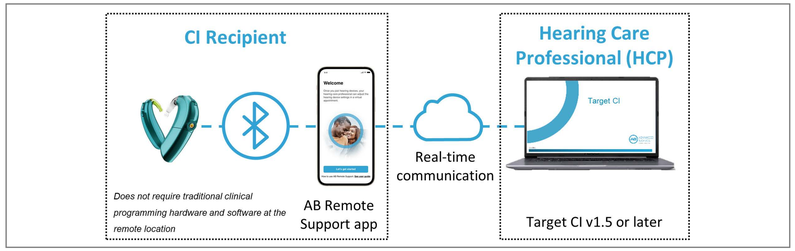
- Check impedances
- Verify everyday program
  - ✓ Sound quality
  - ✓ Electrode sweep for loudness (M-level)
  - ✓ Gain adjustments
- **Create additional program**
  - ✓ **Assess mic mode preference**
- Measure NRIs
- Measure ambient noise levels
- Measure level of smartphone audio at the subject's ear
- MLV speech recognition testing over remote prog. app (bisyllables)
  - ✓ Audio/Visual
  - ✓ Audio only

End of study

- Final questionnaire
- Mobile Device Proficiency Questionnaire-16
- Soundbooth speech recognition testing
  - ✓ SpAzBio
  - ✓ Bisyllables (MLV)
- Audiologist questionnaire for each subject
- Audiologist end-of-study questionnaire

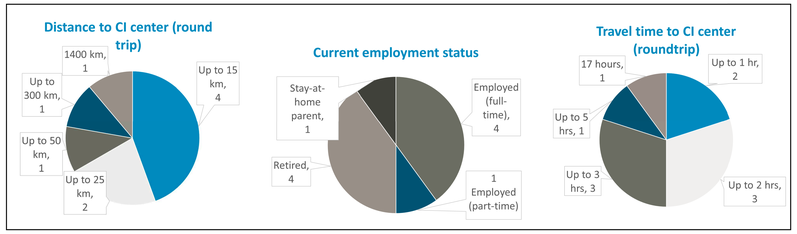
MLV= Monitored Live Voice

How does the AB Remote Programming system work?

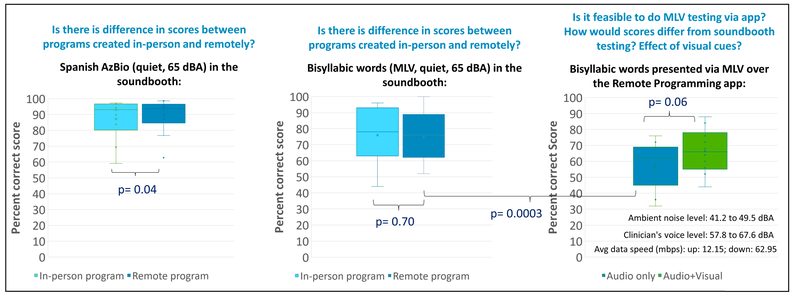


Preliminary Results

Baseline Questionnaire

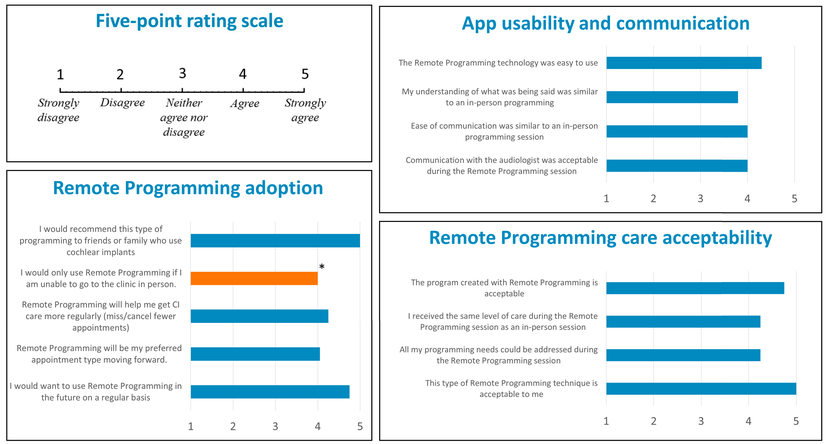


Speech Recognition Outcomes



Preliminary Results

Final Questionnaire



* contrary response

Interim Conclusions

1. The new Remote Programming system enabled conduction of the standard CI programming routine remotely.
2. Speech recognition outcomes were equivalent across in-person and remotely created programs.
3. Speech recognition could be measured over monitored live voice over the remote programming app.
4. Participants reported similar ease and quality of communication across in-person and remote programming sessions.
5. All participants indicated the remote programming methodology and resultant program were acceptable.
6. Remote programming could save from 1 to 17 hours of travel time in the current participant population.

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