

# Performing Listening Checks on Remote Microphone Technology Connected to Cochlear Implants

Chi Tran, BS, Allison Woodford, BS, Kitrie Howell, BS, and Linda Thibodeau, PhD

The University of Texas at Dallas



## INTRODUCTION

Remote microphone technology (RMT) significantly enhances speech recognition in noise for people with cochlear implants (CI) by providing improved signal-to-noise ratios.<sup>1,2</sup> To optimize the listening advantage provided by RMT in multiple settings, it is important to perform a listening check when fitting CI and RMT systems to verify the output and overall sound quality.<sup>3</sup> The connection between CI and the RMT varies widely depending on the manufacturer and model of the CI. An RMT system require two key components: (1) a receiver (integrated [RogerDirect, 20, 21], universal [Roger X]), integrated into the sound processor itself, and/or a streamer), and (2) a transmitter (proprietary remote microphone, Roger Pen, Roger Select, etc.). Phonak Roger is a popular RMT system with a variety of products for users with different listening needs at home and school, in social situations, work environments, meetings, or sports. Unlike the universal listening check protocol for hearing aids, the protocol for cochlear implants varies by manufacturer and model of the speech processors.

## PURPOSES

For an on-the-ear speech processor from each of the three CI manufacturers—Advanced Bionics, Cochlear, and MED-EL—this study had two purposes:

1. Provide a guide of connectivity options and the corresponding set up for listening checks with and without the RMT.
2. Identify smartphone app features for checking connectivity and CI function.

## METHODS

Research was completed for three speech processors as shown in Table 1.

CI manufacturer	Sound processor	RMT transmitter options	RMT receiver options
MED-EL	Sonnet 2	Compatible Phonak/Oticon Mic	Induction neck loop
		Any Roger Mic	Roger 21
		Any Roger Mic	Roger X & FM battery pack cover
		MED-EL Audio Link	Internal
Cochlear	Nucleus 7	Compatible Phonak/Oticon Mic	Induction neck loop
		Any Roger Mic	Roger 20
		Any Roger Mic	Roger X & Cochlear Mini Mic 2+
		Cochlear Mini Mic 2/2+	Internal
Advanced Bionics	Naida or Sky Marvel CI	Compatible Phonak/Oticon Mic	Induction neck loop
		Any Roger Mic	RogerDirect
		Any Roger Mic	Roger X & Installer

**Table 1.** Currently available speech processors for three cochlear implant manufacturers and their remote microphone technology connectivity options.<sup>4,5</sup>

## LISTENING CHECK STEPS AND EQUIPMENT

### Step 1: Verify function of RMT with universal equipment<sup>6</sup>

Use the following **Phonak adapters with Phonak MLx Audio Checker** (picture) with attached headphones

- MED-EL Sonnet 2 – Roger 21 adapter
- Cochlear Nucleus 7 – Roger 20 adapter and Nucleus 7 battery
- Advanced Bionics Naida/Sky Marvel – No adapter needed



### Step 2: Verify function of sound processor without RMT with manufacturer's adapter.

Use the following **CI manufacturer's adapters** with headphones attached to perform a listening check

- MED-EL Sonnet 2 – Sonnet Microphone Test Device and FineTuner / FineTuner Echo / Audiokey2 app to get sound processor into monitoring mode<sup>7</sup>
- Cochlear Nucleus 7 – Nucleus 7 monitor earphones adapter<sup>8</sup>
- Advanced Bionics Naida/Sky Marvel CI – M90 listening check module<sup>9</sup>

## RESULTS

### MED-EL SONNET 2

**Step 1: Listening to the RMT** – Set up as indicated then present audio input to the transmitter

**Induction neck loop**  
Plug compatible headphones into the induction neck loop



**Roger 21**  
Attach Roger 21 to the Roger 21 adapter and plug into the MLx audio checker. Then plug in compatible headphones.

**Step 2: Listening to the sound processor without RMT**

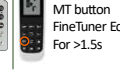
1. Connect the **SMTD adapter** and headphones to the **SMTD**



2. Turn **SMTD** volume to minimum



3. Activate monitoring mode in the app or press the following button on a remote control connected to the SP:



4. Center the SP's coil on the **SMTD adapter**



5. Provide audio input to the SP's microphone and check the signal with the headphones

**Step 3: Listening to the sound processor with RMT**

Perform **step 2** with indicated setup below. Then present audio input to the transmitter

**Induction neck loop**  
➢ SP in **T-coil** program  
➢ Induction neck loop connected to a transmitter



**Roger 21**  
➢ Roger 21 installed on the SP  
➢ Roger 21 connected to a transmitter



**MED-EL Audio Link**  
MED-EL Audio Link connected to the SP



**Roger X and FM battery pack cover**  
➢ Roger X plugged into the FM battery pack cover  
➢ Roger X connected to a transmitter



**Figure 1.** MED-EL Sonnet 2 Listening Check Protocol.<sup>7</sup> Note. RMT, remote microphone technology; SP, speech processor; SMTD, Sonnet Microphone Test Device.

### COCHLEAR NUCLEUS 7

**Step 1: Listening to the RMT** – Set up as indicated then present audio input to the transmitter

**Induction neck loop**  
Plug compatible headphones into the induction neck loop



**Roger 20**  
Attach the Cochlear Nucleus 7 battery, Roger 20 and Roger 20 adapter and plug those into the MLx Audio Checker. Then plug in compatible headphones.

**Step 2: Listening to the sound processor without RMT**

1. Connect **Cochlear Nucleus 7 monitor earphone adapter** in between the top part of the SP and the battery.
2. Plug 3.5mm headphones into the auxiliary jack on the side of the module to perform a listening check.

**Step 3: Listening to the sound processor with RMT**

Perform **step 2** with indicated setup below. Then present audio input to the transmitter

**Induction neck loop**  
➢ SP in **Telecoid** program  
➢ Induction neck loop connected to a transmitter



**Roger 20**  
➢ Roger 20 installed on the SP  
➢ Roger 20 connected to a transmitter



**Cochlear Mini Mic 2 or 2+**  
Cochlear Mini Mic 2 or 2+ connected to the SP



**Roger X and MM2+**  
➢ SP connected to the MM2+ with Roger X attached  
➢ Roger X & MM2+ connected to a transmitter



**Figure 2.** Cochlear Nucleus 7 Listening Check Protocol.<sup>8</sup> Note. RMT, remote microphone technology; SP, speech processor; MM2+, Cochlear Mini Mic 2+.

## ADVANCED BIONICS NAIDA/SKY MARVEL CI

**Step 1: Listening to the RMT**

Set up as indicated then present audio input to the transmitter

**Induction neck loop**  
Plug compatible headphones into the induction neck loop



**Roger X & Installer**  
Plug Roger X directly into the MLx audio checker. Then plug in compatible headphones.

**Step 2: Listening to the sound processor without RMT**

1. Connect the **M90 listening check module** in between the top part of the SP and the Marvel CI battery.



2. Plug headphones into the 3.5mm auxiliary jack on the side of the module to perform a listening check.

**Step 3: Listening to the sound processor with RMT**

Perform **step 2** with indicated setup below. Then present audio input to the transmitter

**Induction neck loop**  
➢ SP in **T-coil** program  
➢ Induction neck loop connected to a transmitter



**Roger X and Installer**  
➢ Roger X installed in the SP and connected to a Roger transmitter.  
➢ **RogerDirect ± mic** program selected

**RogerDirect**  
➢ RogerDirect activated in the SP and connected to a Roger transmitter  
➢ **RogerDirect ± mic** program selected



**Figure 3.** Advanced Bionics Naida/Sky Marvel CI Listening Check Protocol.<sup>9</sup> Note. RMT, remote microphone technology; SP, speech processor.

	AB Remote	Nucleus Smart	AudioKey 2
Volume change	✓	✓	✓
Program change	✓	✓	✓
Check battery life	✓	✓	✓
View hearing statistics	✓	✓	✓
Audio input selection	✓	✓	✓
Microphone status	✓*	✓	✓
Find my processor	✓	✓	✓
Guardian control	✓	✓	✓
Speech processor lock status	✓		
Sound check		✓	

**Table 2.** Smartphone App Features for Checking Connectivity and Cochlear Implant Speech Processor Function.<sup>7,8,9</sup> Note. All apps are compatible with iOS and Android operating systems; \* including T-mic status.

## CONCLUSION

This guide reflects the most up to date technology available through March 2021, and provides a valuable resource for parents, CI and educational audiologists, and CI users to help in selecting, fitting, and troubleshooting CI with RMT systems.

## ACKNOWLEDGEMENTS

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