

# Phonak Insight.

## Roger Unlimited – A new era of Roger receivers

Roger is one of the most scientifically validated remote microphones in the hearing aid industry. With the introduction of Roger Unlimited, we are simplifying usability and saving valuable time to unlock more meaningful connections.

Roh M., September 2024

### Key highlights

- Roger is Phonak's proprietary digital remote microphone system introduced in 2013, and is one of the most scientifically validated remote microphone systems in the hearing aid industry.
- Building on RogerDirect™, Phonak is now introducing unlimited receivers into the Roger microphones, reducing additional hardware and allowing faster workflows for the HCP.
- Roger technology improves with feedback from HCPs and users, and our innovations in Roger receivers have pushed the boundaries of connectivity for greater usability and acceptance of this technology.

### Considerations for practice

- Roger Unlimited overcomes many perceived barriers for remote microphone use for the clinician and client, simplifying the installation process and creating valuable time for the HCP.
- In many cases the EasyGain of RogerDirect does not need to be electro-acoustically verified each and every time. HCPs should still rely on verification as well as subjective feedback when troubleshooting Remote Microphone (RM) systems.
- With greater usability and simplified process, talking about and trialling Roger has never been easier. With unlimited receivers, users can now share their Roger microphones with other Phonak hearing aid users with ease.

## Introduction

Since its introduction in 2013, Roger™ technology has been a cornerstone in the hearing aid industry, offering an effective solution for managing listening situations where the noise is too loud, or when the speech is beyond a hearing aids' critical distance (Figure 1).

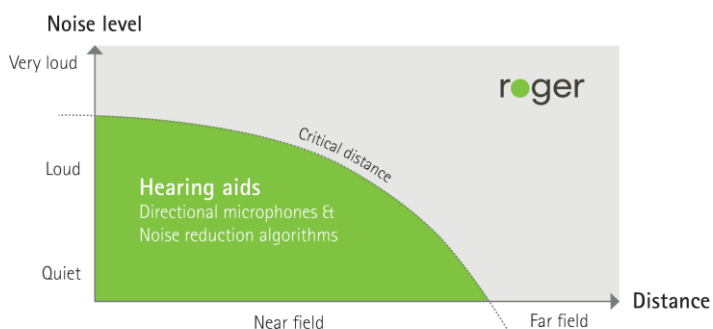


Figure 1. Graph showing the theoretical limitations of hearing aids in the far field, as well as in very loud noise. Note the 'critical distance' is displayed here as a function of noise and distance but this would typically factor in other variables as well.

Constant innovations in the remote microphone space have allowed greater benefit to the Hearing Care Professional (HCP) and end user, giving benefits not only in performance by way of new features but also in ease of use by way of workflow and saving time.

### Is Roger the same as an FM system?

Frequency Modulated (FM) systems were the first remote microphones to market, and indeed dominated the market until the early 2010's with the emergence of digital modulation (DM) systems.

Roger uses a 2.4GHz transmission on the ISM (Industry, Science and Medical band) and therefore is classified as a digital modulation (DM) system. However, RM technology is the over-arching term that encompasses both FM and DM, and is the nomenclature cited in literature today.

Phonak Roger is a dedicated transmission system designed for hearing aids and cochlear implants, and optimized for both usability and performance. It maintains low latency and power consumption while delivering high-quality audio. Additionally, Roger ensures secure, tap-proof networks and offers capabilities for data reception and control, enhancing the overall user experience.

### Benefits of Roger

The benefits of Roger systems (consisting of a transmitter and receiver (typically a hearing aid)) have been well cited in peer-reviewed and other scientific literature, showing benefits over traditional FM systems and other DM systems

as well, especially in high noise environments (Thibodeau, 2014; Wolfe et al., 2015).

Sufficient evidence exists to suggest the benefits of Roger expand beyond speech intelligibility in noise for various populations (Gaastra et al., 2024; Zanin et al., 2024; Thibodeau, 2020).

Studies have also shown Phonak remote microphones can also provide benefits in improved acceptable noise levels (Schafer et al., 2016), reducing listening effort (Wagener et al., 2018), and improved temporal processing (Smart et al., 2018).

Qualitative interviews with users of remote microphone systems, support people, and HCPs, consistently report that RM systems can make a real difference in their communication lives, as well as allow for better social integration (Fitzpatrick et al., 2010; Scarinci et al., 2022).

### Barriers to Roger adoption

Even though the benefits of Roger are well known, there are still barriers to adoption of RM systems overall. Some of these include: increased hearing aid size due to external receivers, complexity of ordering and set-up by the clinician (e.g., determining receiver compatibility, physically attaching the external receivers, etc), and ease of use (Fabry et al., 2007; Fitzpatrick et al., 2010).

Qualitative interviews with users and HCPs cite that remote microphone systems can seem too complicated, and that ongoing training and support is needed for both the user and HCP alike. Difficulties around awareness of the devices in the first place, as well as the need for proper use has also been noted (Scarinci et al., 2022).

It is clear that there is a need to make RM systems a simpler device for everybody to use. Our latest advancements in Roger receivers have introduced two significant innovations that have already begun—and will persist in—streamlining the Roger experience for both HCPs and end users.

### 2019: RogerDirect™

In 2019, Phonak introduced RogerDirect. This technology allows a direct connection to a Roger microphone without the need for an external receiver, aiming to create a more cosmetically appealing solution, whilst at the same time to improve usability of Roger technology and the benefits it provides above and beyond other RMs.

This marvellous innovation resulted in a hearing device that was up to 42% smaller, with 64% reduced current drain, whilst maintaining full Roger compatibility. Knowing that there are cosmetic barriers to Roger adoption (Fitzpatrick et al., 2010), RogerDirect brought an industry-first by allowing a more discrete solution with Roger functionality (Figure 2).



Figure 2. Image showing an Audéo M-312 overlaid on an Audéo B-13 with Roger 18 design-integrated receiver.

Furthermore, RogerDirect results in less complexity around ordering and set-up, enabling greater ease of use for both HCPs and users.

Field studies have indeed demonstrated specific advantages in terms of installation time: the introduction of RogerDirect has resulted in a 27% reduction in installation time compared to using an external receiver. Furthermore, 81% of participants rated the installation process to be easier than when using external receivers (Gordon & Crowhen 2020).

## 2024: Roger Unlimited

The removal of additional hardware has been a long-time ask from HCPs, especially those working with the Roger for Education portfolio. This was partially addressed with the introduction of RogerDirect and the removal of audio shoes and intermediary devices for Phonak hearing aids.

With the latest innovation in the Roger space, we have now furthered the transition of removing external receivers, by introducing unlimited Roger O2 receivers inside our main Roger transmitters.

Roger Unlimited brings several advantages to the HCP and other professionals working with Roger:

- Removes any additional hardware required for Roger connections in hearing aids with RogerDirect.
- Reduces the time taken to install and connect Roger and hearing devices.

- Removes the need to uninstall or worry about lost receivers – a new receiver can be retrieved from the transmitter for an unlimited number of times.
- Removes the worry about whether a hearing aid contains a O2 or O3 receiver.
- Users can now share their Roger transmitter with other hearing aid users with RogerDirect.

The removal of additional hardware should simplify the receiver installation process for the HCP and thereby give additional time to focus their efforts on the user.

To test this hypothesis, a total of 56 participants were asked to participate at a Roger booth during an internal international event. Participants consisted of a mixture of audiologists and non-audiologists, with some having no prior experience with the Roger Touchscreen Mic, and none having prior experience with the new process.

Participants were provided with a Phonak Roger Touchscreen Mic 3 and a Phonak Audéo hearing aid, both of which were switched on. They were instructed to complete a single Roger receiver installation as quickly as possible. Step-by-step instructions were provided with time allowed to read prior to the task. Participants were timed beginning to end.

The median time taken to install one Roger receiver was 9.85 seconds, with all participants completing the installation process in less than 20 seconds (Figure 3).

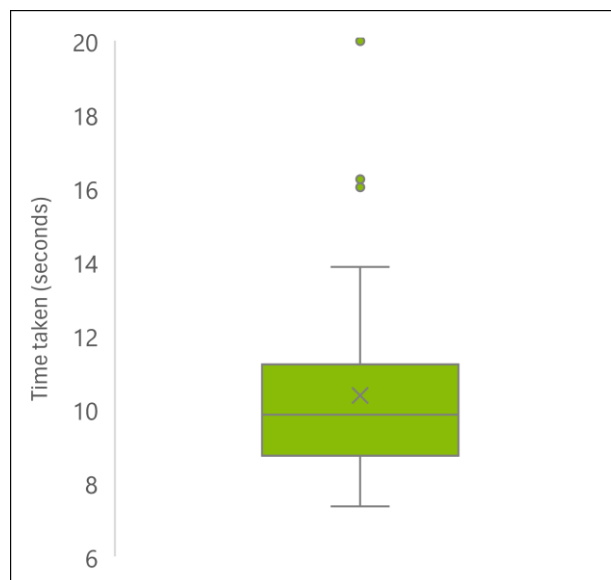


Figure 3. Box-and-whisker graph showing time taken (seconds) to install a Roger receiver from Roger Touchscreen Mic 3 to an Audéo hearing aid using RogerDirect (N=56).

This new installation process also automatically connects the hearing aid to the transmitter, thereby saving the additional step of connecting after installing. Therefore,

including conservative time estimates to turn on the Touchscreen Mic and hearing aids, the median time to install a binaural set of Roger receivers into a pair of hearing aids would be estimated at 46.7 seconds.

Up until now, HCPs who use a Roger Touchscreen Mic were required to install Roger receivers via the Roger X and Roger Installer and then pair the microphone to the hearing aids. Gordon & Crowhen (2020) estimated this median time to be approximately 1 minute and 20 seconds. Compared to this estimate, these results suggest the new method could potentially reduce installation & connection time by up to 51.6%.

Subjective ratings on the ease of installation for this new process was obtained from 16 of the 56 participants that took part by completing a feedback form, with the results shown below (Figure 4).

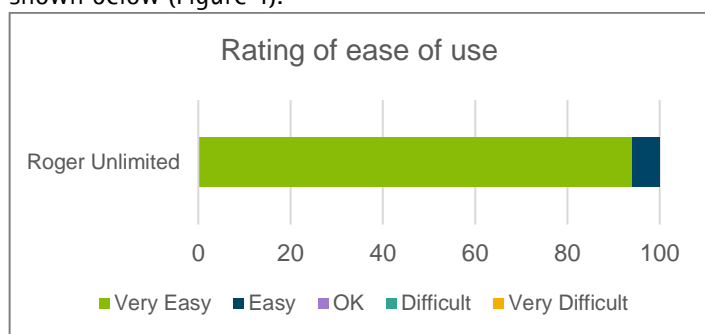


Figure 4. Bar graph showing rating of ease of use for Roger receiver installation process (N=16).

When participants were asked to rate the ease of installation, 94% of participants rated the process as 'Very Easy', with all participants rating the process as 'Easy' or 'Very Easy'.

Open field comments highlighted the ease of use with the new process (present in 8 of 11 comments) as well as comments such as 'no more installer pad' and 'no more Roger X'.

## Verification with RogerDirect

One of the reasons for verification of remote microphone systems is due to impedance mismatch of receiver hardware being physically attached to the hearing aid/intermediary device. Verification of RM systems are done by demonstrating transparency; that the output of the hearing aid microphones is equal to the output of the remote microphone. The rationale and process is outlined in the American Academy of Audiology publication (AAA, 2021), with specific instructions for Roger transmitters adapted in the Roger Verification Guide (Phonak, 2021).

While this process is not mandatory in many countries, some countries mandate the verification of such devices prior to use, especially in children where subjective checks may not be reliable or able to be completed.

Previous studies comparing a variety of Roger transmitters and external receiver combinations have shown that there can be variations of this transparency measure, and therefore would require verification each time (Qi & Thibodeau, 2022).

With the introduction of digital receivers and the removal of physical attachments, this impedance mismatch has been removed in theory, and thus the verification of RogerDirect devices may not be required each and every time for this purpose.

To confirm this assumption, test box measurements were done on various Roger transmitters and hearing devices with RogerDirect, across a variety of audiograms.

Because transparency is checked across the overall system (i.e. Roger transmitter and receiver set), it was important to test across a variety of different hearing aids as well as transmitters. i.e. simulating multiple audiograms on the same transmitter and receiver combination would not be representative of multiple RM verification sessions.

Regardless, because different audiograms would generate different output levels, we were interested to see whether there were significant effects of audiogram thresholds on variations of transparency, as cited in previous literature for the universal receivers (Qi & Thibodeau, 2022).

The below audiograms were used to simulate various degrees of hearing losses (HL) that attempt to be ecologically valid in the clinic. These were configured to monaural losses (lateralisation was randomized) across a variety of age and gender groups.

- Flat 40dB sensorineural hearing loss (HL1)
- Flat 40dB conductive hearing loss (HL2)
- N3 sensorineural hearing loss (HL3)
- N4 sensorineural hearing loss (HL4)
- N5 sensorineural hearing loss (HL5)
- N6 sensorineural hearing loss (HL6)
- N7 sensorineural hearing loss (HL7)
- Rising moderate to mild sensorineural hearing loss (HL8)

Hearing devices (HD) across a variety of form factors and power levels were selected, based on the audiogram provided:

- Phonak Sky L90-M (HD1)

- Phonak Naída L90-PR (HD2)
- Phonak Sky L90-SP (HD3)
- Phonak Naída L90-UP (HD4)
- Advanced Bionics Naída CI M90 (HD5)
- Advanced Bionics Sky CI M90 (HD6)

The following remote microphones (RM) were used:

- Roger On V2 (RM1)
- Roger Touchscreen Mic (RM2)
- Roger Touchscreen Mic 3 (RM3)

The Phonak Offset Protocol (POP) was used, with verification measures performed on a single Verifit 2 test box with a HA-4 ear mould substitutes coupled to a 0.4cc wideband coupler. All fittings were occluded in the hearing aid software, to avoid the direct sound compensation that is prescribed for streaming programmes with an open fitting. To simulate inter-subject variation, hearing aids were run through the test box individually for each remote microphone measurement.

Verification of Roger for cochlear implants were done using the protocol described in literature (Schafer et al., 2013).

A total of 45 HD/RM/HL combinations were verified. The results are summarised below:

	RM1	RM2	RM3	Sum of HL tested
<b>HD1</b>	0/3	0/3	0/3	9
<b>HD2</b>	0/4	0/4	0/4	12
<b>HD3</b>	0/4	0/4	0/4	12
<b>HD4</b>	0/2	0/2	0/2	6
<b>HD5</b>	0/1	0/1	0/1	3
<b>HD6</b>	0/1	0/1	0/1	3
<b>Total combinations</b>				<b>45</b>

Table 1. Summary of total measurements done. Each number in the table represents different audiograms and whether EasyGain adjustments were required. E.g. 0/3 means 0 of 3 audiogram combinations required EasyGain adjustment.

Table 1 results show that EasyGain adjustments were not required for any of the hearing losses simulated in this experiment (average offset = 1.11dB). This is in line with the theoretical assumption that the impedance mismatch is the typical cause of having to do EasyGain adjustments, and that this effectively removed with RogerDirect, both for hearing aids and cochlear implants.

There was no effect of the hearing loss on the degree of transparency offset seen, though most of the offset was in

one direction (meaning RM response tended to be louder compared to the hearing aid mic response) (Table 2).

Audiogram (HL)	Average offset (dB)	Sample size
<b>HL1</b>	-1.3	6
<b>HL2</b>	-1.7	6
<b>HL3</b>	-1.5	6
<b>HL4</b>	-1.1	6
<b>HL5</b>	-0.9	6
<b>HL6</b>	-1.1	3
<b>HL7</b>	-0.1	3
<b>HL8</b>	-1	3

Table 2. Sub-analyses of recordings to assess effects of Hearing Loss on the offset of transparency.

This is not an exhaustive list of all audiogram configurations and some open fittings and atypical audiograms may not conform to these findings. However the results of this small investigation suggest that there is no significant impedance mismatch when Roger receivers are digitally installed into RogerDirect hearing devices, across a large variety of audiograms. Thus there is no need to routinely check transparency for impedance mismatch in RM systems.

Regardless, transparency still remains an important aspect of remote microphone testing and can be done to monitor sensitivity of the remote microphones over time. Furthermore, HCPs should always validate the effectiveness of remote microphone systems with behavioral measures to ensure benefit of the RM is being achieved (AAA, 2021).

There is still a need for development of other electro-acoustical protocols that can demonstrate RM performance. Such measures would allow HCPs to objectively see the advantage RM systems can provide in noise, rather than simply checking for transparency in quiet. These protocols would ideally encompass both speech in distance and speech in noise measures, and be compatible across various devices including cochlear implants and bone-anchored hearing devices. Examples of such work can be seen in Salehi et al. (2018) & Hussedt et al (2022).

## Conclusion

Remote microphones, in particular Roger, complement the benefits of hearing aids to give additional benefits in noise and distance.

The assumptions of difficulty using the product and complexity when installing the product is now removed with unlimited digital Roger receivers. By removing additional hardware, this helps to reduce time spent on installations and simplifies usability with Roger for both the HCP and users.

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