

REM vs Fitting Formula Outputs for Phonak Lumity L90-RL (APD 2.0)

Comprehensive Reference Guide: Comparing Real Ear Measurement (REM) Target Outputs to Fitting Formula Outputs for Phonak Lumity L90-RL with APD 2.0

Introduction

Fitting advanced hearing aids such as the Phonak Lumity L90-RL to deliver optimal clarity and individualized benefit demands precision, especially when distinguishing between manufacturer-first-fit (generic formula) outputs and fine-tuned, in-situ measured Real Ear Measurement (REM) outputs. With the introduction of Adaptive Phonak Digital 2.0 (APD 2.0), Phonak further refines its proprietary fitting algorithm, promising more natural sound, optimized comfort, and improved audibility for users who desire a high degree of clarity. Hearing care professionals (HCPs) commonly rely on both REM verification and fitting formulas (derived from SPL 2cc/output measurement standards) to ensure fittings meet audibility, comfort, and clarity targets.

This reference guide is specifically designed as a printable cheat sheet for professionals using Phonak Target 11.1 software, Phonak Lumity L90-RL hearing aids set for maximal clarity (high clarity program), and employing the APD 2.0 prescription. Key technical aspects-including frequency-specific gain targets, compression ratios, and acoustic considerations such as Real Ear to Coupler Difference (RECD) and ear canal resonance-are analytically compared between REM-best-practice targets and typical fitting formula outputs for the SPL 2cc/output standard. Each section provides highly structured tables for instant reference, immediately followed by detailed analysis to foster operational clarity in the clinic.

Overview of APD 2.0 and Clinical Context

Evolution and Rationale of the APD 2.0 Fitting Formula

Adaptive Phonak Digital (APD) 2.0 is Phonak's latest proprietary fitting formula, designed for platforms including Lumity. It aims to provide an ideal balance between speech clarity, loudness comfort, and natural sound quality, leveraging adaptive compression speed, a new linearized high-level gain structure, and updated gain precalculations for users with mild-to-moderate hearing loss. Unlike generic algorithms (NAL-NL2 or DSL v5), APD 2.0 integrates device-specific processing capabilities for an optimized starting point and reduces listening effort-particularly notable in noisy environments^{[2][3]}.

The key procedural context for this guide:

- **Device:** Phonak Lumity L90-RL (Premium, rechargeable, RIC)
- **Fitting Formula:** APD 2.0 (not APD 3.0)
- **Software:** Phonak Target 11.1
- **Output Standard:** 2cc SPL/Output measurement
- **Program:** High Clarity (maximal speech brightness and clarity)
- **Verification:** REM using in-situ probe microphone measurement, considered clinical gold standard
- **Comparison:** REM target outputs vs. software-calculated fitting formula outputs

Gain Adjustment Reference

Frequency-Specific Gain Targets: REM vs. APD 2.0 Fitting Formula Outputs

The following table summarizes typical gain targets (in dB SPL) at key audiometric frequencies for an average moderate, sloping hearing loss. The figures provided are representative reference values combining published Phonak APD 2.0 targets, clinical REM averages, and acknowledging 2cc coupler standards. Actual targets for individualized audiograms are determined in situ and will vary.

Example: Frequency-Specific Gain Targets at 65 dB SPL Input (Average Speech)

Frequency (Hz)	REM Target Gain (dB)	APD 2.0 Fitting Formula (2cc) Gain (dB)	Typical Generic (NAL-NL2, 2cc) Gain (dB)
250	12-16	13-16	16-19
500	18-22	18-20	20-23
1000	22-25	22-24	24-28
1500	24-27	25-28	28-32
2000	25-29	28-31	30-35
3000	24-28	27-30	29-34
4000	22-26	25-28	27-31
6000	18-23	21-25	21-27
8000	15-19	18-22	16-23

Note: Values are generalized based on moderate-to-severe sloping loss; actual prescription is audiogram specific. Where REM targets at the eardrum differ from 2cc outputs due to ear canal resonance and individual coupling filters, REM values can be higher or lower than 2cc, especially at high frequencies.

Analysis

Comparing REM target gains to APD 2.0 fitting formula outputs, several principles emerge:

- **REM targets are typically measured in-situ** and incorporate individual ear canal acoustics; thus, they may show slightly higher high-frequency gain requirements than the software-derived 2cc formula, especially above 3 kHz, to offset individual canal resonance and domes/molds effects.
 - **APD 2.0's new precalculation** brings moderate input gain (G65, G80) closer to NAL-NL2 for users with mild-to-moderate loss, but remains modestly lower than DSL v5.
 - **At low and mid frequencies (below 1 kHz)**, REM and formula targets generally align within ± 3 dB, depending on venting and doming; overamplification of bass is avoided in APD 2.0 to minimize upward spread of masking and maintain clarity^{[5][3]}.
 - **High Clarity programs** in Target 11.1 typically increase gain, especially above 2 kHz, by 1-3 dB relative to default, further elevating clarity but possibly requiring feedback threshold management.
 - **REM corrections** may be necessary in the clinic, particularly if open domes or large vents are used, as 2cc-coupler-derived targets do not fully account for direct sound leakage or canal resonance nulls.
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Quick-Reference: Typical Gain Target Adjustments

- **Target increase:** If REM shows gain 2-4 dB below prescription target at 3-6 kHz, increase program gain in this range, monitoring for feedback risk.
 - **Target reduction:** If user reports excessive sharpness or "tinny"ness, especially with high clarity settings, consider tapering gain above 4 kHz or reducing "clarity" mixing ratio in Target's global tuning.
 - **RECD Adjustment:** For users with unusually shaped or short ear canals, consider importing a detailed RECD profile into Target to automatically correct formula gain targets, maximizing match-to-target fidelity.
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Compression Ratio Reference

Frequency-Specific Compression Ratios: REM vs. APD 2.0 Fitting Formula

Compression ratio (CR) is critical for balancing soft speech audibility and loudness comfort. APD 2.0 introduces adaptive compression, combining fast and slow time constants depending on the signal envelope and program context.

Example: Compression Ratio Table (by Frequency, Typical for Moderate Sloping Loss)

Frequency (Hz)	REM-Validated CR	APD 2.0 Formula CR (default)	Typical NAL-NL2/DSL v5 CR
250	1.2-1.4	1.3	1.2-1.5
500	1.3-1.5	1.4	1.3-1.6
1000	1.4-1.6	1.5	1.4-1.7
1500	1.5-1.7	1.7	1.5-1.8
2000	1.5-1.8	1.8	1.5-2.0
3000	1.6-1.9	1.8	1.6-2.2
4000	1.7-2.0	1.8	1.6-2.3
6000	1.6-2.0	1.8	1.6-2.4
8000	1.5-1.9	1.7	1.4-2.1

Analysis

- **APD 2.0's compression ratios** are designed, especially in calm and speech-in-noise programs, to start at moderate levels for soft-to-loud transitions and increase slightly for high frequencies and more severe loss configurations.
 - **REM results** tend to validate software CRs if the fitting was done properly, but individual canal acoustics and venting can affect perceived loudness growth, sometimes requiring adjustment on a per-frequency basis.
 - **Comparative note:** DSL v5 and NAL-NL2 may prescribe slightly higher CRs above 2 kHz for severe losses, but APD 2.0 intentionally maintains more linear high-level gain (lower CR) at loud input levels to avoid loudness recruitment discomfort and preserve speech envelope cues.
 - **Clinical tip:** Use the Target "Gain & MPO/Fine Tuning" panel to view and adjust CR directly per frequency channel, ensuring that neither speech clarity nor loudness comfort are compromised.
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Acoustic Considerations

RECD, Canal Resonance, and Coupling Effects

Key Acoustic Factors

- **RECD (Real Ear to Coupler Difference):** RECD measures the frequency-specific difference (in dB) between the SPL generated in the real ear and a standard 2cc coupler. Individual RECDs account for unique canal volume and resonance characteristics, allowing the fitting software to more precisely transform 2cc-based formulas into actual in-ear outputs^[7].

- **Canal resonance:** Human ear canals typically exhibit a primary resonance peak between 2-4 kHz, often centered at around 2.5 kHz for adults. This can raise unaided gain at those frequencies. REM measurements incorporate this real-world peak, whereas formula outputs on a 2cc coupler average or miss the effect.
- **Venting and dome type:** Open domes and large vents enable direct sound to reach the eardrum, reducing low-frequency aided gain effect and flattening overall frequency response. Closed or power domes increase low frequency output but can also produce occlusion or feedback.

Example Table: Acoustic Adjustments and Practical Consequences

Acoustic Factor	Impact on REM	Impact on 2cc Fitting Formula	How to Adjust / Consider in Target
RECD (measured)	Accurate in-situ SPL	Not included (unless imported)	Import measured RECD; improves 2cc → real ear conversion accuracy
Ear canal resonance	Enhances 2-4 kHz gain	Not present; average is lower	Software corrects high-frequency response if RECD is measured
Dome/vent type	Reduces low-frequency gain for open	Formula may overestimate bass gain	In "Acoustic Parameters," specify dome/vent type; Target compensates for leakage
Earmold tubing	Length affects HF roll-off	Not considered by generic formula	Customize in Target by specifying tube length (for BTE/ITE)
Insertion depth	Shallow reduces high-frequency gain	Not directly modeled	Coach on proper insertion; verify probe/microphone placement during REM

Analysis

- **RECD use in adults:** While not as critical as in pediatric fittings, measuring RECD in adults is increasingly recommended for more accurate prediction of real-ear SPL, especially for atypical canals, surgical ears, or where open dome venting is used^[7].
- **Formula limitations:** 2cc coupler-based targets can over- or underestimate output, particularly at high frequencies (>4 kHz); REM and RECD personalize output, correcting these errors.
- **Venting correction:** When using open domes/earmolds, manually indicate coupling type and

vent size in Target to enable the most accurate acoustic simulation and feedback management.

- **Probe tube placement:** Must be within 5 mm of the tympanic membrane; incorrect placement reduces high-frequency REM accuracy.

Phonak Lumity L90-RL: High Clarity Program and Technical Highlights

High Clarity Program Settings in Target 11.1

The “High Clarity” program leverages Target’s fine-tuning modules to prioritize the speech spectrum’s upper frequencies, enhancing audibility for consonants and sibilants. Key adjustments typically include:

- **Clarity slider adjustment:** Boosts mid and high frequencies (specifically 2000-6000 Hz) by an additional 1-3 dB depending on global gain setting.
- **Speech Enhancer activation:** Applies up to 10 dB of additional gain for detected speech in quiet or low-noise environments when SNR is >0 dB, further promoting articulation.
- **SoundRecover2 frequency lowering:** Dynamic frequency compression system, set by default for significant loss above 2 kHz. Fine-tuning maximum output and cut-off frequencies preserves balance between audibility and sound quality^[9].
- **Compression and feedback:** Increased high-frequency gain may require raising the feedback threshold or reducing vent diameter to avoid feedback, particularly for open domes.

Program Feature Table: High Clarity Settings

Feature	Default State (High Clarity)	Customizable?	Target Path
Clarity Boost	On (+2-3 dB HF)	Yes	“Global Tuning” → “Clarity”
Speech Enhancer	Adaptive (+ up to 10 dB)	Partial*	“Fine-Tuning” → “Speech Enhancer”
SoundRecover2	On (adaptive compression)	Yes	“Fine-Tuning” → “SoundRecover2”
Compression Ratio Bias	Slightly higher at HF	Yes	“Fine-Tuning” → “Gain & MPO”
Feedback Management	Auto (based on gain/vent)	Manual allowed	“Feedback/Real Ear Test”

- Speech Enhancer is always on in Calm programs when gain is set to $\geq 90\%$.

Clinical Tips

- **REM verification:** Always run REM with the High Clarity program active; settings may differ substantially from the audiogram-first-fit or other user programs.
 - **Feedback and clarity balance:** If encountering persistent feedback at the required clarity gain, consider reducing venting, switching to a custom earmold, or using gain shaping to selectively limit risk areas.
 - **Clarity vs. comfort:** For users who find the highest clarity program fatiguing (e.g., in non-speech environments), advise use of a secondary user program with lower clarity boost.
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Technical Specifications Table: Phonak Lumity L90-RL Receiver Output (2cc Coupler Reference)

Receiver Type	Max. Output (dB SPL)	Max. Gain (dB)	Frequency Range (Hz)	Suitable Loss Profile
S	111	47	<100 - >8000	Mild to moderate
M	114	51	<100 - >8000	Mild to moderately severe
MAV	119	50	<100 - >8000	Mild to severe
P	122	59	<100 - 6300	Moderate to severe
UP	132	71	<100 - 6100	Severe to profound

- **Program tuning:** Maximum available gain/output depends on coupling, individual hearing loss, and selected program settings; actual in-ear output (via REM) will always be less than peak 2cc output due to venting, insertion, and resonance effects^[11].
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Summary Comparison Table: REM Target Outputs vs. APD 2.0 Fitting Formula Outputs

(Example for Moderate Sloping SNHL, M Receiver, 65 dB SPL input, Closed Dome)

Frequency (Hz)	REM Target (dB SPL)	APD 2.0 Formula (dB SPL, 2cc)	Observed REM-Formula Delta (dB)	Notes

250	16	14	+2	Canal can boost slightly
500	21	19	+2	
1000	25	23	+2	
2000	27	29	-2	Resonance, coupling diff.
3000	26	30	-4	In-situ venting loss
4000	24	29	-5	High-freq canal roll-off
6000	21	24	-3	
8000	18	19	-1	

Cheat Sheet: Operational Steps for Clinical Use

1. **Initial Fit:** Program Lumity L90-RL in Target 11.1 using APD 2.0; select "High Clarity" if maximal speech brightness is desired.
 2. **RECD Measurement (Optional but Recommended):** Measure RECD for patient, especially with custom earpieces or unusual canal anatomy. Import into Target for maximum output accuracy.
 3. **Fine Tuning:** In "Fine Tuning > Gain & MPO," adjust gain sliders at 2-6 kHz to match REM-instrumented measurements, not just software targets.
 4. **Clarity/Compression Tuning:** Adjust clarity boost and verify CR per frequency.
 5. **Feedback Management:** Run Feedback/Real Ear test after all gain boosts to assure stable (non-whistling) high-frequency output.
 6. **REM Verification:** Use in-situ speech mapping to visually confirm aided output traces match REM target lines across the frequency spectrum, for soft, moderate, and loud speech levels.
 7. **User Validation:** Counsel client on the difference between formula-based and individually measured fits; encourage subjective feedback on clarity, comfort, and fatigue.
 8. **Documentation/Export:** Print and annotate program settings and gain/compression data for future follow-up visits.
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Best Practices for Printable Reference Guides

- **Keep tables simple, consistently formatted, and highly readable** for clinical printouts.
- **Left-align frequencies and gain values; right-align numerical data and dB values** for instant visual scanning.
- **Use purposeful bold/italic emphasis** only for critical values or action steps.

- **Annotate program names, dome/vent types, and date of fitting on cheat sheet printouts** for case history completeness.
- **Include update date/version of software and hardware** to ensure fits are not based on out-of-date formulas.

Conclusion

REM verification should always be considered best practice when fitting Phonak Lumity L90-RL using APD 2.0-even if initial fitting formulas claim to be "matched," only REM can confirm if the real-ear acoustic needs are met. APD 2.0 offers gains and compression ratios closely aligned with the best evidence-based fitting targets while incorporating receiver-specific and program-specific processing twists (like adaptive compression and linearized high-level gain) to optimize the experience. High Clarity settings, when combined with REM and precise acoustic coupling information (vent/dome/RECD), deliver the highest likelihood of achieving clarity without sacrificing comfort or naturalness.

Use the tables and procedural outline in this guide to ensure consistent, transparent, and evidence-based hearing aid fittings in your clinical workflow. Always adapt these reference targets to the patient's actual audiogram and acoustic coupling, confirming the outcome with REM and ongoing user validation.

For quick clinic access, print this guide front and back, keeping the comparative gain/compression tables, REM verification checklist, and high-clarity setup tips immediately at hand.

Key References: APD 2.0 technical and white papers, REM best practice literature, Phonak Target 11.1 user workflow documents^{[8][4][14][15][9][1][3]}.

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