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Cochlear implants and radio aids update

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1. Background
2. Findings
3. Challenges

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How to create consistent comparative response curves of Cochlear Implant microphones

Adapted from a design by the Ewing Foundation for deaf Children.

1. Cochlear Nucleus Freedom BTE – DCTEST2 Lead only. **2.** Cochlear Nucleus 5 CP810 BTE – DCTEST3 Lead only.
3. Cochlear Nucleus 6 CP910 BTE – DCTEST3 Lead only. **4.** Advanced Bionics Harmony – DCTEST4 lead and AB Harmony Listening Check. CI-5821.
5. Advanced Bionics Neptune – DCTEST4 lead and Neptune Connect AB: CI-5241-WHT (White)-BLK (Black).
6. Advanced Bionics Naida Q70, Q90 BTE – DCTEST4 lead and Naida Listening Check. CI-5823.
7. MED-EL OPUS 2 BTE - DCTEST4 lead and Microphone Test Device 02883, Mini Battery Pack (28cm lead) 08264, MBPMTD Connecting Cable 08082.
8. MED-EL RONDO – DCTEST4 lead and Microphone Test Device 02883, Mini Battery Pack with Rondo Connection cable, MBPMTD Cable 08082.
9. MED-EL SONNET BTE – DCTEST4 lead and MED-EL Microphone Test Device Kit for SONNET [32965] **10**. Cochlear N7 – DCTEST4 Lead & mono adapter

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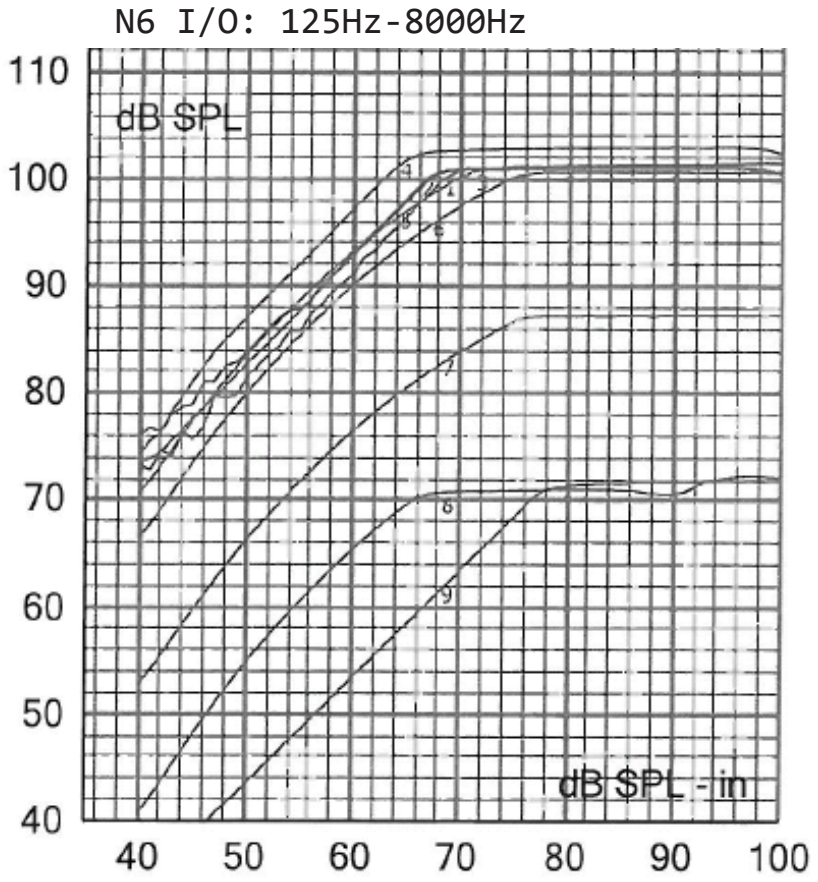
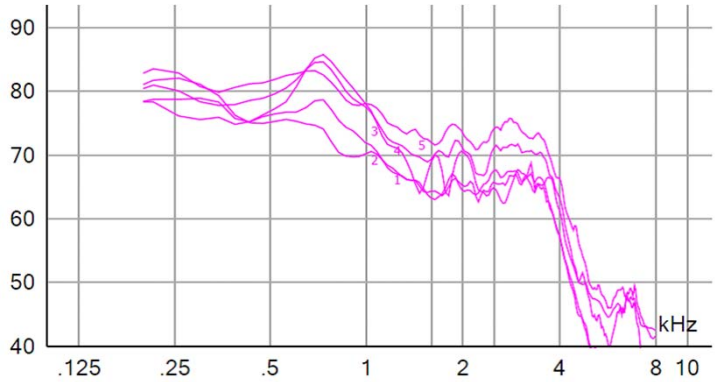
Not 60 or 65: compression in the N6 and N7

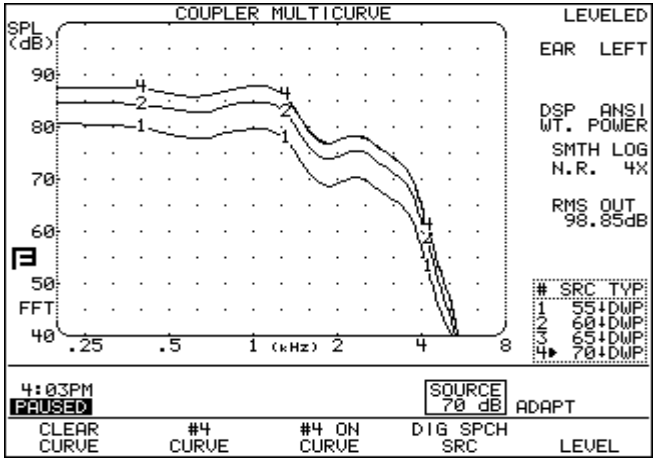
The Cochlear N5 processor will respond in a standard way to a 65 dB test signal in electroacoustic checks.

The N6 and N7 have ‘front-end’ compression before low- mid- and high-AGC. This auto-sensitivity control (ASC) has an activation threshold of 57 dB SPL. ASC aims to prevent excessive compression for inputs exceeding 65 dB SPL. (Wolfe and Schafer, 2015).

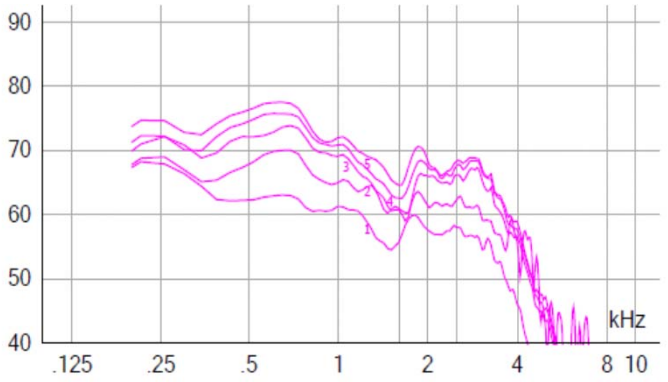


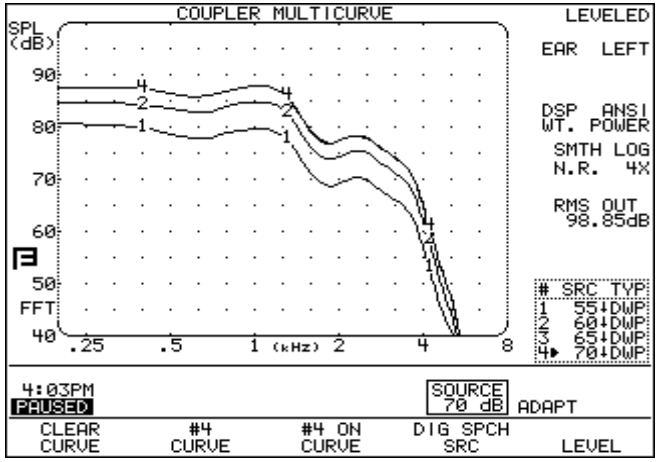
N6


90
80
70
60
50
40
.125
.25
.5
1
2
4
8 10
kHz


COUPLER MULTICURVE
LEVELED
SPL (dB)
EAR LEFT
DSP ANSI WT. POWER
SMTH LOG N.R. 4X
RMS OUT 98.85dB
FFT
SRC TYP
1 55↓DWP
2 60↓DWP
3 65↓DWP
4▶ 70↓DWP
.25 .5 1 (kHz) 2 4 8
4:03PM
PAUSED
SOURCE 70 dB
ADAPT
CLEAR CURVE
#4 CURVE
#4 ON CURVE
DIG SPCH SRC
LEVEL

N7


90
80
70
60
50
40
.125
.25
.5
1
2
4
8 10
kHz


COUPLER MULTICURVE
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SPL (dB)
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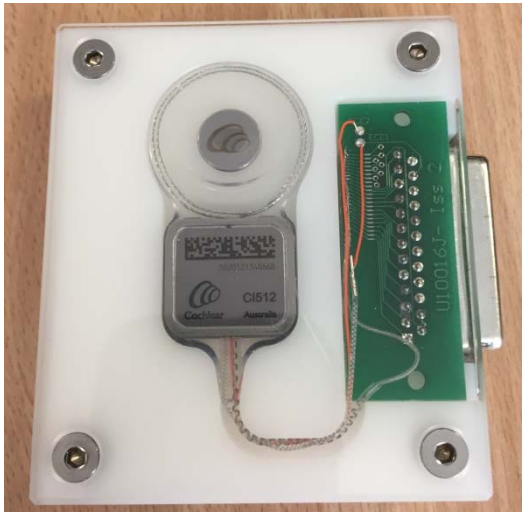
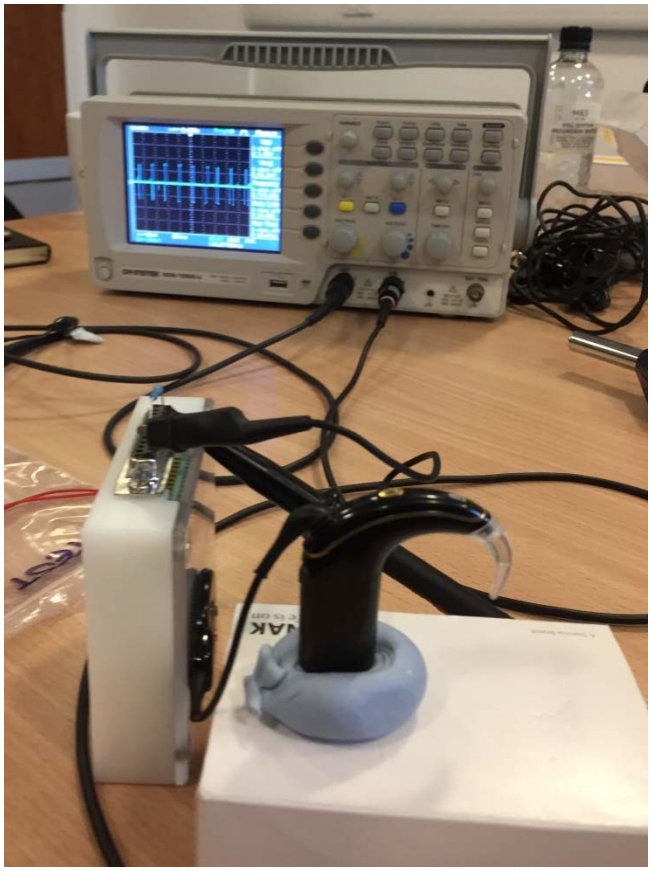
.25 .5 1 (kHz) 2 4 8
4:03PM
PAUSED
SOURCE 70 dB
ADAPT
CLEAR CURVE
#4 CURVE
#4 ON CURVE
DIG SPCH SRC
LEVEL

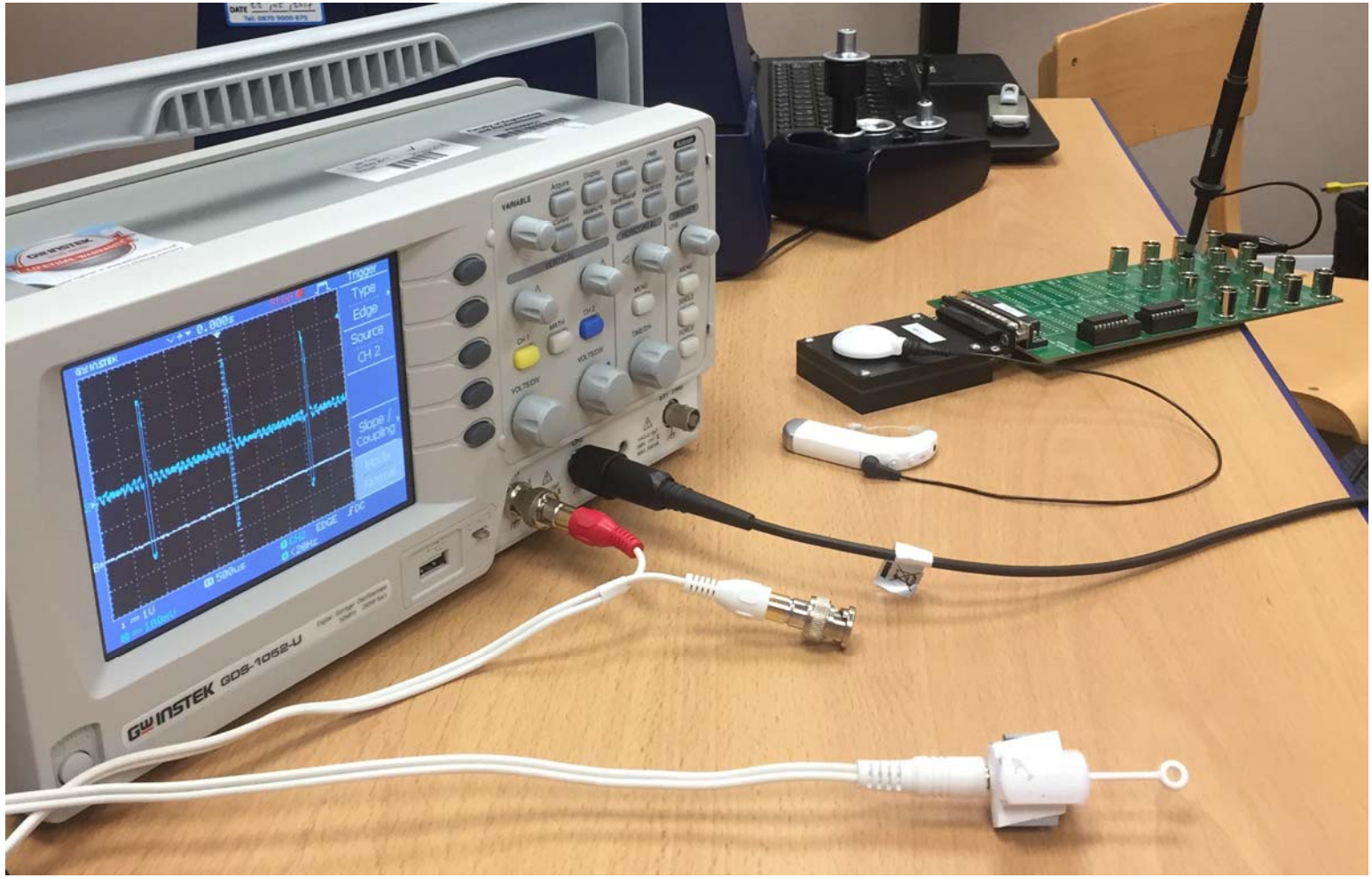
What happens at the electrode level?

Output from the CI512 implant: electrode 16 responding to a 1 kHz warble tone to the N7 processor.



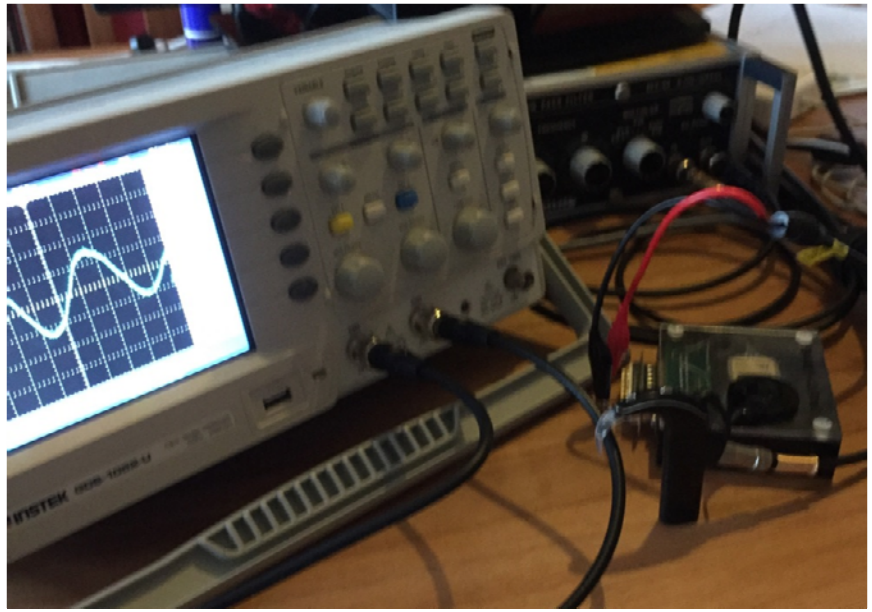
± pulse




GW INSTEK GDS-1052-U
Trigger
Type
Edge
Source
CH 2
Slope /
Coupling

Responses from the monitor earphone adapter

- The implant response at the electrode level and the output from the monitor earphone adapter (MEA) can be evaluated as ‘peak-to-peak’ voltage.
- Is the response at the electrode level reflected by a similar response with the MEA? So, when we change radio aid gain is this seen at the electrode level and in electroacoustic responses?



audio signal (sine wave for illustration)

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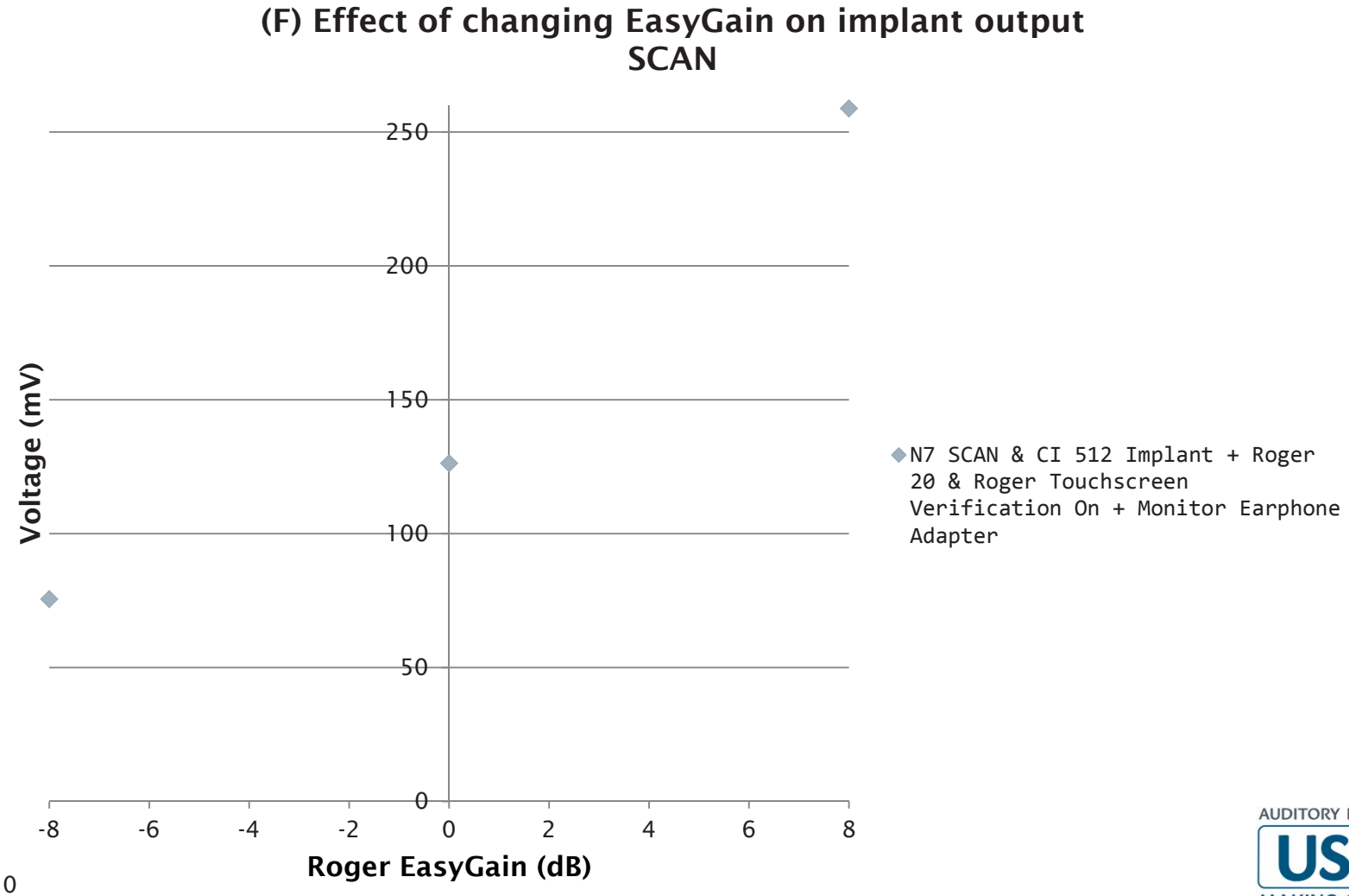
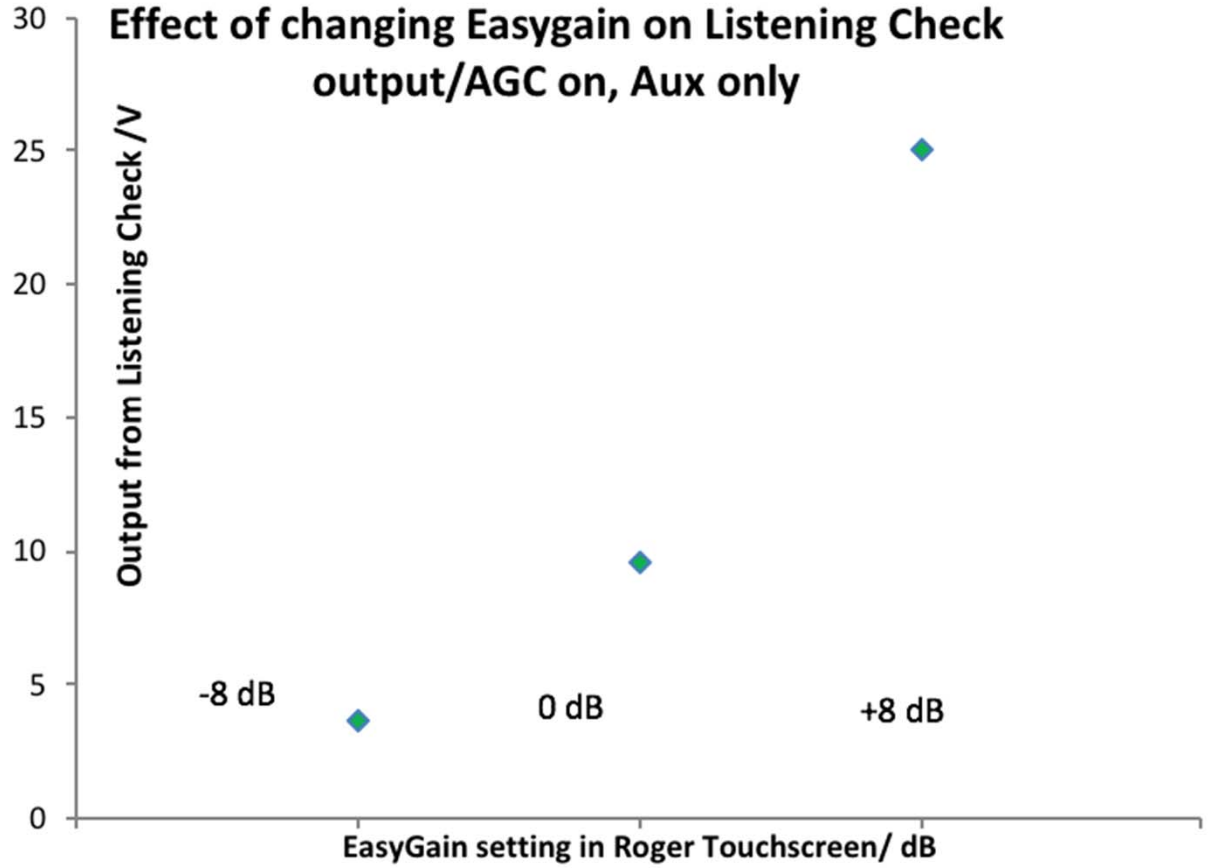
Electrode level: N7 SCAN & Roger 20 at -8, 0 and +8 EasyGain



Electrode level: Naida CI Q90



Standards and Guidance

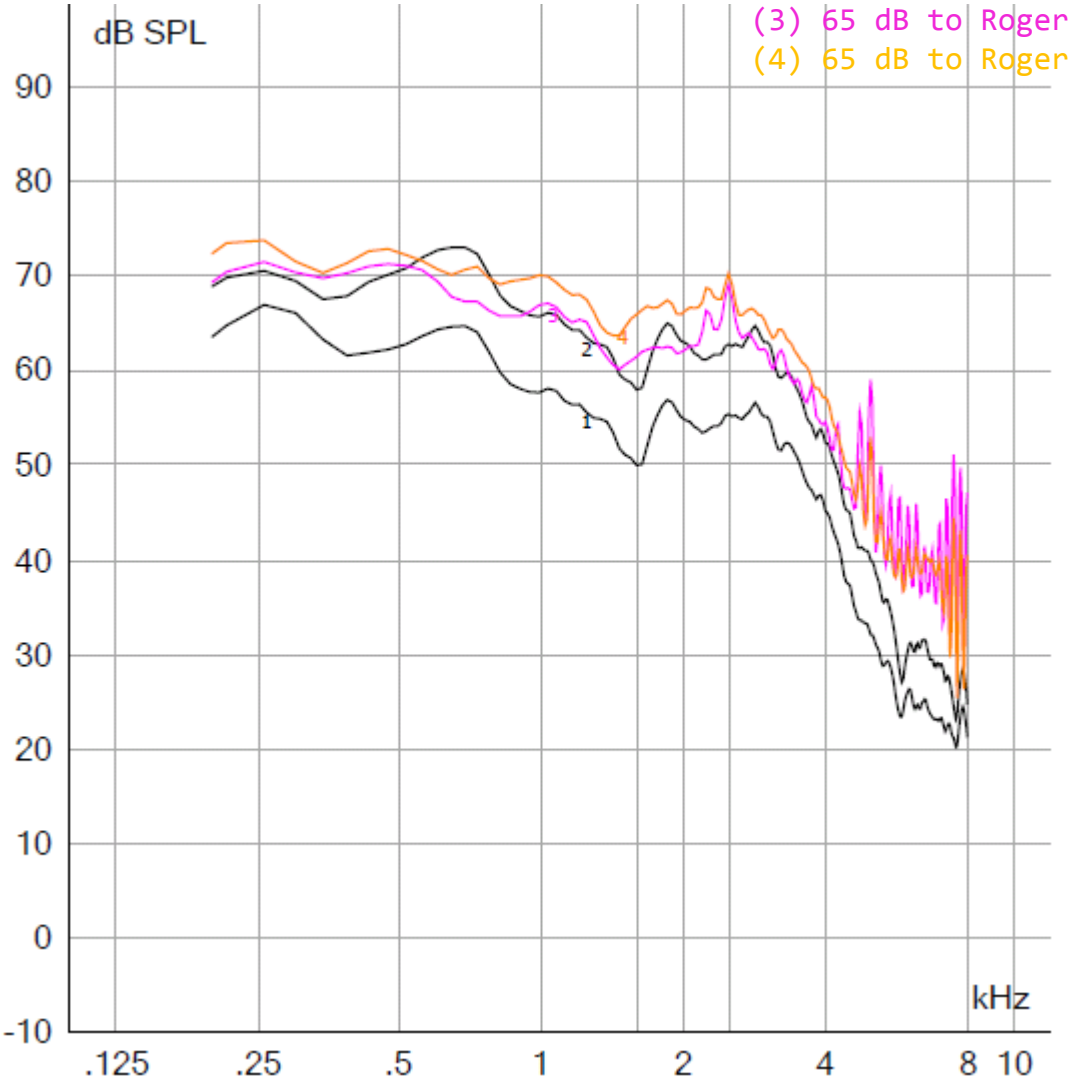
- UK Children's Radio Aid Working Group
  Currently still at http://www.fmworkinggroup.org.uk/
- Quality Standards for the use of personal radio aids: Promoting easier listening for deaf children (NDCS 2017)
- Good Practice Guide for Radio Aids – on the website
- QS3: The personal **radio aid must be set up** with the child's individual hearing aids or implants **to ensure that the radio signal provides the desired advantage.**

Standards and Guidance

- UK Children's Radio Aid Working Group
  Currently still at http://www.fmworkinggroup.org.uk/
- QS8 Electroacoustic checks with auditory implant systems
- Research with cochlear implants and radio aids is ongoing.
- USAIS working with Phonak, Advanced Bionics, Cochlear and MED-EL.

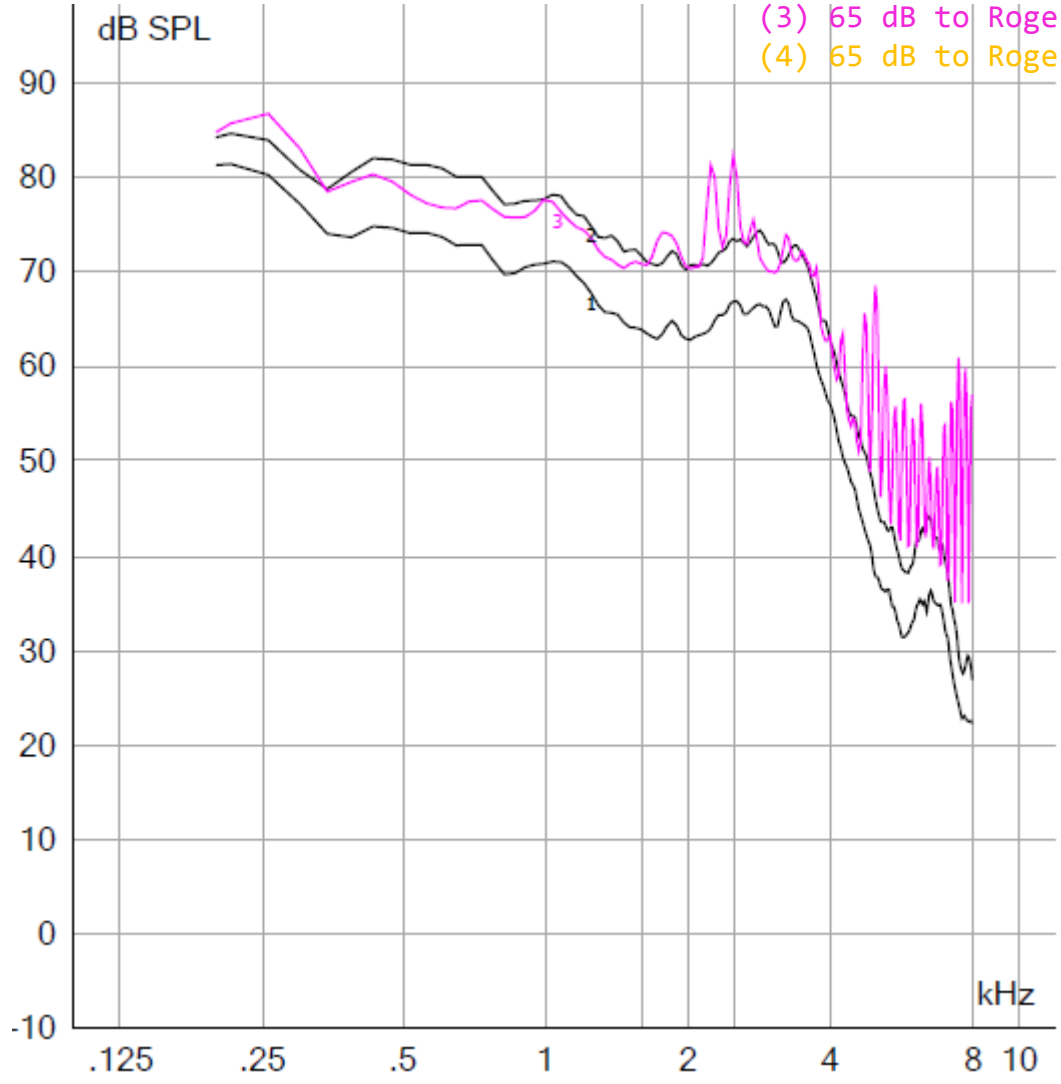
Roger 20 and N7

(1) & (2) 60 & 65 dB to N7
(3) 65 dB to Roger 20 EasyGain 0 via Touchscreen
(4) 65 dB to Roger 20 EasyGain +8



Roger 14 and N6

(1) & (2) 60 & 65 dB to N7
(3) 65 dB to Roger 20 EasyGain 0 via Touchscreen
(4) 65 dB to Roger 20 EasyGain +8



Advanced Bionics, MED-EL OPUS2 & RONDO and Cochlear's N5

To the processor:

- 1) run a frequency response curve with a digital speech signal or speech-weighted signal at 60 dB input.
- 2) run a frequency response curve with a digital speech signal or speech-weighted signal at 65 dB input.

To the radio aid:

- run a frequency response curve with a digital speech signal or speech-weighted signal at 65 dB input.
- Adjust the volume, 'FM advantage' or 'EasyGain' level of the receiver radio aid curve so that the radio aid response curve matches a sound processor response curve* to within 2 dB for 'transparency' or 'balance'.
  ** Signals of equal intensity may provide a match, or as per the original protocol, you may decide to opt for a match to the 5dB the lower curve, or between the two.*

MED-EL SONNET, Cochlear N6 and N7

To the processor:

- 1) run a frequency response curve with a digital speech signal or speech-weighted signal at 50 dB input.
- 2) run a frequency response curve with a digital speech signal or speech-weighted signal at 55 dB input.

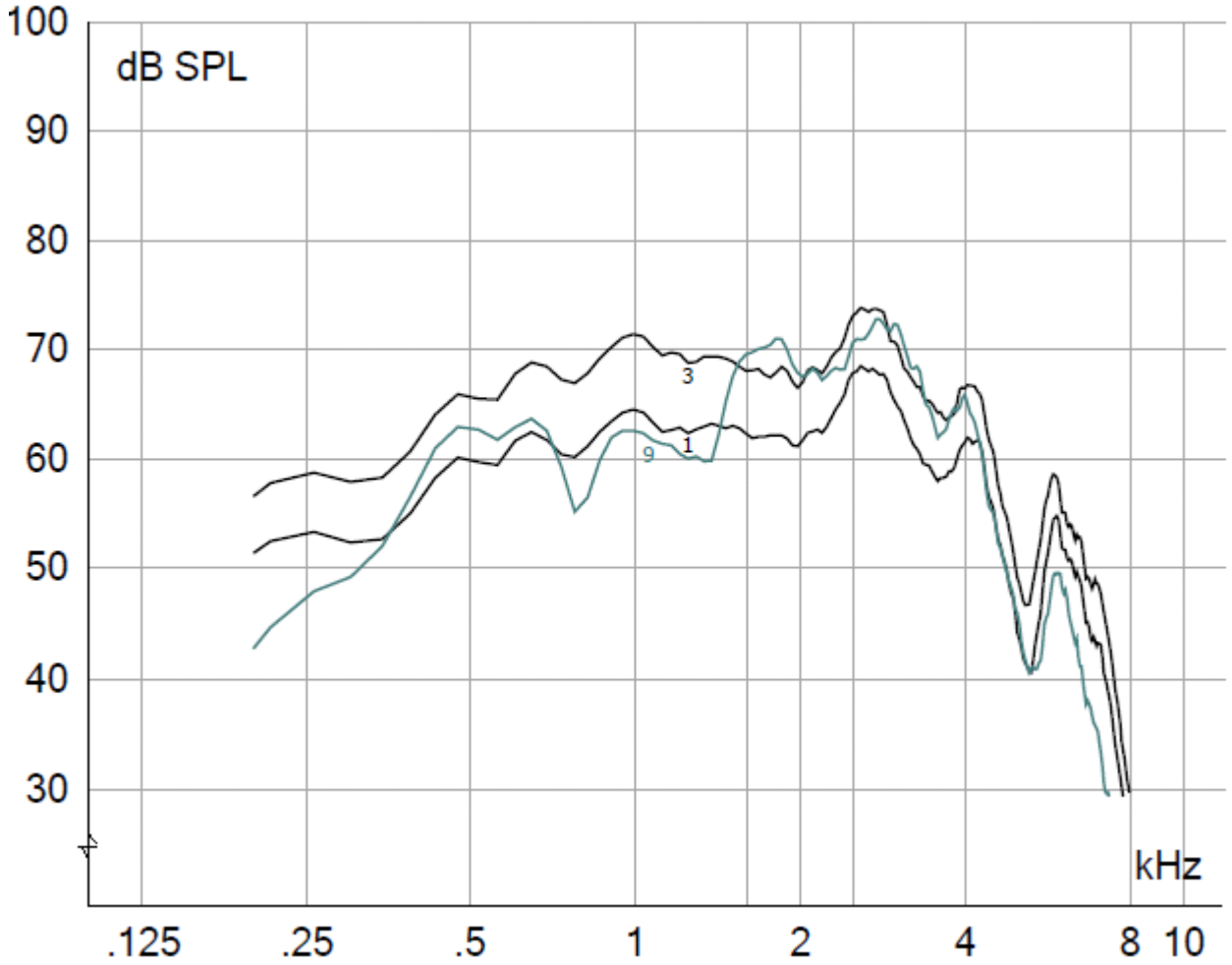
To the radio aid:

- run a frequency response curve with a digital speech signal or speech-weighted signal at 55 dB input.
- Adjust the volume, 'FM advantage' or 'EasyGain' level of the receiver radio aid curve so that the radio aid response curve matches a sound processor response curve* to within 2 dB for 'transparency' or 'balance'.
  ** Signals of equal intensity may provide a match, or as per the original protocol, you may decide to opt for a match to the 5dB the lower curve, or between the two.*

Challenges …

- IANL/Background noise and lower intensity signals
- Loop systems
- Transmitter microphone position, e.g.
  - Inspiro
  - Touchscreen
  - Pen

Naida Q70 & Comfort Audio DM10/DH10



References

National Deaf Children's Society and UK Children's Radio Aid Working Group (2017). *Quality Standards for the use of personal radio aids: Promoting easier listening for deaf children.* London: NDCS

Wolfe, J. and Schafer, E.C. (2015) *Programming cochlear implants*. 2nd edn. San Diego, California: Plural Publishing.

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YOUR QUESTIONS

Go boldly!

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