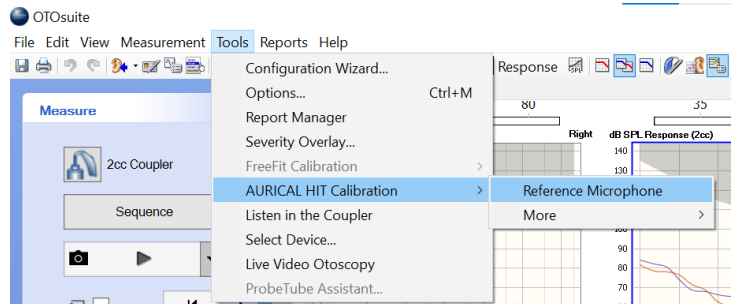


Testing Cochlear processors in the Aurical Hearing Instrument Test (HIT) Box

You will need a [mono jack adapter](#) and a [Connevens DCTEST4 lead](#).

Step 1 – Connect the Aurical HIT, start Otsuite and calibrate.

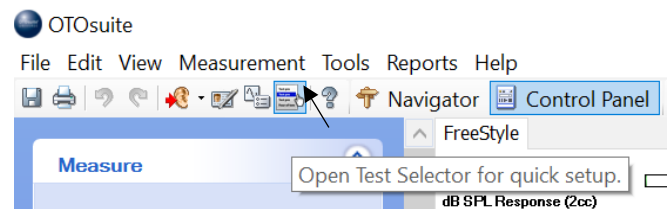
You will record processor curves to compare with the RM responses.



Step 2 – Select the appropriate test from the Test Selector icon.

There is first-stage compression¹ in the N7 and N6 processors, so a 55dB signal is suitable, but quiet conditions are required.

If this is not possible, use a 65 dB signal.

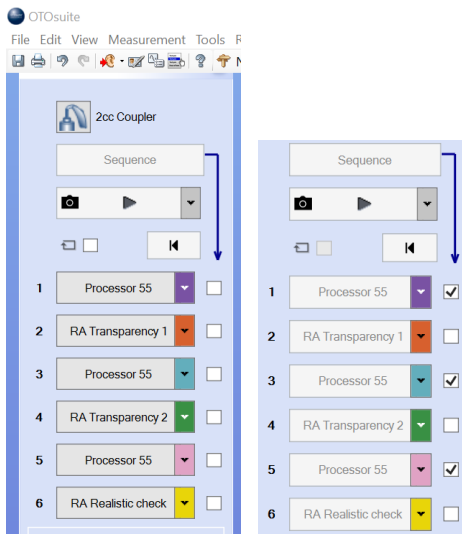


Select RM Transparency and Reality 55dB.

Step 3 – Connect the listening check to the processor.



¹ There is no first-stage compression in the N5 processor, so a 65dB signal is appropriate.



Step 4 – Signal and Sequence

Position the processor and the reference microphone appropriately in the Aurical (Figure 2). Close the lid, checking that the reference microphone does not move position.

Tick the boxes for curves 1, 3 and 5.

Click on **Sequence**.

This will create three overlapping processor curves.

Figure 2.



Judicious use of acoustic putty will help you position the processor mid-line with the speaker and the reference microphone within 1–2 mm of the forward microphone.

Now attach the Roger 20 to the N7 (below the processor and above the adapter). Connect the DCTEST4 lead with mono jack adapter.

Put the Roger transmitter into verification mode and then connect to the receiver.

Make a note of the receiver's current EasyGain setting, and then reset the receiver to the *default* setting (even if already on EasyGain 0).

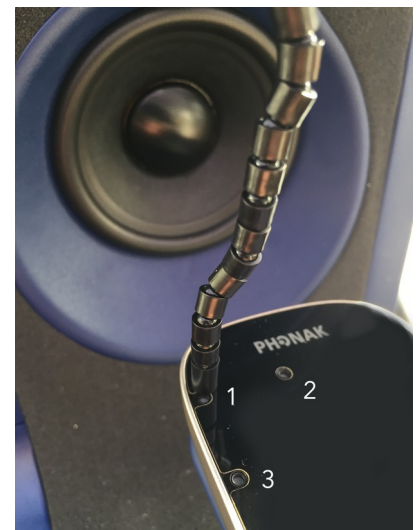
Place the processor with its receiver to one side (preferably in a muffled box).

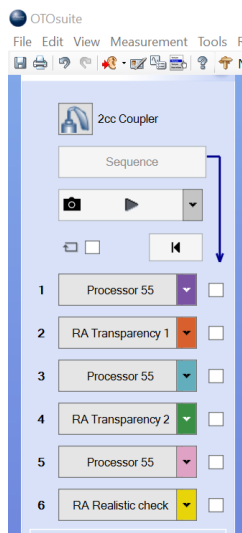
Now place the Roger transmitter in the Aurical with the reference microphone within 1–2 mm of the active transmitter microphone. In verification mode position 1 is active.

Step 4 – Remote Microphone (RM) signals

Carefully close the Aurical's lid, then reopen briefly to check the reference microphone has not moved; adjust if needed.

Now run a RM curve on the default setting.





Run curve 2. Click on **RM Transparency 1** and note the response. If you need to adjust the EasyGain, do so.

Run curve 4. Click on **RM Transparency 2** until transparency is reached (by repeating and overwriting curve 4).

Now run a 'reality check' with a more realistic signal level, like a teacher's voice. Compression in the whole system means you are likely to see a difference between the processor and RM signals of 6 dB or more (Figure 3 below), but well less than the Roger's maximum gain of 20 dB.

How do you know when you have achieved transparency?

- By eye and the gain difference table (Figure 3).
- Using the standard offset protocol.
- Or using the new QS8 methods, e.g. using the RMS protocol for hearing instruments in line with BS EN IEC 60118-16.

1. By eye – The processor and the RM responses should overlap, and the gain difference table should show suitable values for each pair of curves (CI) and (CI + RM).

2. Standard protocol – compare the mid-frequency average for processor and RM.

Frequency (Hz)	750	1000	2000	Average	Difference
CI dB (SPL)	a	b	c	$A_1 = (a+b+c)/3$	
CI & RM dB (SPL)	x	y	z	$A_2 = (x+y+z)/3$	$A_2 - A_1$

3. Revised offset protocol – calculate the broad average 750 Hz – 4 kHz for processor and RM and compare.

4. New RMS protocol – calculate the broad average for processor and RM and compare.

Compute the root mean square of the difference in one-third octave levels from 800 Hz to 5 kHz of the output signal of the processor with the output signal of processor and RM. If the difference is 2 dB larger than the measurement tolerance*, then two output signals are different.

Frequency (Hz)	800	1000	1250	1600	2000	2500	3150	4000	5000	RMS	Difference
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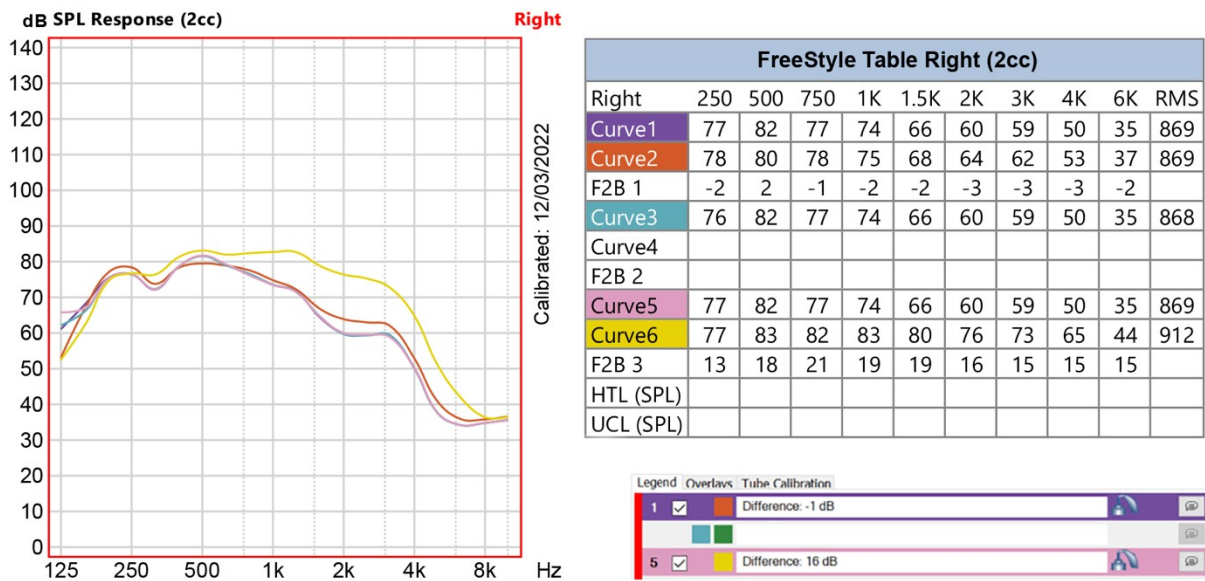
CI dB (SPL)	a	b	c	d	e	f	g	h	i	R ₁	
CI & RM dB (SPL)	r	s	t	u	v	w	x	y	z	R ₂	R ₂ - R ₁

$$R_1 = \sqrt{((a^2+b^2+c^2+d^2 + e^2 + f^2 + g^2 + h^2 + i^2)/9)}$$

$$R_2 = \sqrt{((r^2+s^2+t^2 + u^2 + v^2 + w^2 + x^2 + y^2 + z^2)/9)}$$

* For the Aurical, the measurement tolerance is 1 dB, so transparency is achieved if the processor and RM responses are within 3 dB of each other (± 3 dB).

Figure 3. Cochlear N7 and Roger 20 at EasyGain 0 showing electroacoustic transparency.



1. By eye – Aurical report

Curves 1 & 2: Difference -1 dB, Curves 5 & 6: Difference 16 dB

2. Standard protocol – compare the mid-frequency average for processor and RM.

	Frequency (Hz)	750	1000	2000	Average	Difference
[1]	CI dB (SPL)	77	74	60	70.3	
[2]	CI & RM dB (SPL)	78	75	64	72.3	2.0

	Frequency (Hz)	750	1000	2000	Average	Difference
[5]	CI dB (SPL)	77.0	74.0	60.0	70.3	
[6]	CI & RM dB (SPL)	82.0	83.0	76.0	80.3	10.0

3. **Revised offset protocol** – calculate the broad average 750 Hz – 4 kHz for processor and RM and compare.

N7	750 Hz	1 kHz	1.5 kHz	2 kHz	3 kHz	4 kHz	Average	Difference
1	77	74	66	60	59	50	64.3	
2	78	75	68	64	62	53	66.7	2.3

N7	750 Hz	1 kHz	1.5 kHz	2 kHz	3 kHz	4 kHz	Average	Difference
5	77	74	66	60	59	50	64.3	
6	82	83	80	76	73	65	76.5	12.2

4. **New RMS protocol** – calculate the broad average for processor and RM and compare.

Compute the root mean square of the difference in one-third octave levels from 800 Hz to 5 kHz of the output signal of the processor with the output signal of processor and RM. If the difference is 2 dB larger than the measurement tolerance*, then two output signals are different.

	Frequency (Hz)	800	1000	1250	1600	2000	2500	3150	4000	5000	RMS	Difference
[1]	CI dB (SPL)	81.6	79.1	76.3	73.5	71.7	64.1	59.9	59.4	59.2	37.8	
[2]	CI & RM dB (SPL)	79.5	78.9	77.5	74.8	72.3	66.6	63.9	63.0	62.0	41.0	3.2

	Frequency (Hz)	800	1000	1250	1600	2000	2500	3150	4000	5000	RMS	Difference
[5]	CI dB (SPL)	81.6	79.0	76.5	73.6	71.6	64.4	59.7	59.3	59.4	37.7	
[6]	CI & RM dB (SPL)	83.1	82.0	82.4	82.7	82.7	78.7	76.4	75.3	72.7	51.3	13.6