



OLLO Audio
research & development

Full Report

MEASUREMENTS REPORT
2 0 2 1 - 0 4

Prepared for

Public, open document

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Thank you
for taking
the time to
dive
deeper

Who is this for

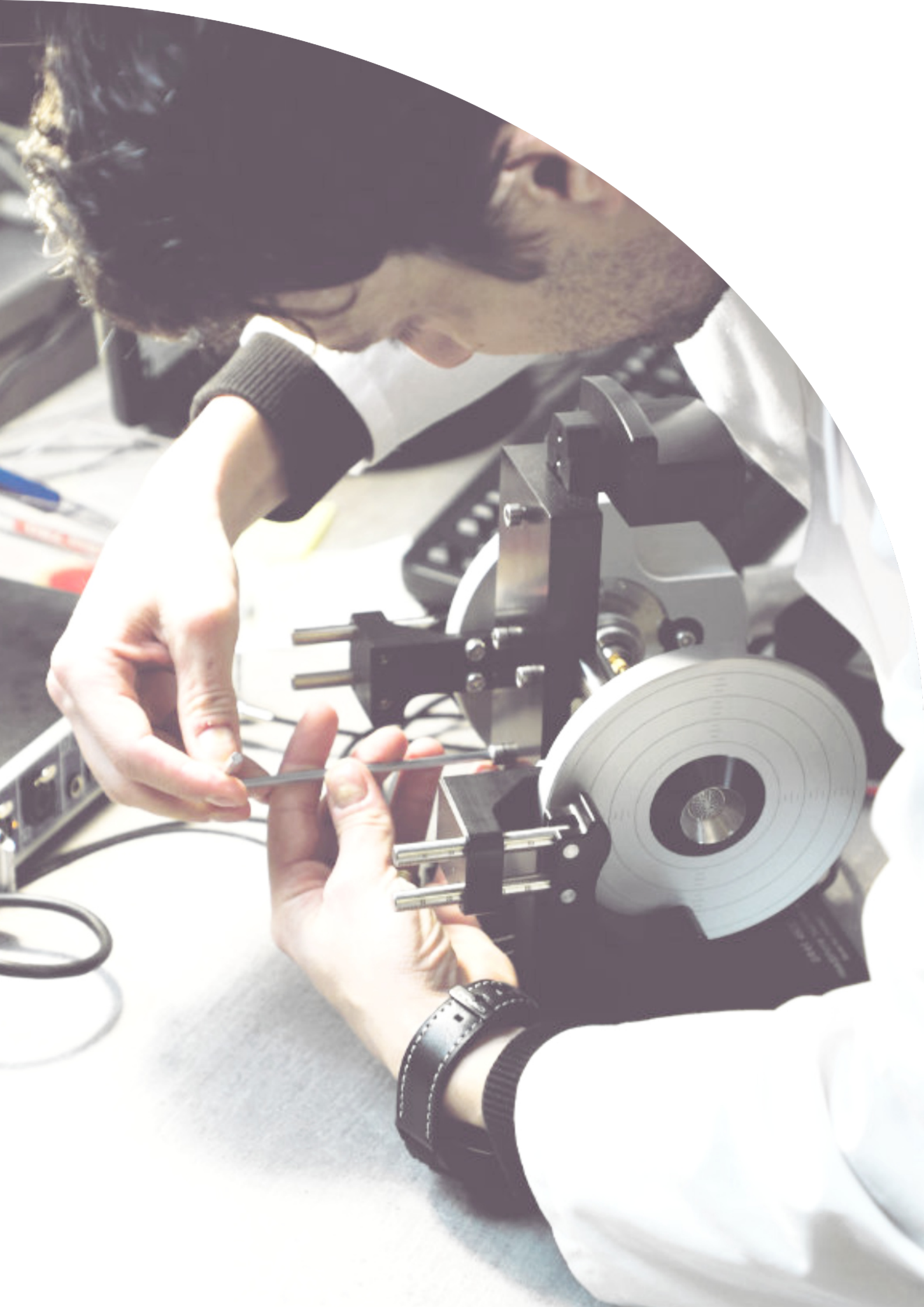
We strongly believe that transparency is the future of all business communication. There is no need to hold information inside R&D labs as general public and our users are more and more educated in audio engineering. We can now freely share information and know how, knowing that enough of the final users will understand it in depth.

If you're reading this, then it's for you. You're the one we were making this for.

info@olloaudio.com

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Why we offer measurements

We believe in full transparency in designing professional audio equipment. Every user must have **access** to how we create our products, what standards we use and how products' characteristics fall into their signal chain or workflow. That's the basis of achieving top-level results in any studio environment, home or professional - **knowing your gear.**

There is no real consensus in the audio industry when it comes to measuring the quality of sound. There are ways that we agree on, to some extent. Whenever we compare products, we have to use exactly the same systems and listening environments to have any valid reference point, for results that matter. You can read a lot on this topic of sound quality in the AES library, here's one of the scientific articles (Francis Rumsey) available here: <https://www.aes.org/e-lib/browse.cfm?elib=15525>

In short, the quality of sound is very subjective and measuring it is always somewhat abstract. Many authors in the AES library suggest brain waves recording, but there's still some ambiguity left to the different ear canal and pinna shapes. Not to mention how little we know and understand the human brain, even more so in the audio domain. We'd also argue that any sound quality-

related research will be altered depending on your historical experience with sound. You can read about audio perception and historical experience with sound influencing your perception by Terry Pennington at this link: <https://www.aes.org/e-lib/browse.cfm?elib=11474> A small abstract of Terry's paper says:

"It is critical that anyone involved in such subjective evaluation be aware that what we believe we hear is much more a function of what goes on inside our heads than what occurs on the outside. It is also imperative that audio equipment manufacturers realise, that subjective evaluation must not take precedence over science and common sense,"

...and we can sign under that statement as well. Science first, but listening to subjective experiences close second.



Access all information

We offer data sets from your headphones' individual measurements



Feedback is our drive

Every email, support ticket and social media chat is heard. Feedback gathering and analytics are in the core of OLLO



Good research is timeless

We rely heavily on research and methods proven over decades

Where does that leave us?

We believe sharing our methods, exact standards and gear used, can benefit our users' understanding and interpretation of measurements per se, more importantly, can help them make their purchasing decisions. Not necessarily our product.

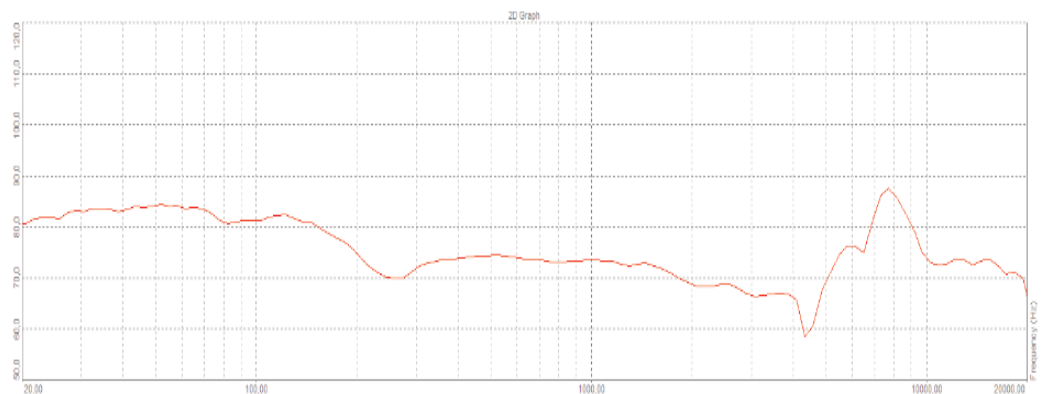
When designing OLLO lab, we went to Bang& Olufsen facilities in Struer Denmark to get first-hand information and experience in their Sound Hub. To skip ahead, we purchased G.R.A.S. 45CC + IEC 60318-1 over the ear headphones coupler RA0039. You can watch OLLO Measurements Engineer David Rijavec talk about it in this video: [MEASUREMENTS OF HEADPHONES AT OLLO AUDIO - PART 2 | #012 – OLLO Audio](#)



There is no ideal measurement gear, and there is no perfect target curve to go after. We can only work with approximations and averages as do IEC and ISO standards. That is the reason we do not have a unified standard for so-called “flat” monitoring systems. Best audio labs can do, is design products within x% tolerances of such and such standard (IEC, ISO, etc.).

Based on above, we believe sharing our methods, exact standards and gear used, can benefit our users' understanding and interpretation of measurements per se, more importantly, can help them make their purchasing decisions. Not necessarily our product.

A quick internet search will result in many very different measurements for the same headphones model. Below is an example of DT 1770 headphones measured at DIY Heaven and Sonarworks. (Source google images)



The above are DT1770 measured at OLLO Audio lab on IEC 60318-1 RA0039 device (L&R avg)

Different Labs use different gear and standards. That is fine as long as you know what standard they use in performing their measurements.

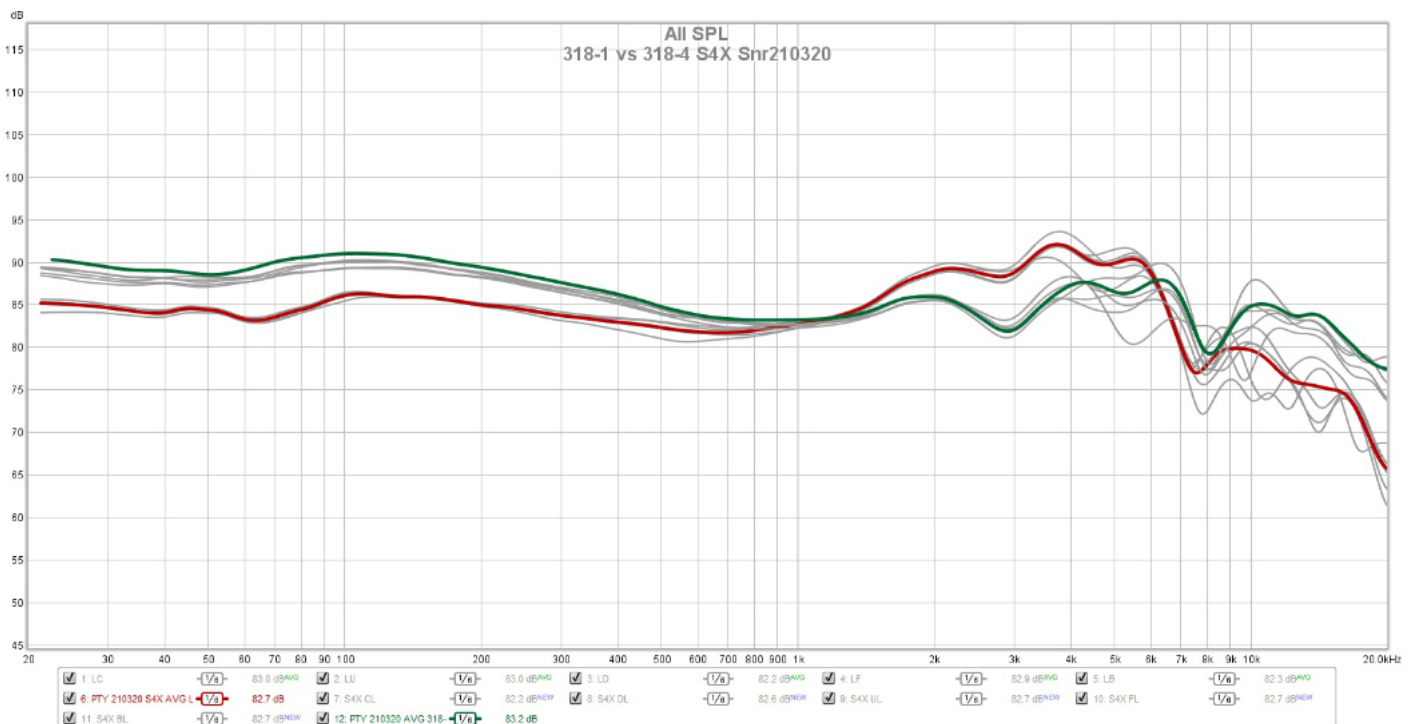
These are very different curves. Making any decisions or constructing your own opinion based on these is very hard. You need to fully understand how they perform measurements and what you're looking at. So both labs are doing their job just fine. The issue is that results are not directly comparable. That makes it impossible for the final user to make decisions based on plots from two different labs.

That's the core reason why we publish our measurements and include comparisons with other headphones models by different manufacturers.

Is our way better? No, not at all! Just another lab results that are not directly comparable. In a way, this forces final users to make educated decisions based on one or another lab results.

Different Labs use different gear and standards. That is fine as long as you know what standard they use in performing their measurements. The most questionable results are from labs that are secretive about their techniques and standards used. To address this we decided to offer as much as possible about the gear and processes we use, so the final user of our headphones and measurements can interpret them and compare with other lab results.

S4X 1.1 2021 S4X - Open back - Mixing headphones Red:60318-4, Green: 60318-1



The above are measurements of S4X unit serial Number PTY 210320 using both standards. These plots have 1/6 smoothing applied. Red is so-called 711 coupler and Green is RA39.



How we measure headphones frequency response

First measurements of headphones were made by telecom companies in the early 20th century when head-sets were first developed for telco operators.

It starts with the signal exciting the drivers. So even if two labs would be identical, they can still use different test signals that will produce different results. For example, if you're using pink noise or white noise, the results will be very different. Also, a log frequency sweep or pink noise will have slightly different results.

In our opinion, the best representation of music is pink noise. So we use that in our measurements.

After the signal is generated, it will be amplified and then converted from digital signal to analogue. DA conversion happens inside the sound interface where it's important to have DA conversion at the highest level. When measuring, it's crucial to have reproduction at levels that reflect real scenarios. In our case, we decided to go with 85dB SPL per channel for calibration. If you drive the unit at 100+ dB SPL, distortion will change and alter the response. The same goes for low SPL levels. After researching best SPL levels for mixing music, we learned that most music producers would use about 83-90dB SPL when working on a production. Also, a well known K metering by Bob Katz is based on these numbers and adopted worldwide. We also did a short take on K-Metering using headphones in this video: [K-metering with S4X studio headphones | #017 – OLLO Audio](#)

After calibration is set, we run the measurements 5 times at different positions on the measurement fixture. Results are averaged to have as accurate representation as possible.

Hardware test fixture is GRAS 45CC with RA 0039 coupler based on IEC 60318-1 standard. The signal is produced by RME Fireface UCX or 400 and picked up by Dewesoft Sirius Mini DAQ with their native software Dewesoft X run on Windows 10.

You can watch a short video we did when Dewesoft come to us for the first installation here: [MEASUREMENTS OF HEADPHONES AT OLLO AUDIO - PART 1 | #010 – OLLO Audio](#)

To be more precise we have 45CC set to KEMAR head size at 14.3cm breadth, output on Fireface is at 4dBu standard and calibration is done using pink noise to achieve 85dB SPL on each channel. Pinknoise is generated by Studio One Professional 4 built-in tone generator and Dewesoft DAQ is calibrated with ear simulators to show 100% true SPL values. Microphones are calibrated once a year.



IEC 60318-1

We use IEC60318-1 with RA 0039 couplers by GRAS in all public measurements reports

We use IEC60318-1 with RA 0039 couplers by GRAS. We often see that even reviewers do not fully understand the difference between their gear and our gear, leading to false conclusions and misinformation. In short, these are two very different ways of measuring headphones frequency responses and can not be directly compared. Neither is better, just made for a different purpose. For example, IEC60318-1 is far more

IEC 60318-4

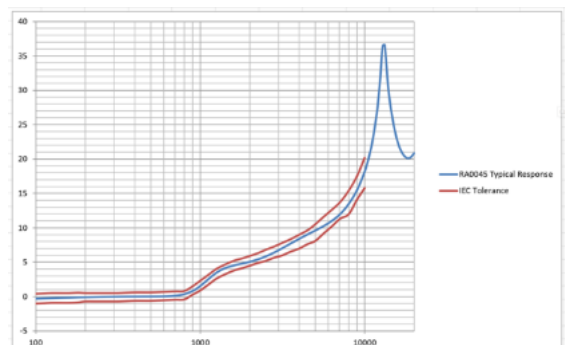
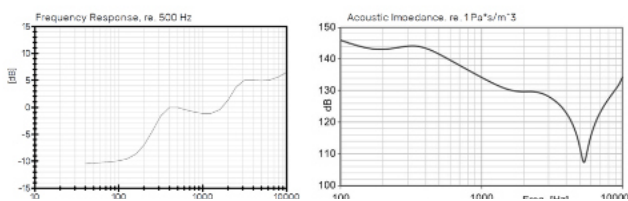
consistent with results while 60318-4 is very hard to position headphones the same way, every time. The latter is also a DRP device while IEC60318-1 is an ERP device. DRP means that sound waves are recorded at the simulated eardrum position while ERP means ear reference point for picking up sound waves. That's just before they enter the ear canal. Just that alone will result in a very different results and plots.



IEC 60318-1



IEC 60318-4



Charts you get in the box

For every day use you need to look at the chart as a whole - an overview of the response. Only then you can make EQ adjustments

Every OLLO customer gets an individual measurements chart of their unit, using the previously explained standard.

What you see is a rough representation of how they sound. You can only interpret these measurements from a distance. You can see they have a slight boost in low and low mids frequencies. You can also see the 3.5kHz dip that is there for the concha gain to jump in and make it "flat". The 7.5kHz dip is a resonance that our S4X and S4R headphones have. Due to being very short in the frequency range, it's not really perceived when listening to music. Only if you have a very specific sound right in that area, you'll notice it. Fixing it with EQ will make them sound bad. Go ahead, try.

The most value this chart brings is when you look at it from a "distance". If you wish to play with EQ, you can predict how the final response will change based on the chart. For example, you can cut about 250Hz with Q1 or less for 2-3dB and end up with the sound close to the Harman Target curve as the low end will stay where it is. Same goes for highs.

Secondly, you can use our comparison charts to simulate other headphones using our S4X or S4R models. For example, when your client uses M50X, you can roughly simulate that response by using your chart and comparisons measurements. This comes in handy when a client claims there's a specific problem, but you can't pick it up. Mirroring their monitoring headphones will do wonders in communication.



Above is an example of S4X comparison with M50X. To mirror your clients' monitoring you need to boost low end and remove low mids heavily. In the high frequency range you need to add a shelf boost from about 5kHz. It will of course not sound like the M50X but will help with clear communication with your client. You can find many popular headphones charts on our webpage. IEC60318-1 RA0039

Measurements results



Comparisons IEC60318-1

For detailed research into frequency response based on ERP (ear reference point) measurements.



Comparisons IEC 60318-4

For in depth research based on DRP (ear-drum reference point) and ability to compare with other labs using this standard.

Measurements Sections

Please understand measurements does not answer the question, which headphones sound better than others. That's on you.

1. IEC 60318-1

All measurements since 2019 that OLLO published were made using this standard. We will continue to use it and give full individual measurements to every customer, based on this standard.

2. IEC 60318-4

This is a very popular 711 coupler that many reviewers use. So here's our measurements using same signal chain and sources as with 60318-1 measurements.

3. Word of caution

A quick word on what you need to take into consideration when reading any of the charts in this report.

Apx. 1 & 2

First are all measurements with 60318-1 and second with 60318-4. You can see distribution (dispersion) and how average was made. These are raw, non smoothed curves.

What they said about us

"I love my S4X reference headphones: they sound fantastic, are reliable and trustworthy, sit comfortably on my head and around my ears, don't give me ear-fatigue and don't press my ear onto the glasses allowing for continued and comfortable use."

MARC URSELLI

SENIOR SOUND ENGINEER
AUDIO MIXER
MUSIC PRODUCER

U2,
FOO FIGHTERS,
NICK CAVE,
LOU REED,
STING,
KEITH RICHARDS, ...

"These headphones are such a pleasure to work on - natural, comfortable and true."

LEO ABRAHAMS

LADY GAGA,
ADELE,
FLORENCE AND THE MACHINE,
CHRISTINA AGUILERA,
PAOLO NUTINI,
LILY ALLEN

"These are my favorite headphones. They sound great and are very comfortable. I'm able to use them for long hours without listening fatigue or discomfort. They come in "closed back" for recording and "open back" for mixing duties."

GARY NOBLE

AMY WINEHOUSE,
JOSS STONE,
JESSIE J,
JAMES ARTHUR,
SEAN PAUL,
ESTELLE,
3X GRAMMY WINNING



Respons
nts



OLLO Audio

CERTIFICATE OF AUTHENTICITY

This certificate guarantees that the OLLO Audio product you have purchased was hand-crafted by OLLO Audio engineers in Slovenia, EU. All our products are carefully inspected, individually measured and tested before leaving our facility.

30800051
SERIAL NUMBER

11.08.2020
DATE

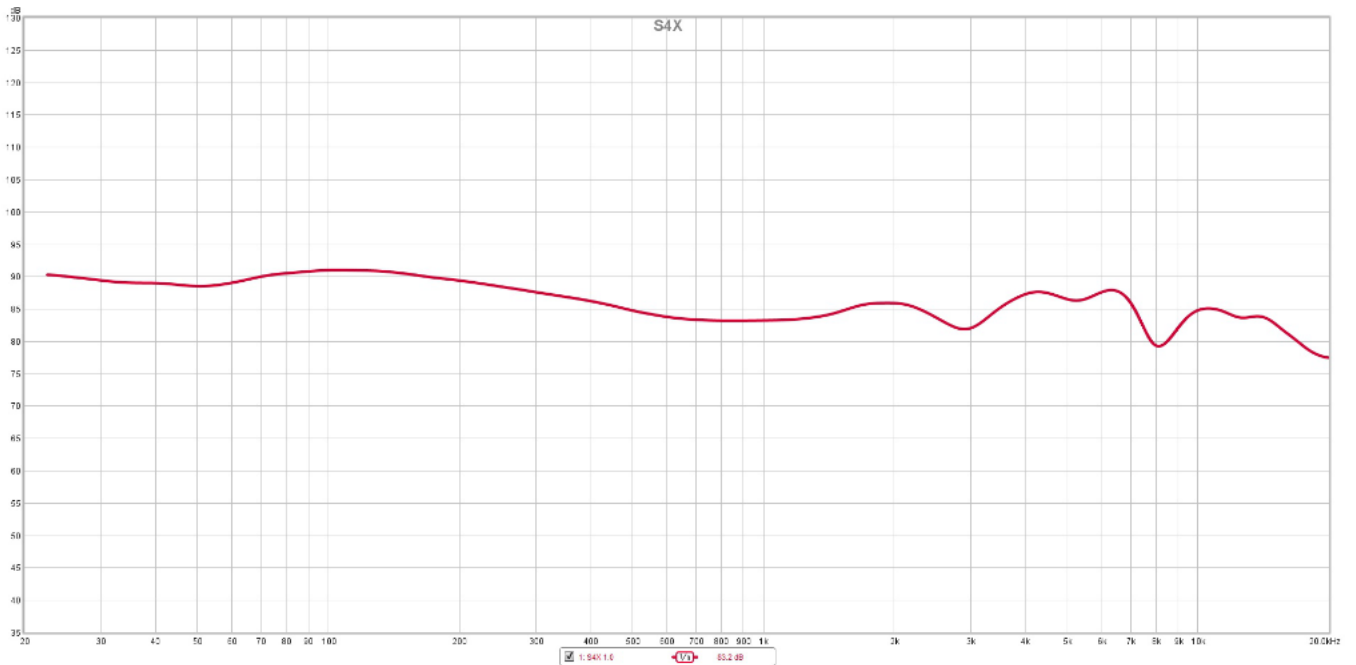
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Rok Gulič, CEO

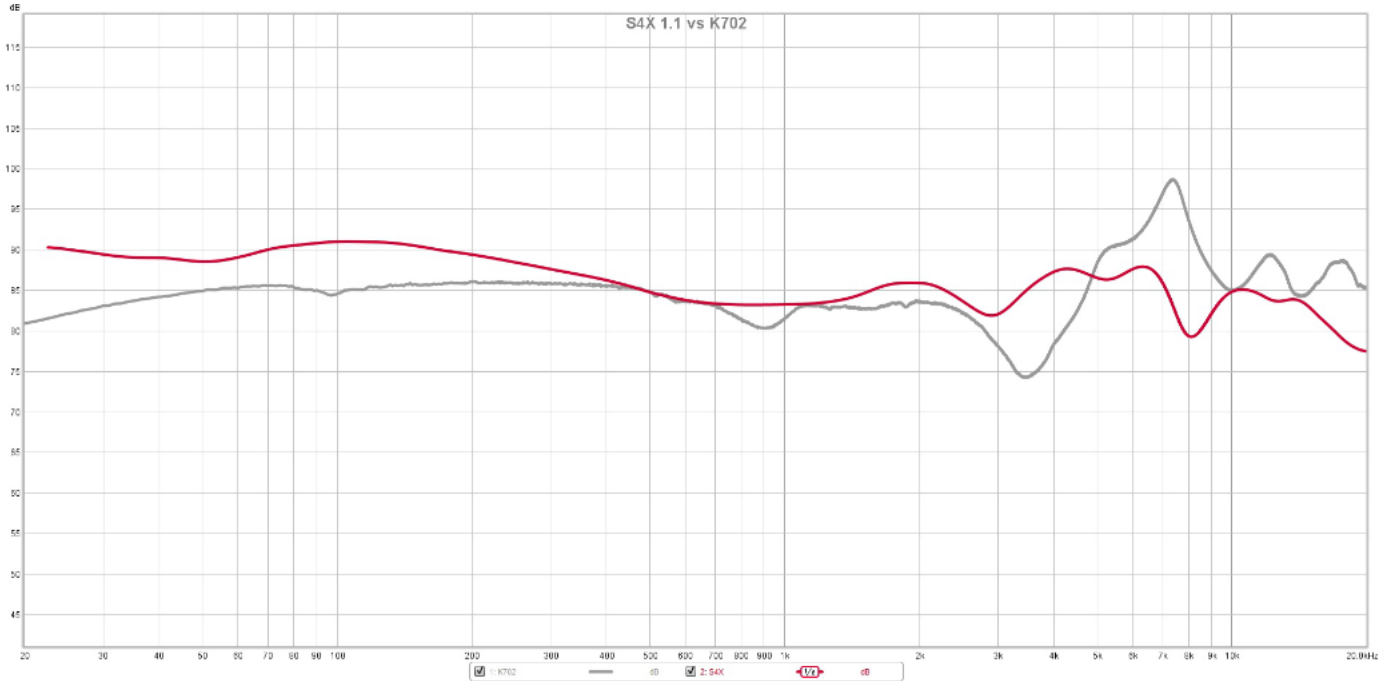
1. IEC 60318-1

S4X 1.1 comparisons

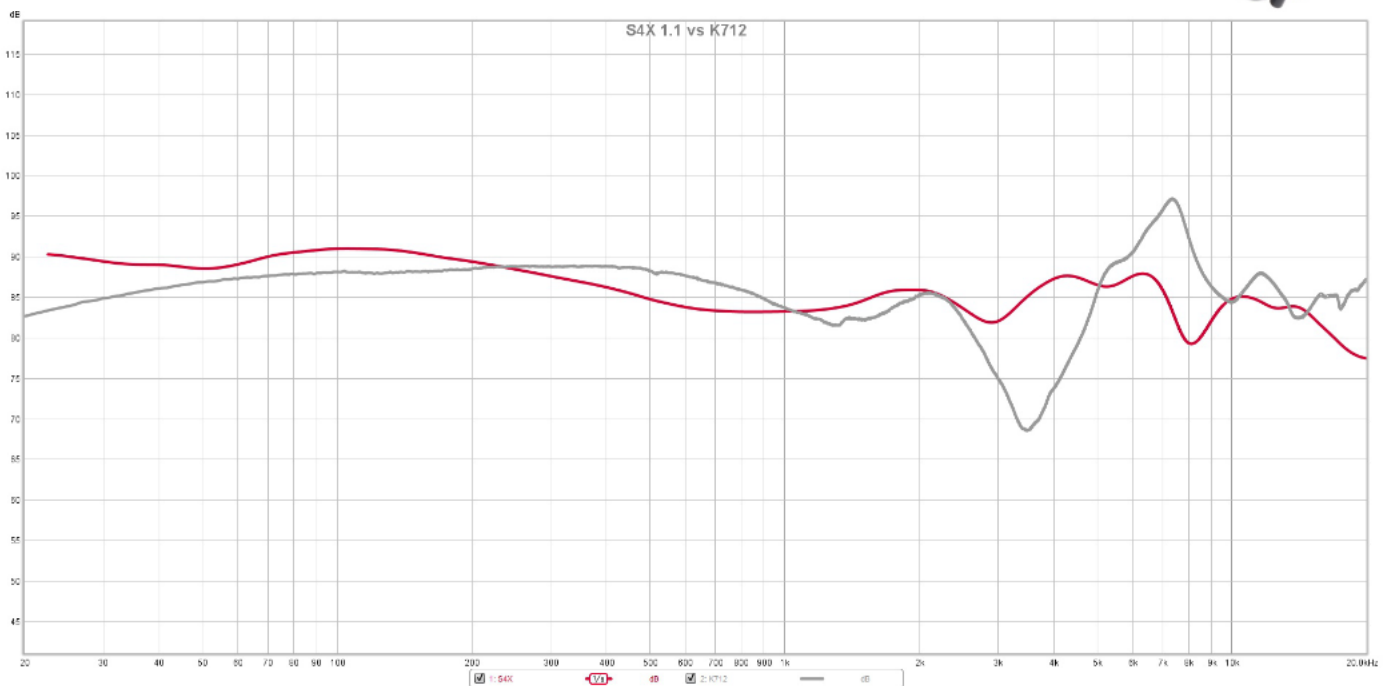
S4X - Open back - Mixing headphones



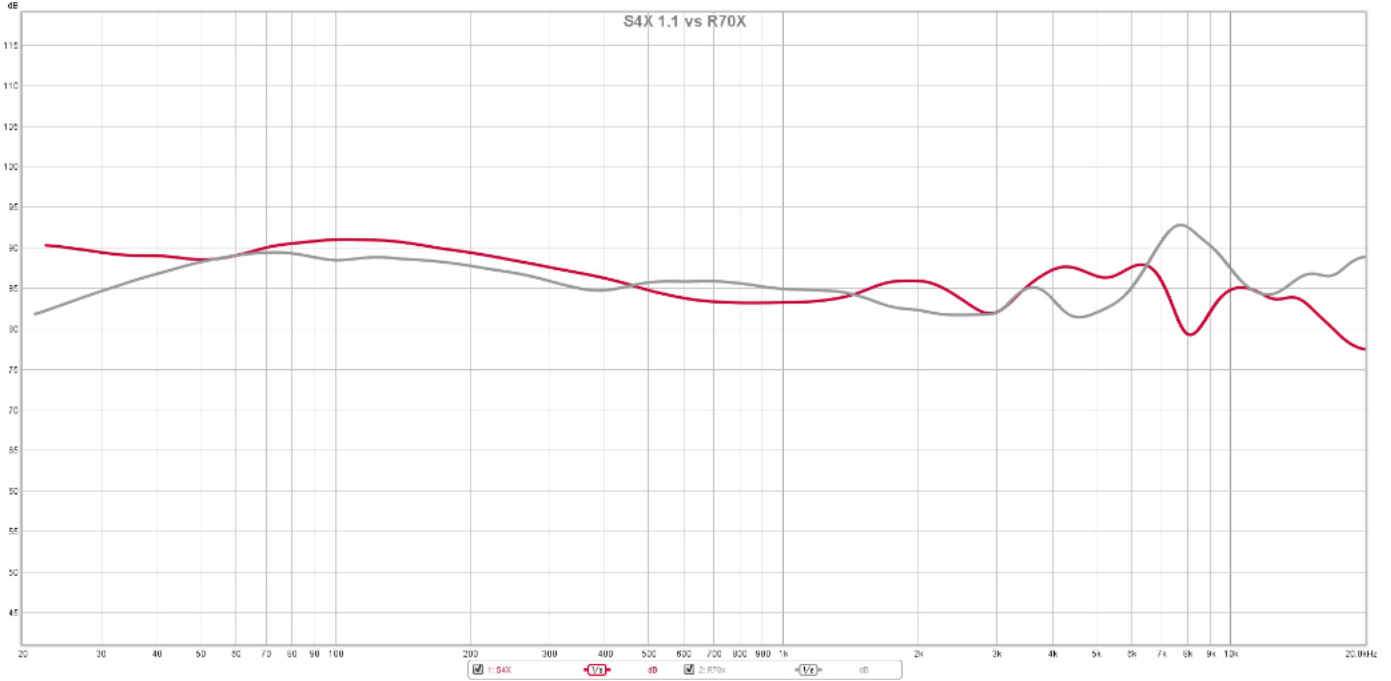
K702 by AKG



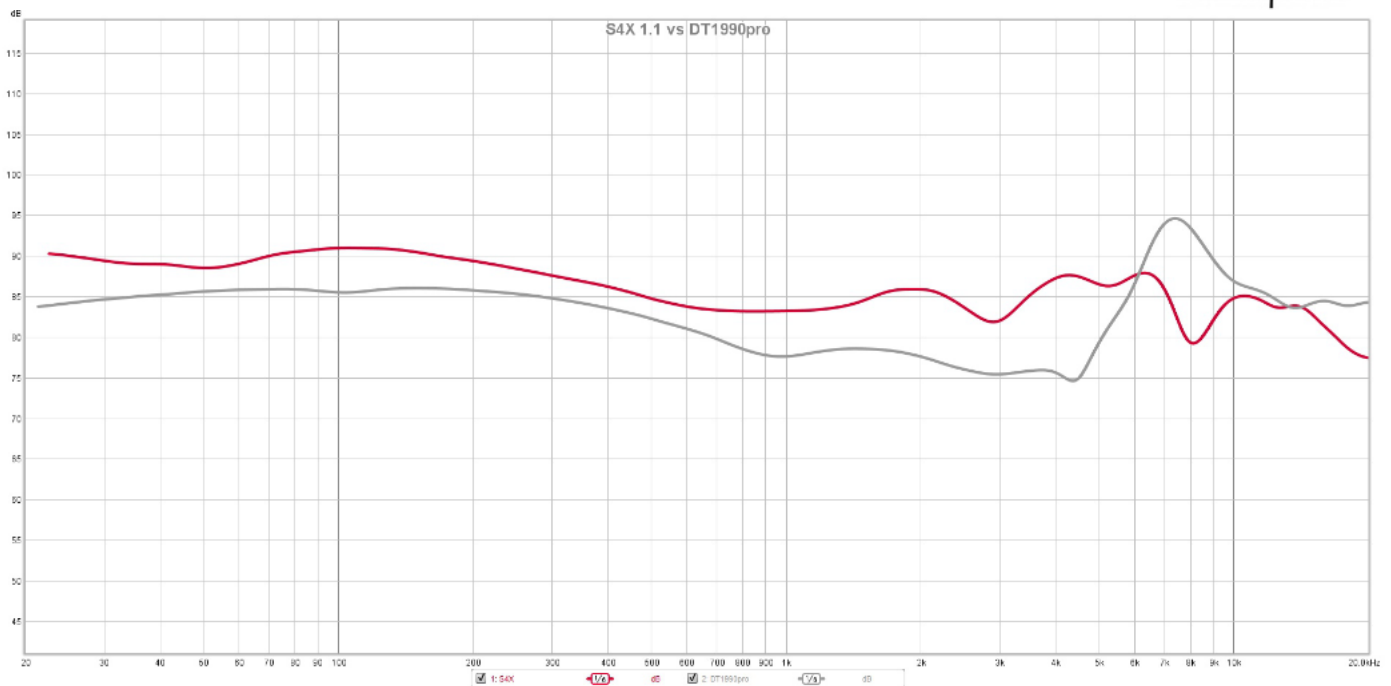
K712 by AKG



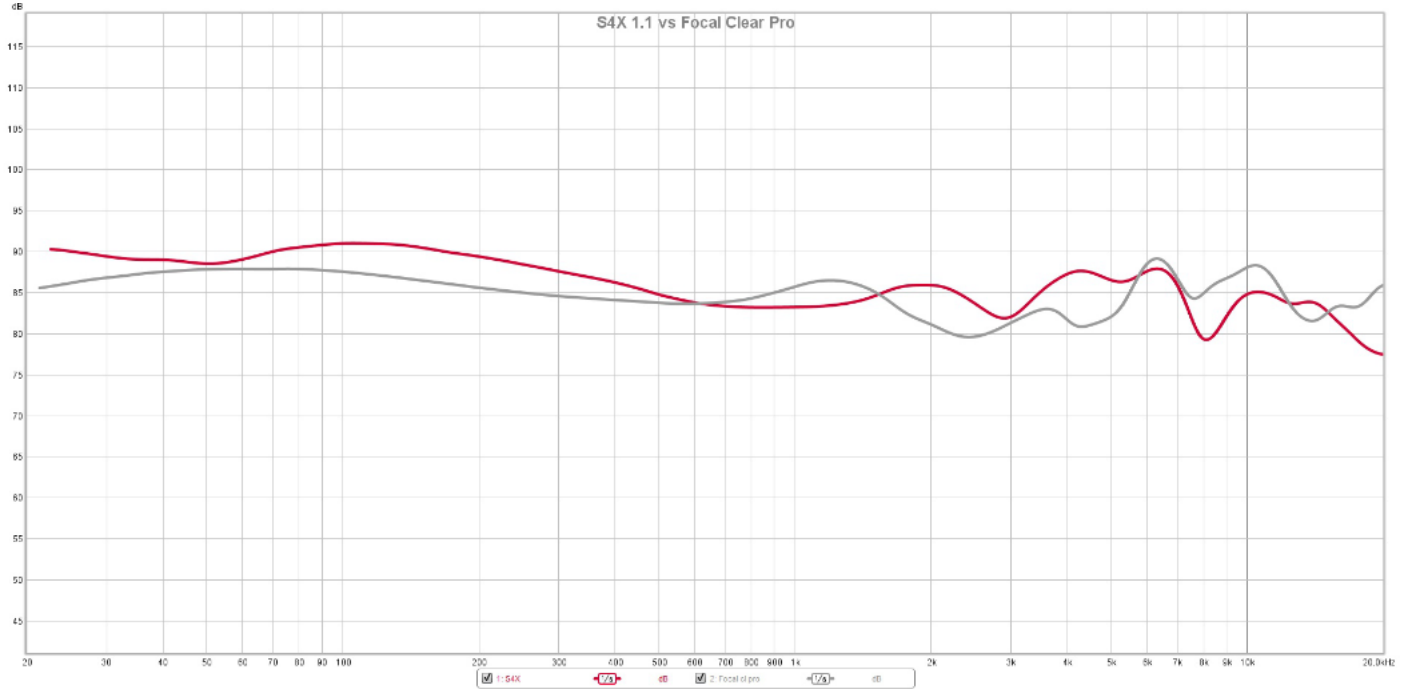
R70X by ATH



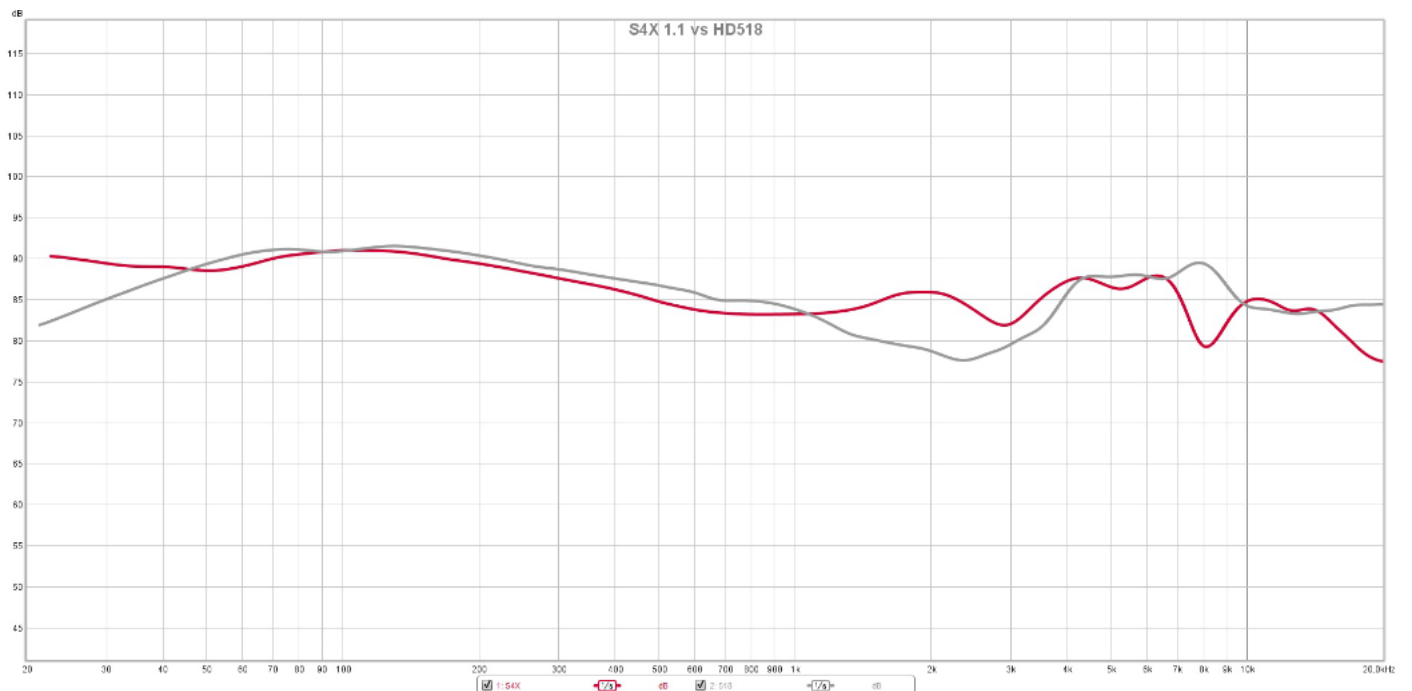
DT1990pro by BEYERYNAMIC



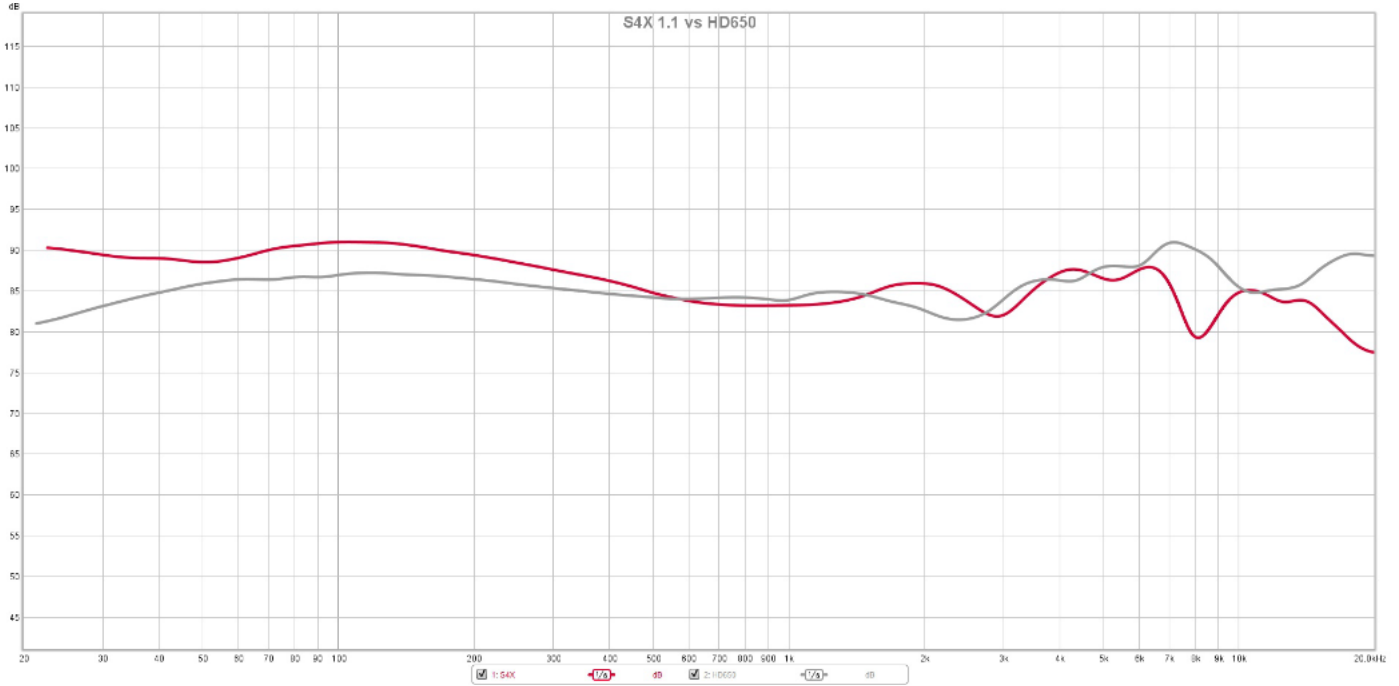
CLEAR PRO by FOCAL



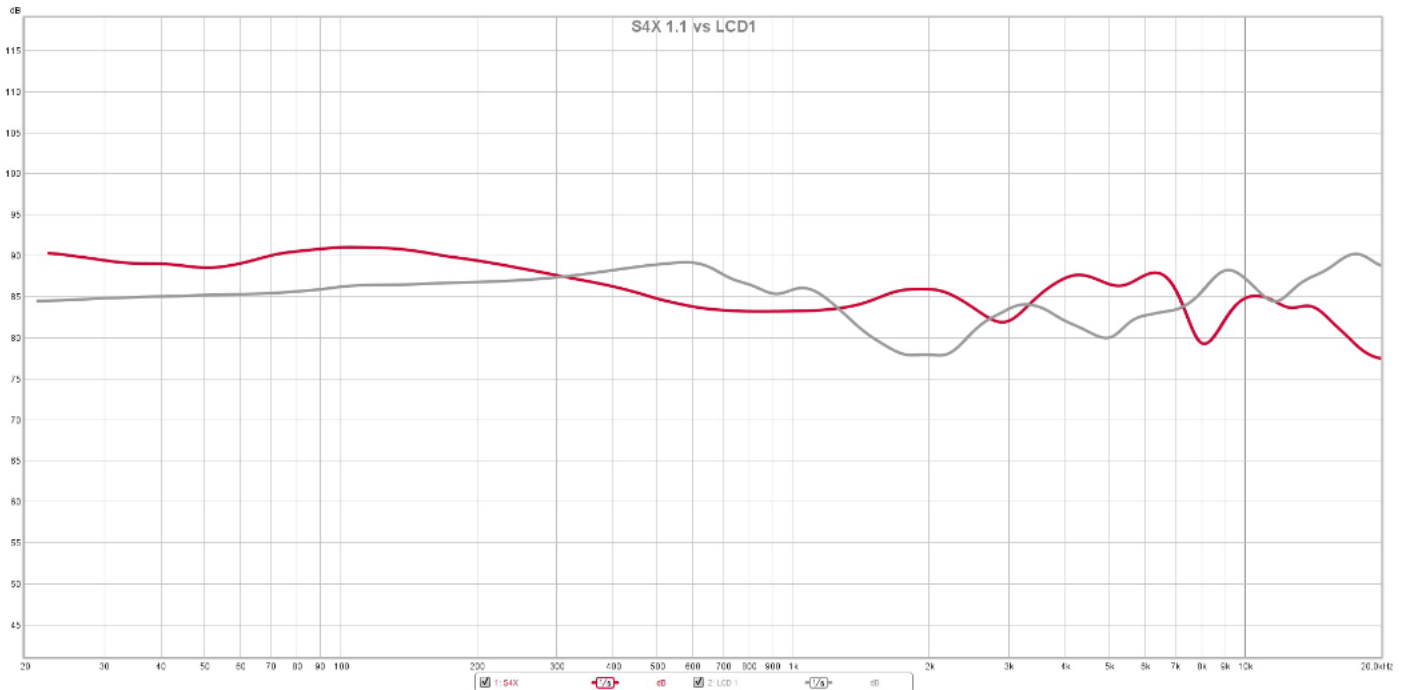
HD518 by SENNHEISER



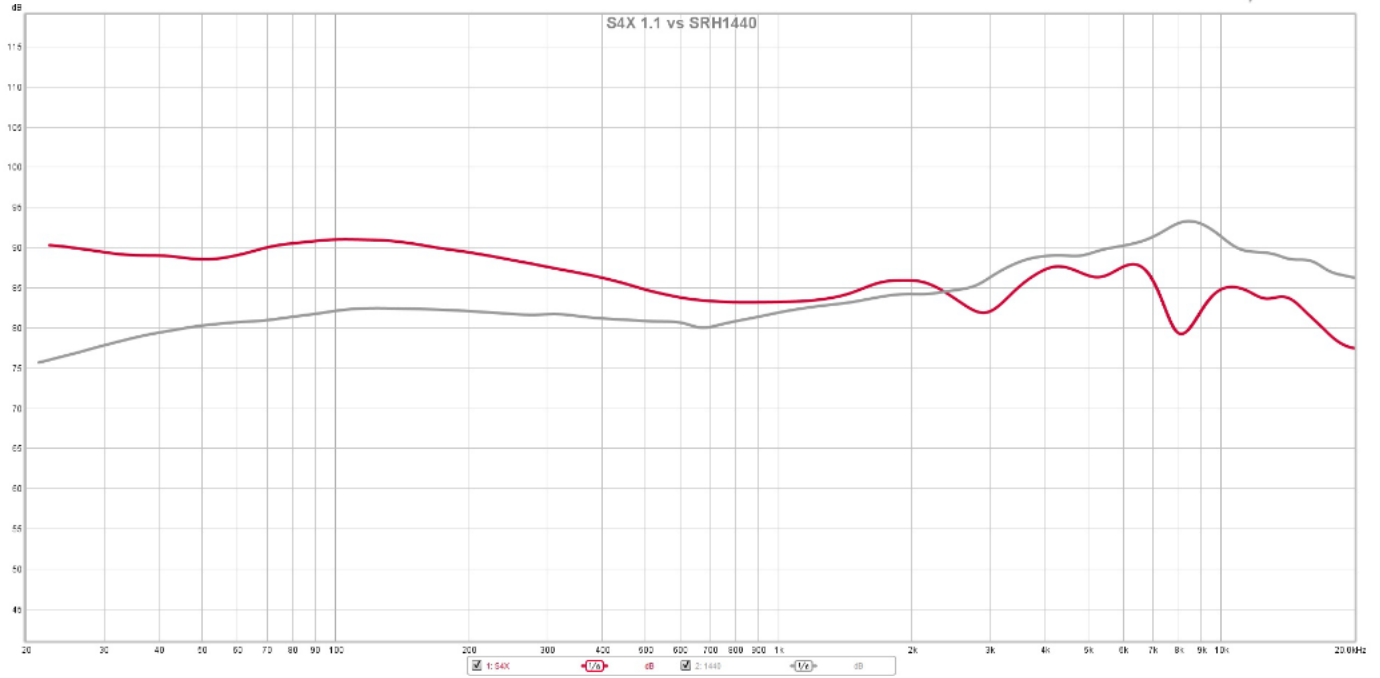
HD650 by SENNHEISER



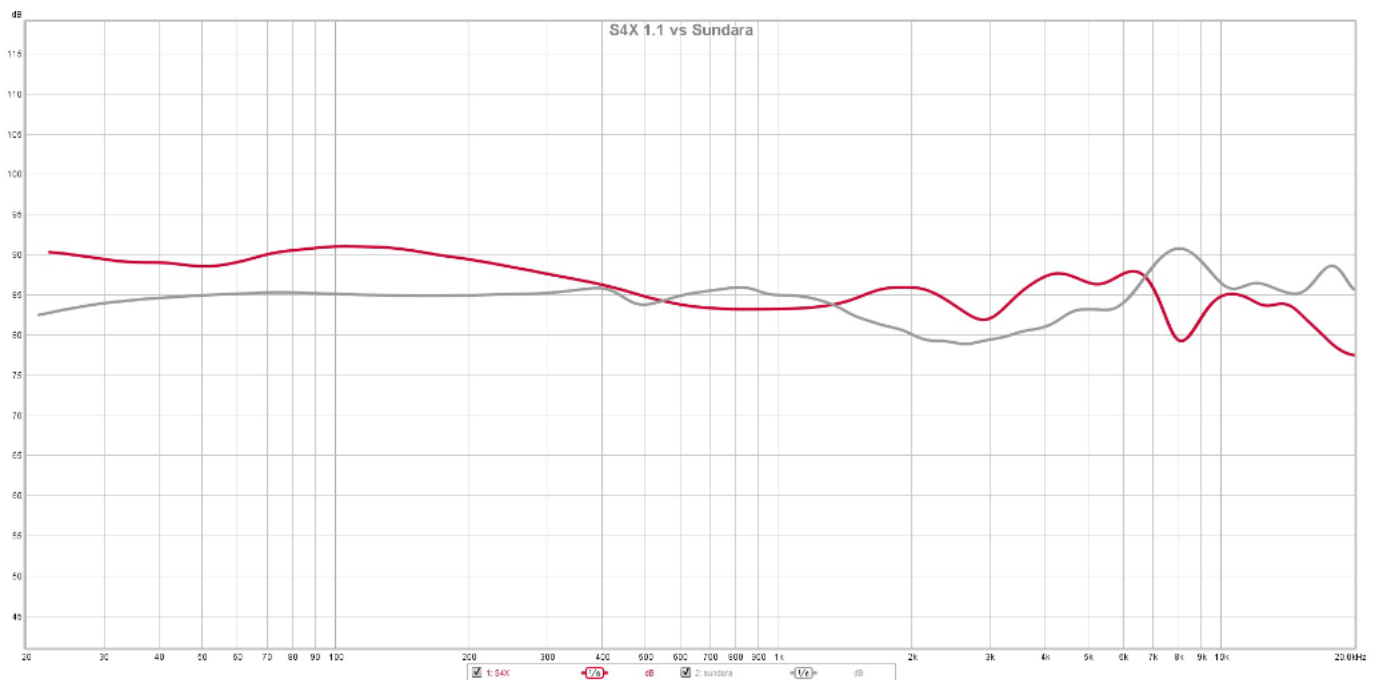
LCD 1 by AUDEZE



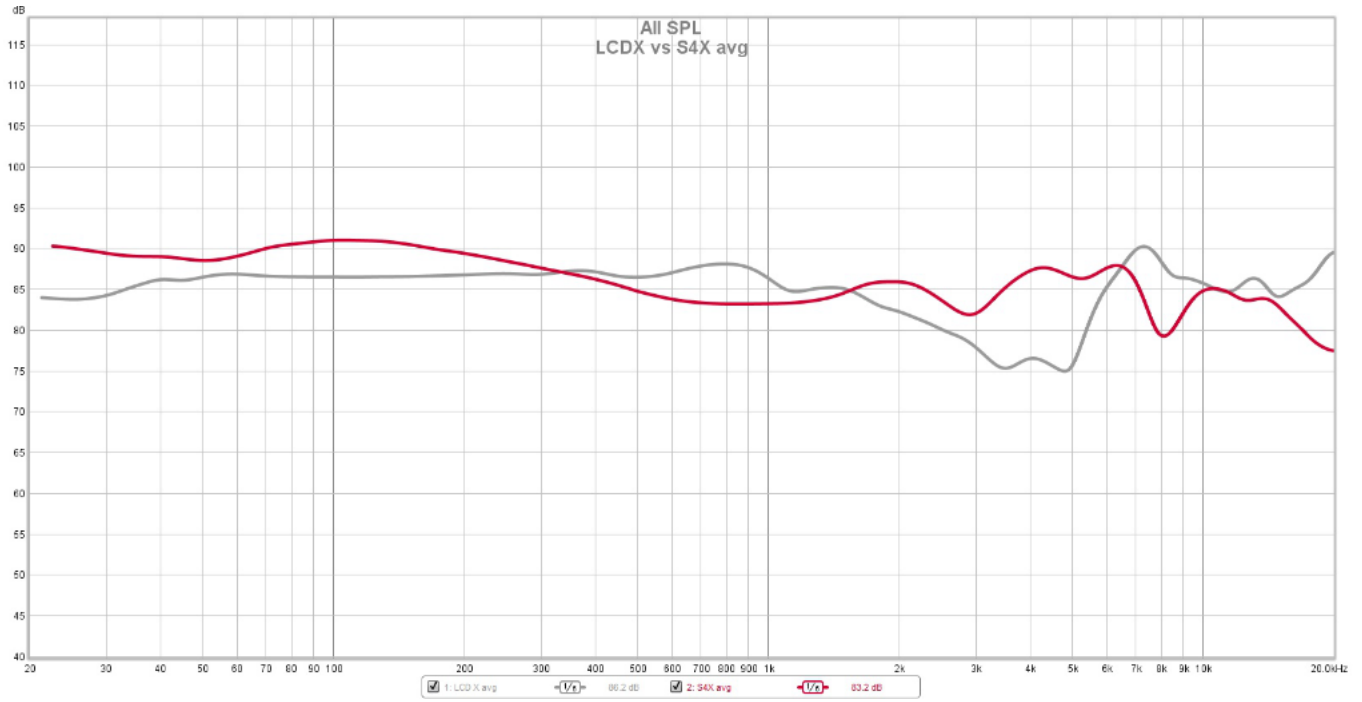
SRH1440 by SHURE



SUNDARA by HiFiMAN

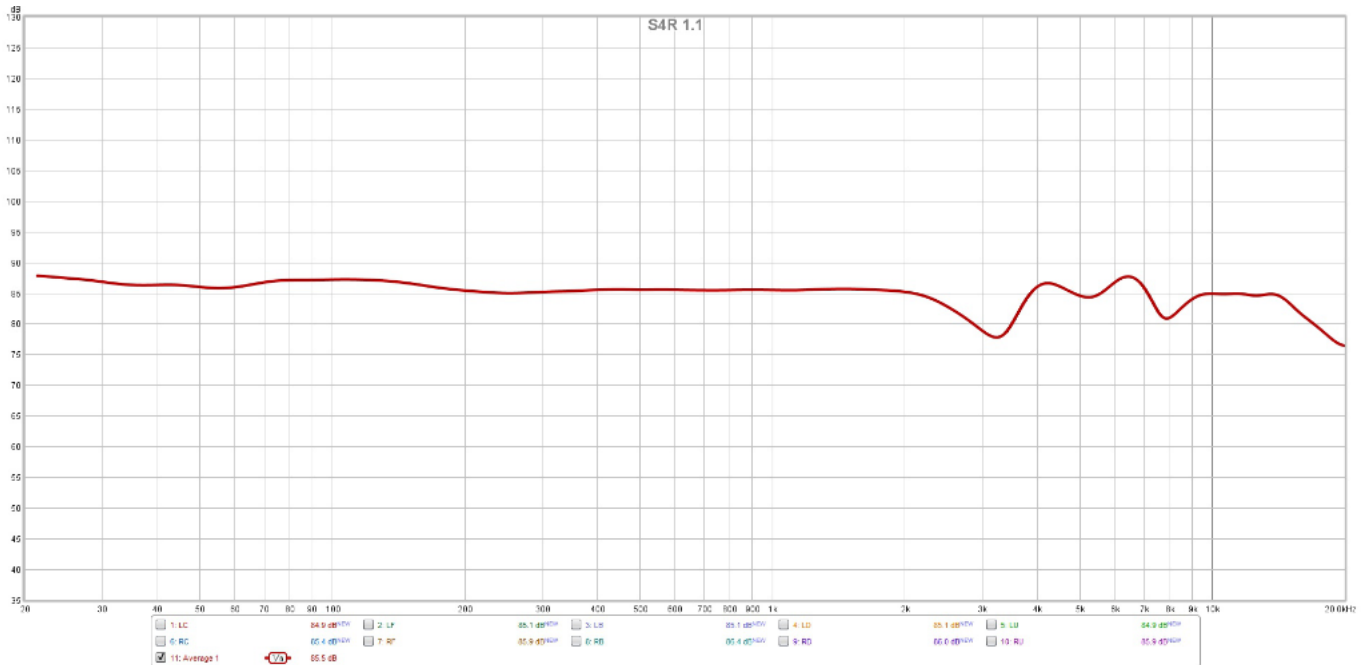


LCD X by AUDEZE

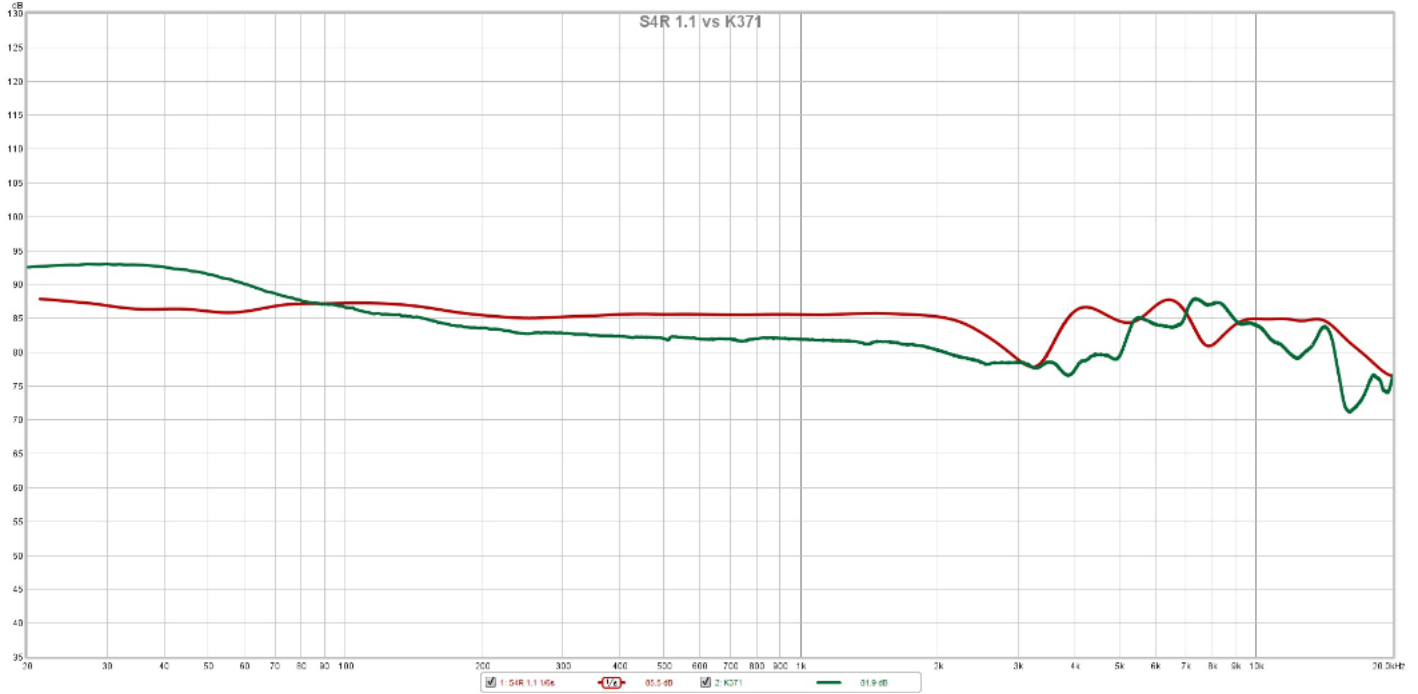


S4R 1.1 comparisons

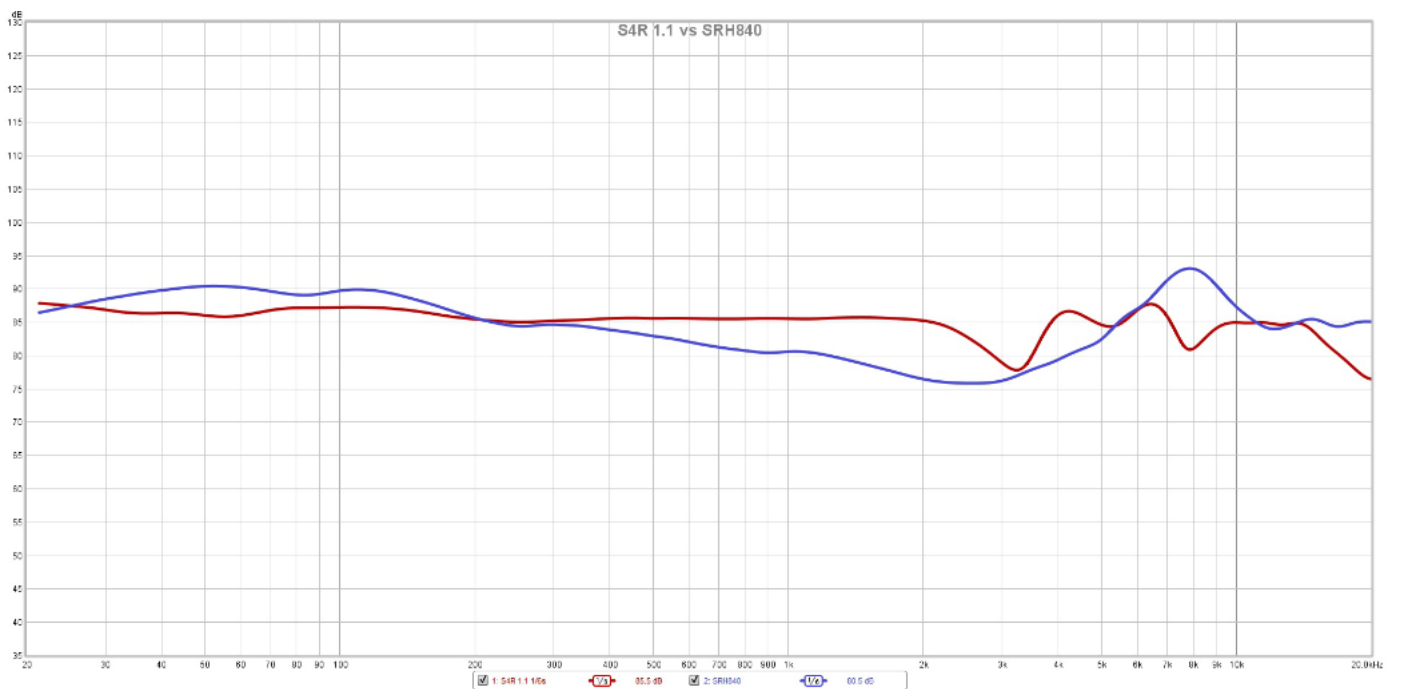
S4R - Closed back - Recording headphones



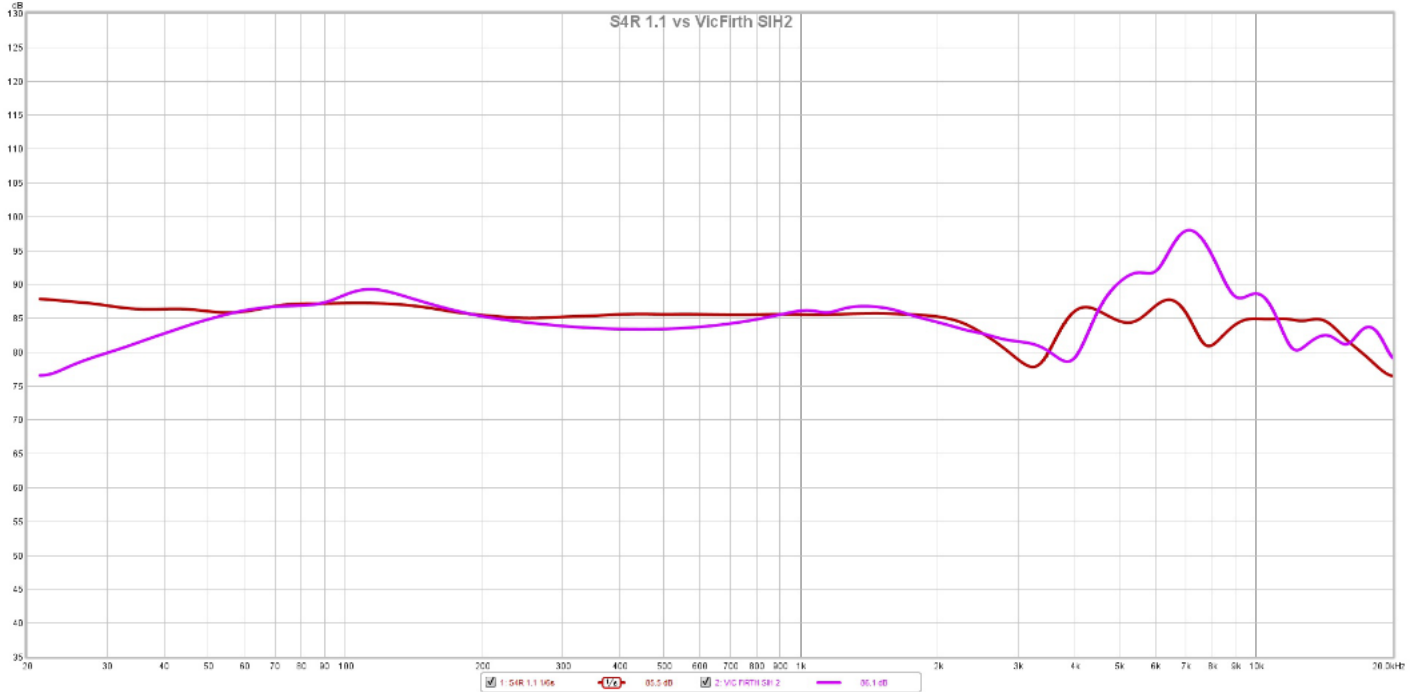
K371 by AKG



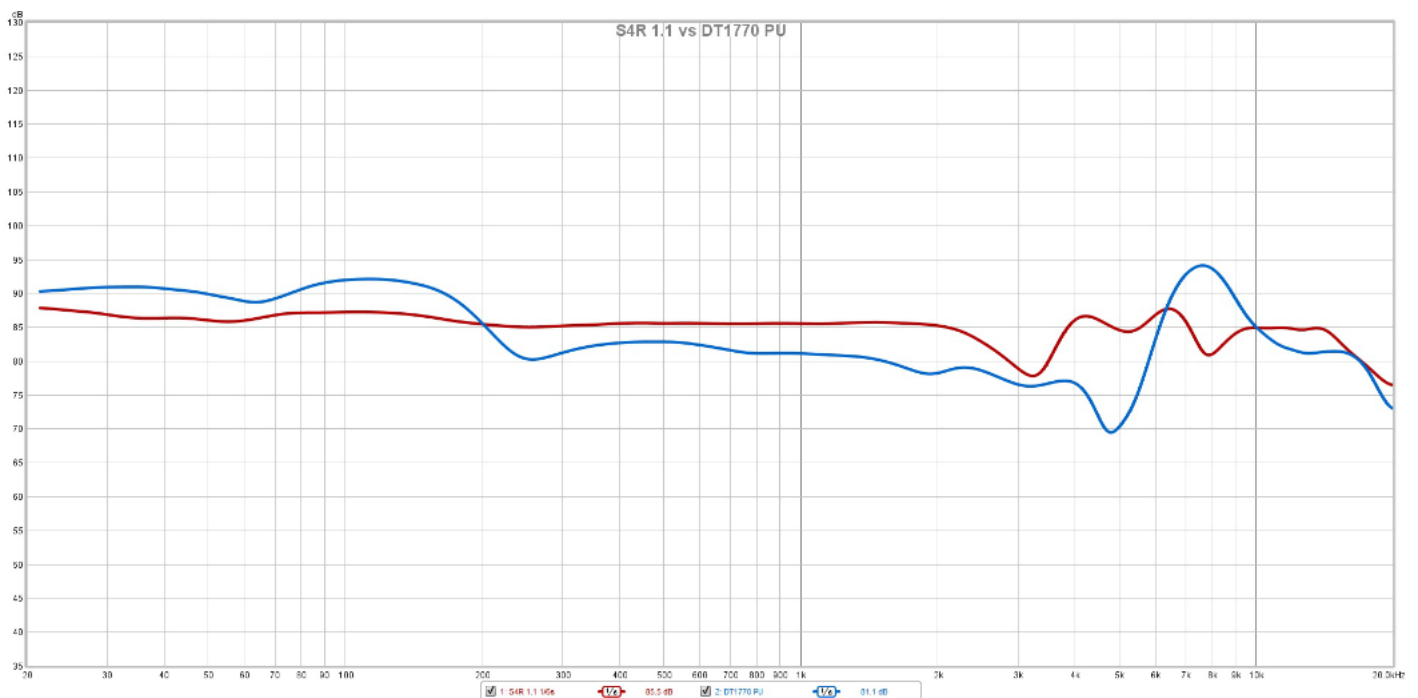
SHR840 by SHURE



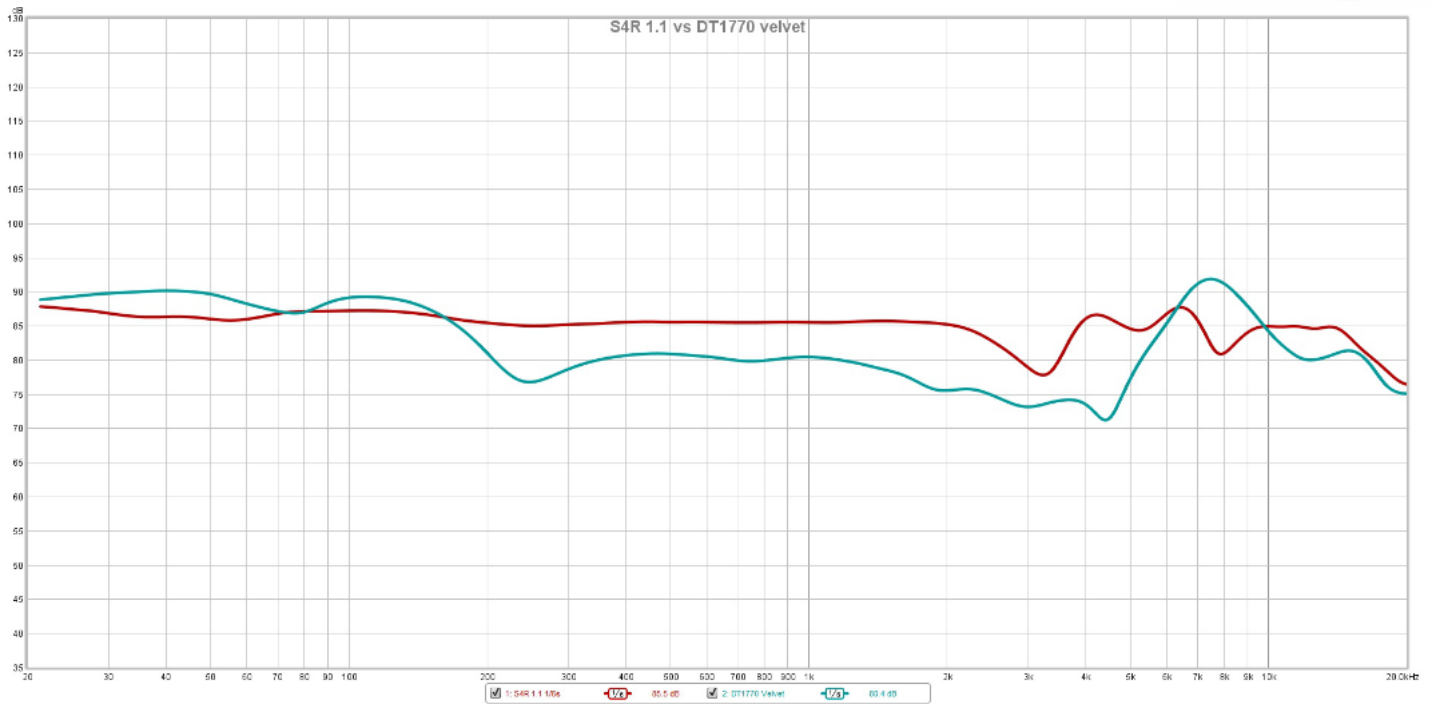
SIH2 by VIC FIRTH



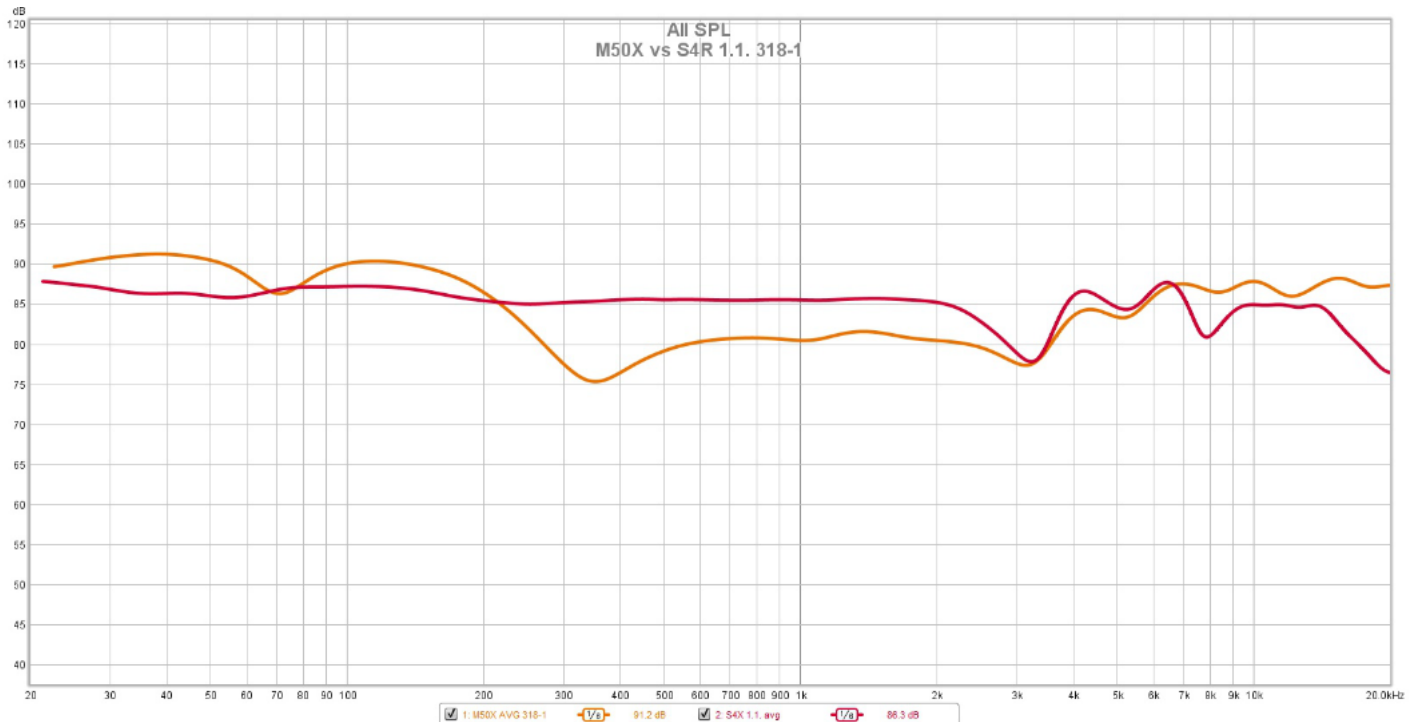
DT1770 by BEYERDYNAMIC leather



DT1770 by BEYERDYNAMIC velour

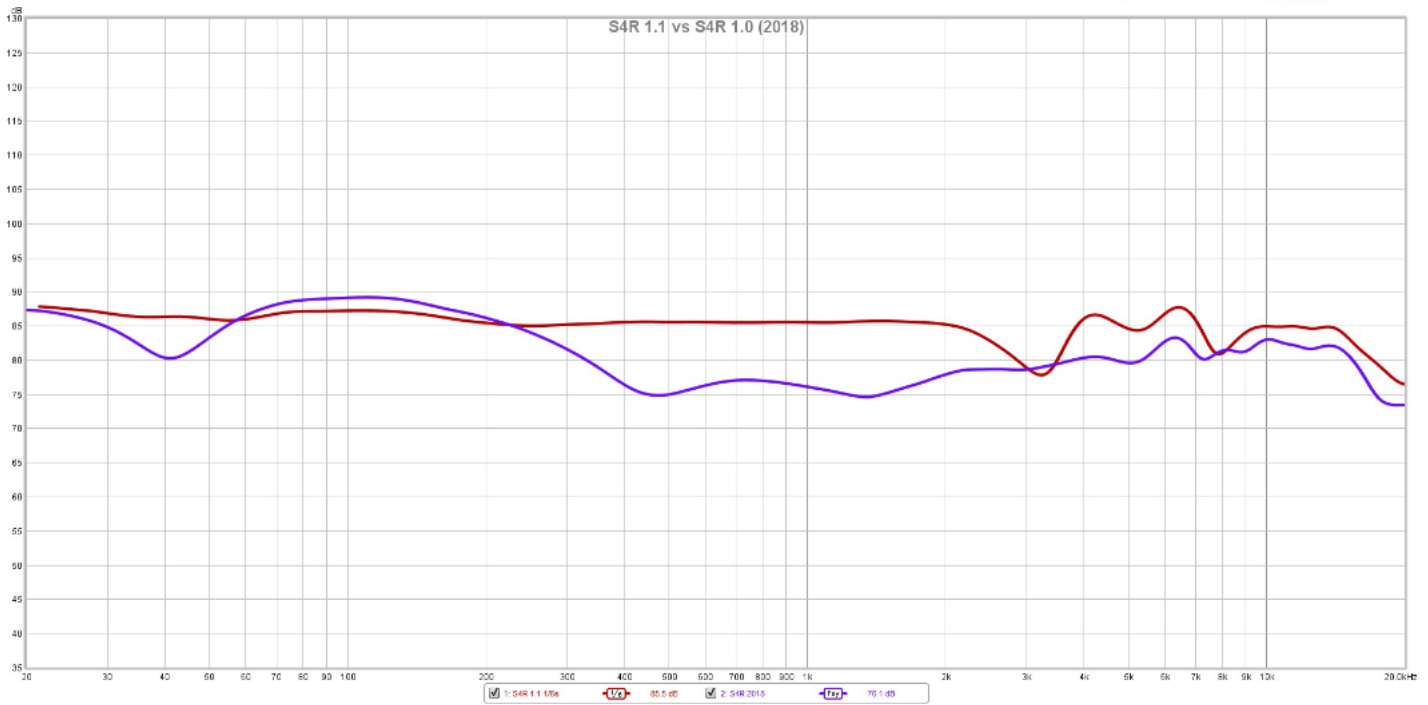


M50X by AUDIO TECHNICA



MORE COMING SOON

S4R 1.0 vs 1.1 (2021) Red 1.1



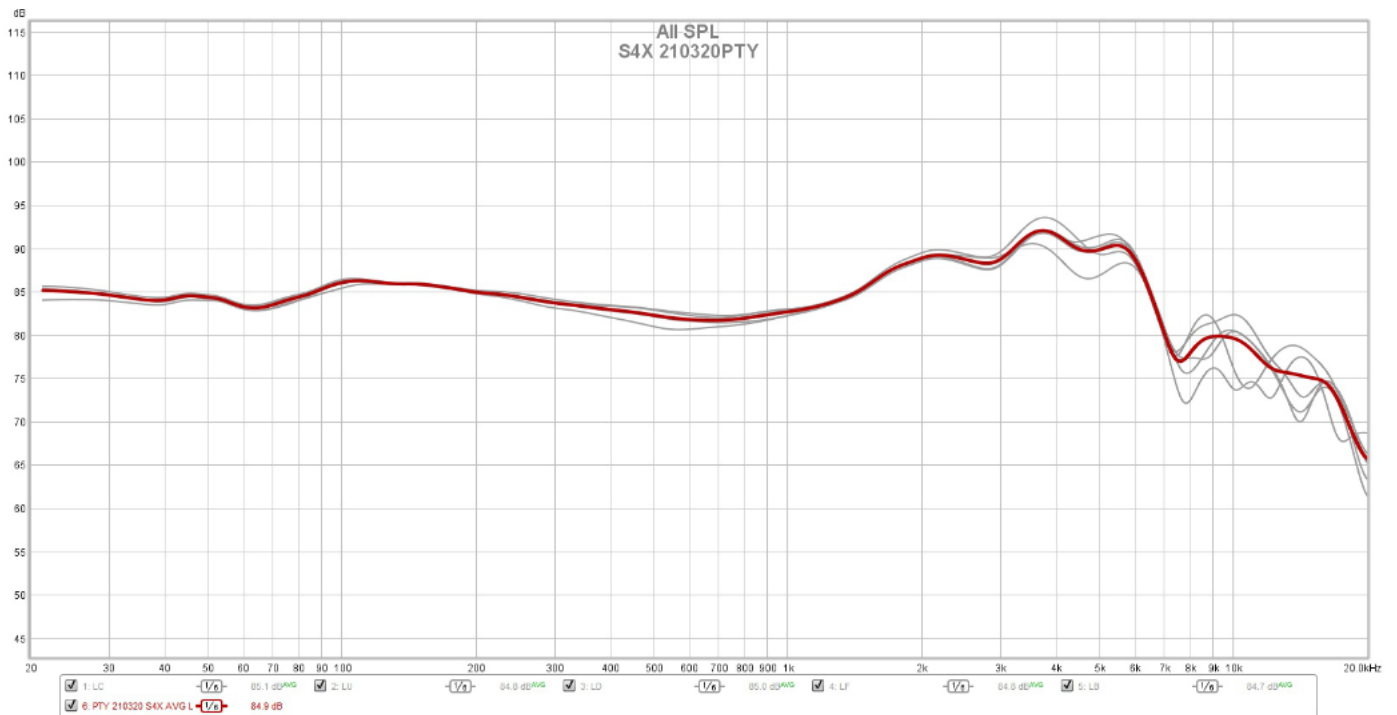


2. IEC

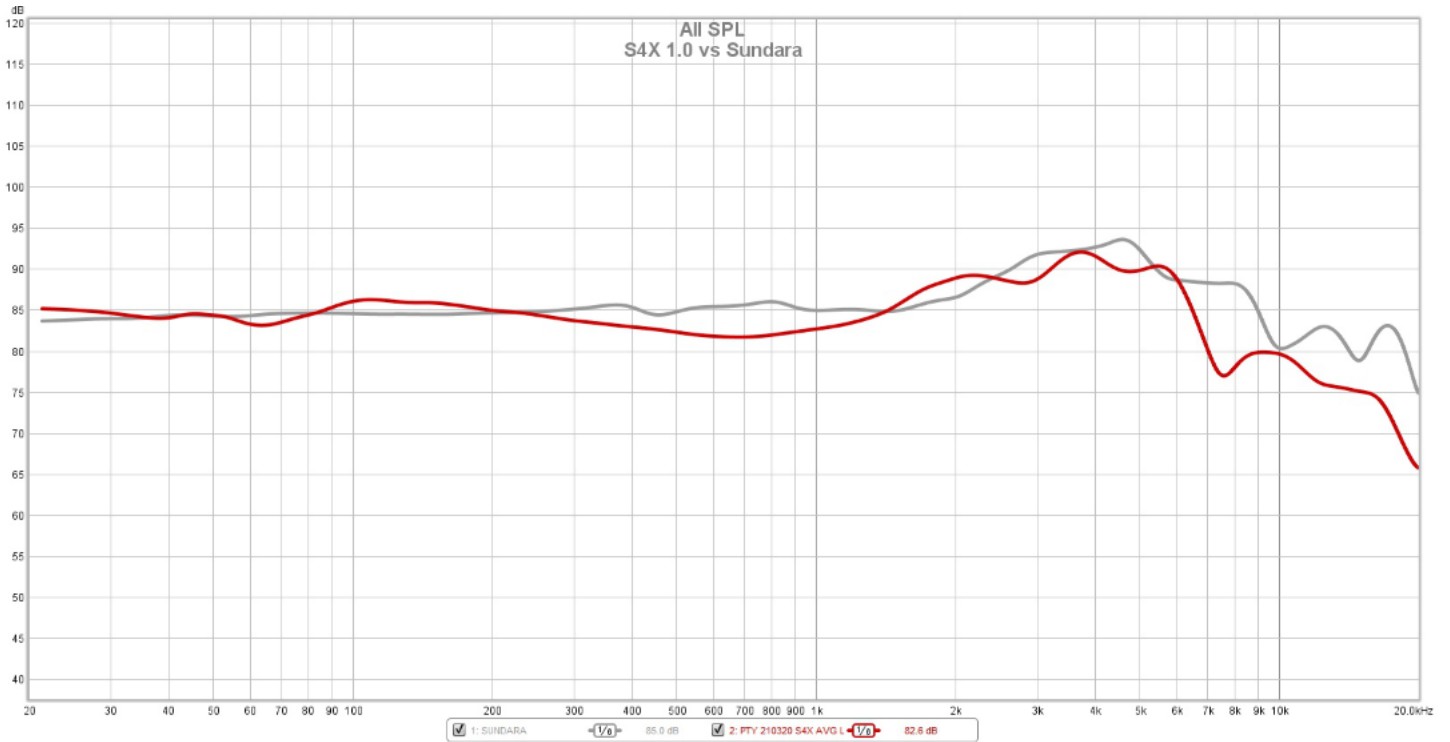
60318-4

S4X comparisons

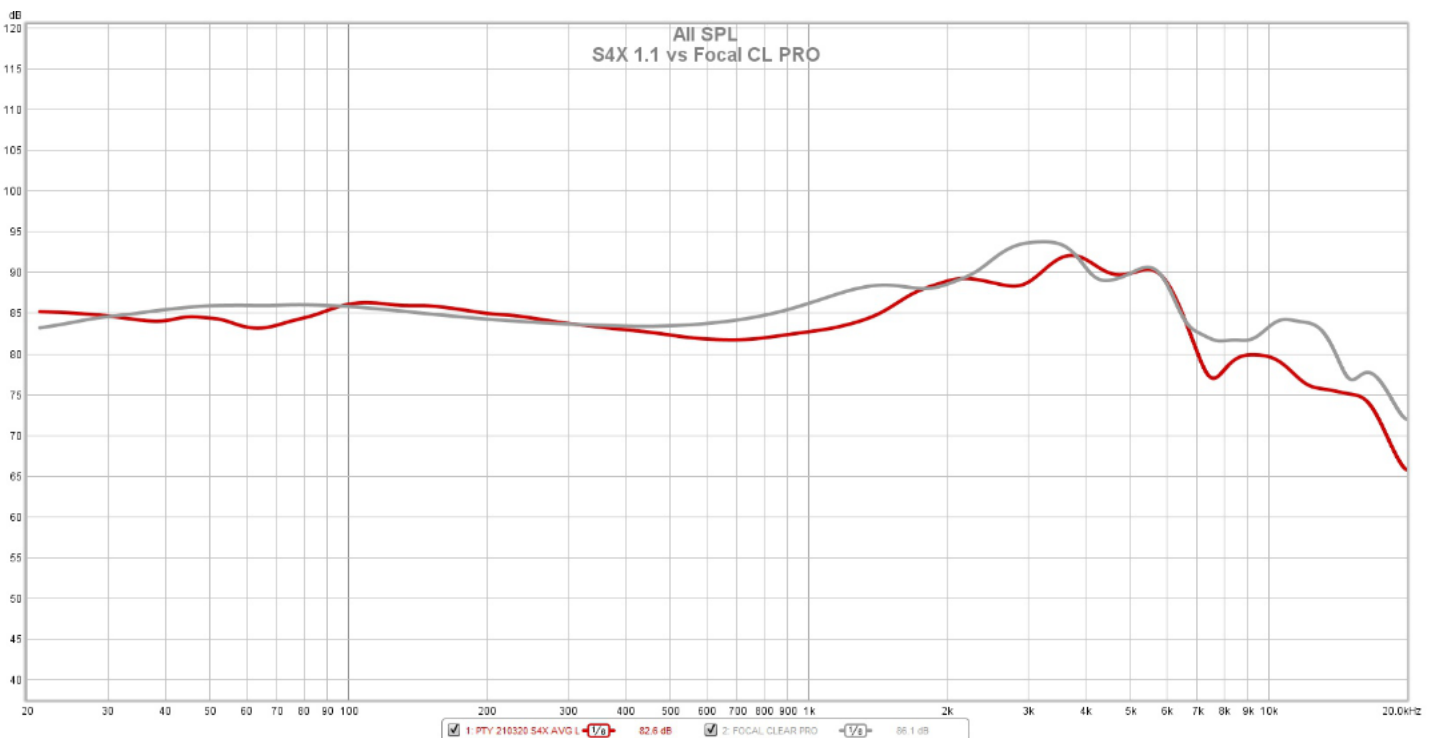
S4X - Open back - Mixing headphones



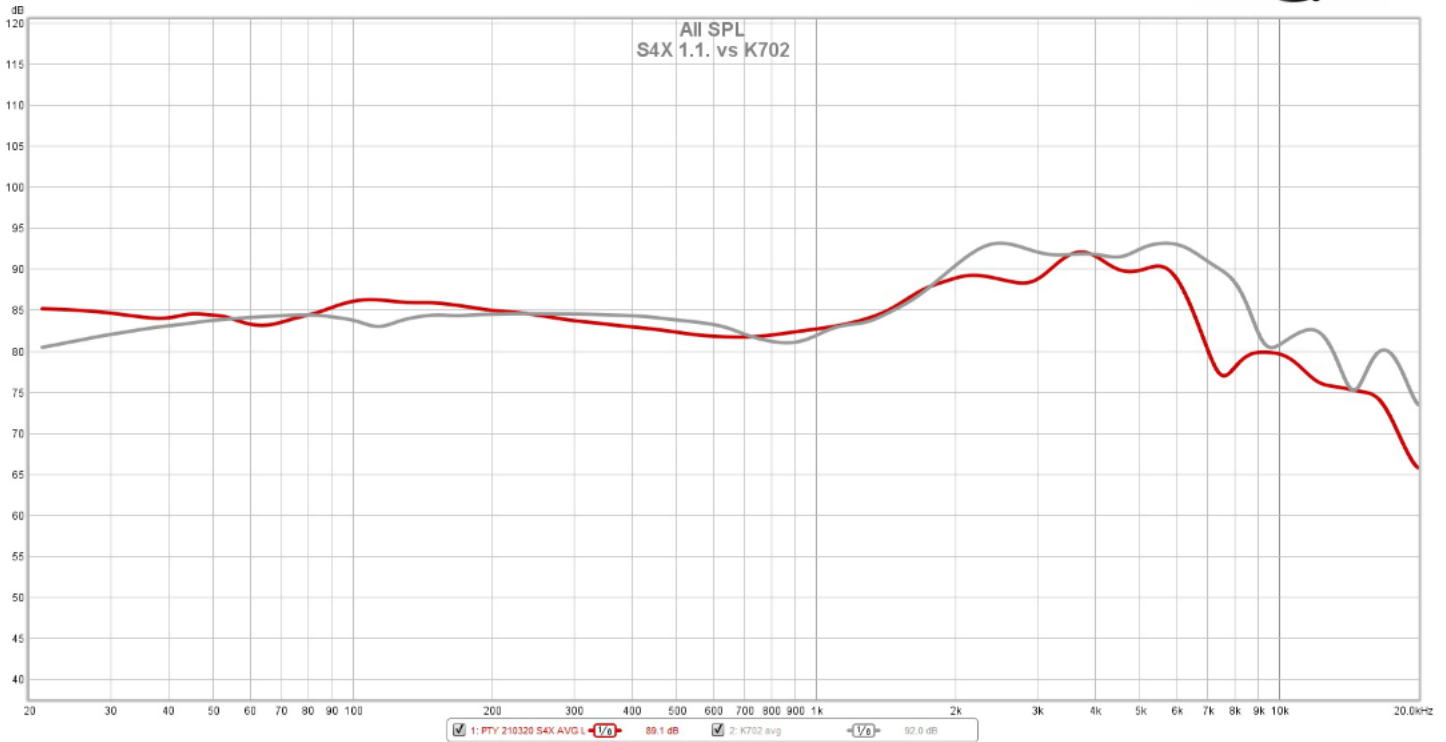
S4X 1.1 vs Sundara



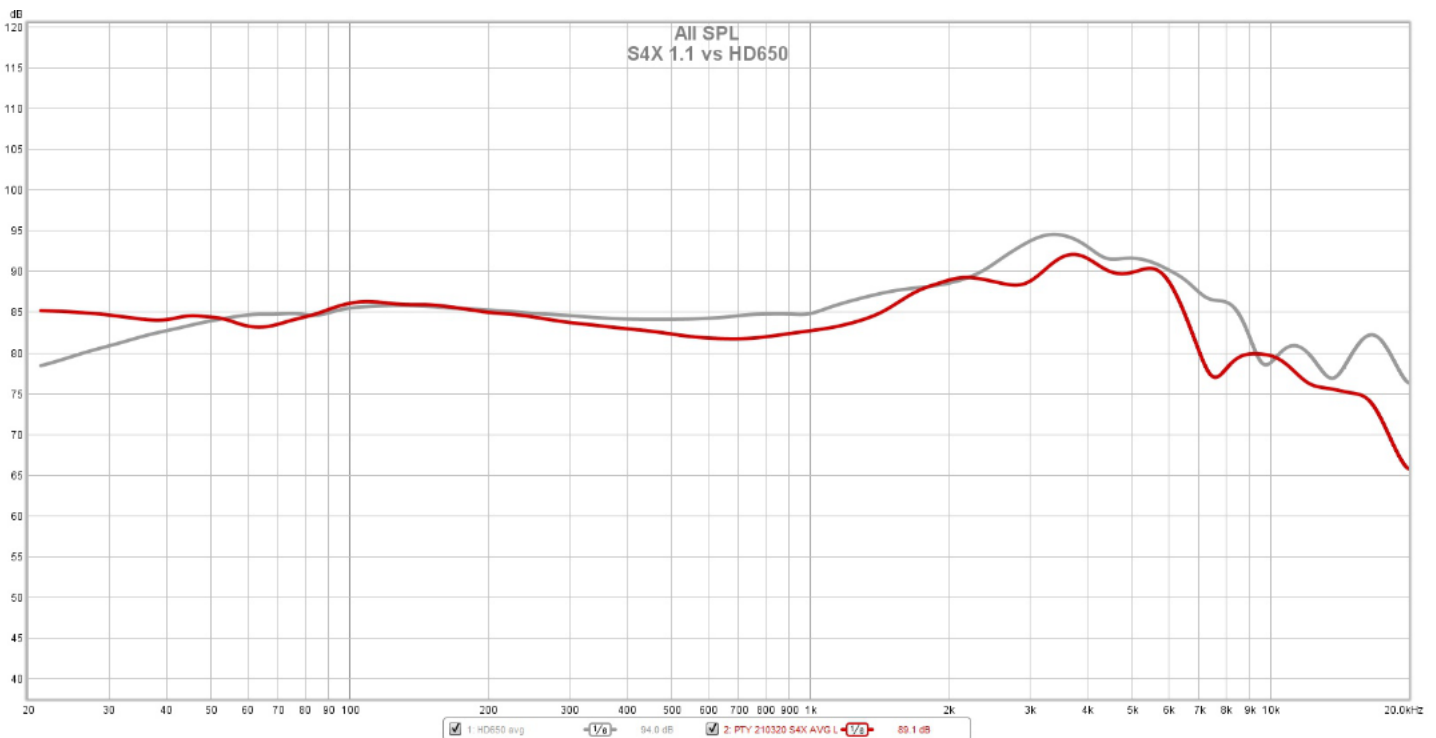
S4X 1.1 vs Focal Clear Pro



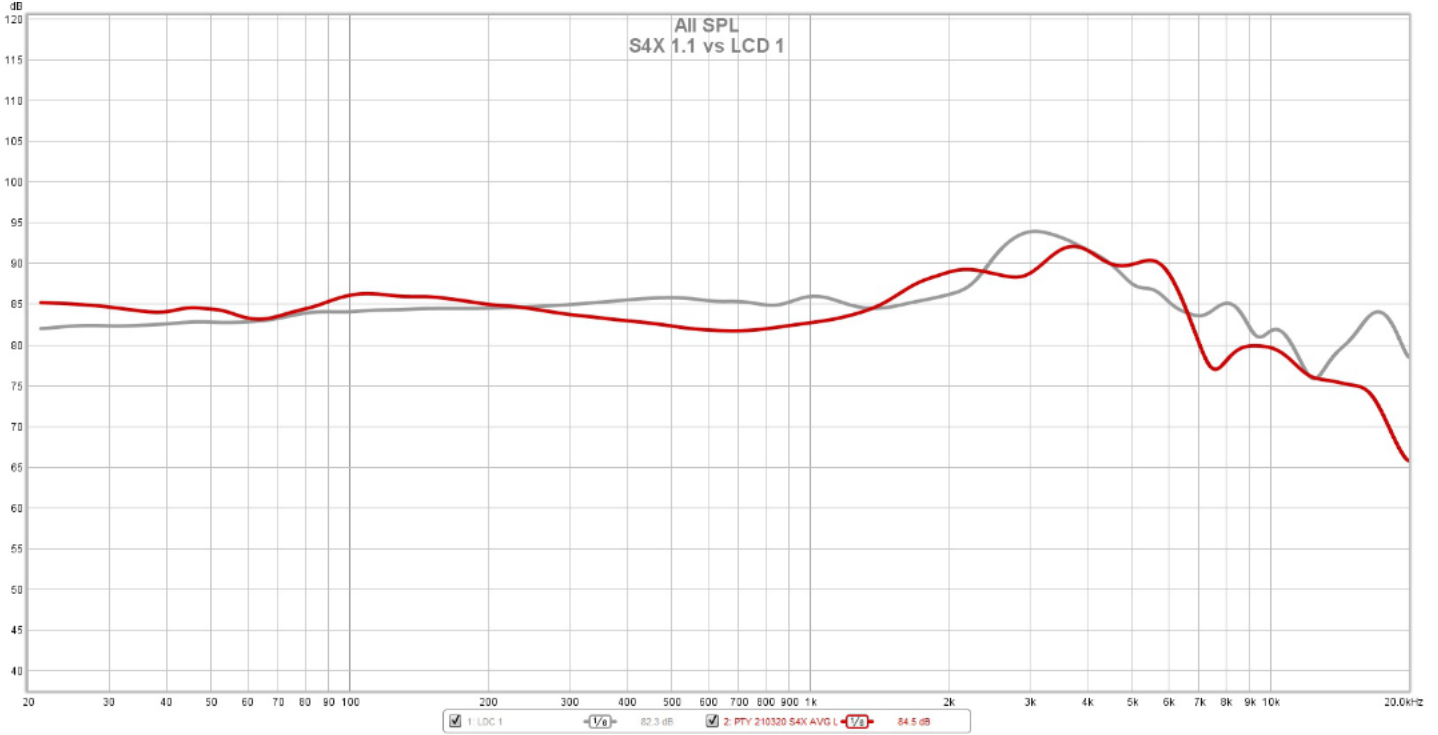
S4X 1.1 vs K702



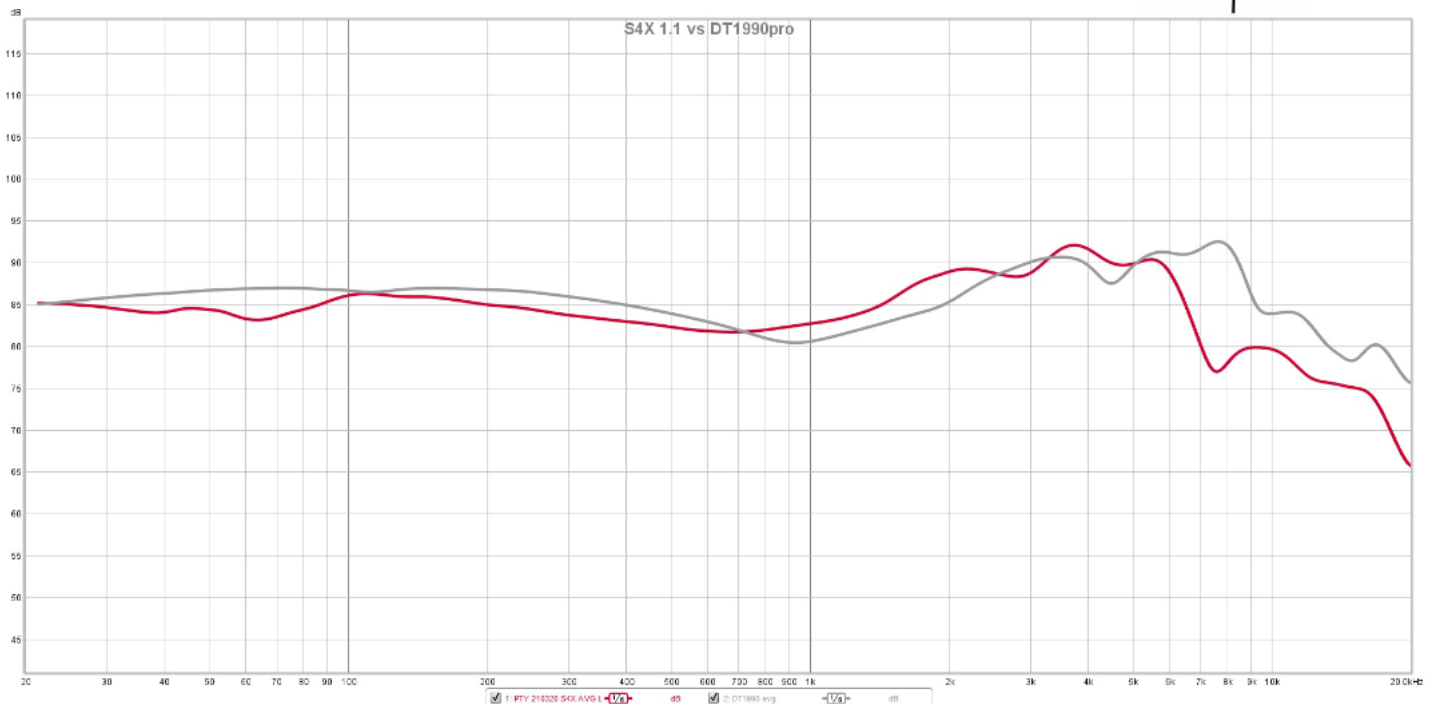
S4X 1.1 vs HD650



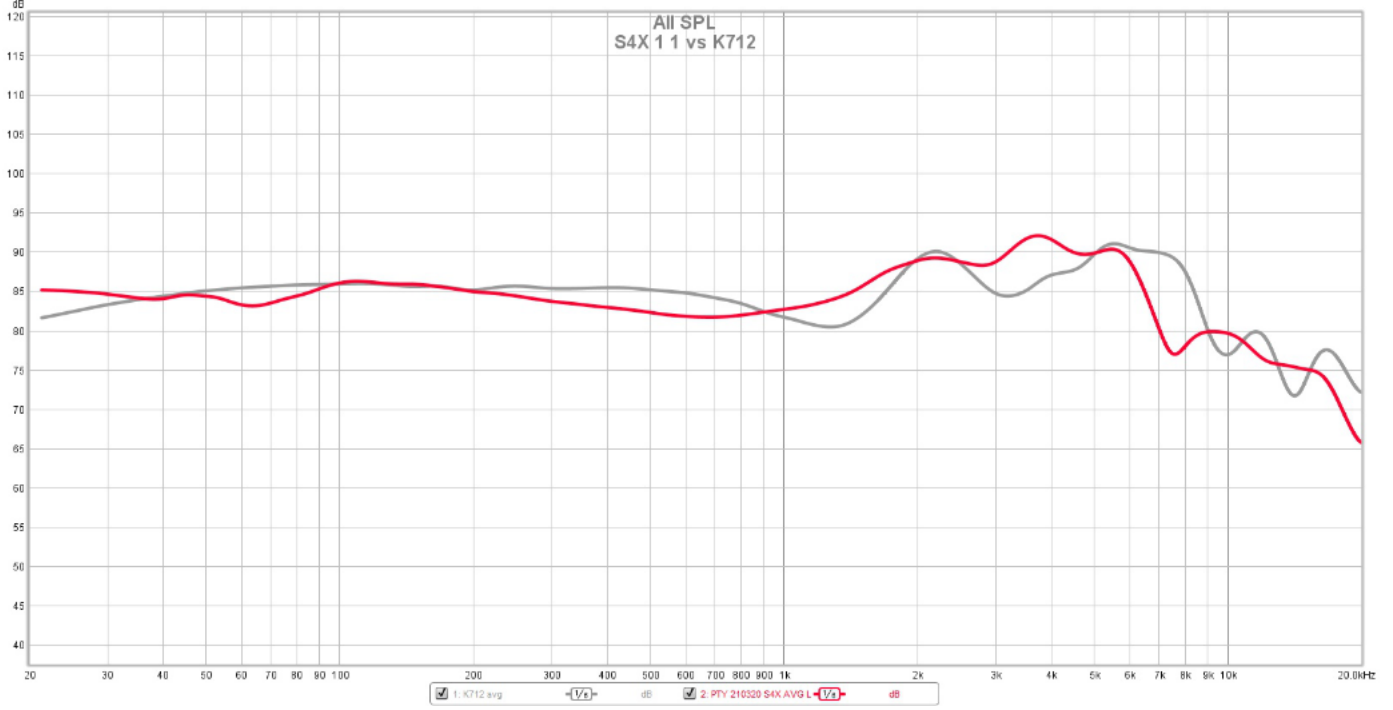
S4X 1.1 vs LCD 1



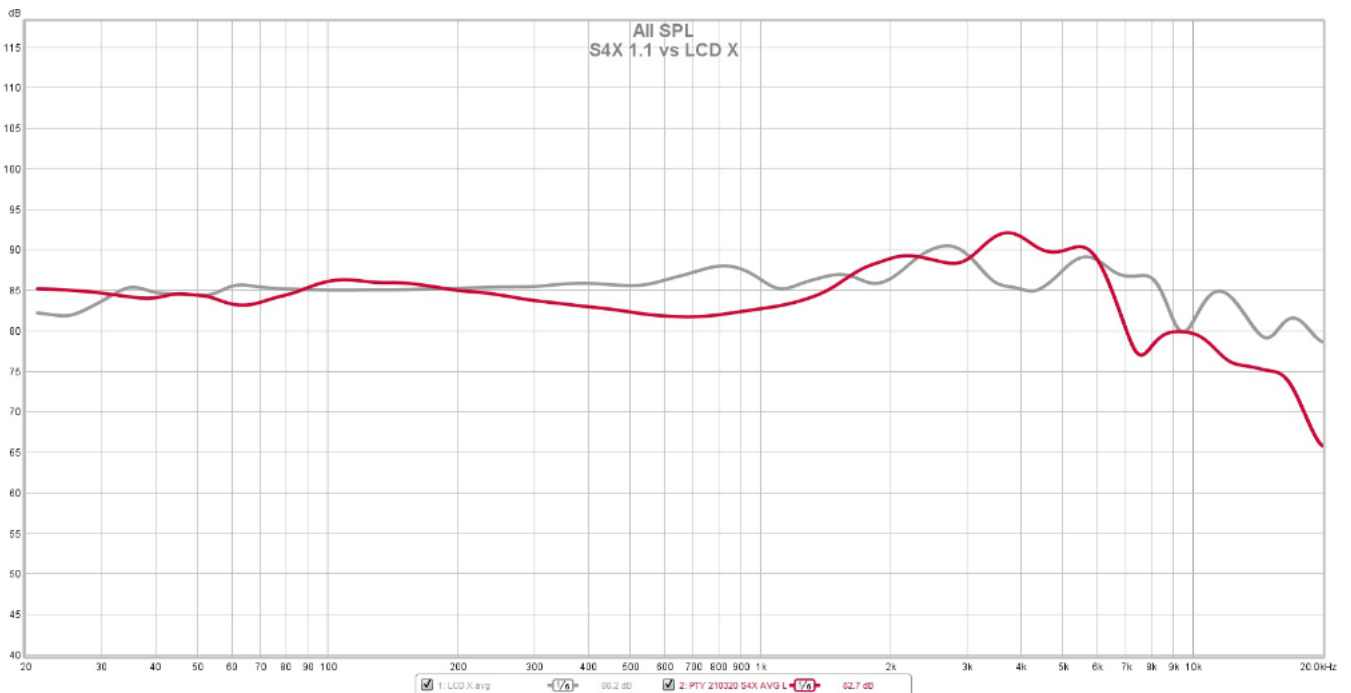
S4X 1.1 vs DT1990pro



S4X 1.1 vs AKG712

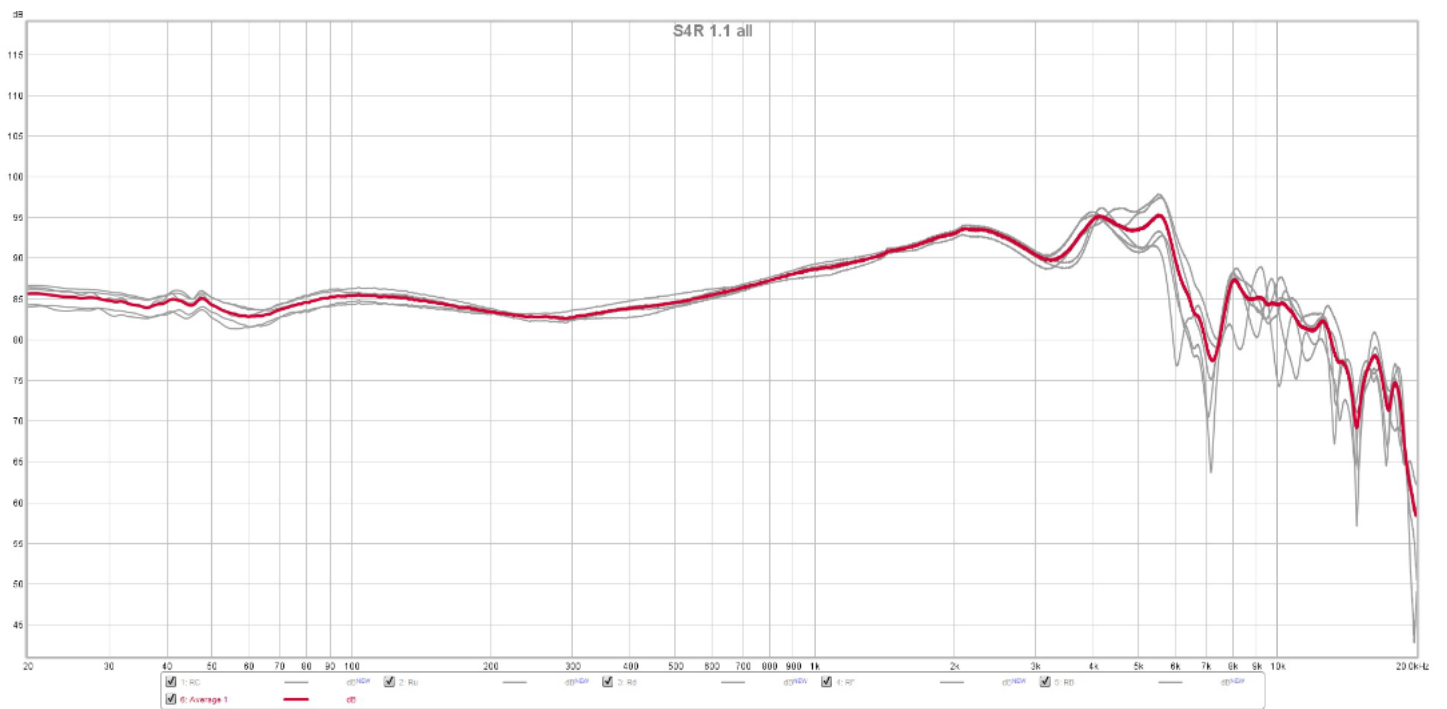


S4X 1.1 vs LCD X

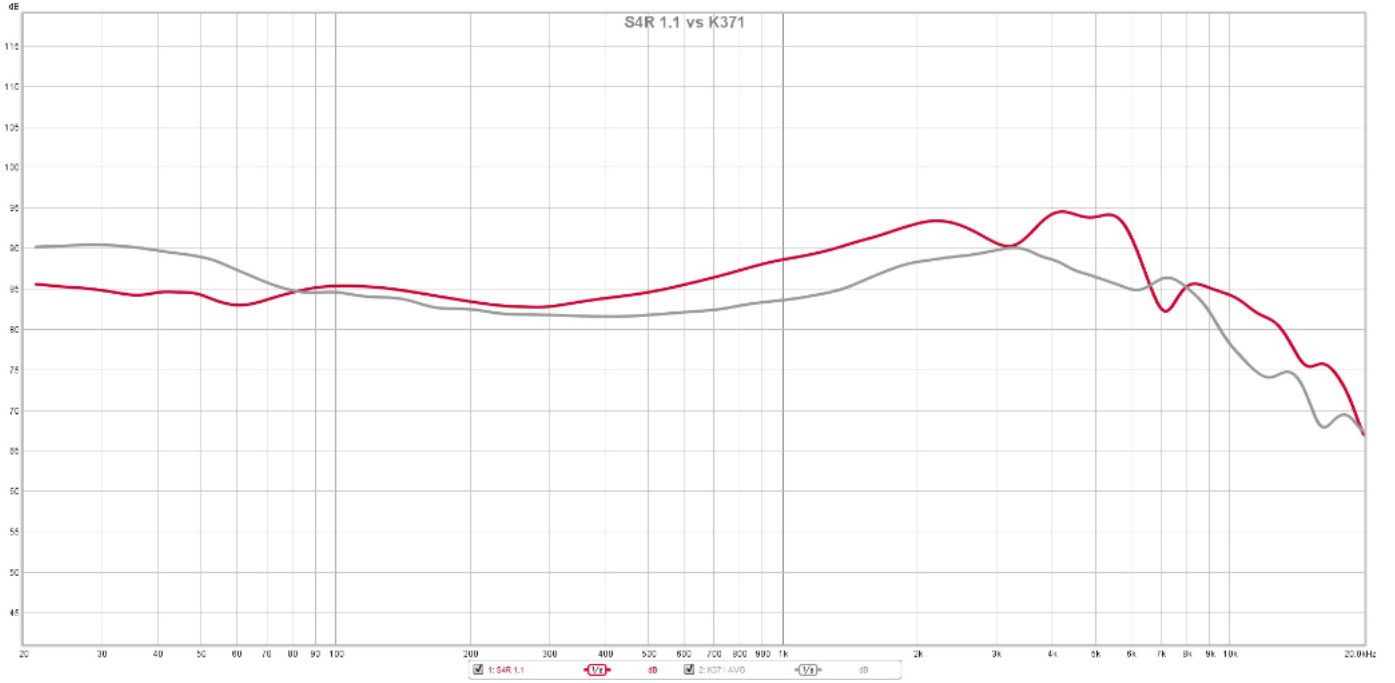


S4R 1.1 comparisons

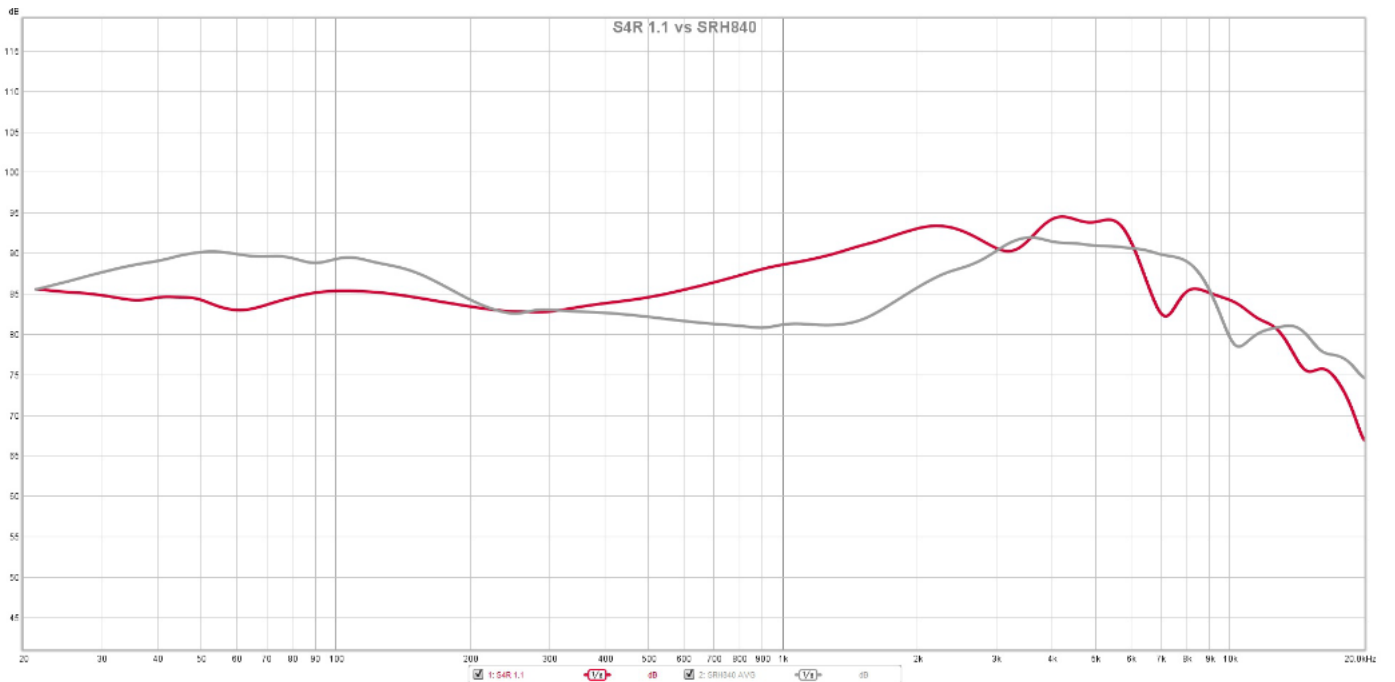
S4R - Closed back - Recording headphones



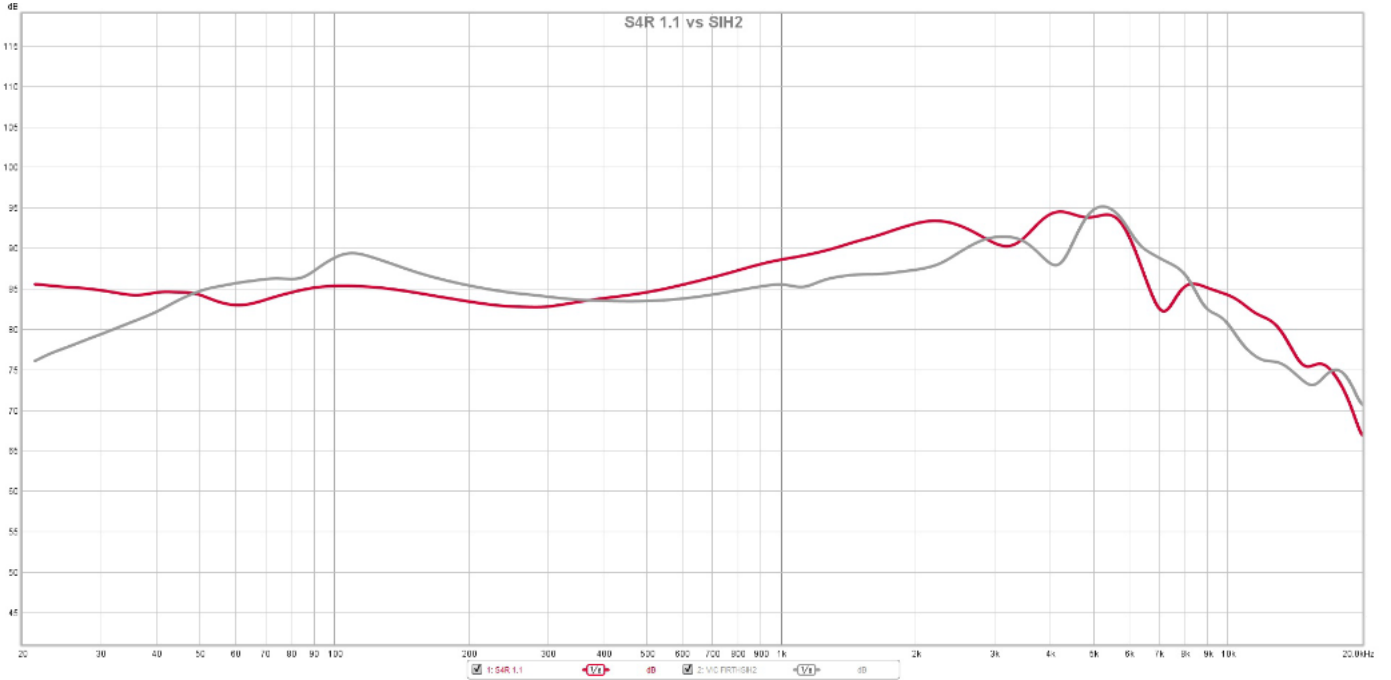
K371 by AKG



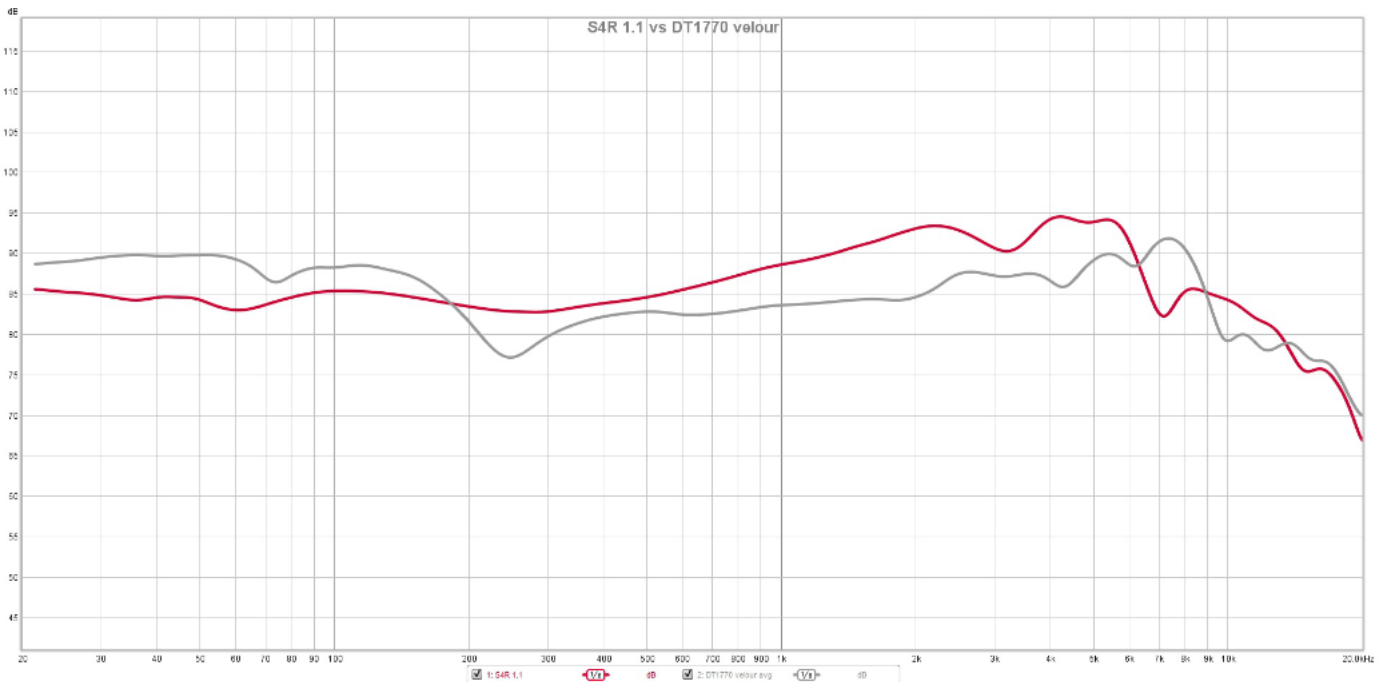
SHR840 by SHURE



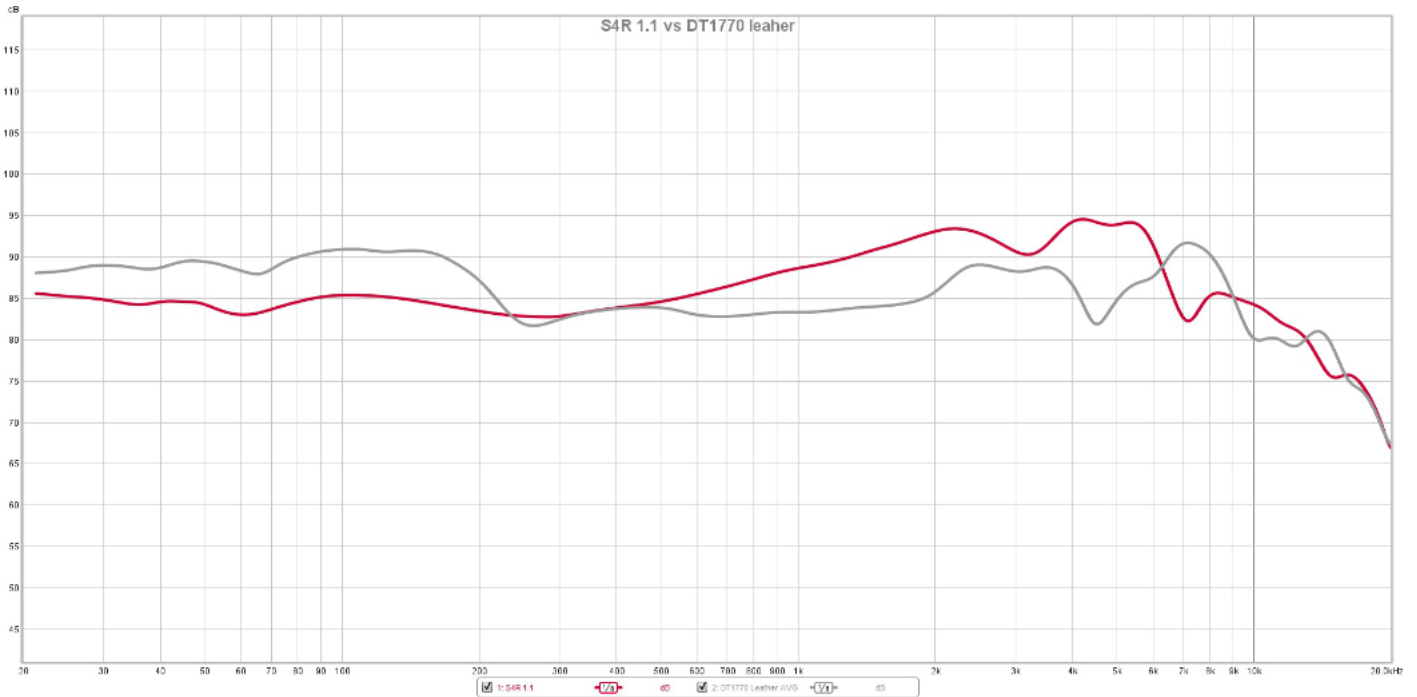
SIH2 by VIC FIRTH



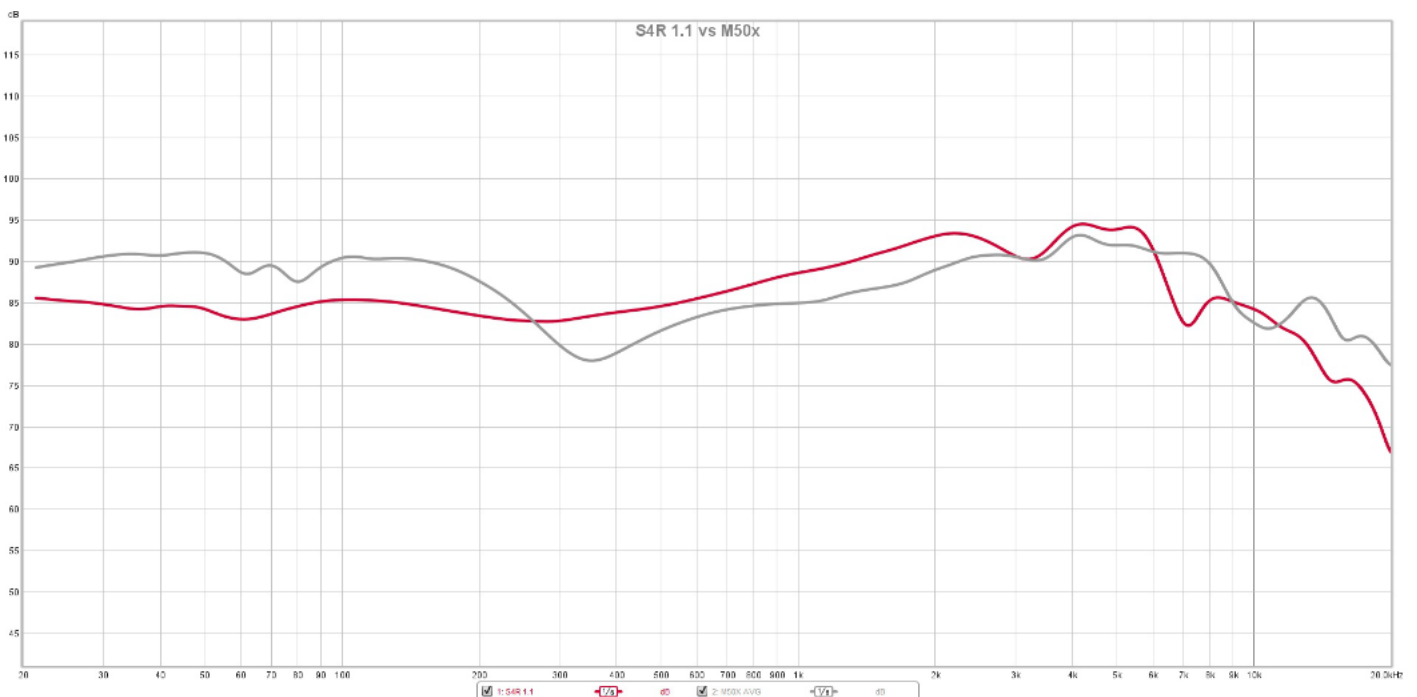
DT1770 by BEYERDYNAMIC velour



DT1770 by BEYERDYNAMIC leather



M50X by AUDIO TECHNICA



3. A WORD OF CAUTION

Measurements are here to help with educated decision when you're considering buying OLLO Audio headphones. No standard or method for measuring headphones performance is designed to mimic your ears and your taste. Please take this into consideration. Our advice is to try them out as this is the only way to know for sure, if they meet your expectations. If you need more info on trial period, please reach out via info@olloaudio.com or social media chat channels.
Rok Gulič, founder

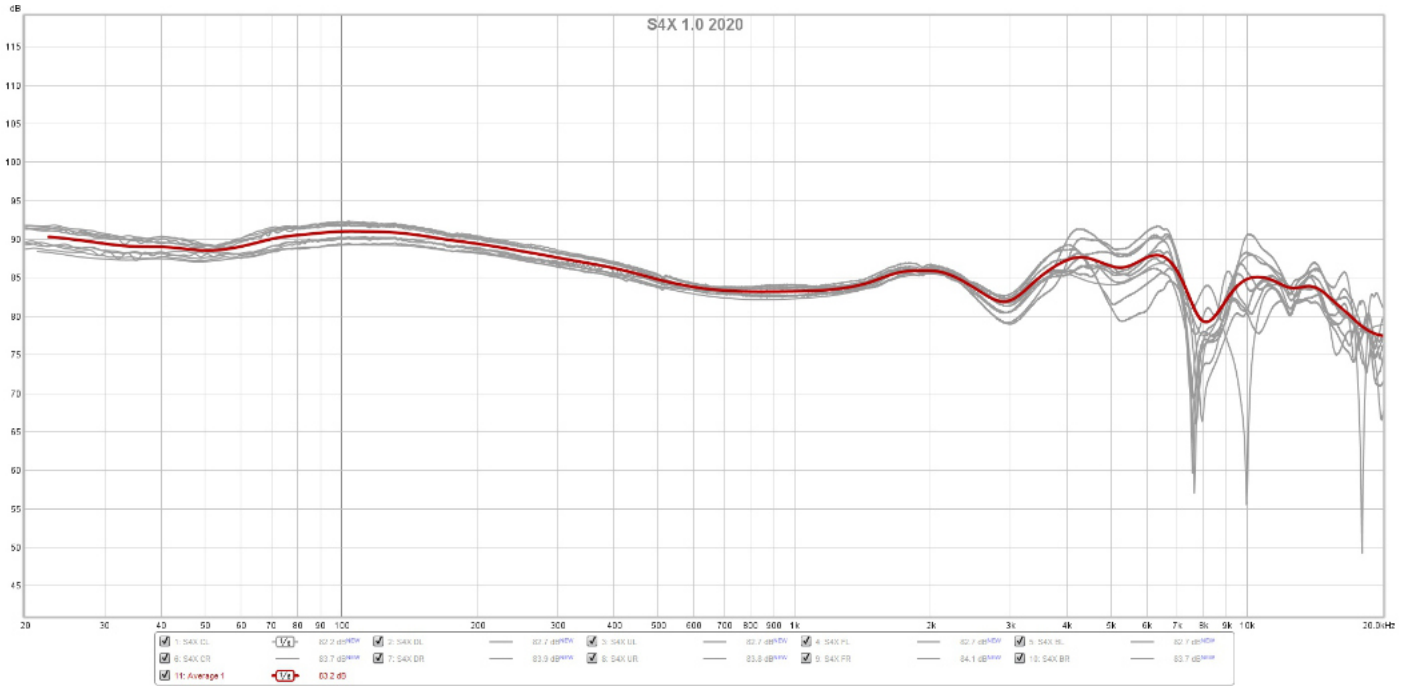


APX1.ALL

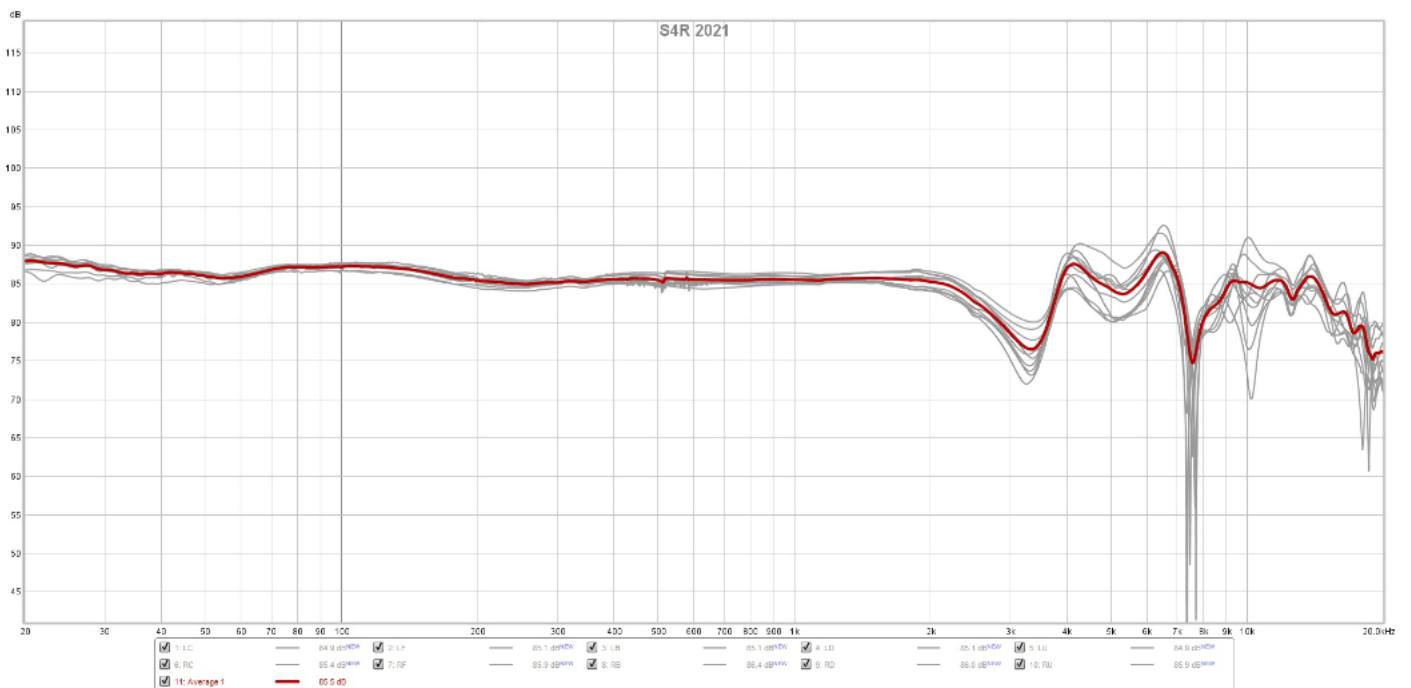
MEASUREMENTS

In this appendix you can find all the measurements of every headphone we have in the lab with 60318-1 standard.

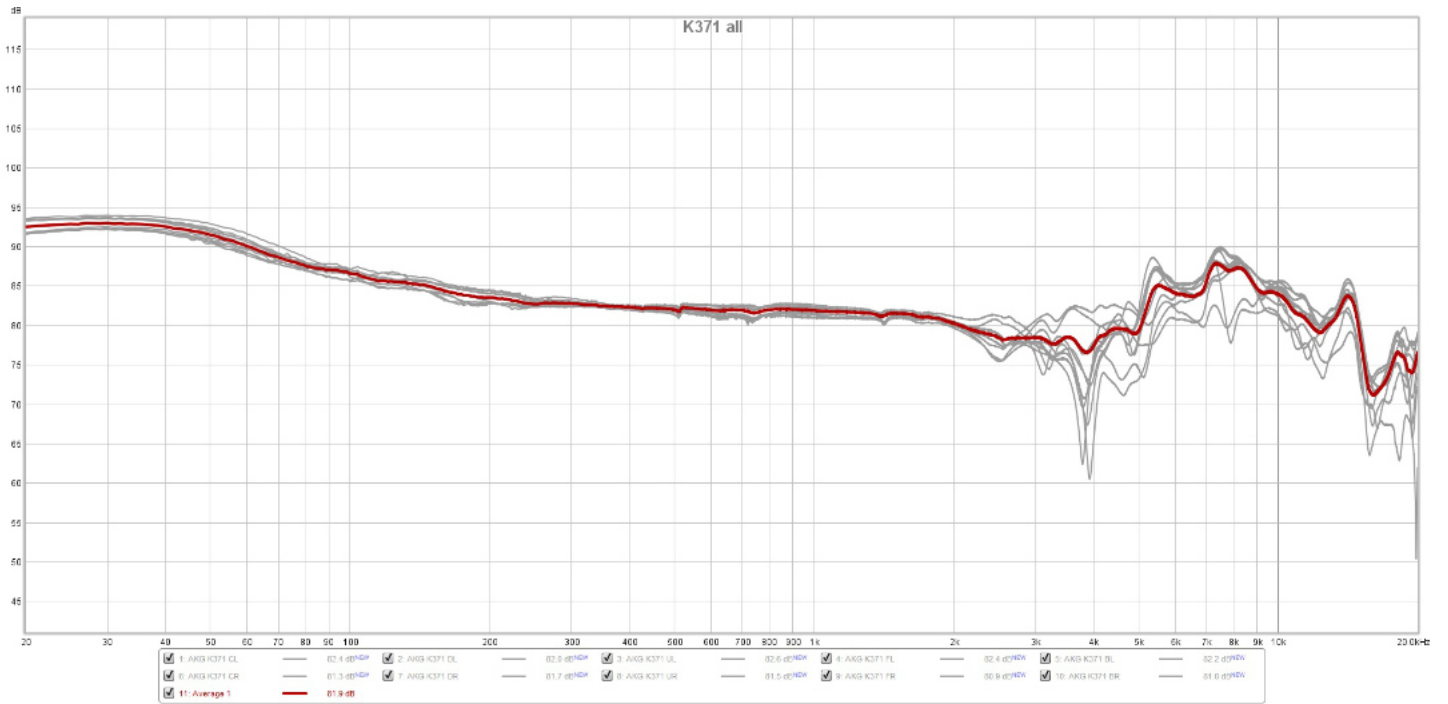
S4X 1.1 2020



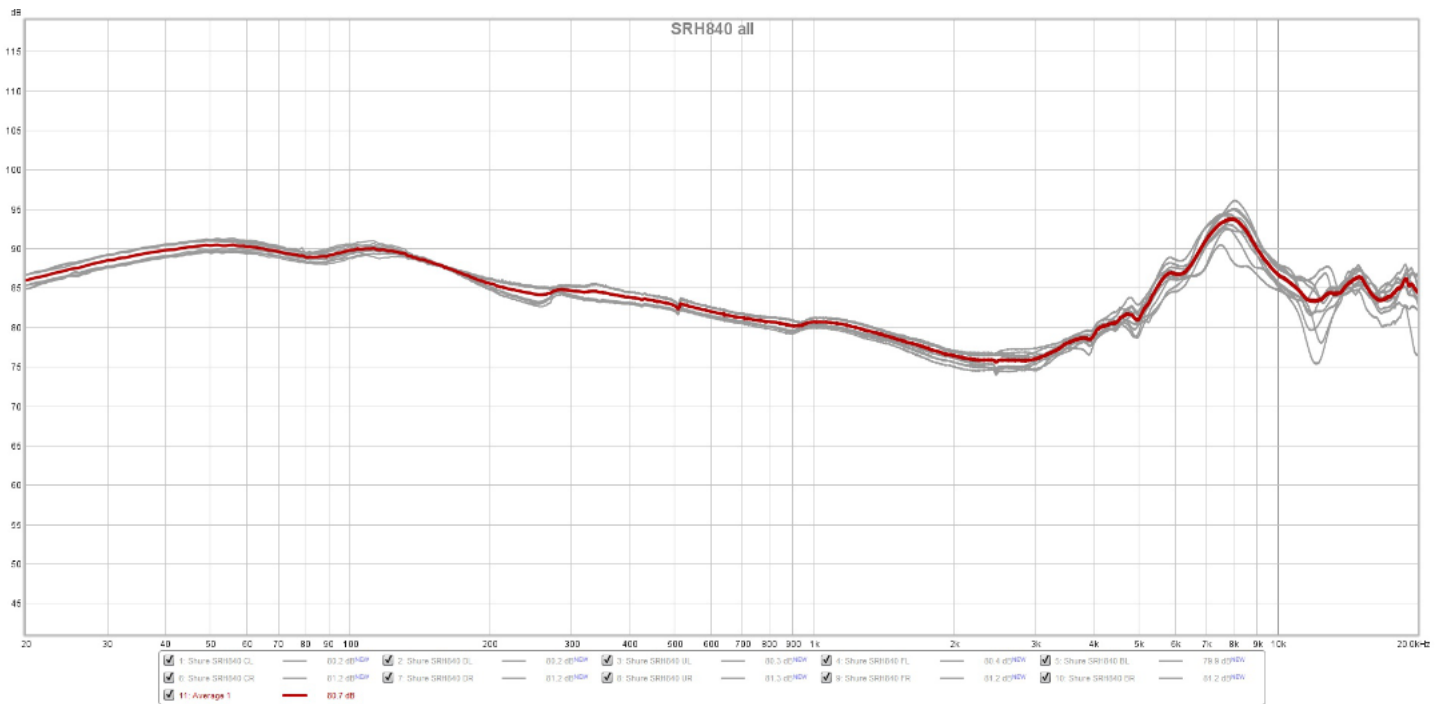
S4R 1.1 2021



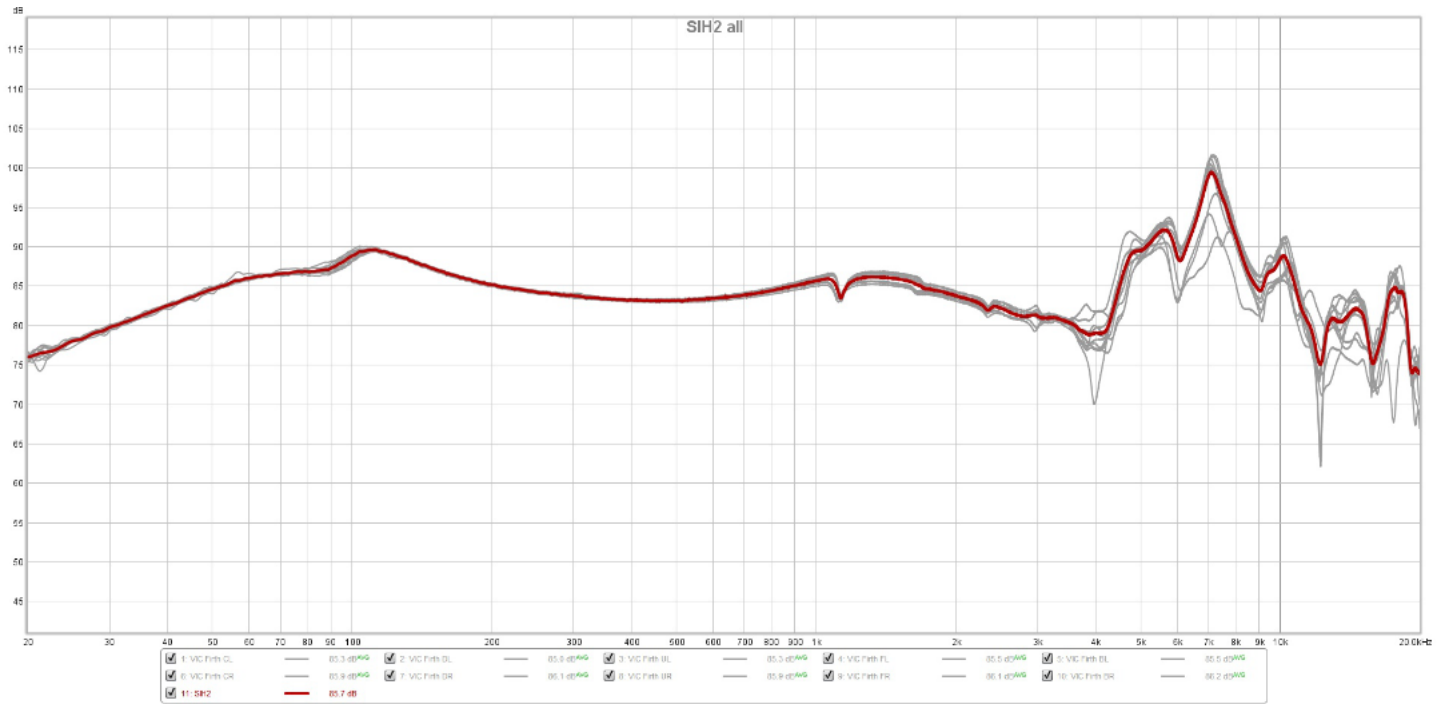
K371



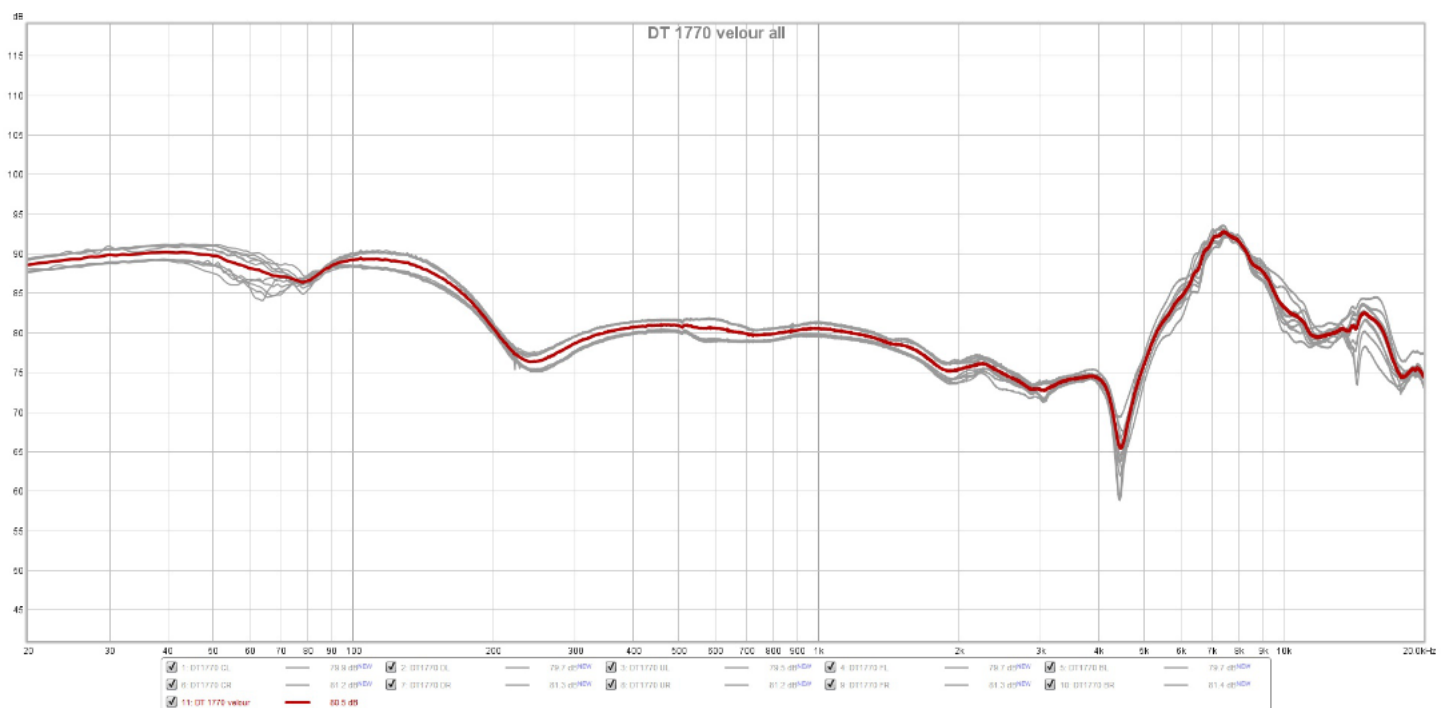
SRH840



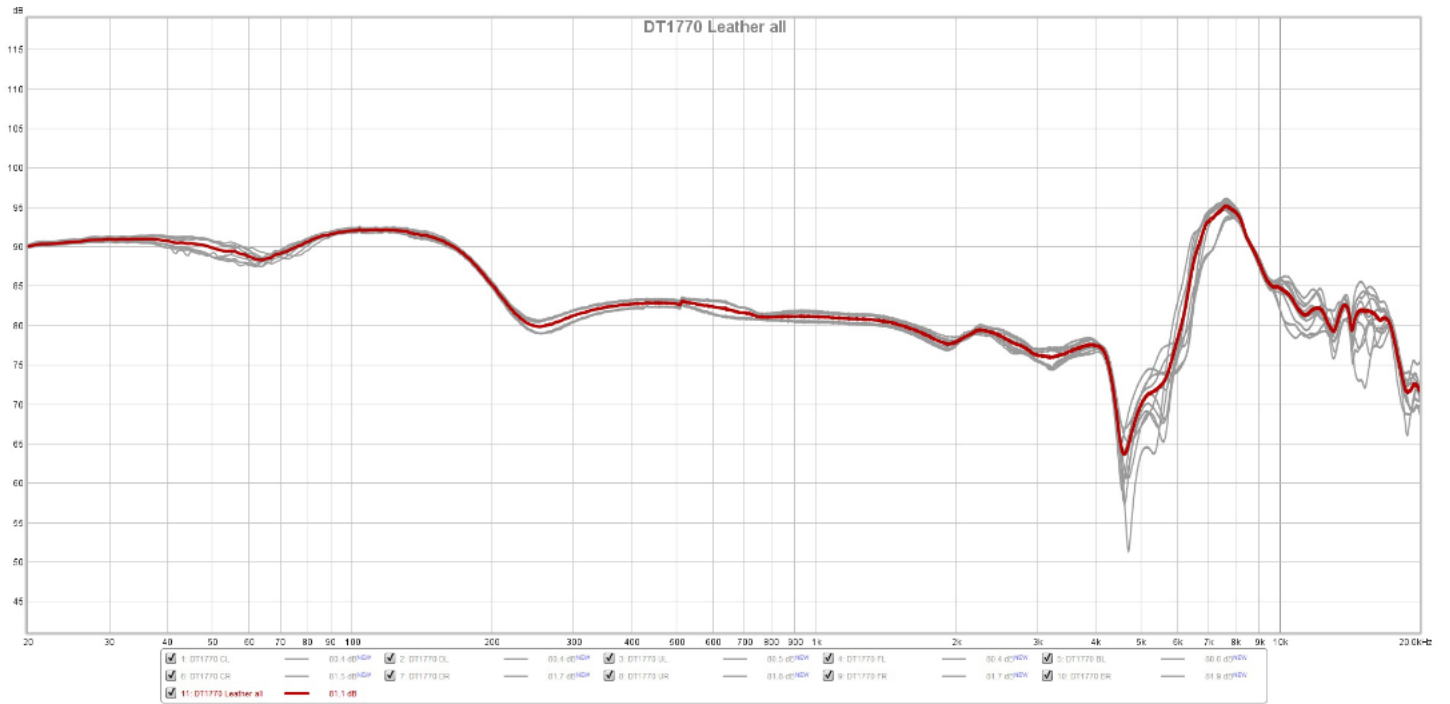
SIH2



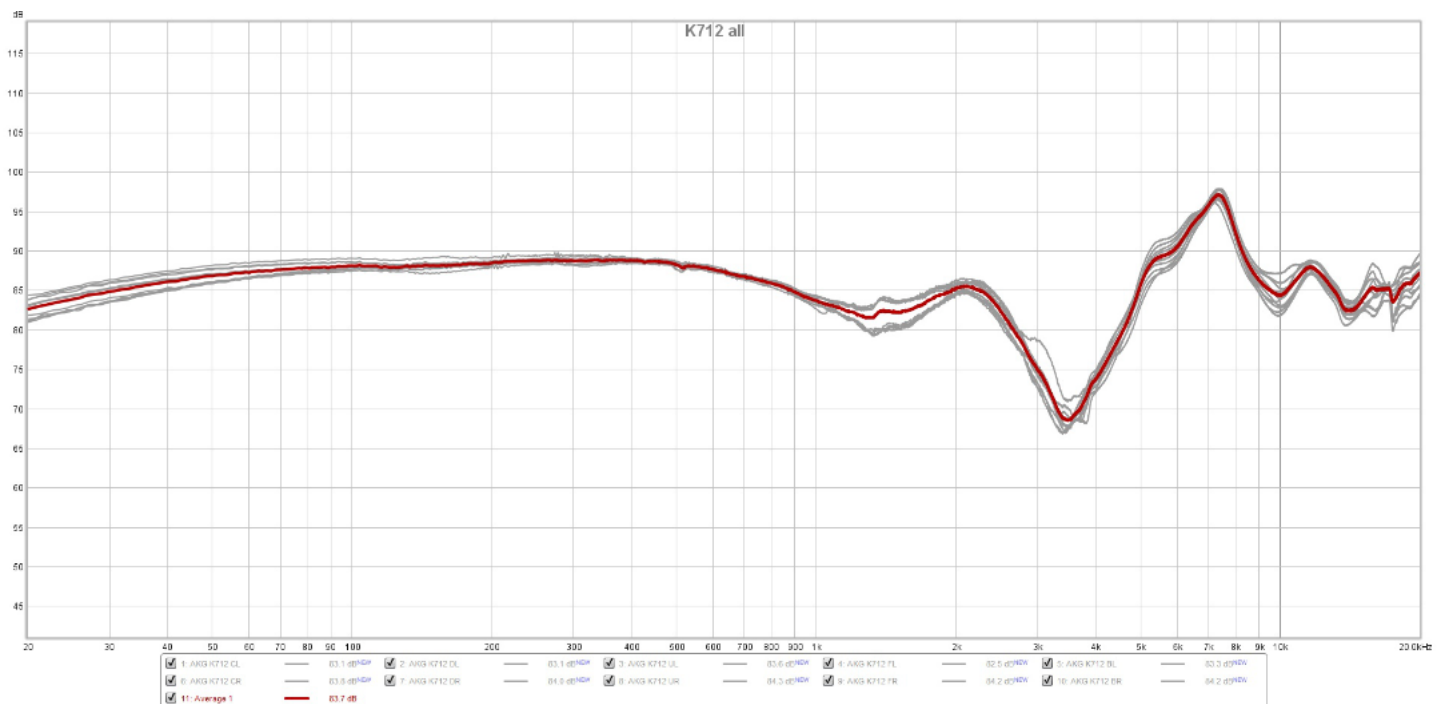
DT1770 velour



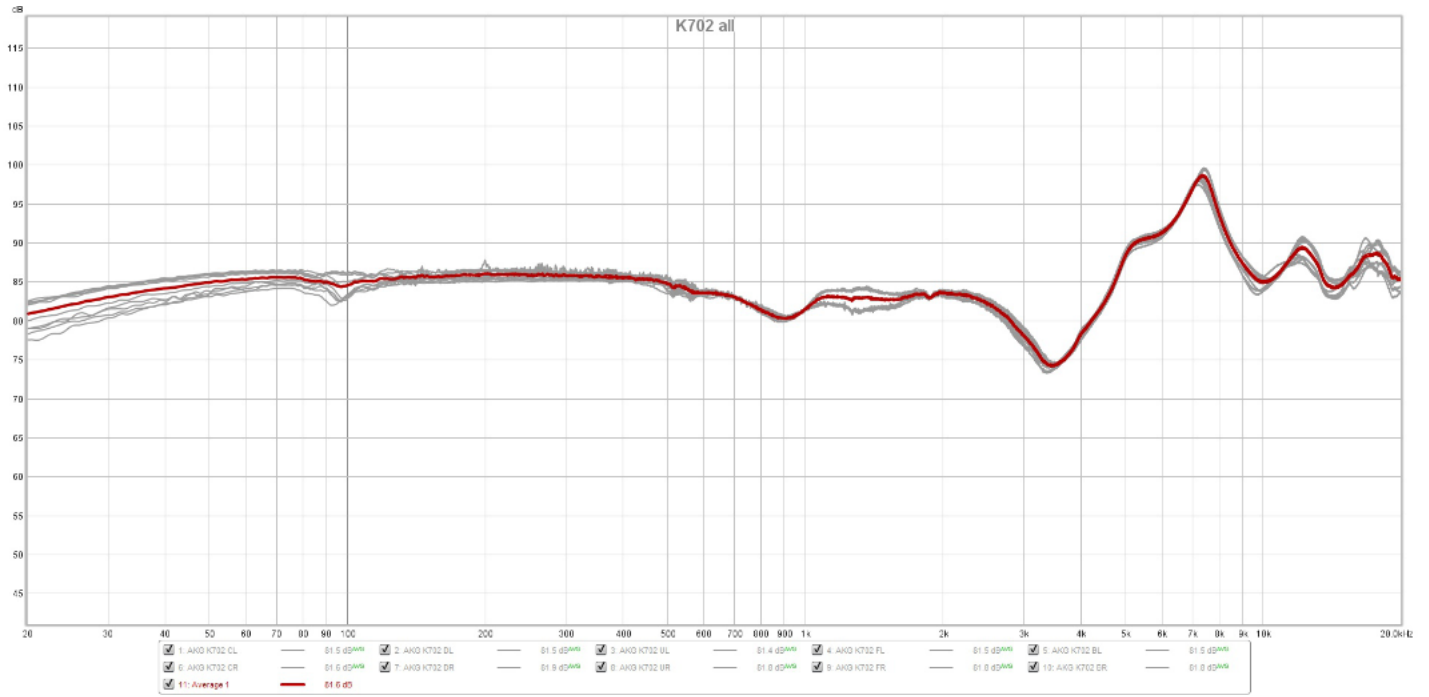
DT1770 leather



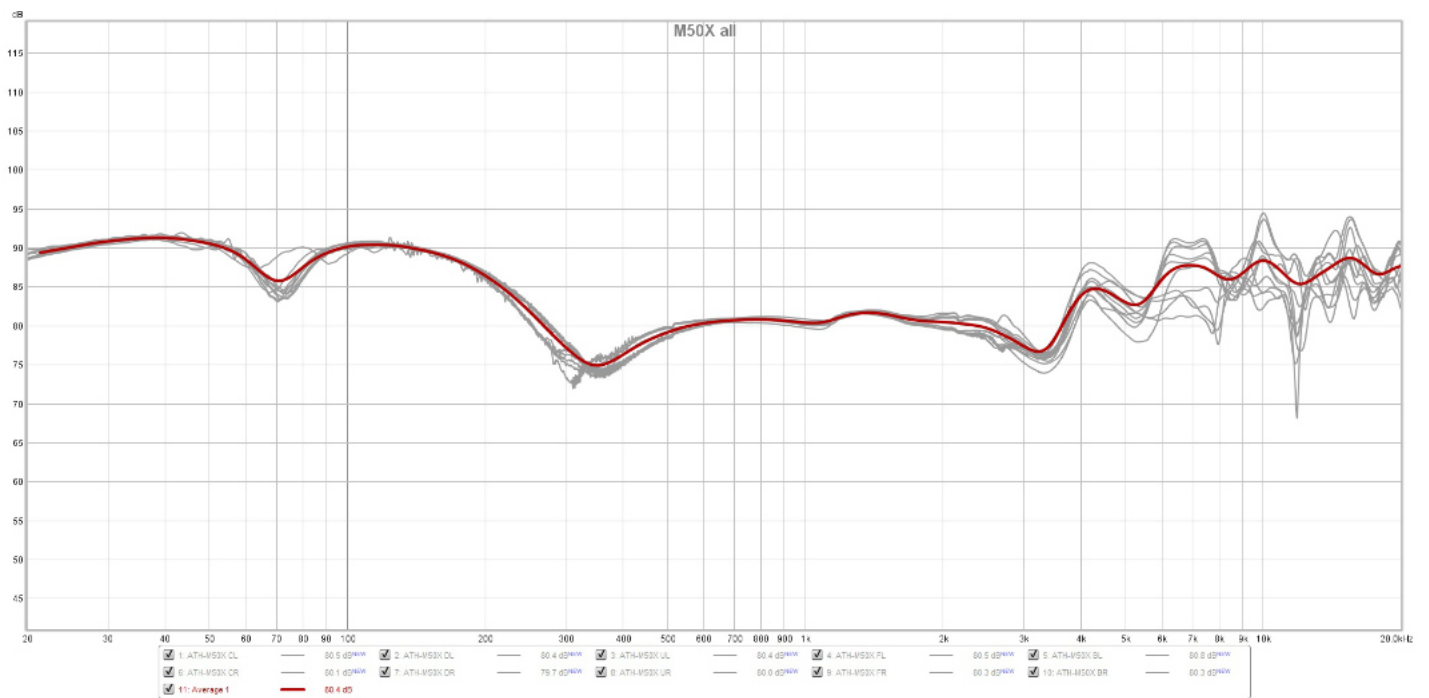
K712



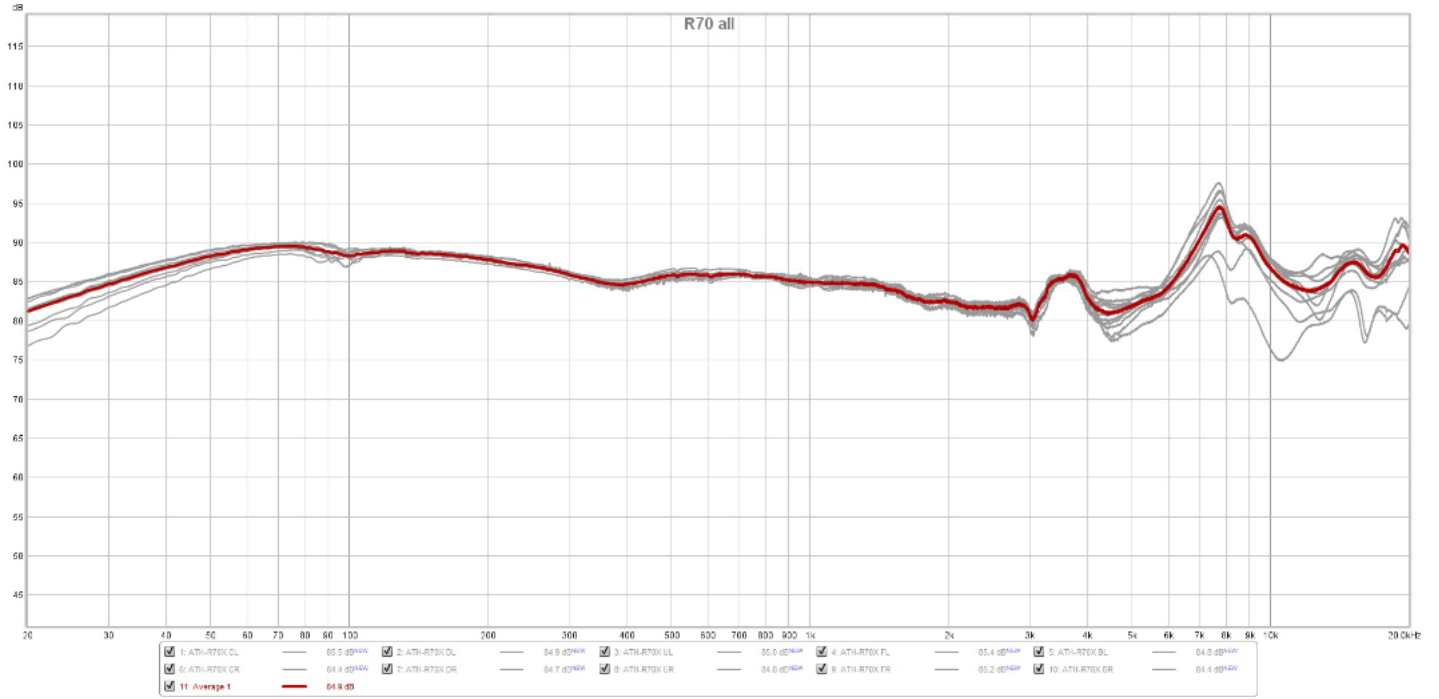
K702



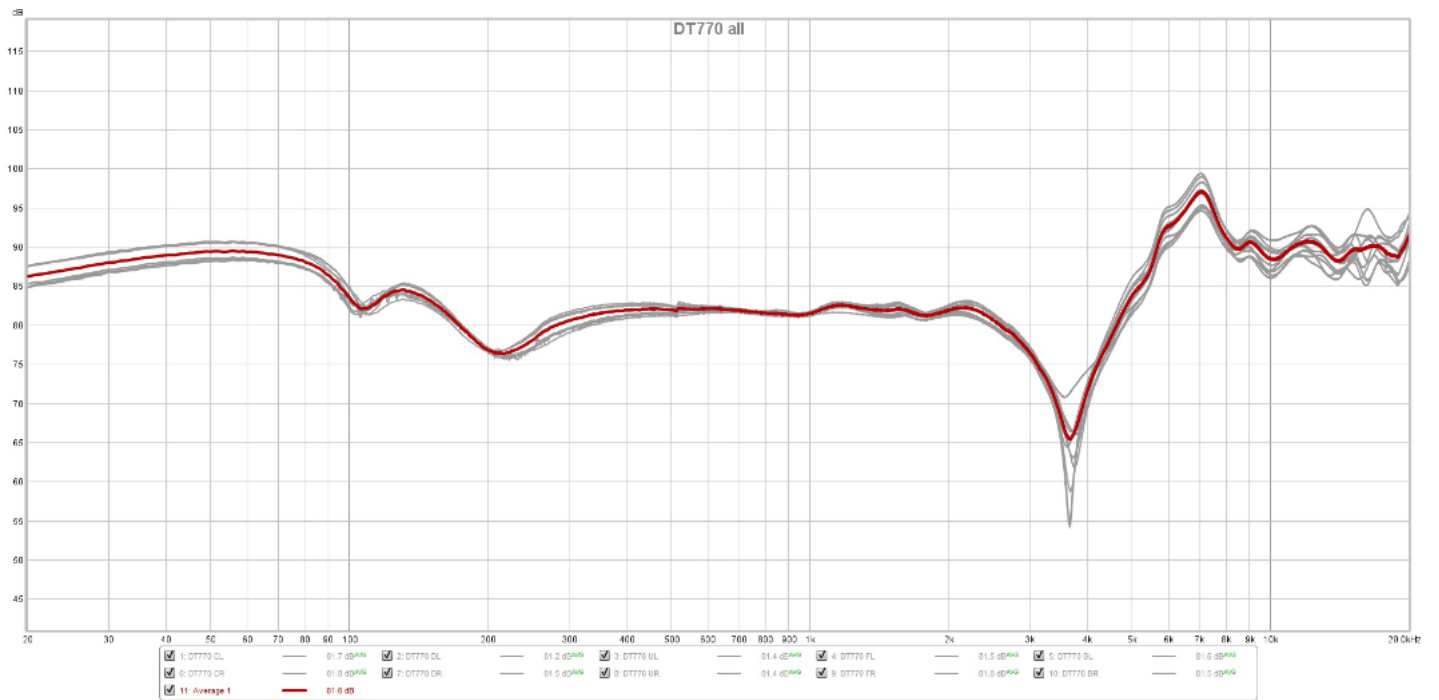
M50X



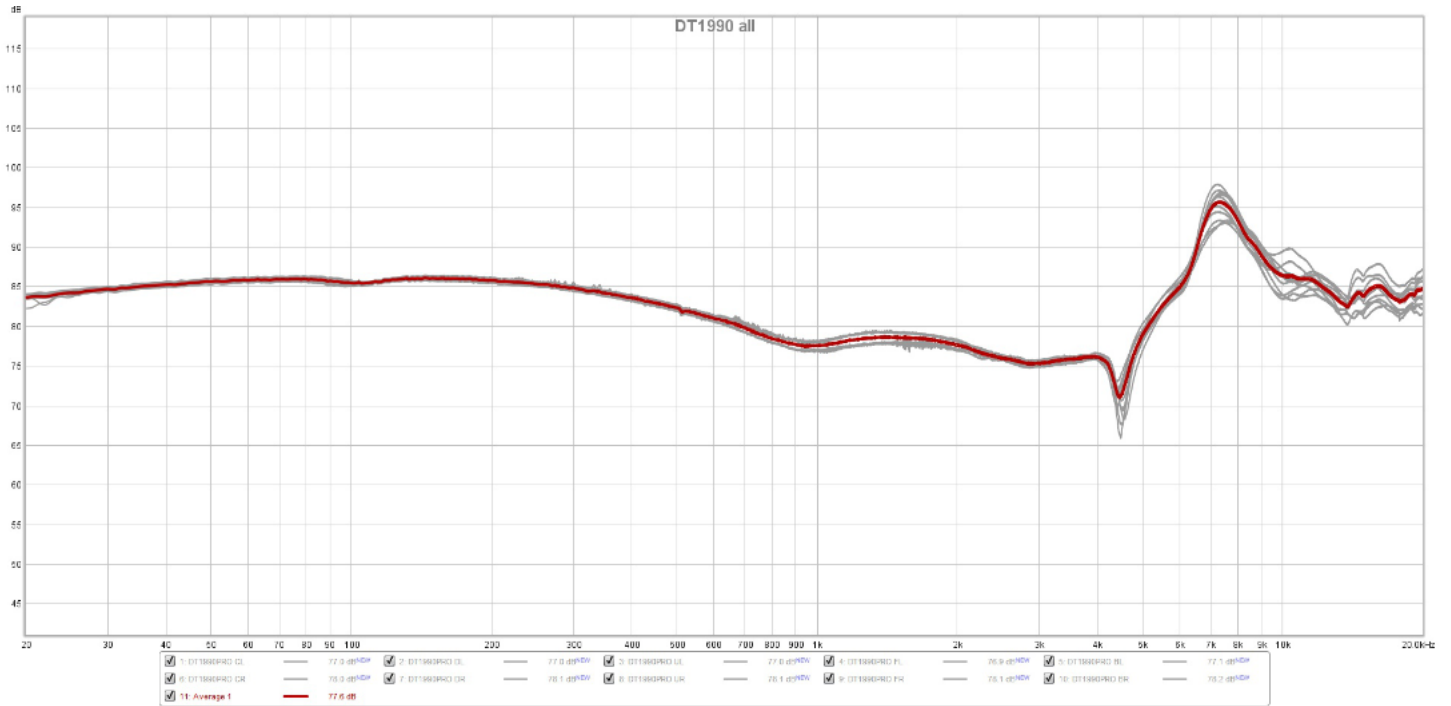
R70



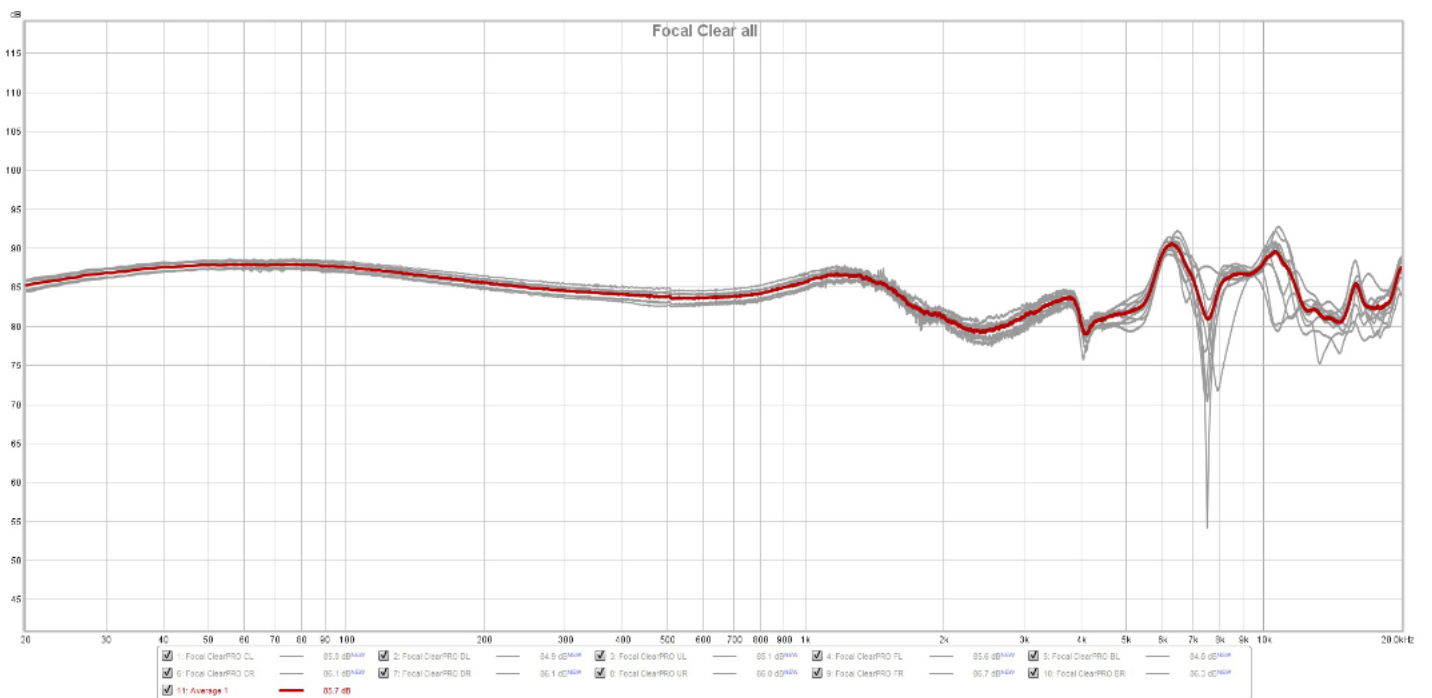
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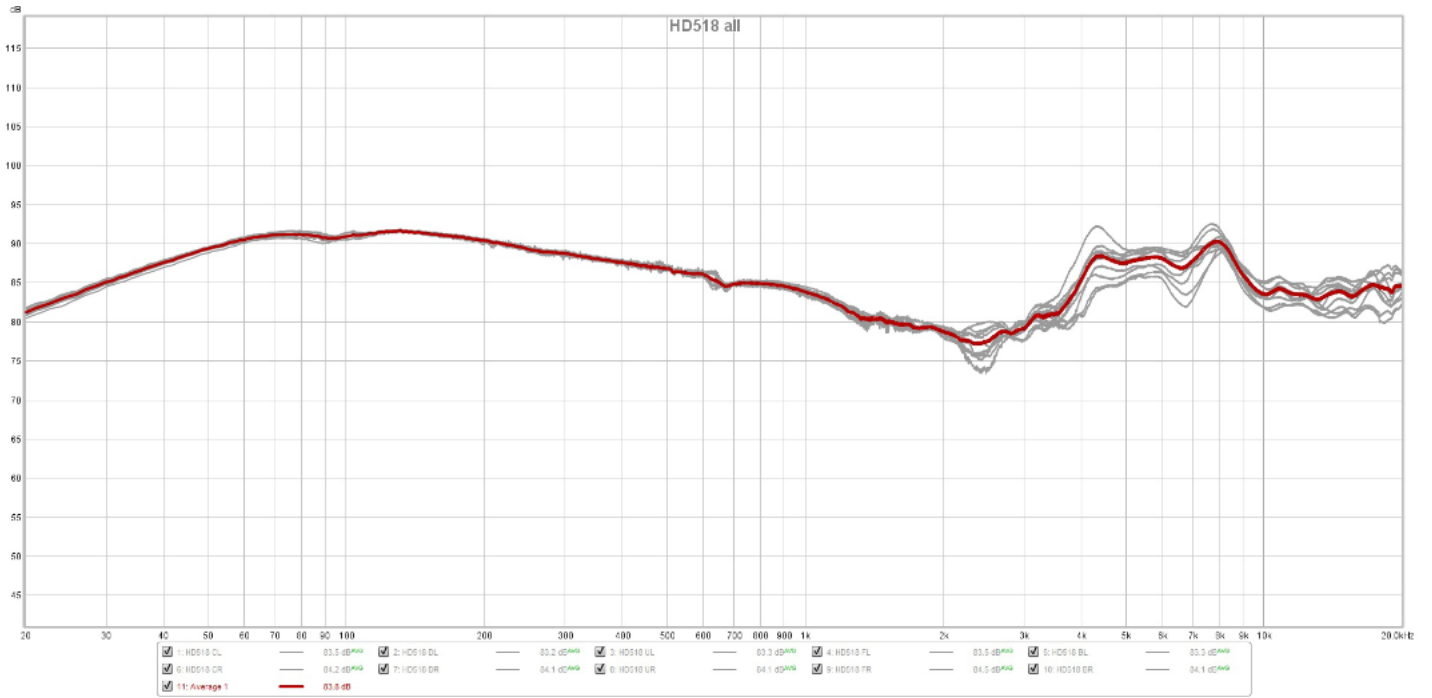
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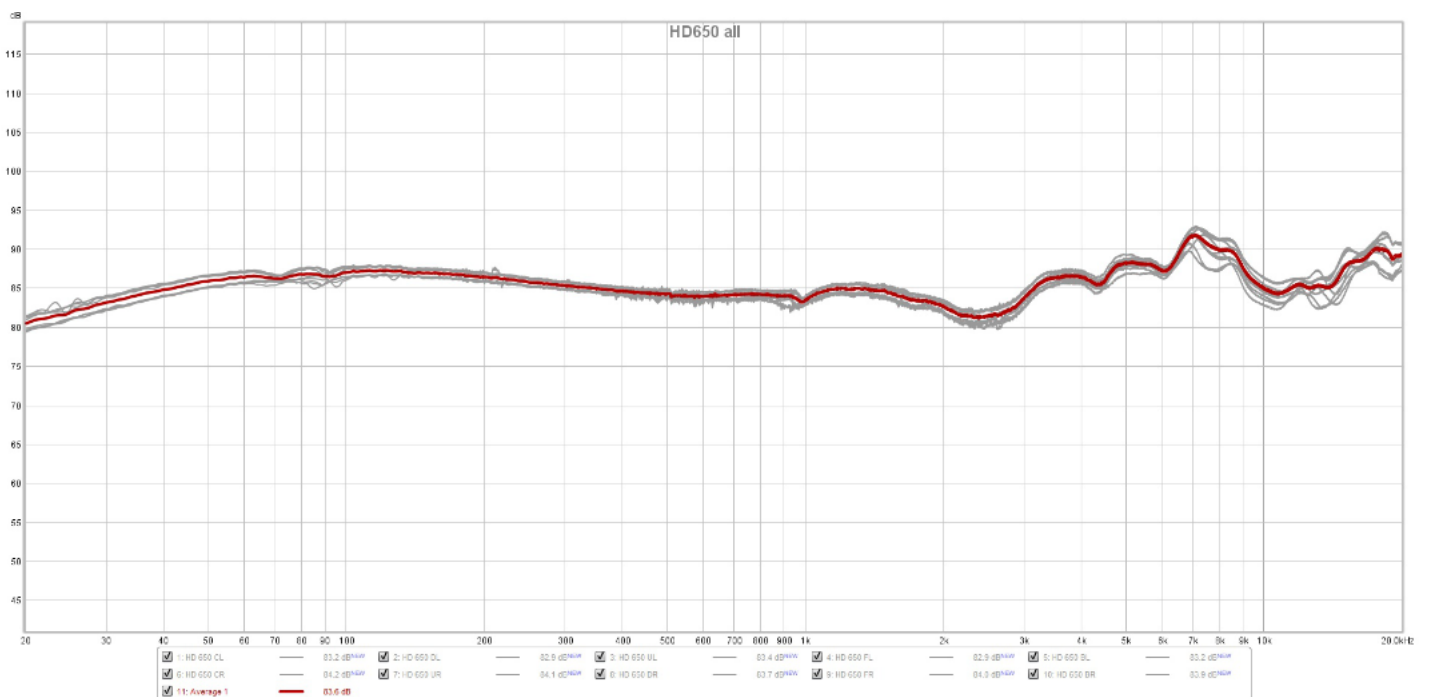
FOCAL CLEAR PRO



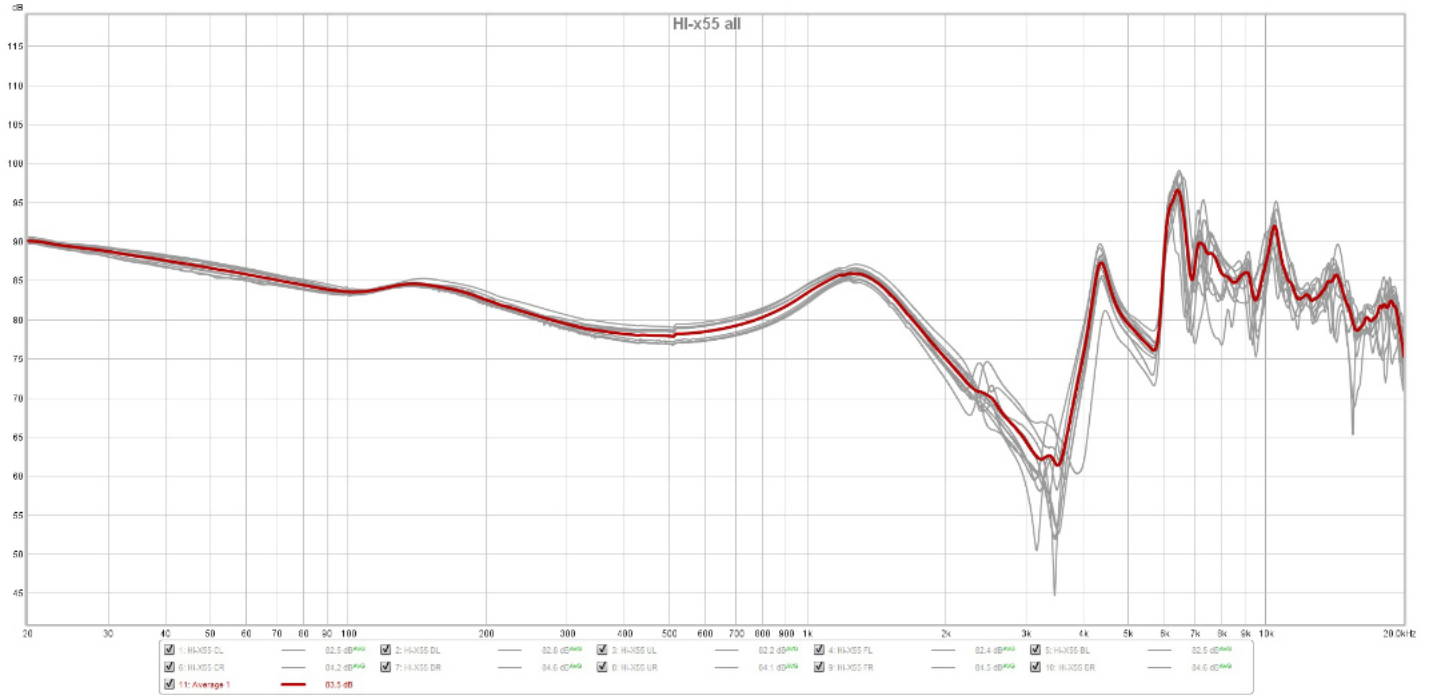
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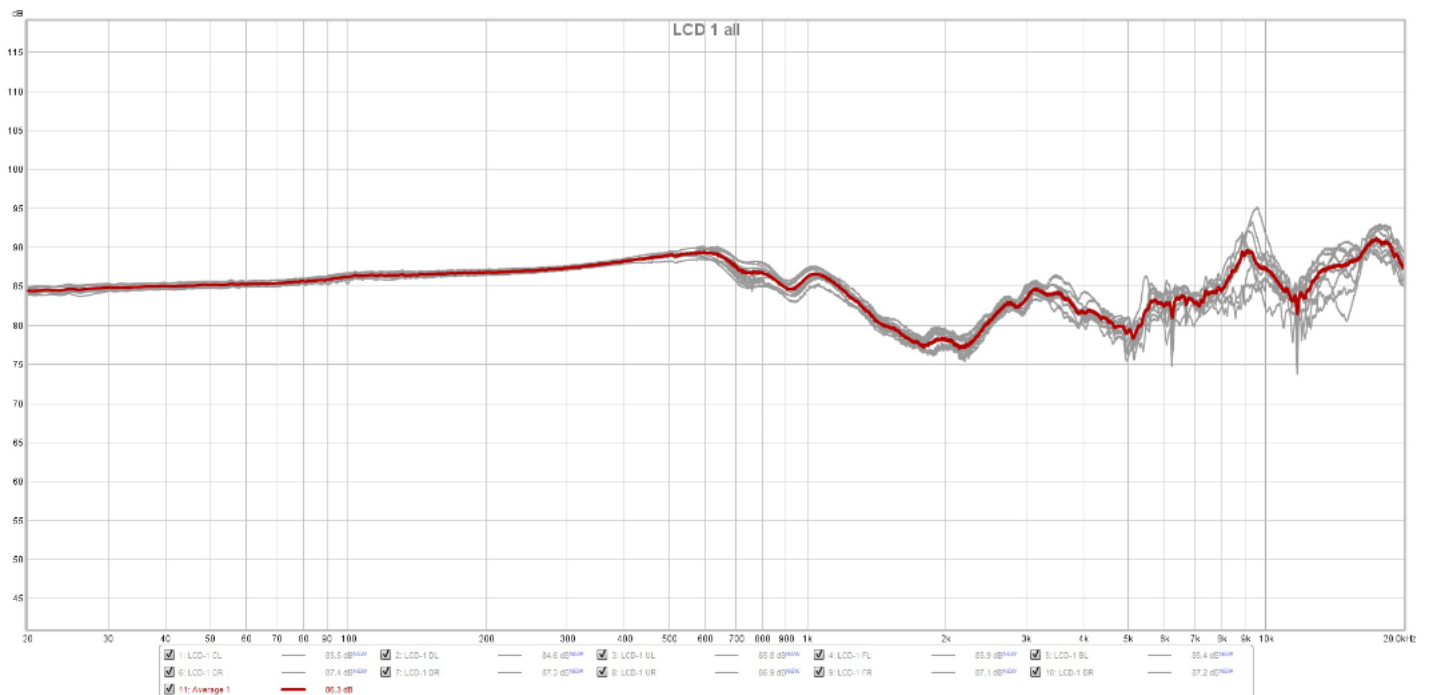
HD650



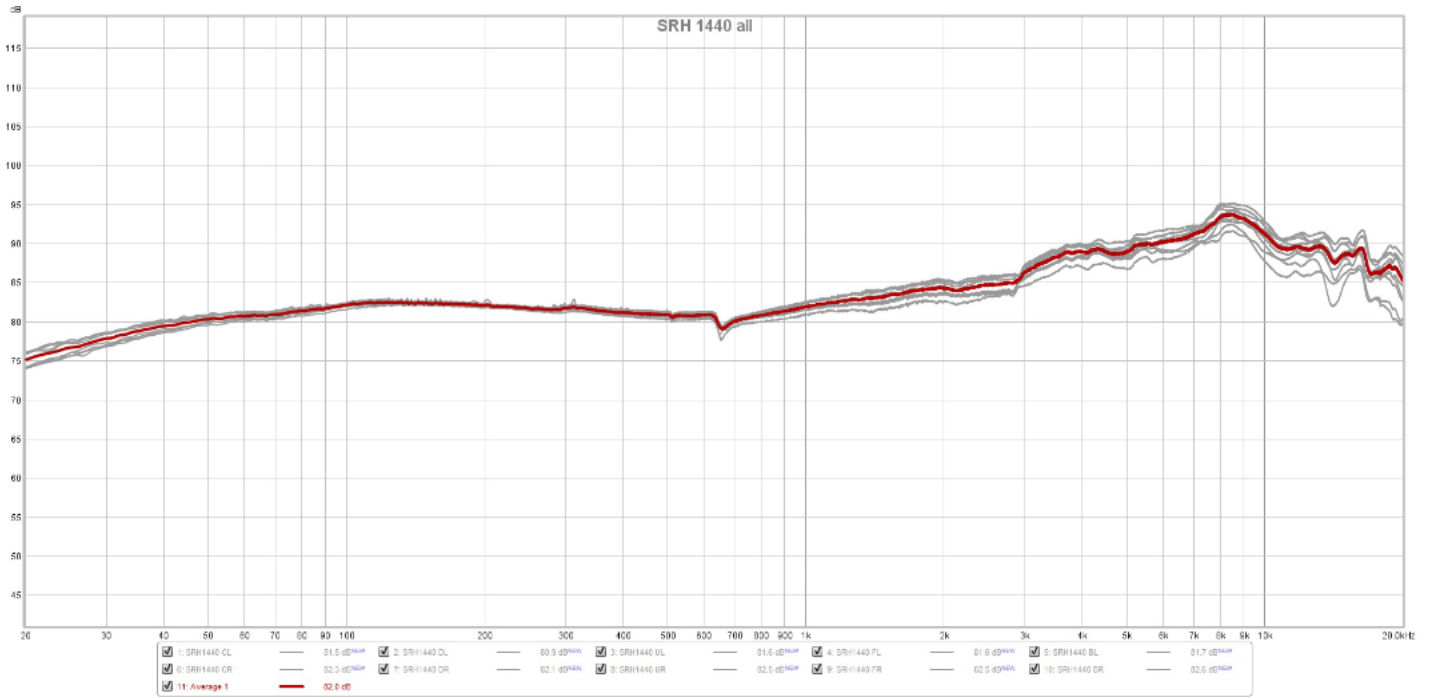
HI-X55



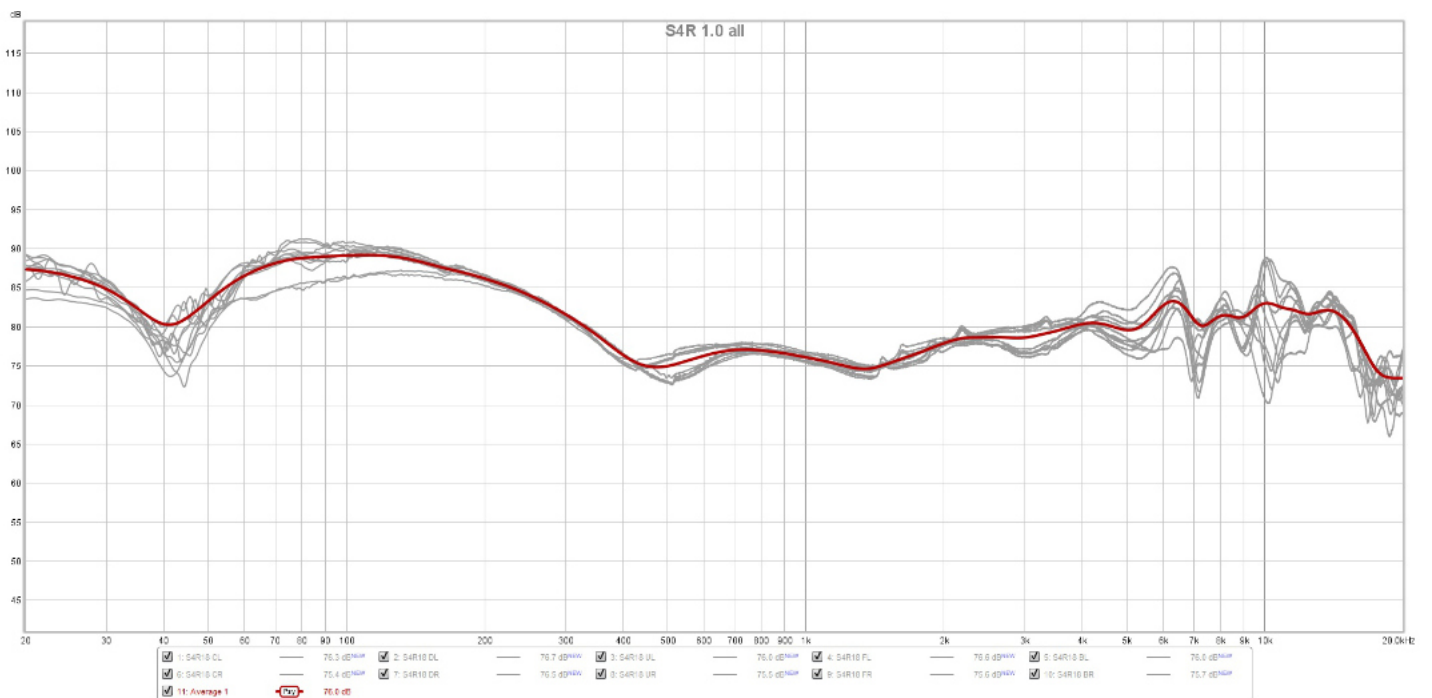
LCD 1



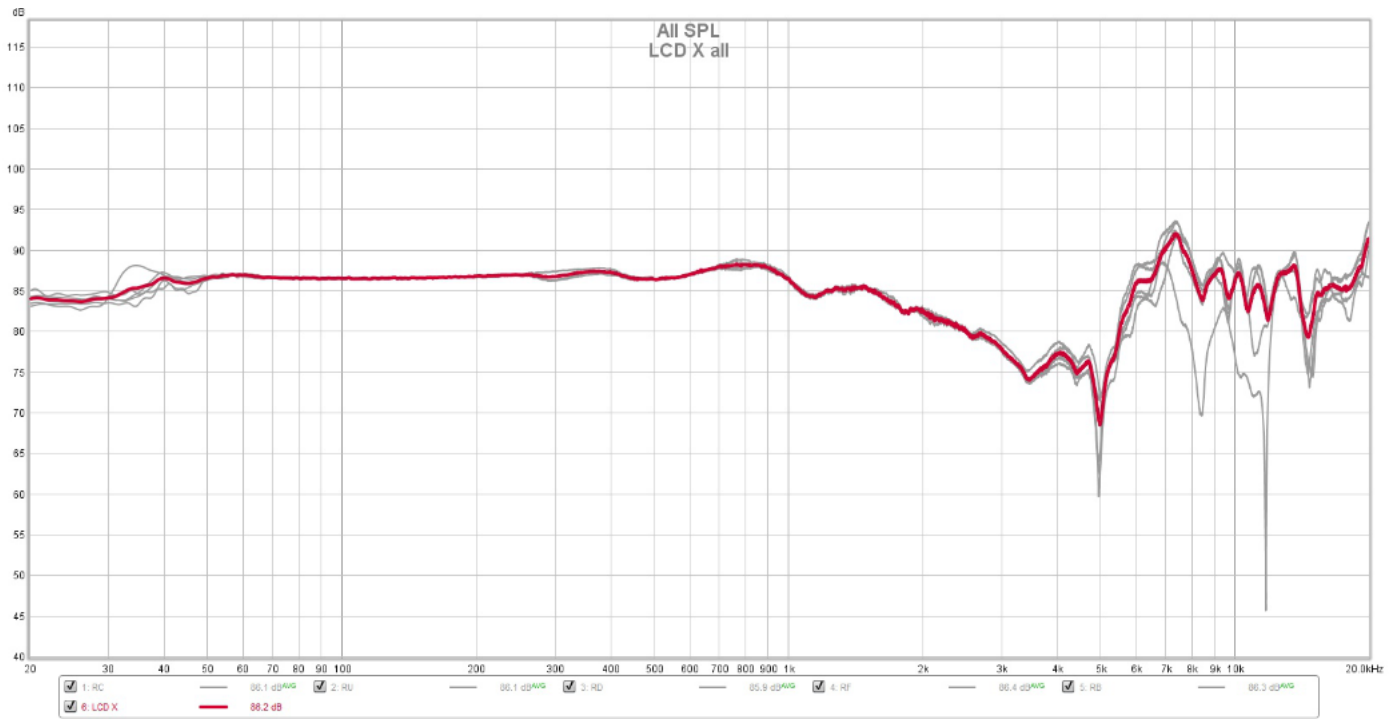
SRH 1440



S4R 1.0 2018



LCD X

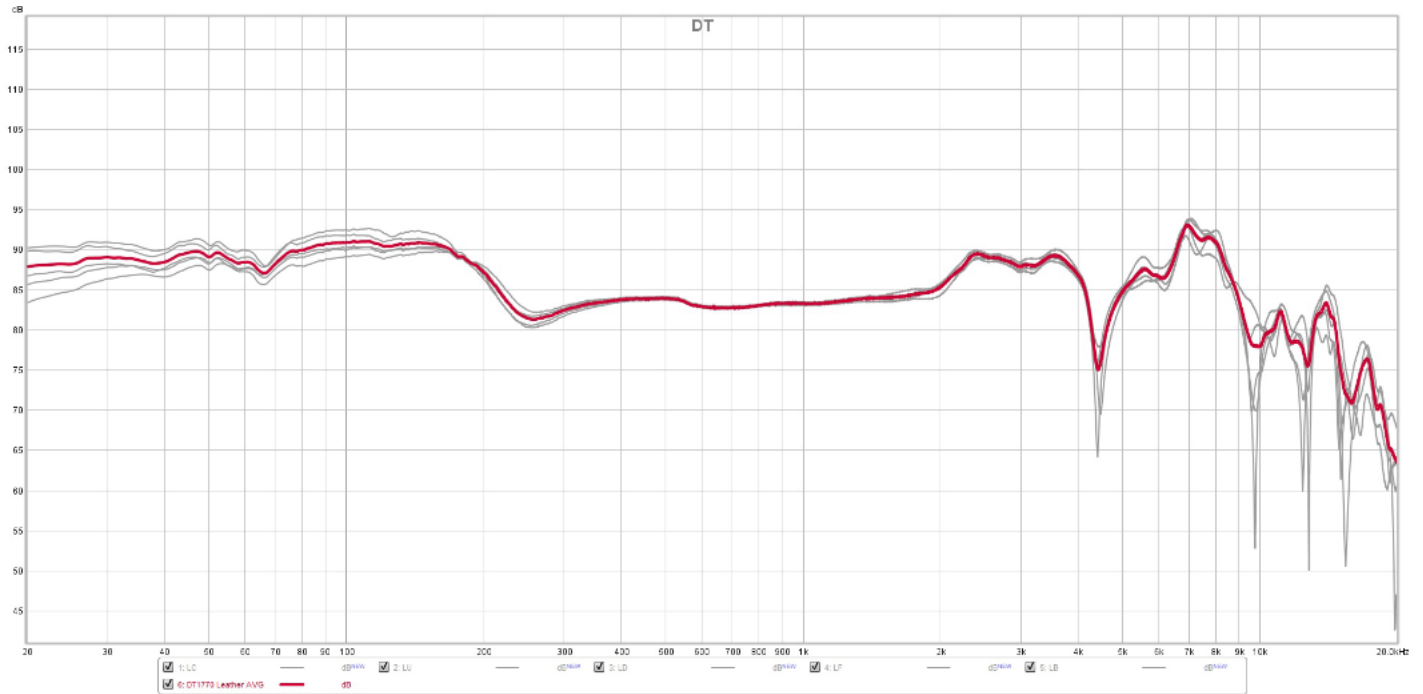




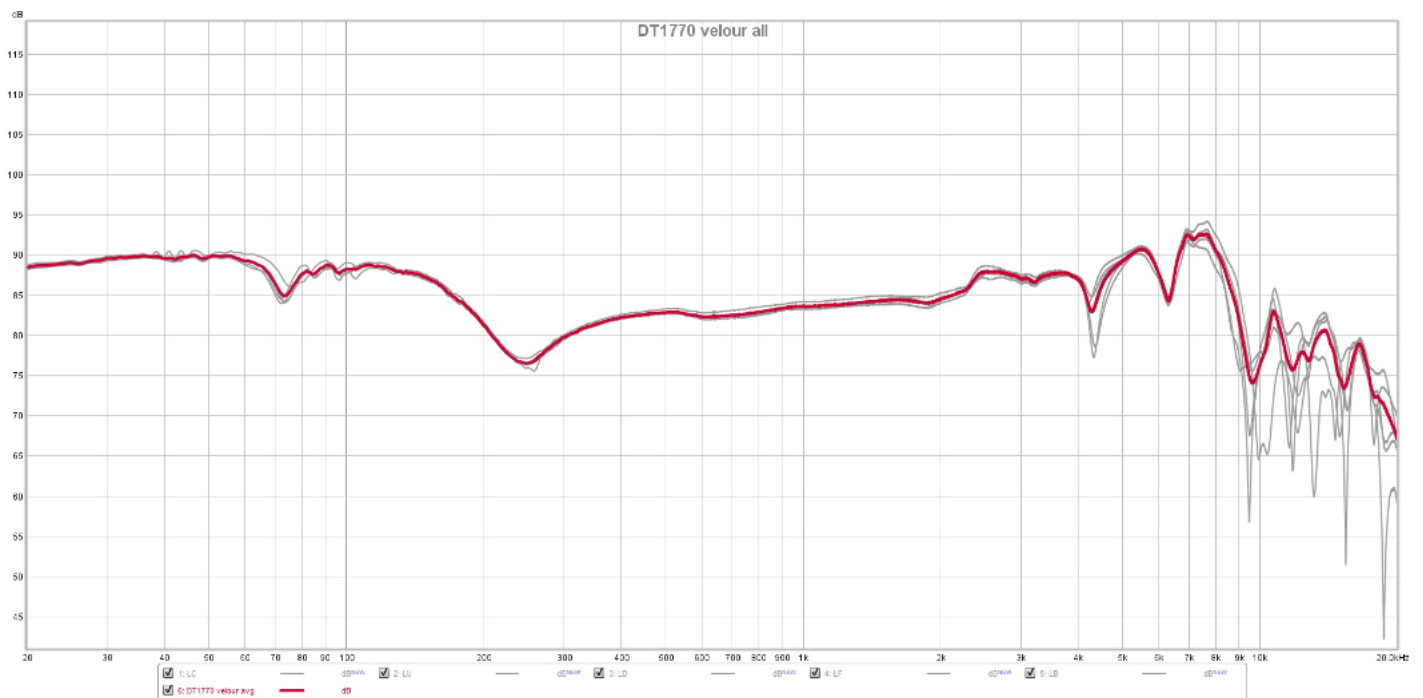
APX2. ALL MEASUREMENTS

In this appendix you can find all the measurements of every headphone we have in the lab with 60318-4 standard.

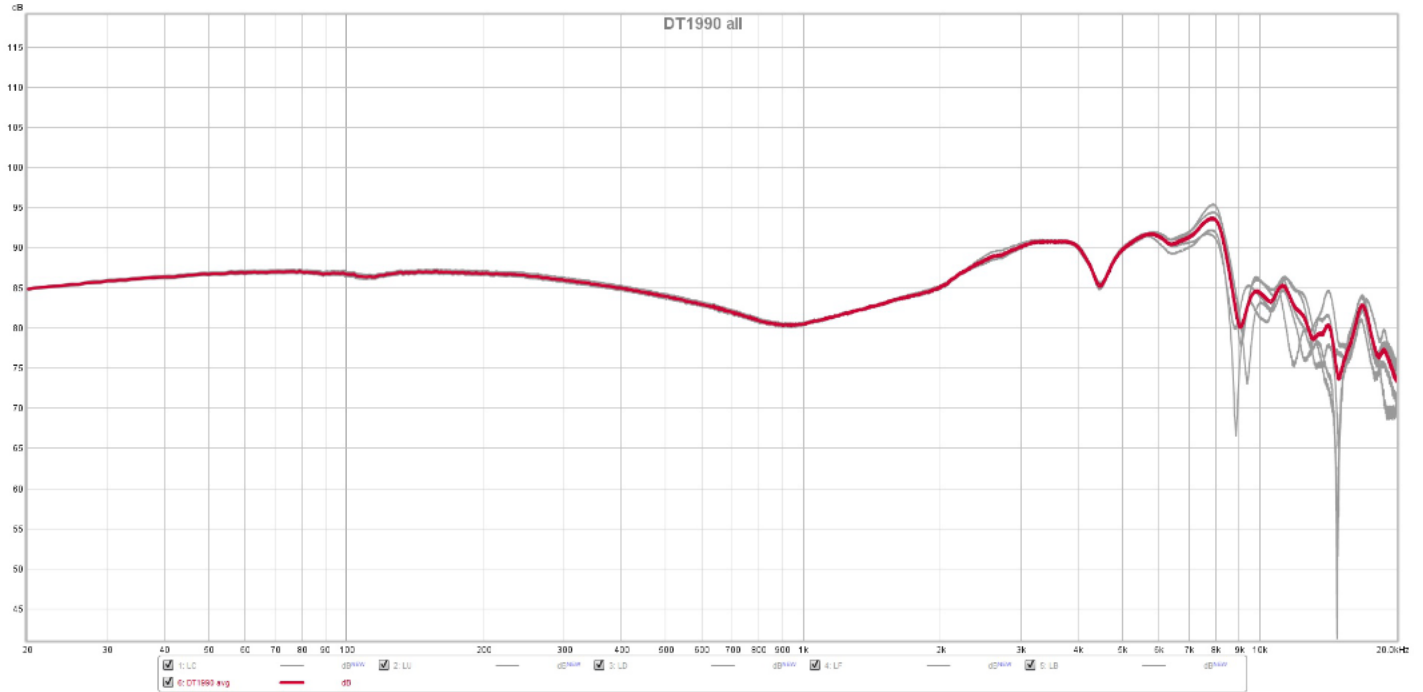
DT1770 leather



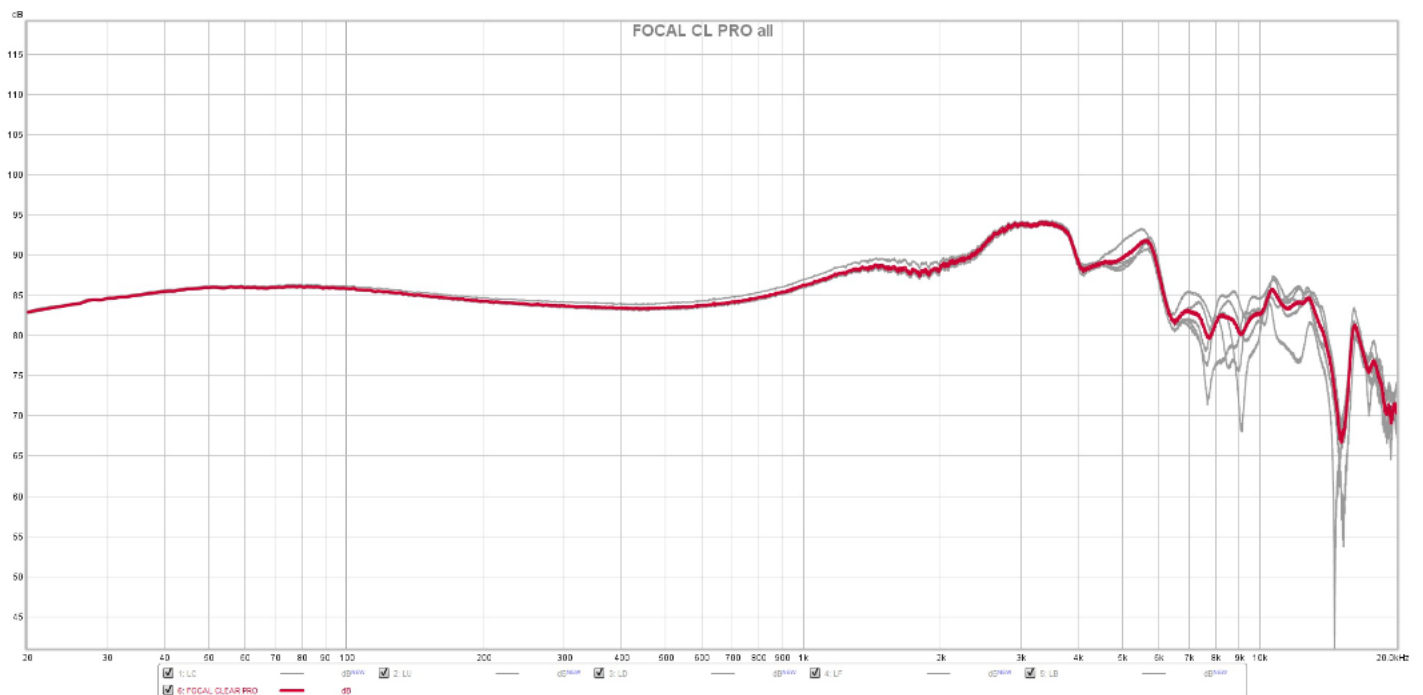
DT1770 velour



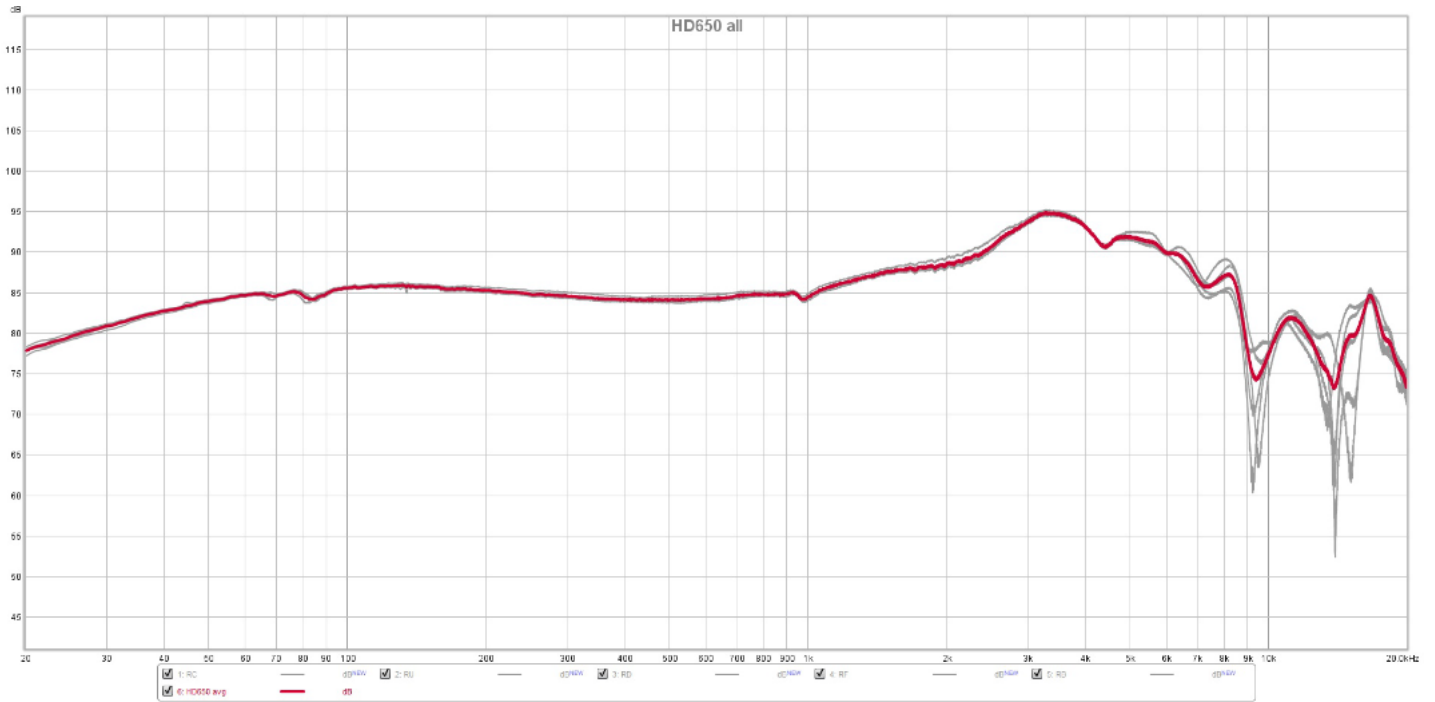
DT1990



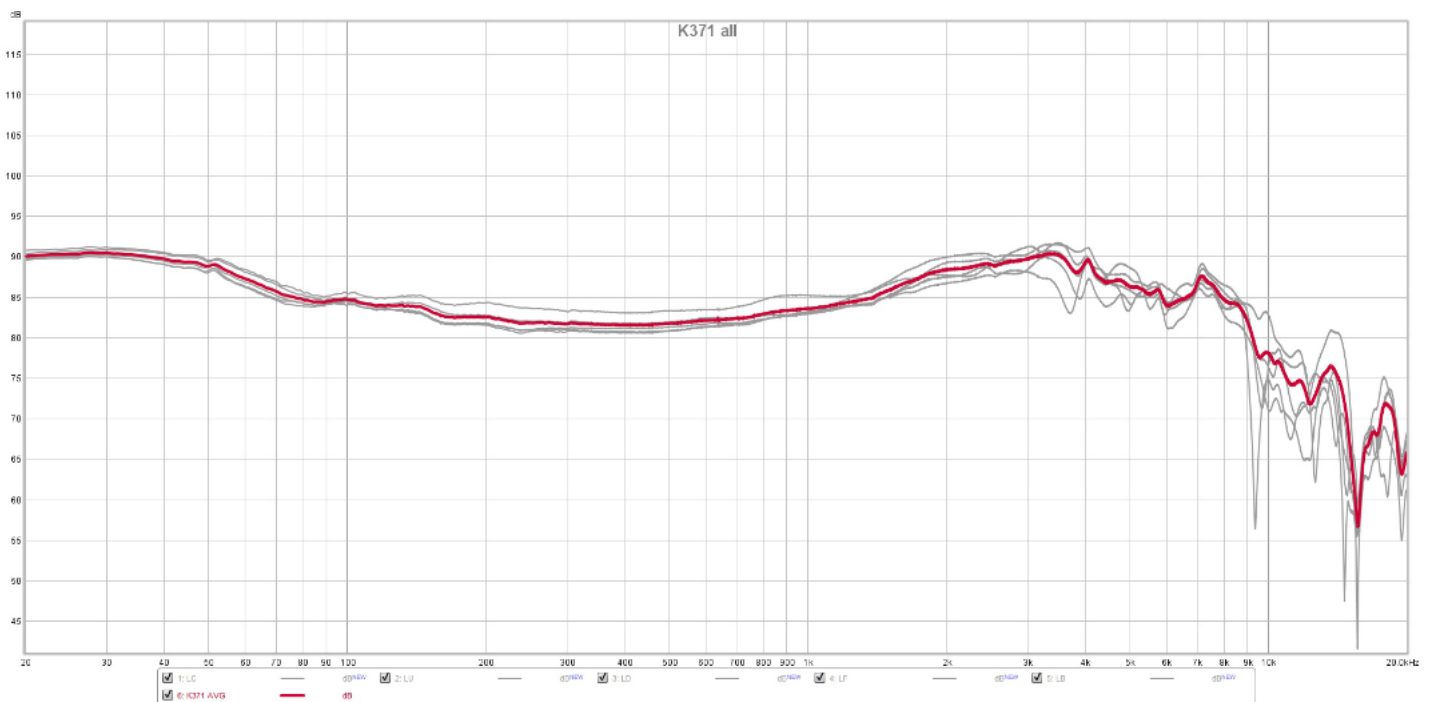
FOCAL CLEAR PRO



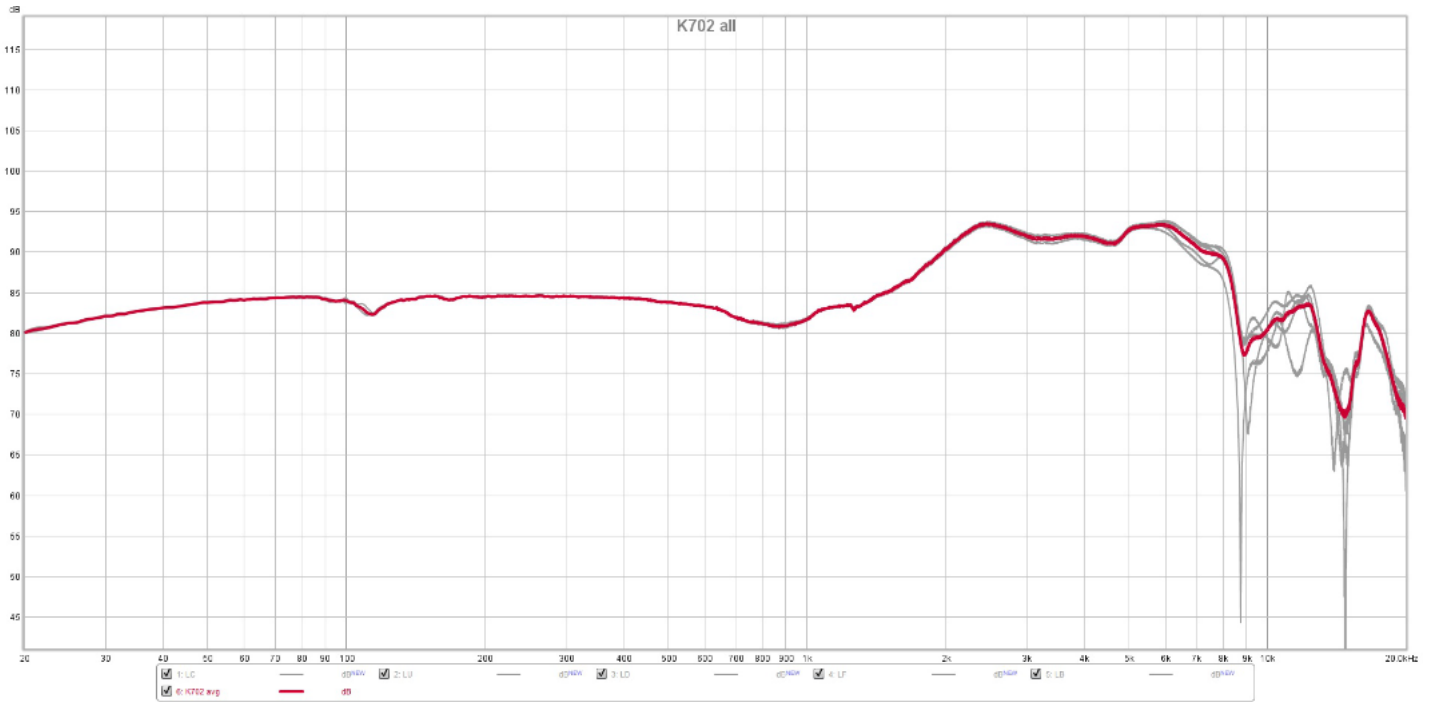
HD650



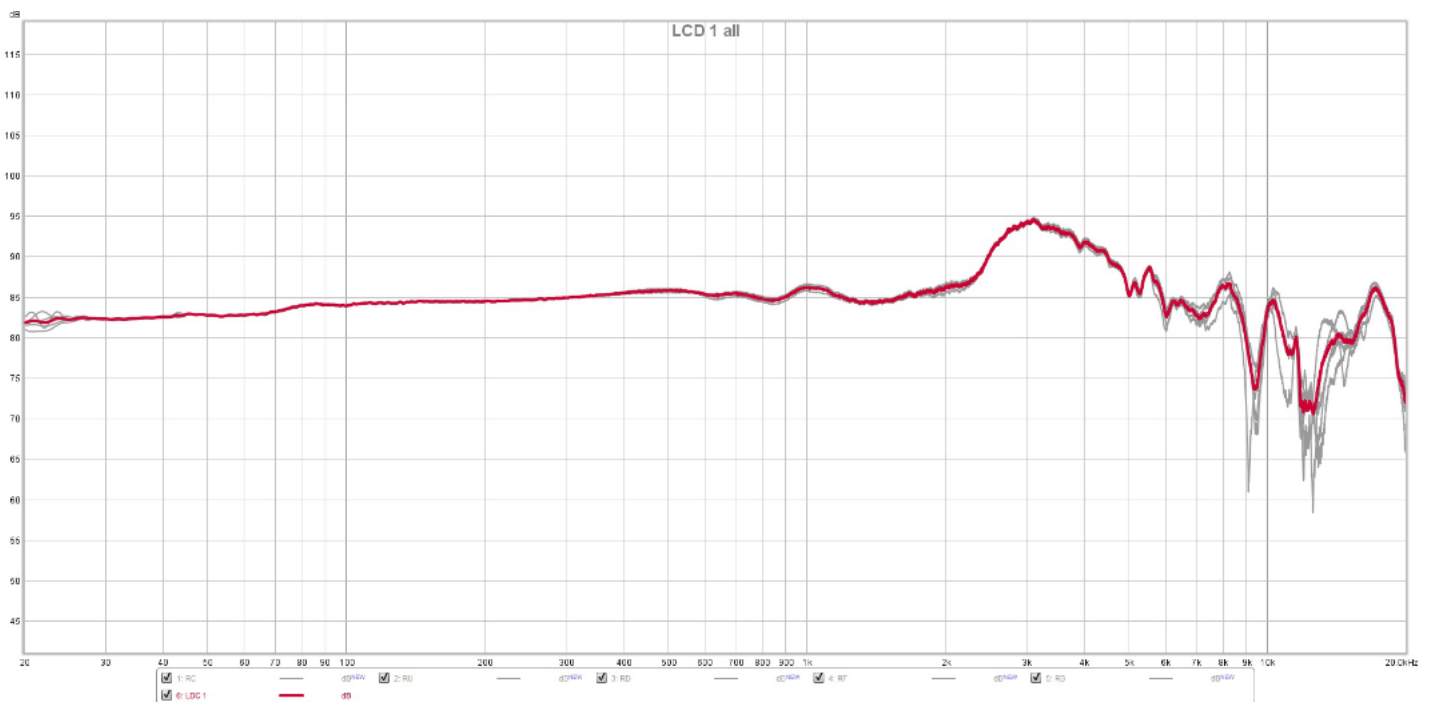
K371



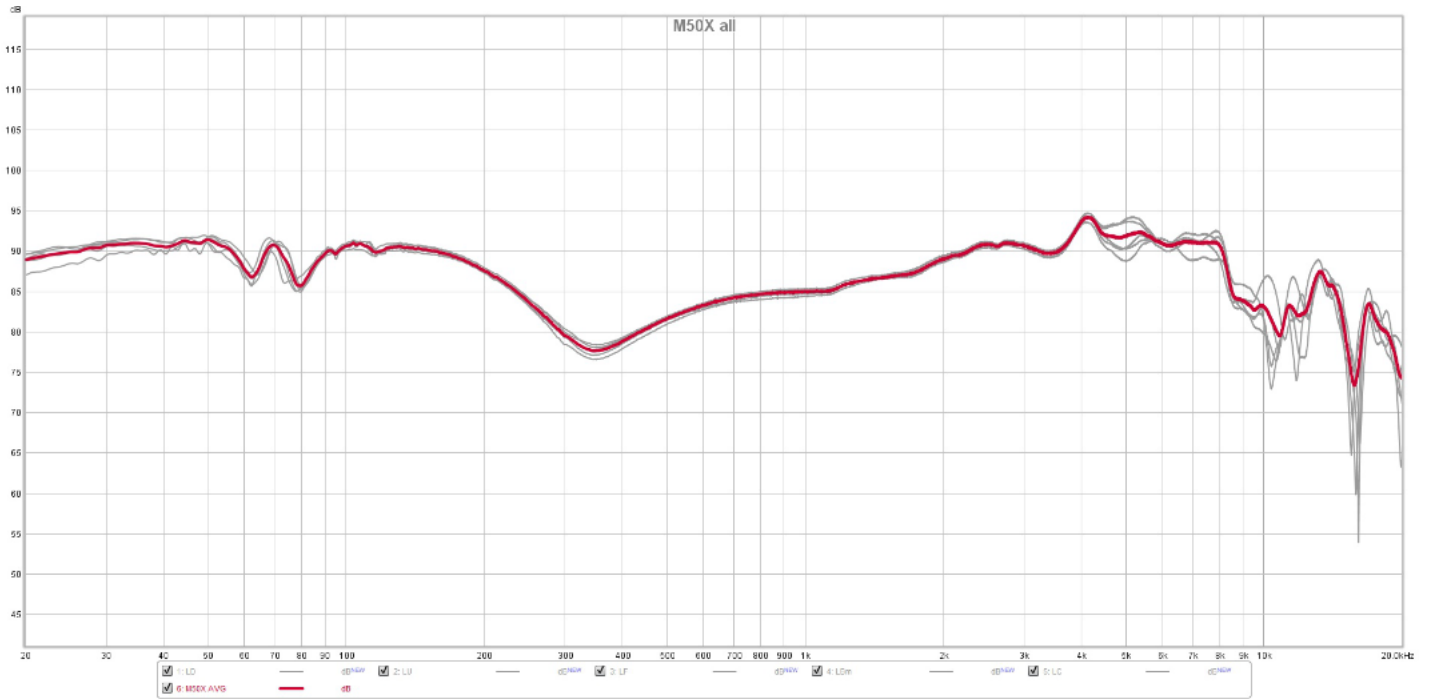
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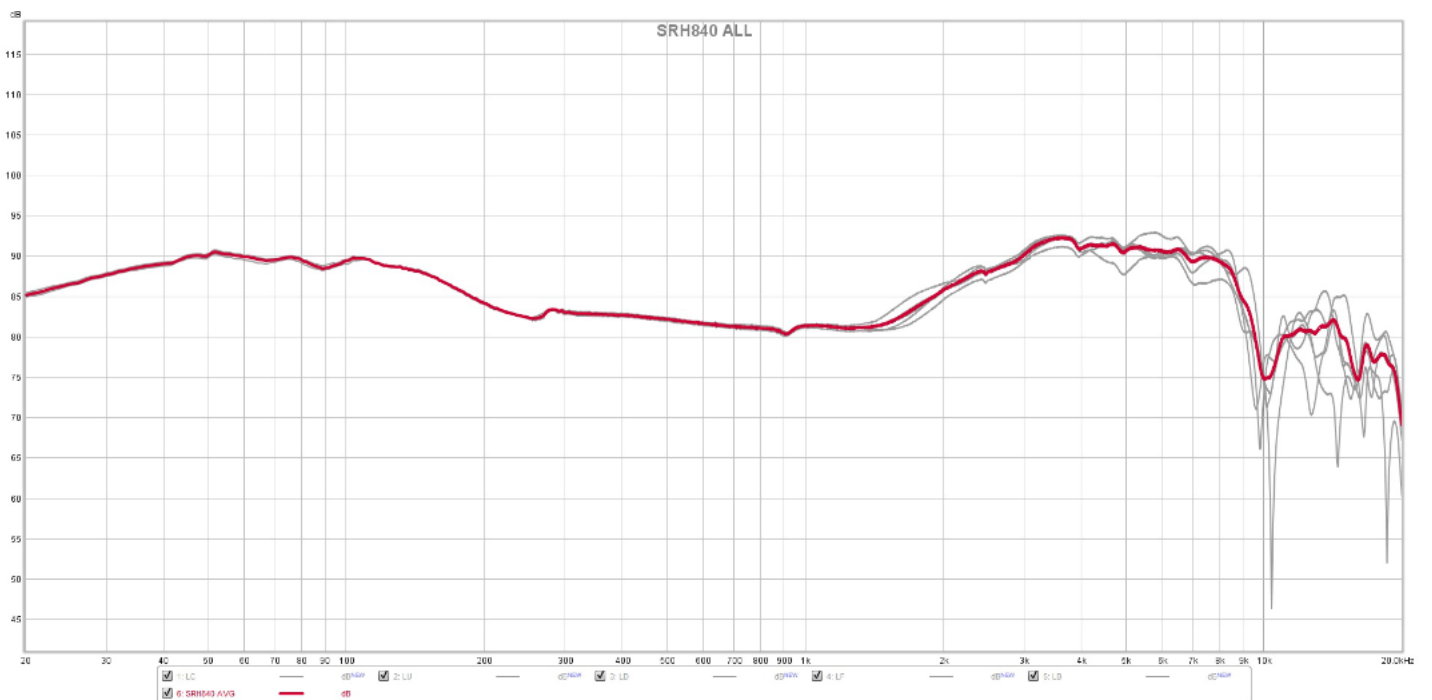
LCD 1



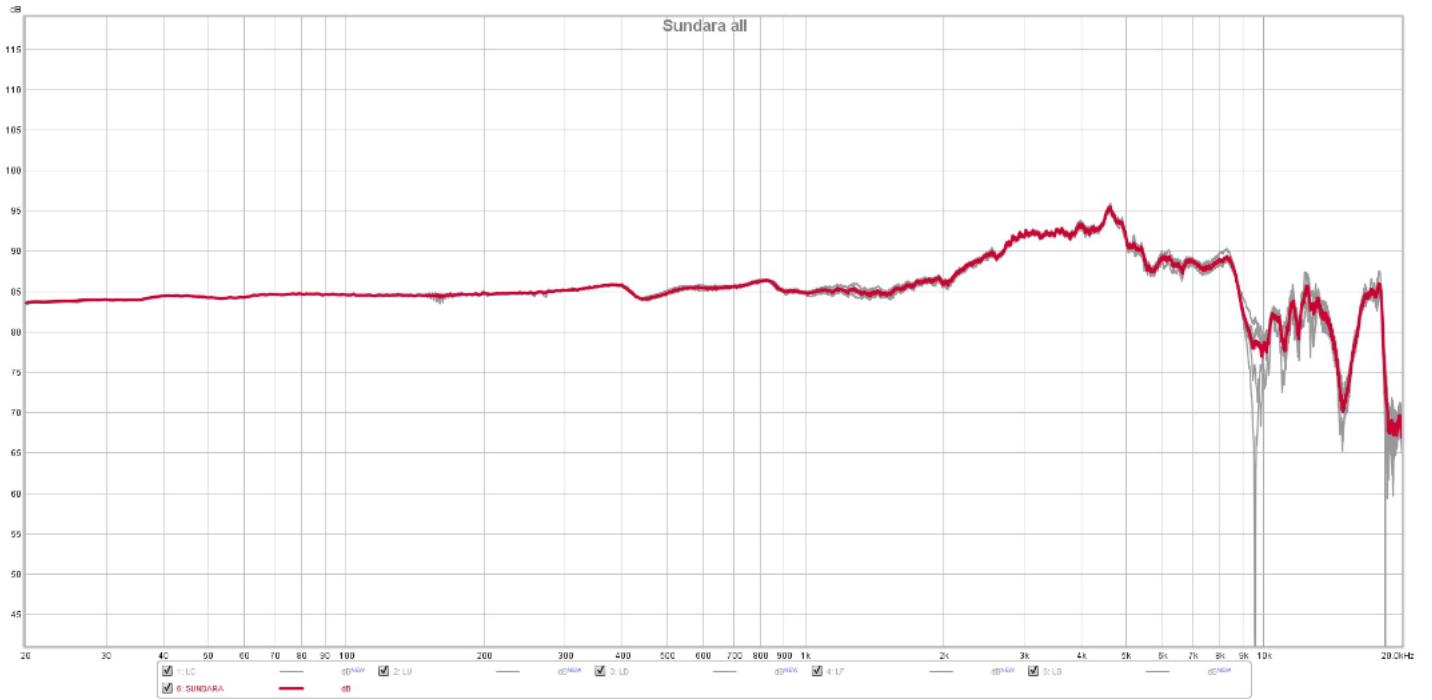
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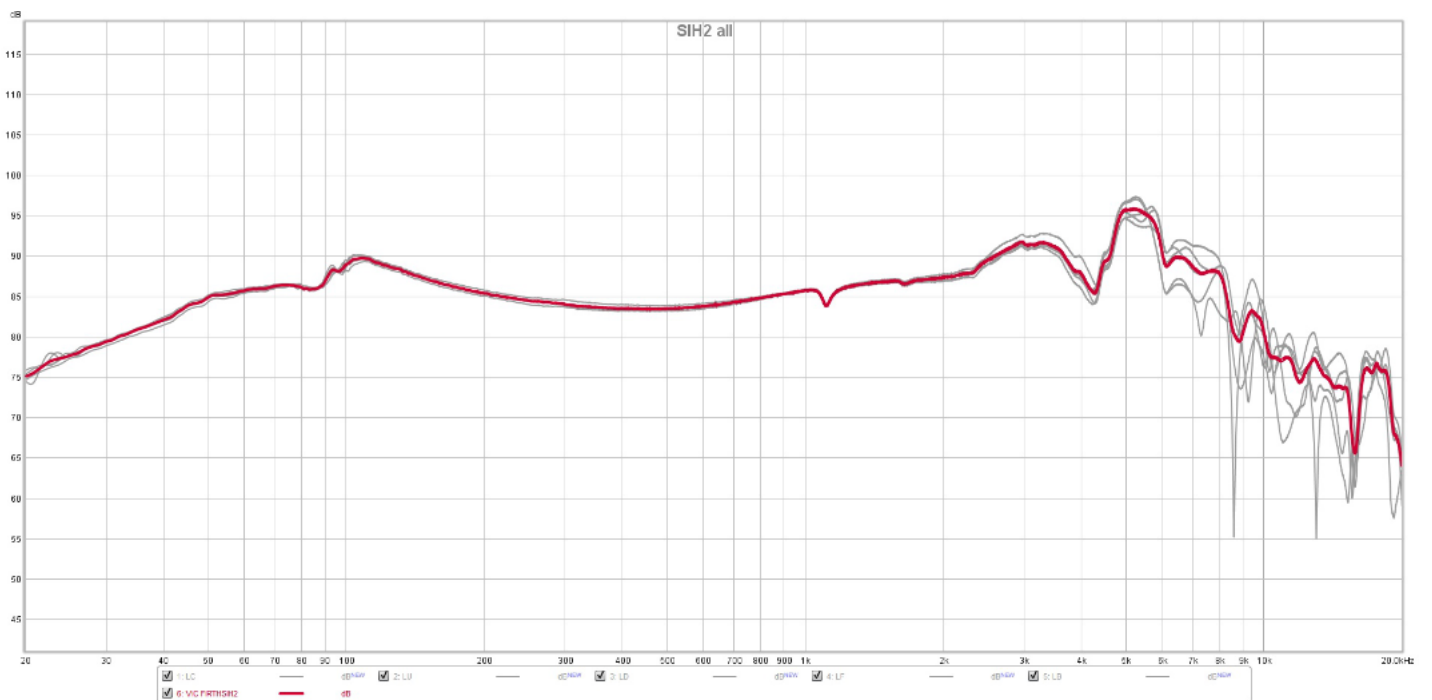
SRH840



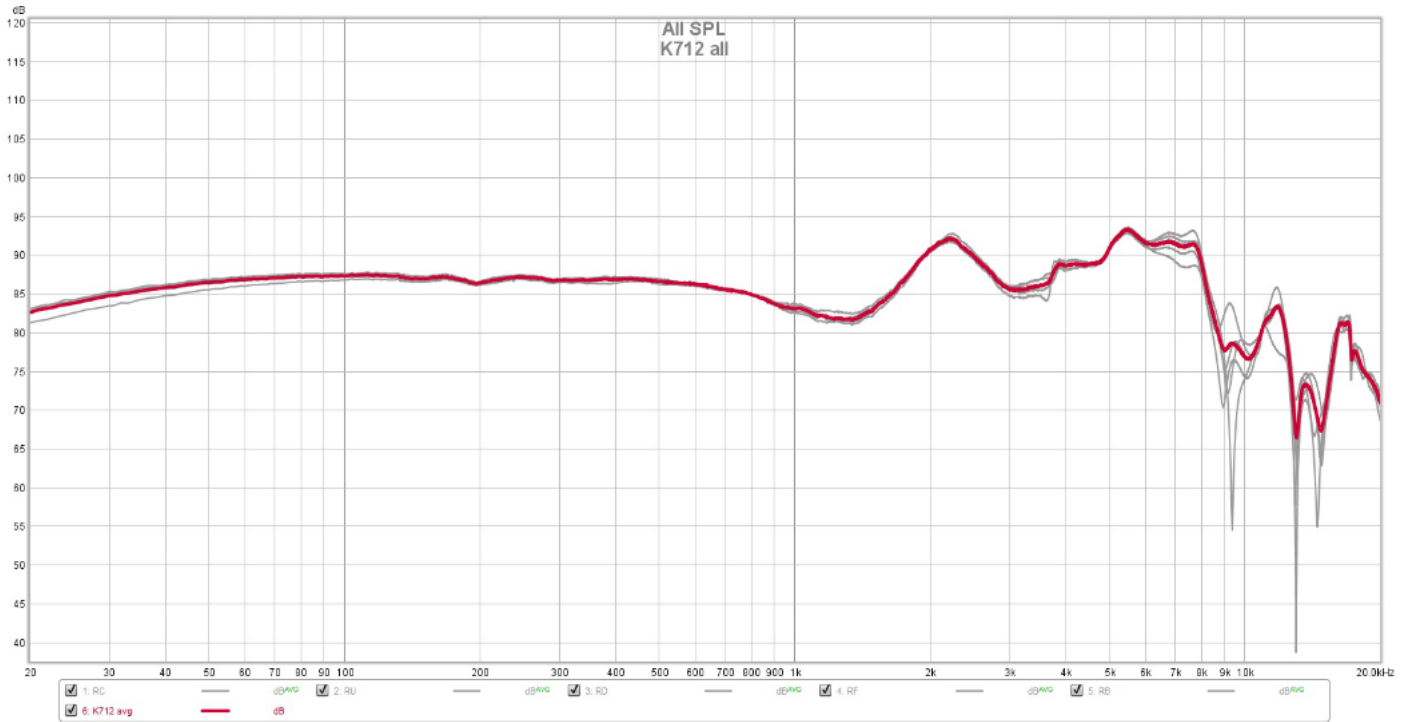
SUNDARA



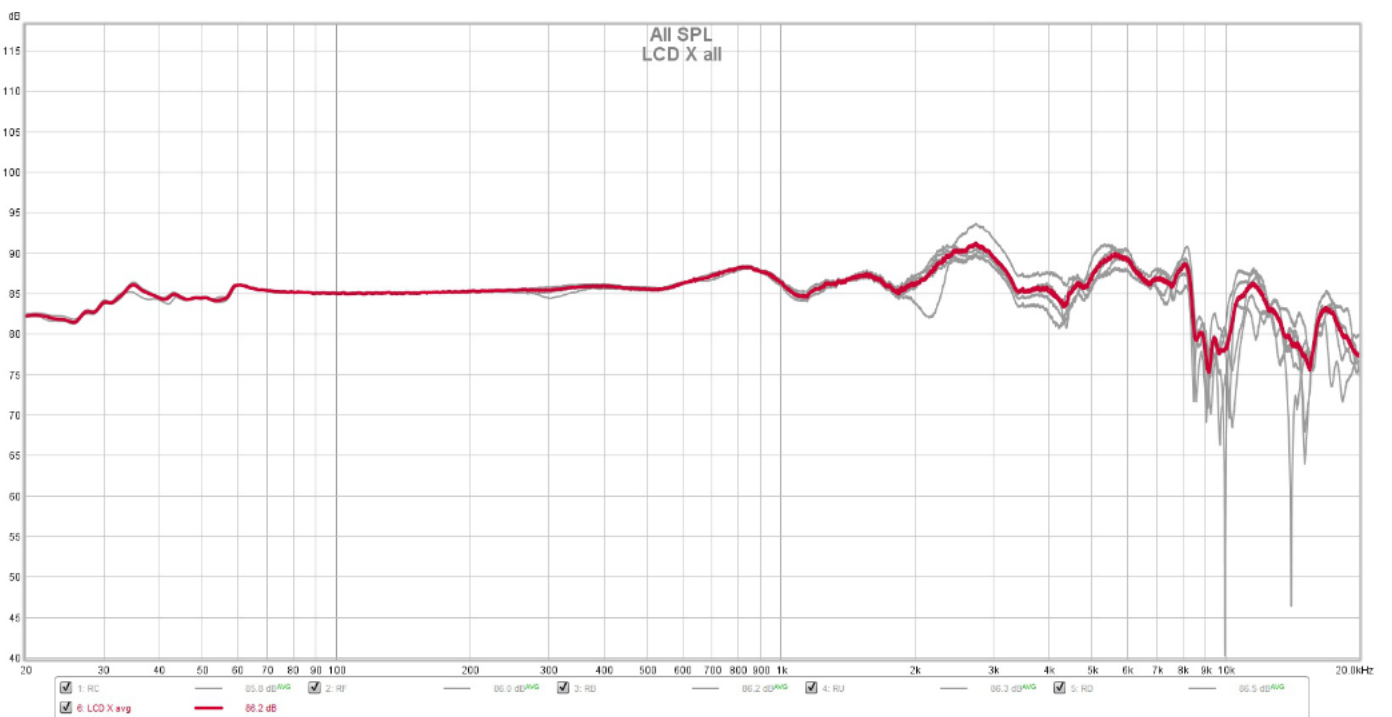
SIH2



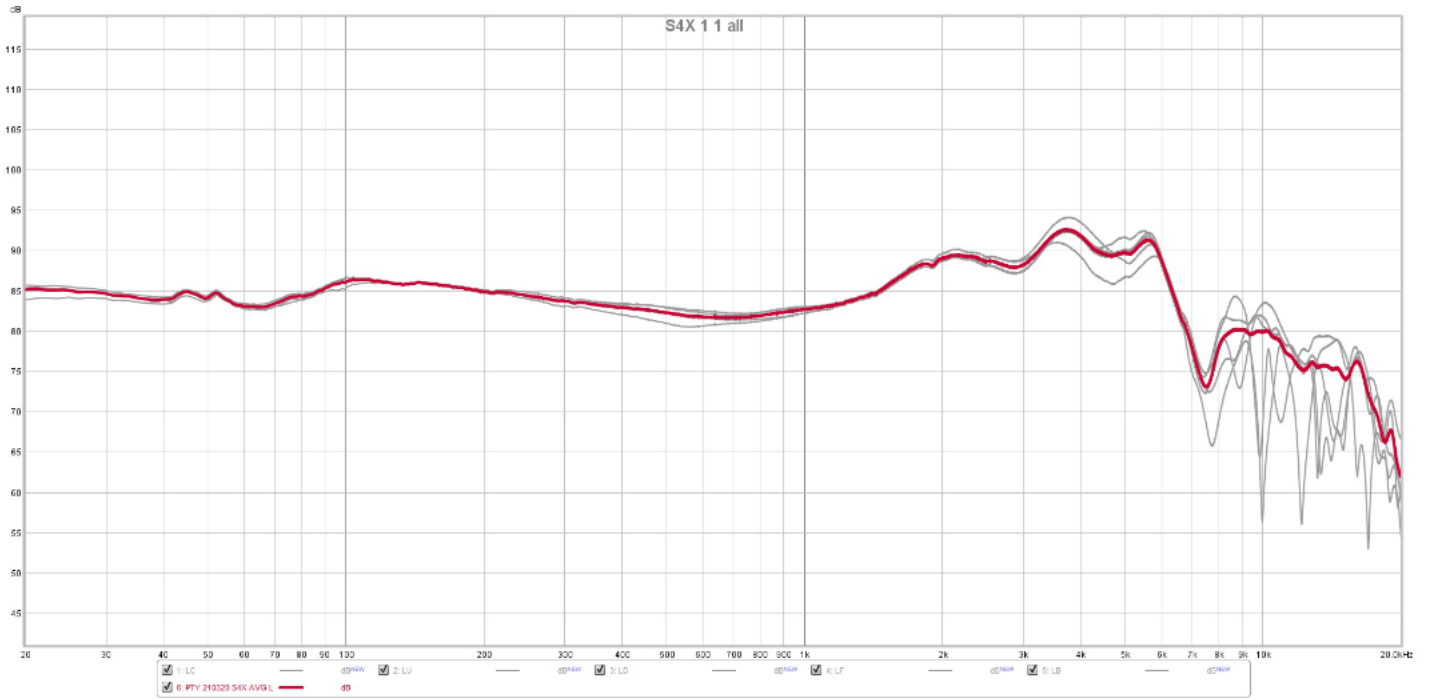
K712



LCD X



S4X 1.1



S4R 1.1

