Azimuth / Crosstalk
Instructions and Whys

A DEEPER LOOK INTO..... 2

HOW TO?..... 3

WHAT FOR? 8

WHY THIS WAY? 9

DISCUSSION OF RESULTS..... 10

A) DENON DL-103. 10
B) DENON DL-103R 11
C) EMT JSD-6 12
D) RESON ACIORE 13
E) LYRA DORIAN 13
F) LYRA SKALA 14
G) ORTOFON VINYL MASTER SILVER 15
H) ORTOFON VENICE 15
I) ZYX R100 YATRA 16
J) ZYX AYAME 16
K) GOLDRING 1006 17

FINAL CONCLUSION 18

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Get it perpendicular!

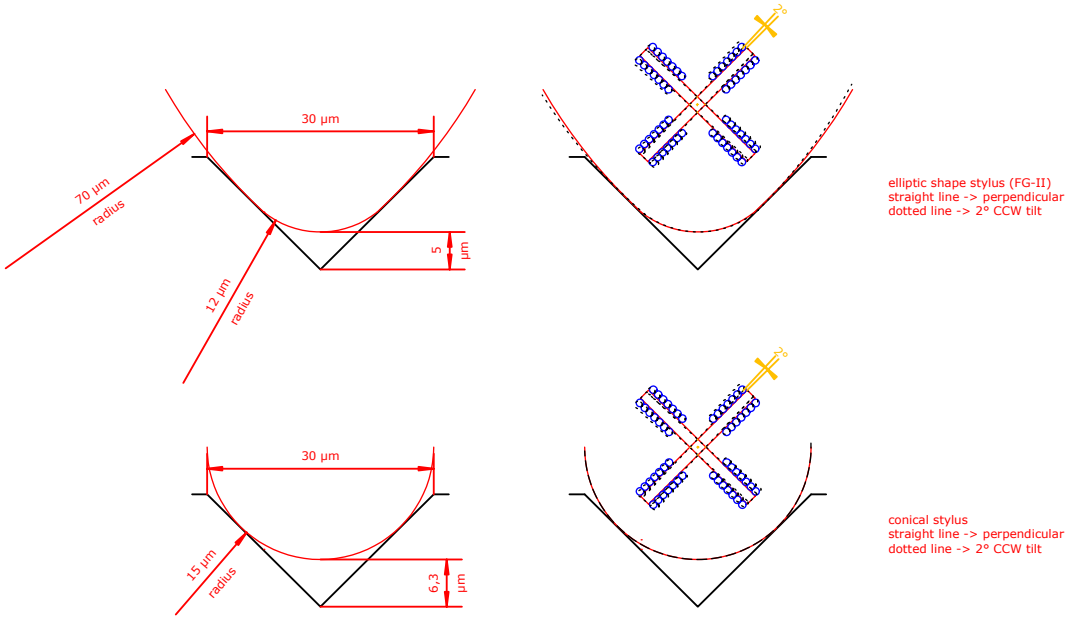
When it comes to cartridge alignment one of the very often asked questions is about the azimuth. What's that? Azimuth describes the geometrical tracking position of the stylus in the grooves of the record.

A deeper look into.....

The cutter head writes its information into the vinyl-acetate or copper master in a V-shaped groove of 90° angle. And this is what is the master for the records produced later on. The stylus of the cartridge should losslessly follow this engraved information. And this is why the geometry of the reading device – the stylus – should be as accurately aligned to the grooves as possible....

Any chance to get this done? Well, a rule of thumb commonly spread throughout the world is: „Place a mirror under the stylus, lower the tonearm on the mirror surface and have a look from the front. Then turn the cartridge so that the catridge body is in perfect alignment with its mirror image". So far so good. But is it the real position that you are looking for?

Let's first look at the geometrical facts:



As you can easily see on the picture above the stylus contact area correlates with the position of the stylus. BUT – as important is the fact that the generator of the cartridge also is off the ideal working position. This means that additional

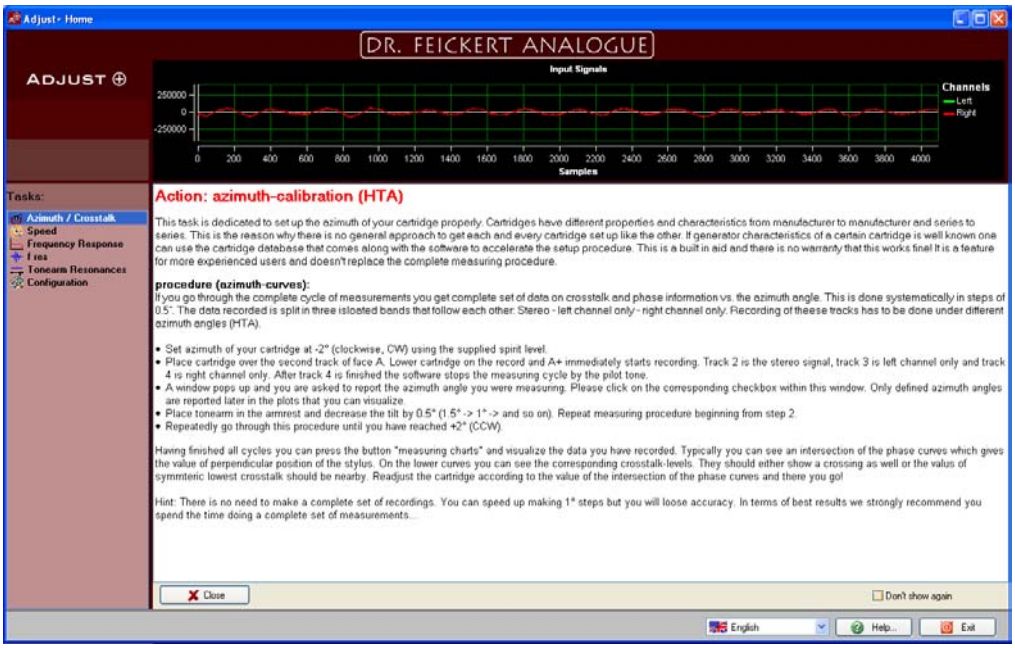
voltage is generated from one channel by the other – in other words: CROSSTALK!

The crucial question now is: Is there any deviation of the stylus in correlation to the body of the cartridge?

The bad news is – in most cases YES! The good news is – we can measure and compensate this.....

How to?

When you launch Adjust+ you will see this window



Please read the information given on this task and/or press the Close button.

What is the procedure like? Well, we don't know the position of the stylus within the cartridge body when we buy a brand new cartridge. One can guess or better measure. How to? Best is to do it like a scientist does - SYSTEMATICALLY!

The procedure is pretty simple and will not take much more longer than half an hour. First you need to look at your tonearm carefully and find out how the azimuth can be changed. Lucky guy you are if you can find a little grub screw on your tonearm that allows you to twist the tonarm in a defined way.... Some tonearms offer screws on the headshell that can be carefully loosened and let you twist the headshell. So this is the first thing you have to find out. If it is not abvious how to do it please reffer to your tonearm manufacturer's manual.

Once it is clear how to alter the azimuth you can start. Let's have a look how this can work out on a Kuzma tonearm. On the first picture you can see the three screws used to adjust azimuth on a KUZMA 4Point. The Kuzma offers a very nice way to tweak the HTA (azimuth). Once the HTA is adjusted properly you can fix the tubing with the two grub screws on the top – simple, easy and very effective.

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Ok, the initial position you will have if you never have changed anything looks on a Kuzma like this. There are marks on the tubing that indicate tilt of the tubing vs. the bearing assembly of the tonearm. This can be very helpfull.

So the first thing we should do now is to find out if the tonearm is level or not.

So we have to place the supplied spirit level on a reference point on the tonearm we have to choose. Why do so? Well, bear in mind that we want to

make a series of measurements that should be reproducable. So once we have found a perfect setting for azimuth we want to be able to find it again with ease. Therefore we have to take care that this chosen reference point perfectly correlates with the tilt of the headshell / arm tubing or whatever can be turned on your tonearm. In most cases this will be the headshell. And this is the point of our focus. In general we highly appreciate if you try to place the spirit level a couple of times to make sure you always achieve the same results;)

So on the KUZMA it will look like this (left hand standard, right hand enhanced spirit level)

So everything seems to be ok. Typically we start to turn the cartridge counterclockwise (CCW) and set at 2°, which translates into +2°. The opposite direction is clockwise (CW) and goes to the extreme value of –2° (the software offers to visualize up to +/-2.5°). The enhanced spirit level offers a wider range of measuring as you can see on the photo. Only in a few cases it is necessary to set beyond theese two extreme positions....

Having chosen one of the two extreme positions it's time to start measuring.

Short hint: Mind your cartridge is not capable of handling unlimited high tracking forces. Please remove the spirit level from the tonearm before you start measuring! Also never put the spirit level on the headshell as long as the cartridge is not in armrest position! Also take care you don't kill the cartridge by heading the cantilever in case the spirit level accidentally falls down.... Another messy thing could be the spirit level falls down on the record and causes scratches. Please take care of your equipment!

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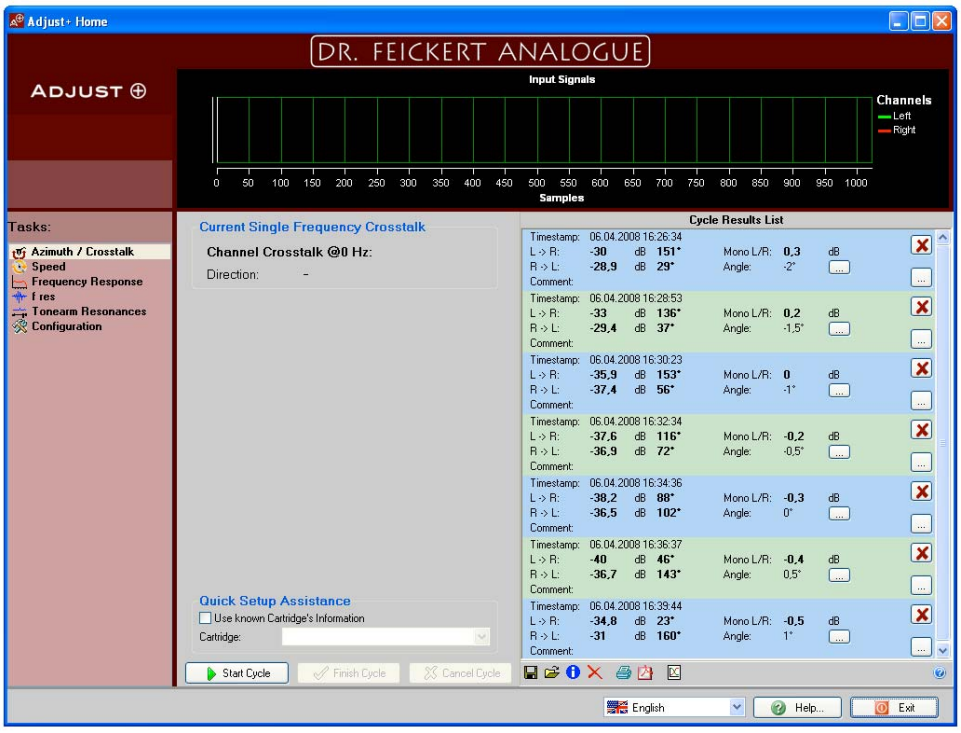
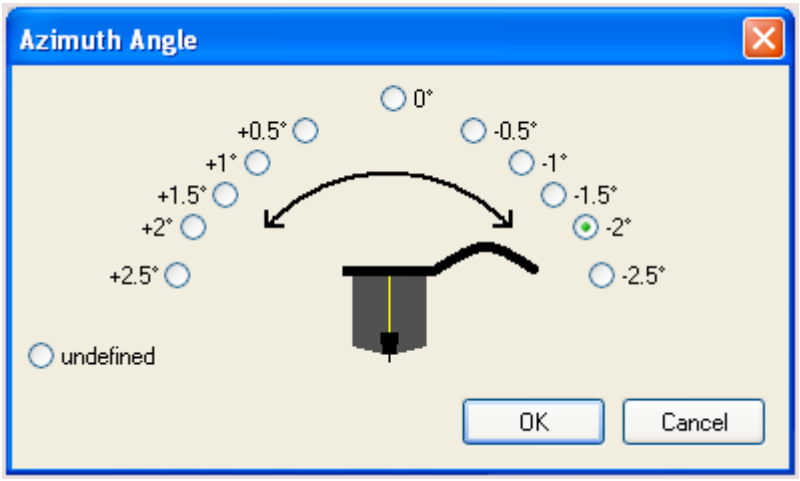
Play track 2 on face A (as shown above) and the software detects the test signal automatically and data recording starts.

First it measures stereo balance between the two channels. Then it detects crosstalk and phase response from left to right channel on track 3 and on track 4 it records crosstalk and phase information from right to left. End of data recording again is detected automatically. But you can stop data recording pressing the „Finish Cycle“ button.

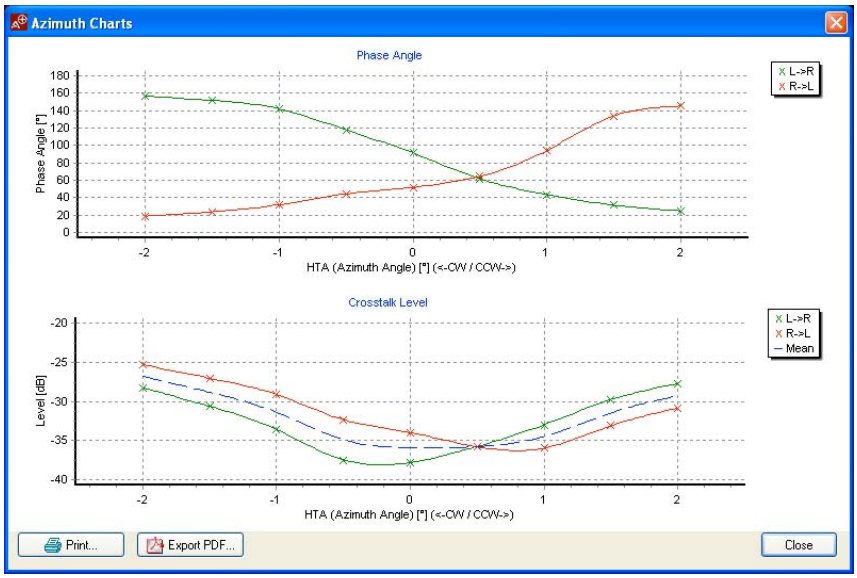


When the end of the track is detected a window pops up asking you for the value of the azimuth you had set.



We recommend to measure in steps of 0.5° but to speed up the whole procedure you can also choose 1° steps. The first case leads to more accurate results and resolves the optimum value of azimuth better than the latter. So you have to repeat this procedure at least 5 times or 9 times worst case.

But how do we get the information we want? Pretty simple by pressing the button „*Measurement Charts*“ right hand of the „*Acrobat*“ button. A new window will pop up and shows the recorded data in a plot of phase response (plot on top) and crosstalk levels (plot on bottom).



Ok, now we can see what we have obtained but what do those figures mean?

We can see that on the plot on top the phase reponse curves intersect at around +0.5° (0.5° CCW). Also you can see that at exactly the same 0.5° the

crosstalk curves cross each other as well showing perfectly symmetrical crosstalk. That's the information we are looking for. The only thing you have to do is to set HTA at 0.5° CCW and there you go.

You easily can extend your series of measuring to find perfect position saving the resluts marking the „*undefined*" check box in the pop up window.

What for?

The answer is pretty simple. Just have a look again at the first picture showing stylus geometry within the groove of the record.

Elliptic stylus (and their derivatives):

- The elliptic shape of the stylus causes that if tilt the contact area with the vinyl is not the same on both sides of the groove. This means that you have different pressure applied from the stylus to the vinyl on left and right channel. It is obvious that this fact leads to higher wear on the vinyl on the channel with lesser contact... Not only that: Much more you get much more higher amount of crosstalk, higher distortions and less trackability.

Conical stylus:

- The conical shape has an advantage over the elliptical shape. It is the fact that even if being heavily out of position contact area of both channels always is the same. This means that trackability and distortions are not that heavily depending on perfect position of the stylus. But this is the only good news. The contact area with the vinyl is far less and resolution of high frequency is heavily limited especially towards the end of the record where the engraved wavelength of high frequencies is getting shorter and the radius of the stylus is no more small compared to the length of the wave train...
- Also it is obvious that as a result out of the smaller contact area the applied force to track the information needs to be higher. This leads to higher pressure and more wear.

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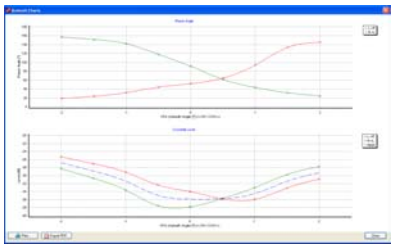
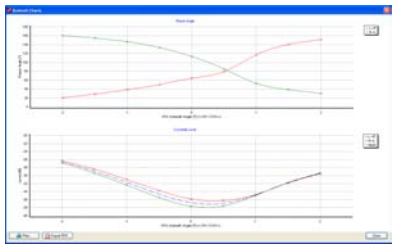
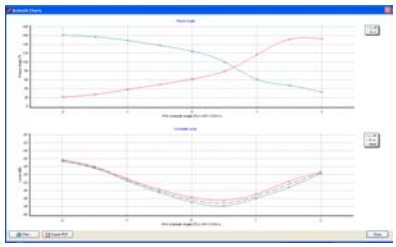
Why this way?

You may ask yourself if there is no easier way to get the job done. Well, there are tips out there telling you that azimuth can be adjusted using a multimeter. Sure in some cases this might work. But only if your cartridges shows an intersection in crosstalk exactly at the phase crossing point. Let's have a look at the following series of 3 graphs:

Despite theese plots are a little small we immediately can see the three curves of the phase response are nearly identical. Ok? Well, the only difference we see is that the intersection points are different in height. Left hand they intersect at 60°, center is around 80° and right hand it is 90°. Now we look at the crosstalk plots and yes, they look completely different. Left hand we have an intersection, middle – ahm, hard to say, and right hand? Forget it... So this must have been different cartridges! No, bad news. It is always the same cartridge we measured. The only difference from one series to the next was – VTA!

So the multimeter method will never ever give you a result with the settings on the right hand side and with the settings chosen on the middle you also will only fool yourself. To give a little more information: The difference in VTA from left to right was as listed

- Left – VTA set that cartridge is level with record surface
- Middle – VTA + 3mm
- Right – VTA + 4mm

What's the conclusion out of this? It clearly shows that the multimeter technique brilliantly can misguide you and we easily could show other types of cartridges that show similar behaviour.

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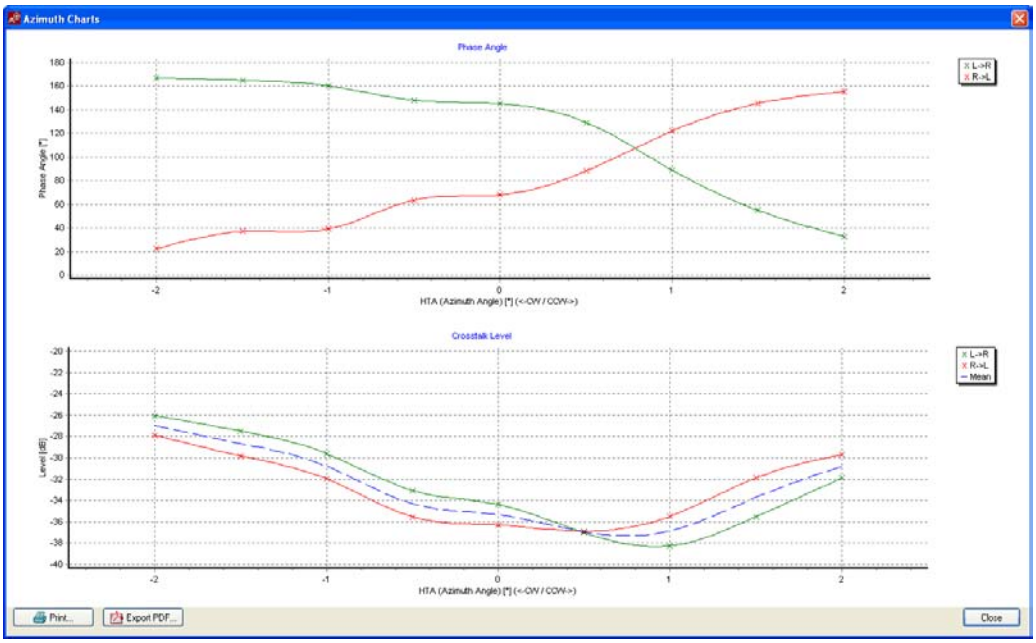
Discussion of results

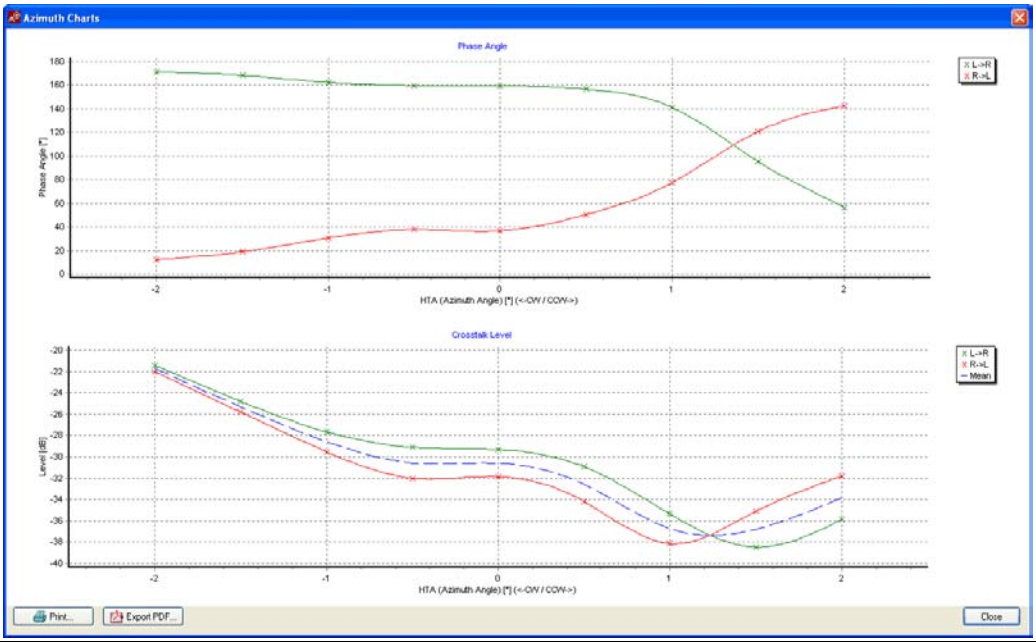
With the information already given we can start interpreting results. This chapter shall show you how to get the information you are looking for

a) DENON DL-103.



Let's look at the plot. Phase response intersects at +0.8° (CCW) with 110°, crosstalk at +0.5°. Well, we recommend to choose +0.8° as the human ear reacts more on the phase response than on the small gap in crosstalk levels of 2 dB. You can clearly see the large phase response deviation at „optical" perpendicular position of about 70°. This will affect focus and imaging in a negative way.

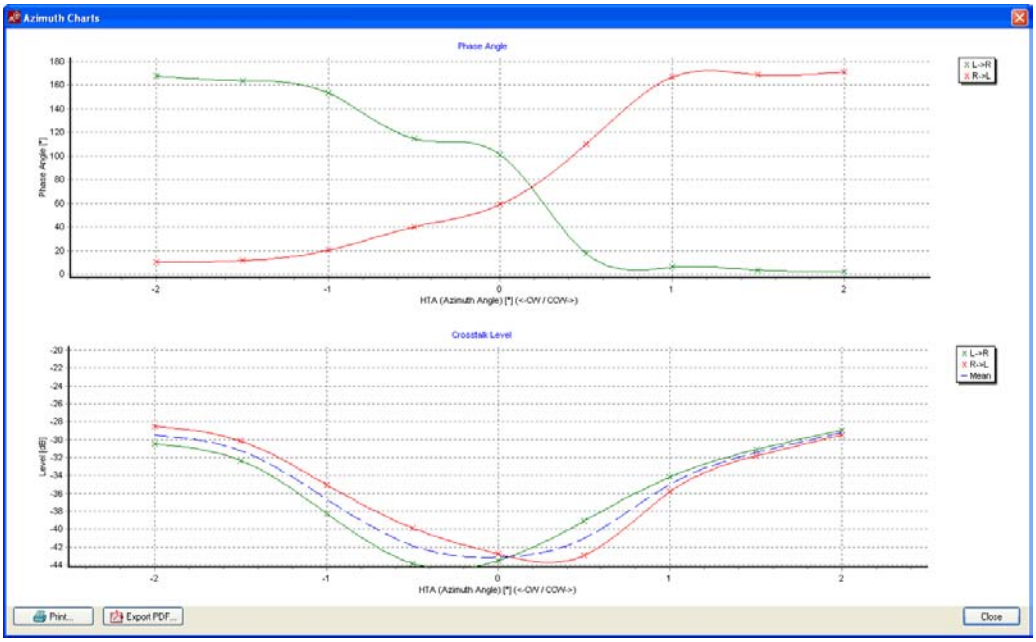
We have another DL-103 that gives results like that



Do we need to say more? At +1.4° (CCW) you gain an additional 7 dB in channel separation. Intersection is at 110° phase angle.

b) DENON DL-103R

We have different 103R but we want to show you the most extraordinary one



This is what we call the perfectly manufactured and adjusted cartridge in terms of azimuth. Intersection occurs at +0.1° giving a stunning 43 dB of channel separation on both channels at 1 kHz. Also phase response indicates to set at +0.25° - perfect!

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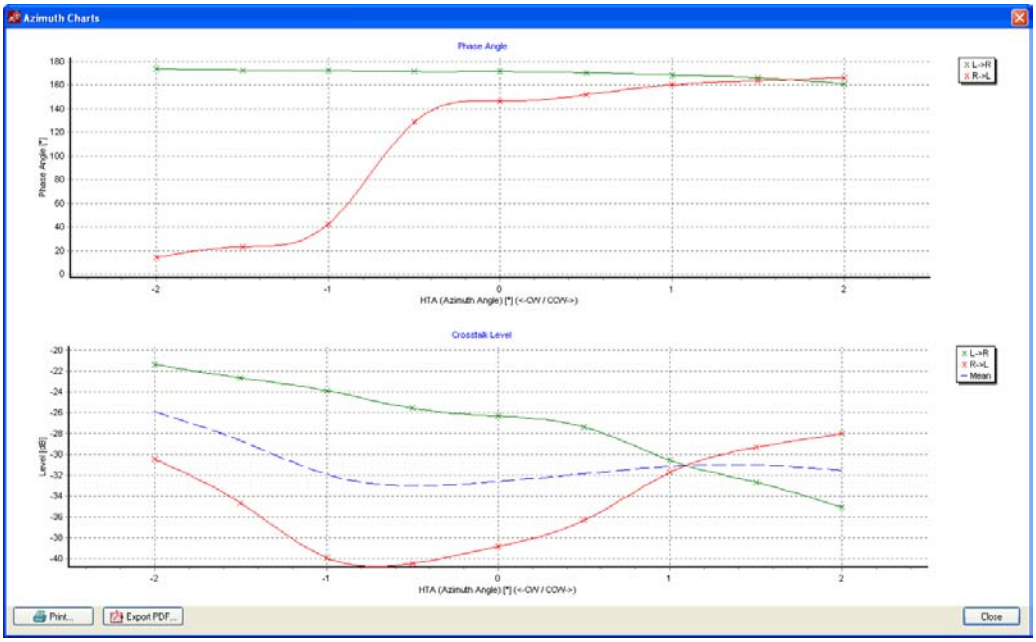
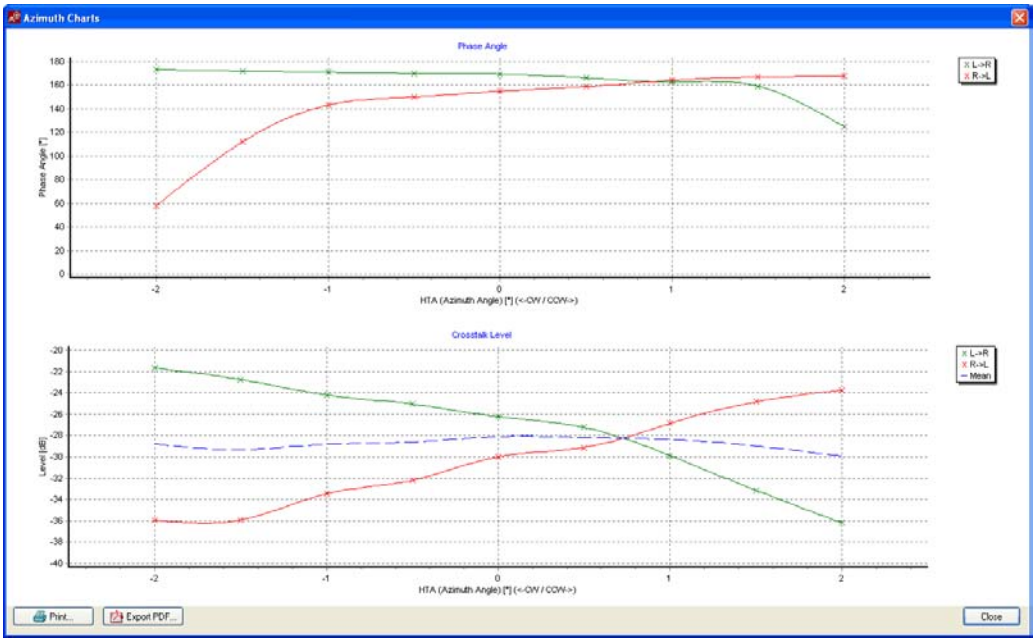
c) EMT JSD-6

We have two different cartridges of the JSD6 (#3343 and #3344) that show similar behaviour in phase response.





The first plot shows the azimuth to be +1.7° (CCW) off, the latter plot shows +0.8°. Unfortunately the crosstalk balance between channels in the first case is 13 dB off assuming you adjust the cartridge in „optical“ upright position! As phases do not differ that much in the region from 0° up to +2° on those cartridges we recommend to adjust for balanced crosstalk levels: +1.1° in the first and +0.75° in the latter case.

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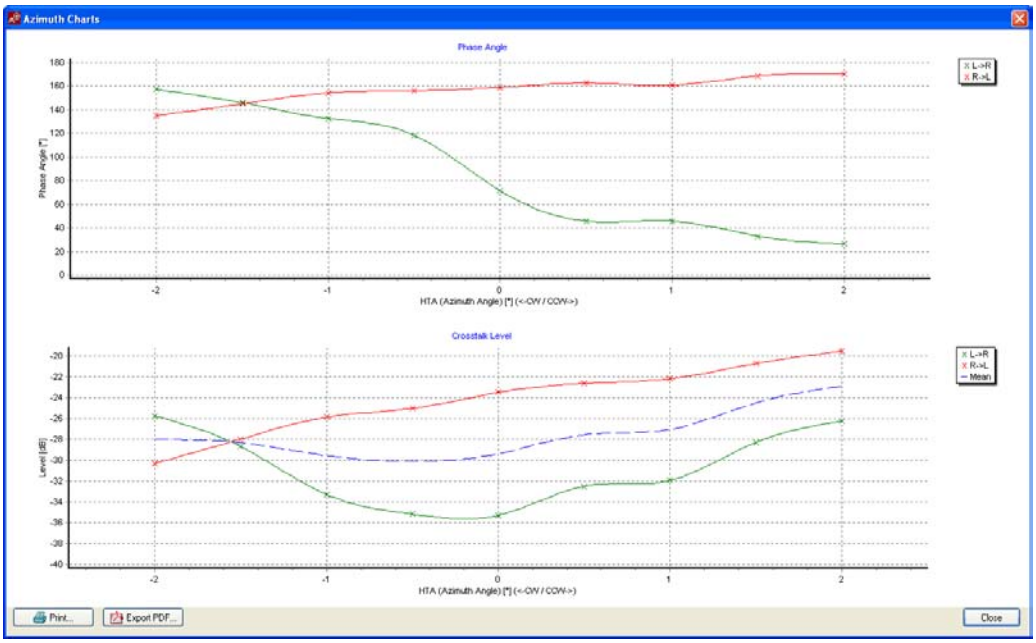
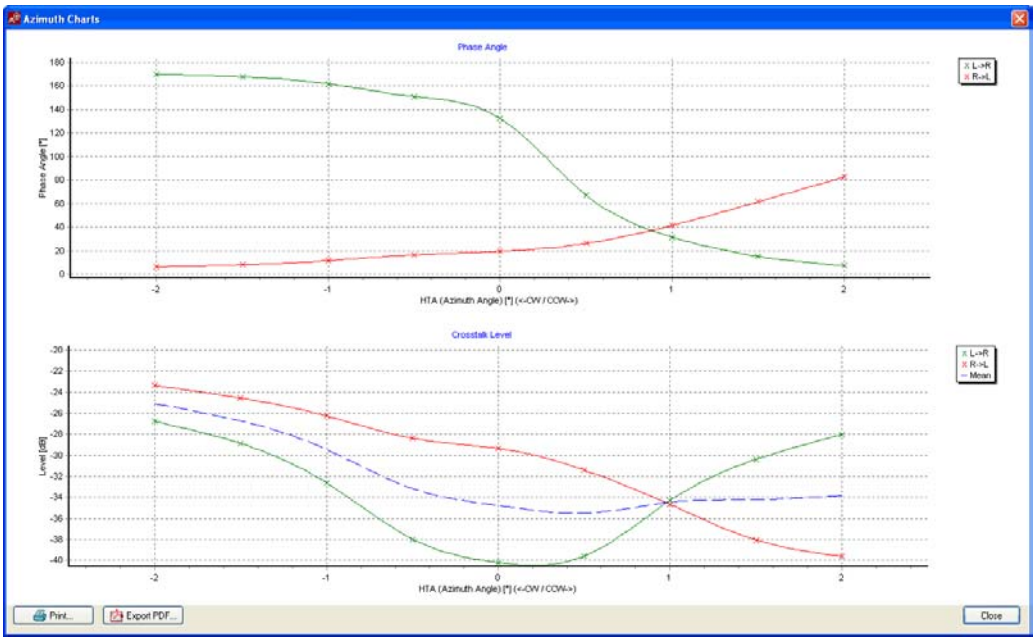
d) RESON Aciore



The RESON Aciore is a mid priced cartridge with a Fritz Gyger S stylus. As can easily be read from the results the only usefull position of azimuth is –1.5° (CW). Crosstalk balance from factory is 12 dB off....

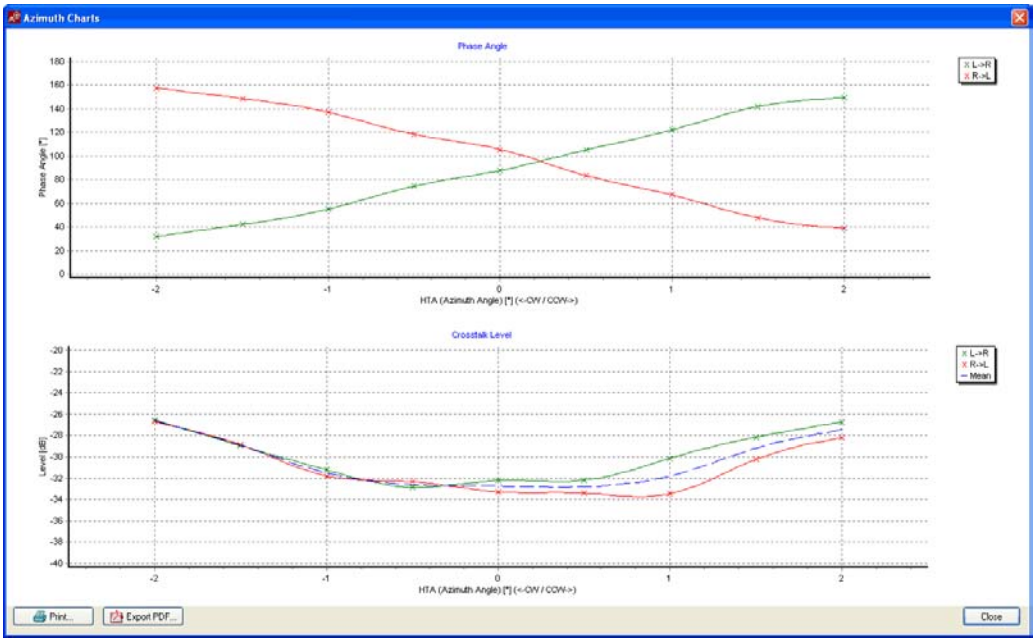
e) LYRA Dorian



Guess which point to choose? +1! (CCW). From factory crosstalk balance is 11 dB off.

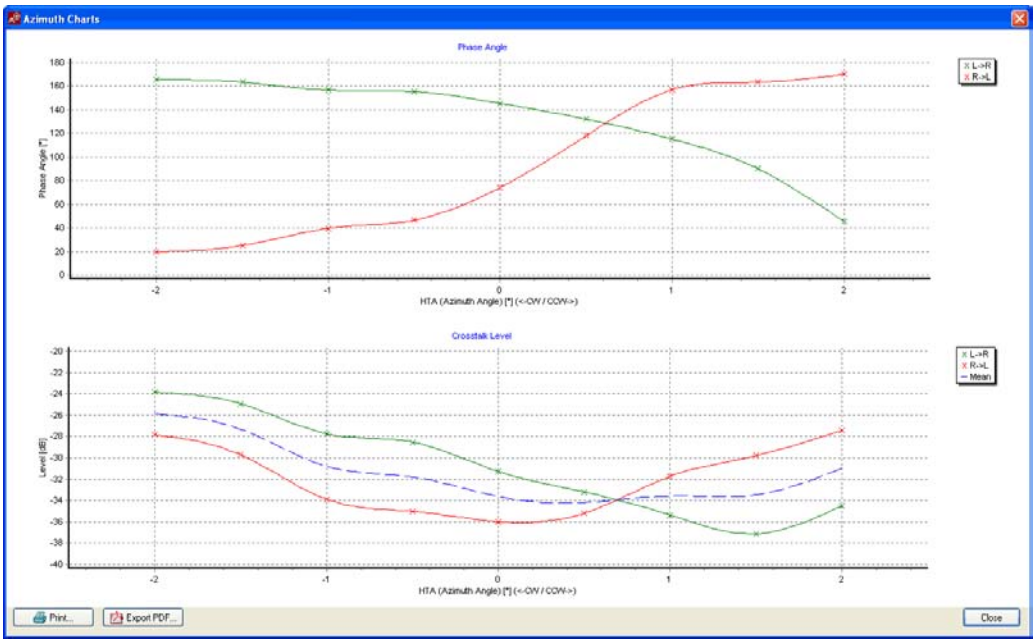
f) Lyra Skala

We have different Lyra Skala cartridges that show similar phase response. One example we want to show you:



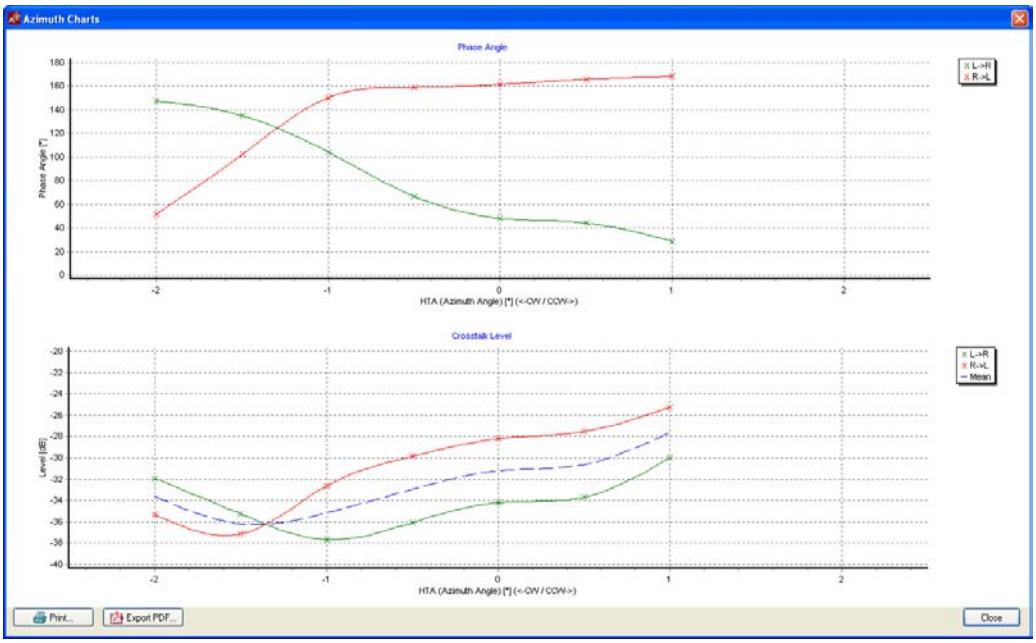
As you can see from the crosstalk levels you have an area from –1° (CW) up to +0.8° (CCW) where it is hard to guess what to do. In this case the only valuable information you can get from the phase response indicating to set at +0.25° (CCW).

g) ORTOFON Vinyl Master Silver



A budget priced cartridge offering a perfect 34 dB of crosstalk attenuation if adjusted correctly. In this case the situation is clear. Perfect azimuth you have at +0.8° (CCW).

h) ORTOFON Venice



One of the higher priced cartridges from ORTOFON. Phase intersection correlates with channel crosstalk balance offering 36 dB of crosstalk attenuation at –1.4° (CW).

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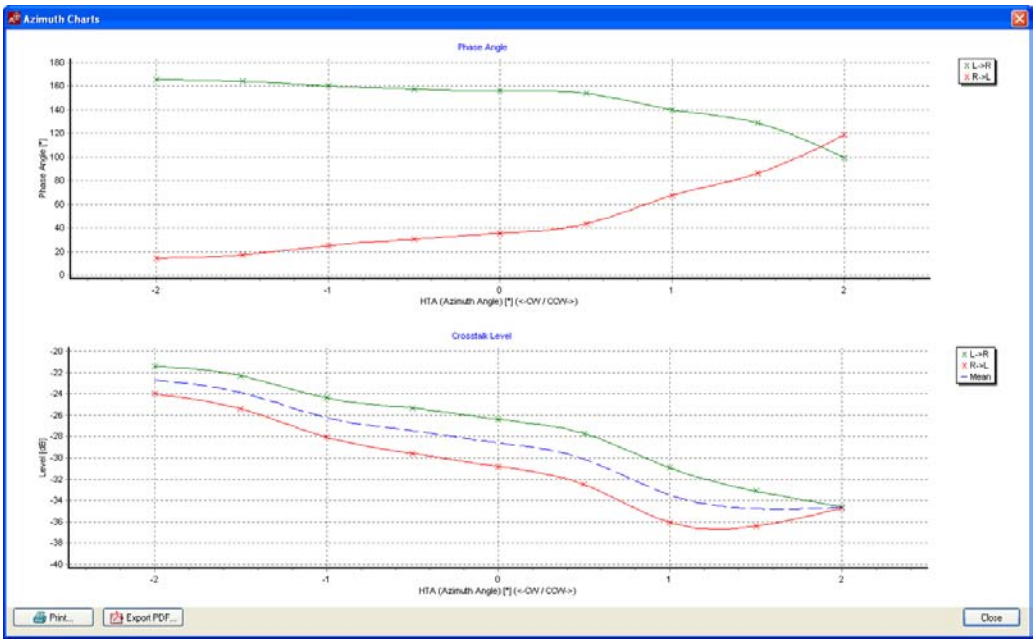
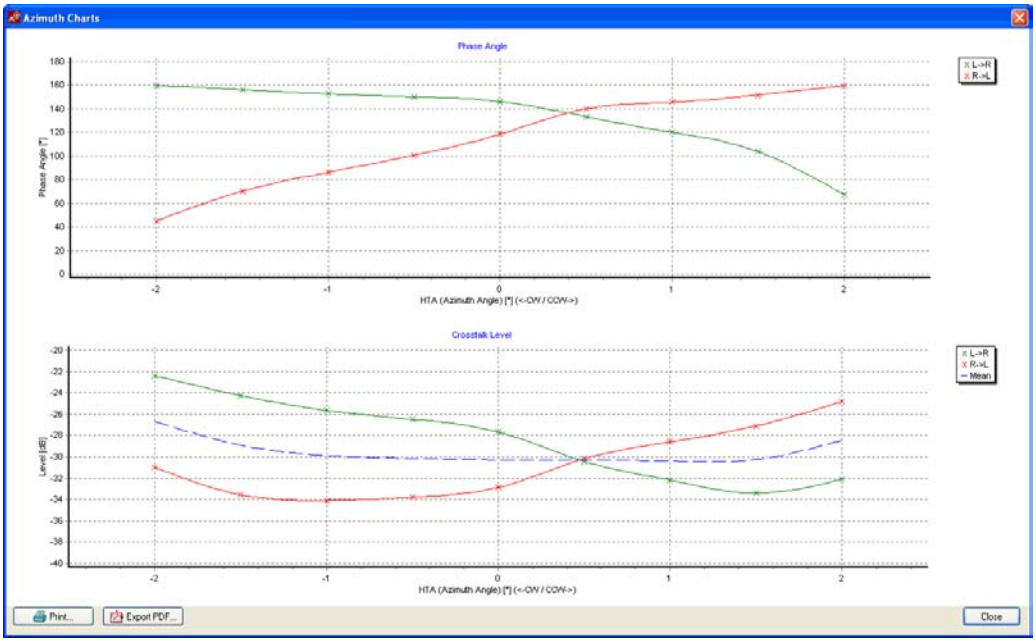
i) ZYX R100 YATRA



One can easily see that this cartridge is largely off azimuth. You get an additional 10 dB of channel separation for free placing it at +2° (CCW). Phase response is in nice correlation to this value.

j) ZYX Ayame



This cartridge is +0.5° off in azimuth. You can choose either phase or crosstalk intersection. The points do match.

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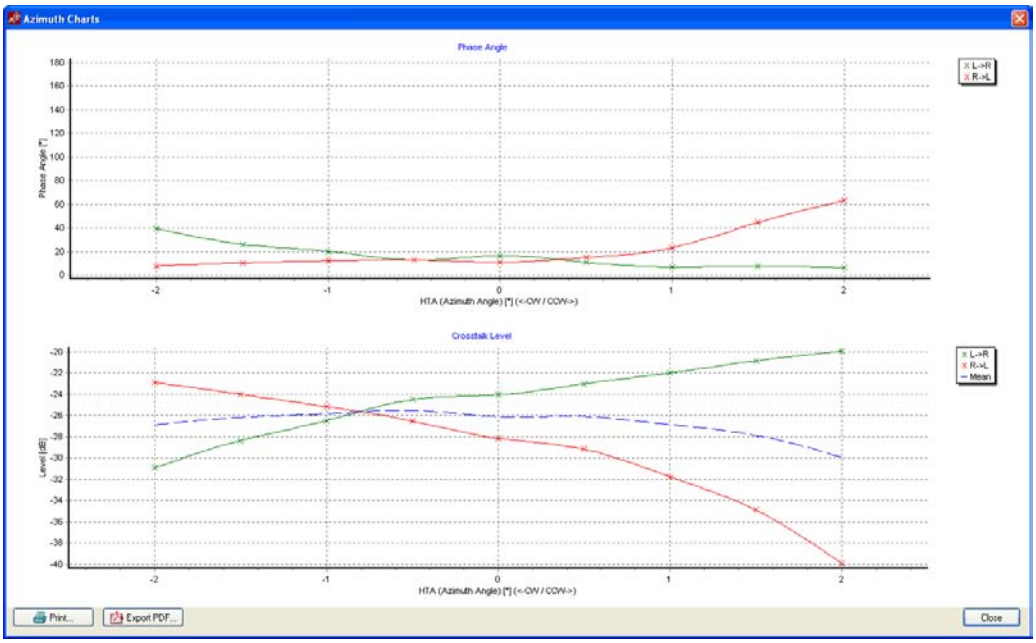
k) Goldring 1006



One can easily see that phase response shows two points where the curves intersect. One cannot get valuable information from the phase response on that cartridge. BUT: You can get perfect crosstalk balance close to the first phase intersection at –0.8°.

Final conclusion

We can distinguish between three cases

1. phase response and crosstalk correlate and show intersection
2. crosstalk doesn't show intersection but phase response does
3. phase response either does or doesn't show intersection but crosstalk does

In the first case the situation is clear. Typically intersection appears at similar HTA positions.

In the second case one should choose the intersection point of the phases.

The latter case forces you to forget about phase response and you should choose the crosstalk intersection point.

A fourth case has to be mentioned as well. Remember the curves obtained with the EMTs. In case that phase difference between the two channels is small but crosstalk level differ significantyl we suggest to look for balanced crosstalk level and forget about the phase information.

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