



PHONO PREAMP

MANUAL



THANK YOU

for purchasing a product from TRINITY Electronic Design.

The TRINITY PHONO sets new standards so that discerning music aficionados can finally enjoy their most beautiful recordings as if it were the true to life original.

The PHONO PREAMP supports RIAA, FFRR, COLUMBIA and EMI equalization.

Enjoy pure sound reproduction with our product.

Sincerely Yours

TRINITY Team

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SAFETY INSTRUCTIONS

1. Please read this operating manual carefully and observe all the instructions affixed to the appliance or written in this manual.
2. Install this product on a stable surface and make sure that nobody can trip over the cables.
3. This product should only be connected to a power source indicated on the product. If you are unsure what power source you have in your region, please contact your local power utility.
4. Never operate this product near water or with wet hands. If the product comes in contact with liquids, immediately disconnect it from the power source.
5. To exclude the risk of an electric shock, please never expose the product to the rain or other source of liquid.
6. In thunderstorms, do not install the product or put it into operation.
7. Never attempt to open the appliance or repair it yourself. If you open or remove the enclosure, you may expose parts that are subjected to dangerous levels of voltage. Any unauthorized opening of the appliance will cause the warranty claim to become null and void.
8. Do not allow children to play with electrical appliances without adult supervision. Children do not always recognize the possible risks and consequences.

SCOPE OF SUPPLY

The scope of supply comprises:

- TRINITY PHONO PREAMP
- TRINITY PHONO Load connectors (4pcs.)
- TRINITY PHONO Tone arm cable (optional)
- Cotton gloves
- Cleaning cloth
- 1 x Flight Case, weight: 13.5kg, dimension: 55cm, 46cm, 24cm

TRANSPORTATION AND CLEANING

Please only transport the parts listed in the scope of supply in the supplied flight case and use the supplied cotton gloves when unpacking and installing the appliances to avoid scratching the enclosures.

Clean the surfaces using the supplied microfiber cloth: immerse the cloth in lukewarm water containing no detergents and then carefully wipe the surface when the cloth is almost dry.

Never use chemical or aggressive detergents.

SELECTING THE POWER VOLTAGE

The implemented wide-range switched mode power supply modules allow an operation from 100Vac to 240Vac. The two fuses on the primary side are placed inside of these modules.

CONNECTING AND STARTING

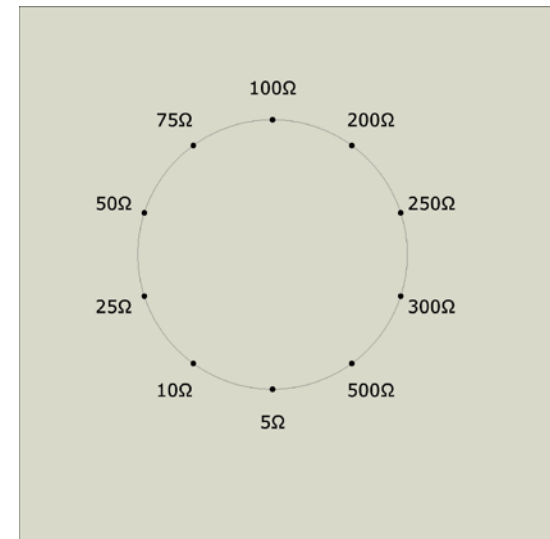
To install the PHONO PREAMP, select a stable, level surface directly next to the turn table so that the connecting cable to the tone arm is as short as possible. Avoid placing the appliance in direct sunlight and never place the modules directly next to radiators or fan heaters.

Protect all supplied parts from humidity and moisture.

Only wire up the components when the device is switched off.

WIRING UP

1. Disconnect the PHONO PREAMP from the power source. Never disconnect any wires unless the device is switched off.
2. Connect the PHONO PREAMP to the tone arm.
3. Connect the PHONO PREAMP to the LINE PREAMP.
4. Connect the PHONO Load Connectors to the load connector XLR inputs.
5. The precision rotary switch can be operated by a coin.
6. Select the matching load for the used MC pick-up.
7. Additional connectors with any values can be ordered as an option.



THE LOW NOISE INPUT STAGE

Even a low noise amplifier contains different noise sources and all resistive sources create thermal noise depending on the temperature.

As Mr. James Bryant from Analog Devices mentioned:

“So anywhere at all that there is resistance in a circuit, whether it is carrying current or not, there is a noise generator with an output voltage noise spectral density of

$$\sqrt{4kTBR}$$

We can reduce the noise by reducing the resistance **R** (this may increase current and/or power consumption), but reducing the temperature **k** is not usually practicable (if we cool a resistor from room temperature (298K) to liquid nitrogen temperature (77K), its noise voltage is still more than half its room temperature value). **And, of course, we can't change Boltzmann's Constant because Professor Boltzmann is dead.”**

The **B** stands for band width and will be discussed later.

When a source like a MC pickup with its matching resistor is connected to a phono preamplifier's input the output noise includes contributions from both the amplifier and the source resistance. There exists an optimum source resistance for any given amplifier, which will provide the lowest noise factor, or in other words the highest signal-to-noise ratio for any specific input signal.

Since the source resistance is determined by the pick-up manufacturer, there is only one way left to optimize the overall noise performance of a phono preamplifier.

The amplifier has to be designed in that way that it matches with these source resistances of the MC pick-ups or at least come close to this value.

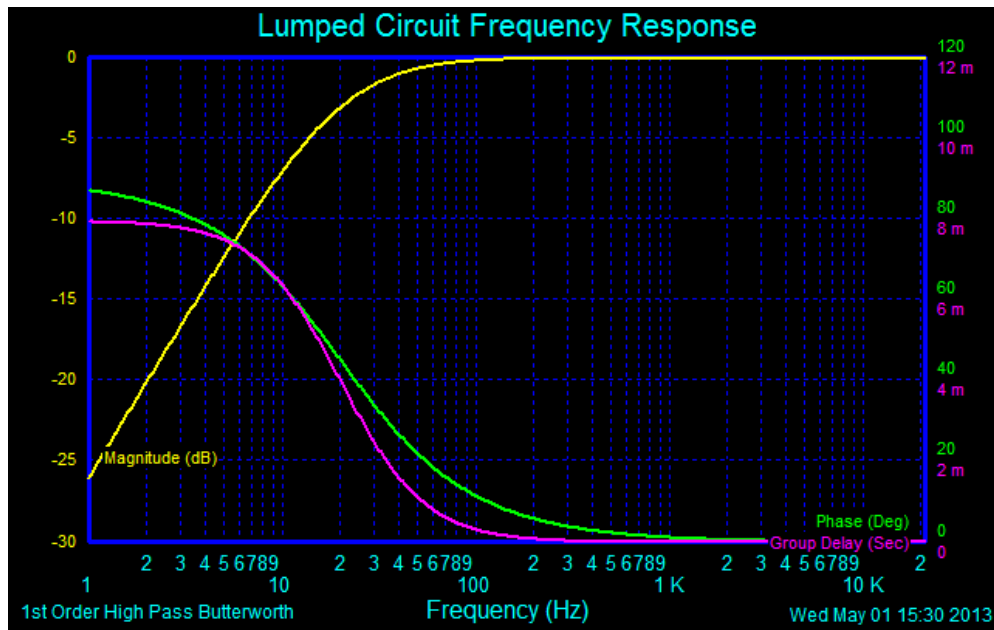
After solving some partial differential equations, it can be shown that the optimum source resistance is

$$R = \frac{e_n}{i_n}$$

That means for a given amplifier the optimum source resistance can be calculated. Beside the low noise performance, the amplifier has to match to other requirements as well. For instance the amplifier has to be linear and should not add any distortion or the bandwidth should be well above the audio bandwidth and so on.

Often step-up transformers are used to match low source resistances with the optimum source resistance of the active electronic. For the noise consideration this is a pretty good solution, but all transformers are limited in the band width, since they cannot transfer DC voltage. Depending on the construction and the transfer ratio of the transformer the lower cut-off frequency can be in the range of 20Hz. That means a transformer acts always like a high pass filter.

A 1st order high pass with 20Hz cut-off frequency has the following amplitude and phase response:



The purple trace shows the group delay, which is easier to understand, since it is the time a signal needs to pass the electronic.

If we consider a complex signal with 20Hz as the fundamental, then the fundamental of the signal needs 4ms from the input to the output. The second harmonic needs only 1.5ms. That means you will hear the harmonics before you hear the fundamental!

It is said, that the gifted people with “Golden Ears” can hear differences of 50µs.

This deviation is reached with a 20Hz high pass at 250Hz. From there on the system is time coherent for the ears.

A few millisecond group delay variation is therefore not time coherent and the reason why the DC servo in the TRINITY PHONO PREAMP starts at 0.5Hz.

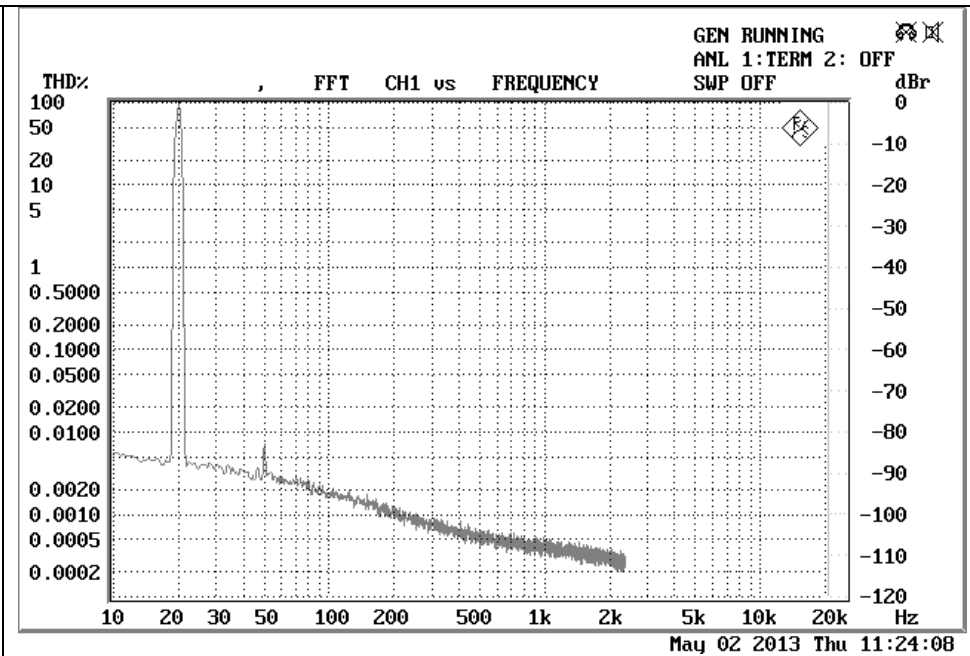
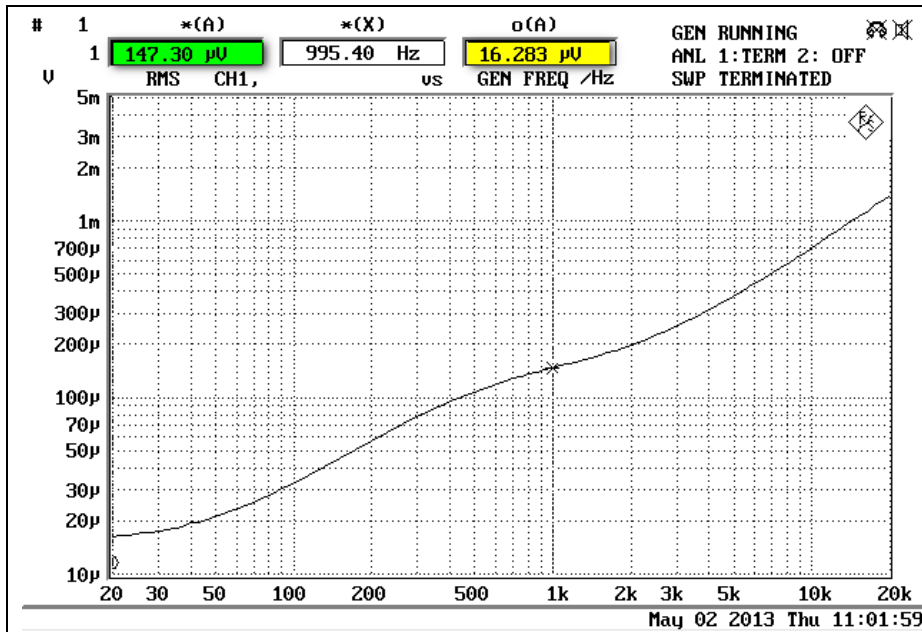
To avoid such a step-up transformer the TRINITY PHONO PREAMP uses 12 gain stages in parallel to reduce the input noise voltage by a factor of

$$\sqrt{12} = 3.5 \equiv 10.8dB$$

Of course you can write just anything down on paper, but what about the reality.

The next figure shows the inverse RIAA used as an input signal for the PHONO PREAMP.

The amplitude simulates a pickup with 150µV at 1kHz.

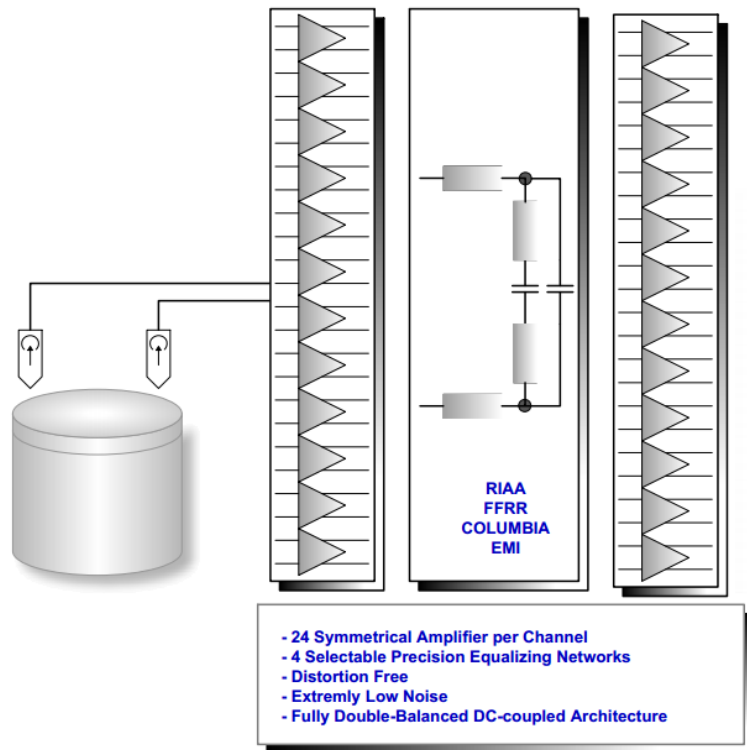


Input signal of $150\mu\text{V}$ at 1kHz related to $16\mu\text{V}$ at 20Hz

The FFT show a noise level at -86dB with an input signal of $16\mu\text{V}$ at 20Hz

Caused by the frequency response of the RIAA equalization the worst case frequency is the lower audio band at 20Hz. Even at this extreme low level of $16\mu\text{V}$ at 20Hz the noise level of the TRINITY PHONO is at -86dB! And the linearity is ideal, since no harmonics are measurable. The only visible spur is at 50 Hz and comes from the radiated hum of the analyser. Its input amplitude is less than 1nV (0.000000001V)!

The noise level is further attenuated by the equalizing network, which is placed after the first gain stages and works like a low pass filter. That is the B (band width) part in this formula



THE GAIN

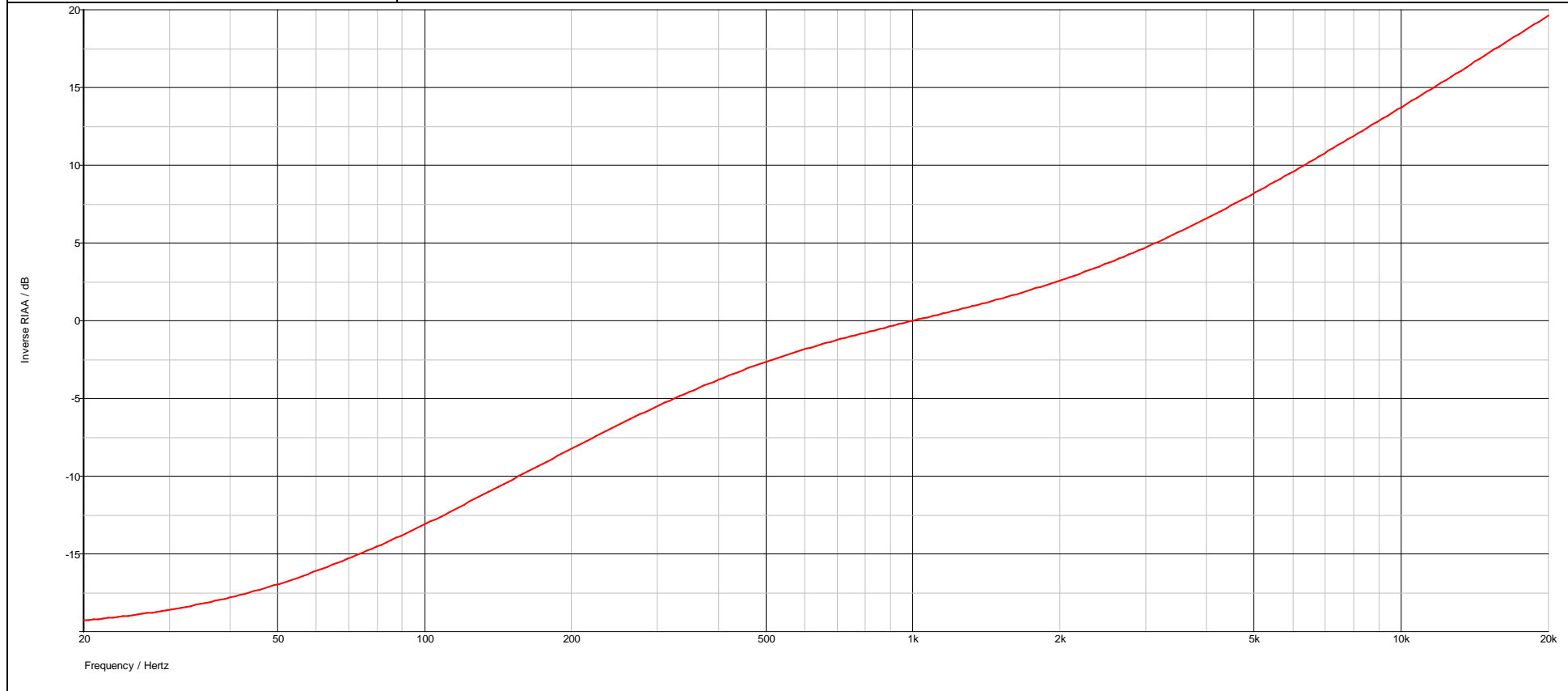
Each of the 24 gain stages has a fixed gain of 40dB. Caused by the double balanced architecture the overall gain is 6dB higher for each gain block consisting of 12 gain stages. The complete gain without equalizer is therefore 92dB. Depending on the different attenuation caused by the equalizing network the gain related to 1kHz is between 72dB for the RIAA und roughly 78dB for the other equalizer settings. Each gain stage has its own DC servo, to avoid that the DC servo affects the accuracy of the equalizing network. That means each channel consist of 48 low noise amplifier plus 8 additional extreme low noise voltage regulators, which are arrange in a point of load regulation architecture.

THE EQUALIZATION

The very high accurate equalization curves are calculated with the help of the Laplace operator and the results are transferred as a look-up table to the audio analyser to measure each device in the correct way. The following graphs show the inverse response of the respective equalizer.

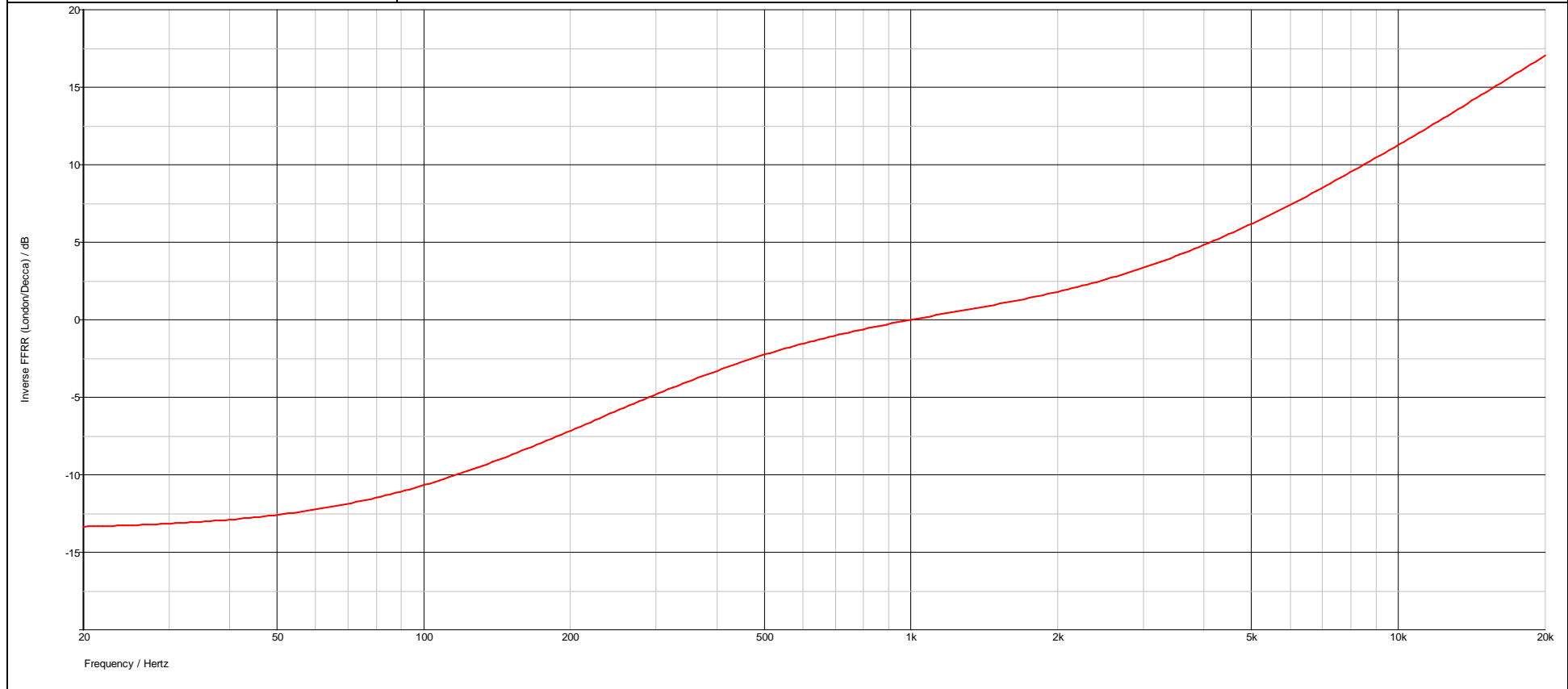
Inverse RIAA

Frequencies	50.05Hz	500.5Hz	2122Hz
Time Constants	3179.9us	317.99us	75.002us
Laplace Operator	$\frac{(1+3180\mu s) * (1+75\mu s)}{(1+318\mu s)}$		



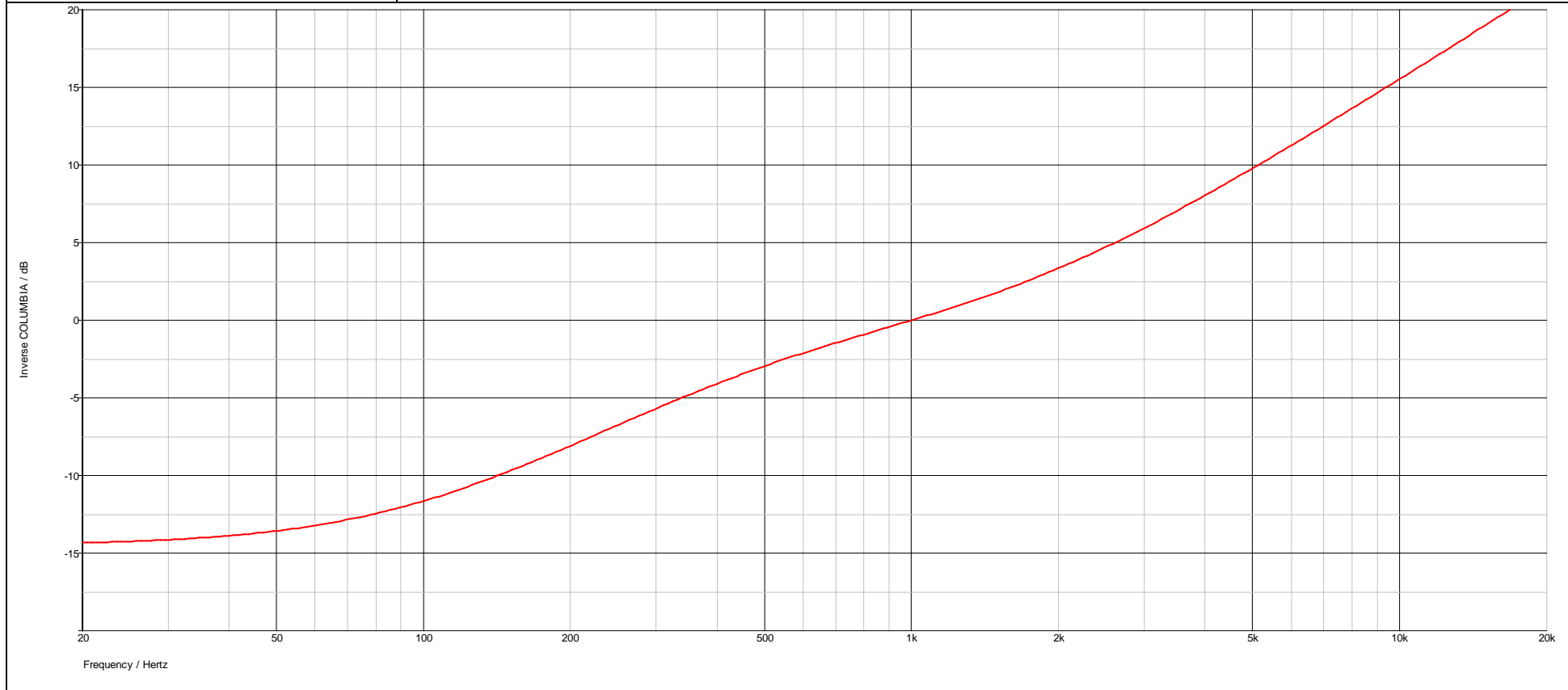
Inverse FRRR

Frequencies	100 Hz	500Hz	3000Hz
Time Constants	1591.5us	318us	53us
Laplace Operator	$\frac{(1+1591.5\mu s) * (1+53\mu s)}{(1+318\mu s)}$		



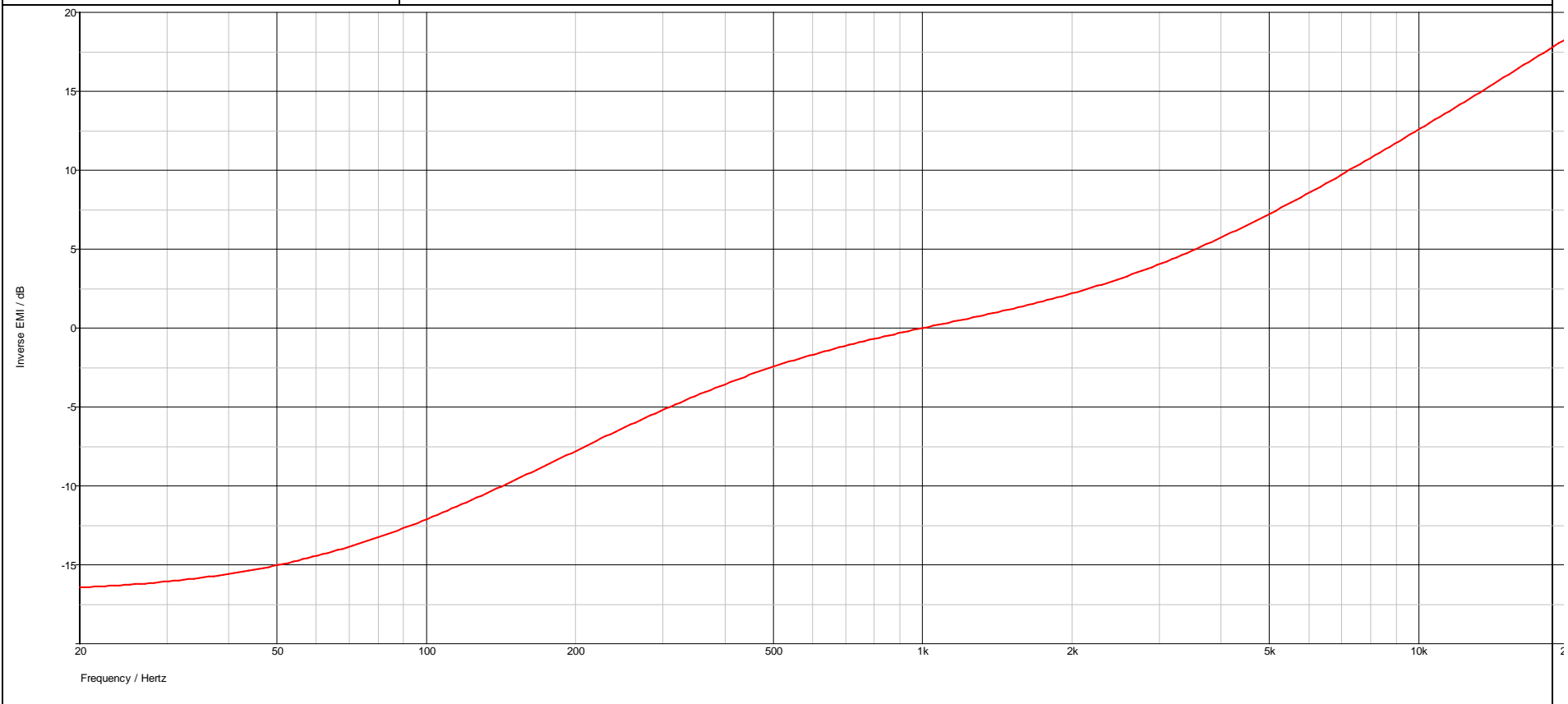
Inverse COLUMBIA

Frequencies	100Hz	500Hz	1590Hz
Time Constants	1591.5us	318us	100us
Laplace Operator	$\frac{(1+1591.5\mu s) * (1+100\mu s)}{(1+318\mu s)}$		



Inverse EMI

Frequencies	70Hz	500Hz	2500Hz
Time Constants	2273.6us	318us	63.6us
Laplace Operator	$\frac{(1+2273.6\mu s) * (1+63.6\mu s)}{(1+318\mu s)}$		





THE FINAL MEASUREMENTS

All TRINITY devices are shipped with a complete measurement protocol and not with some “typical” value published on the web page or in the data sheet.

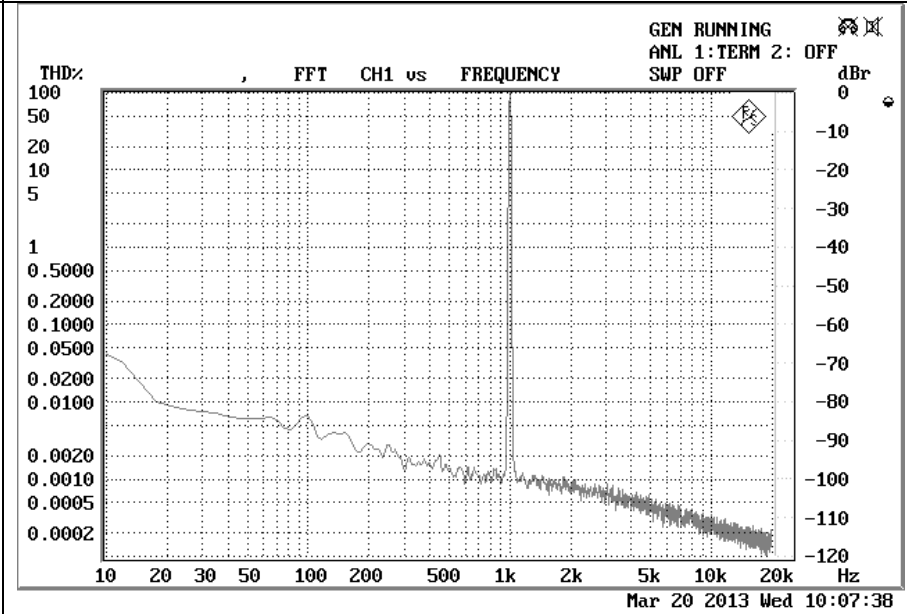
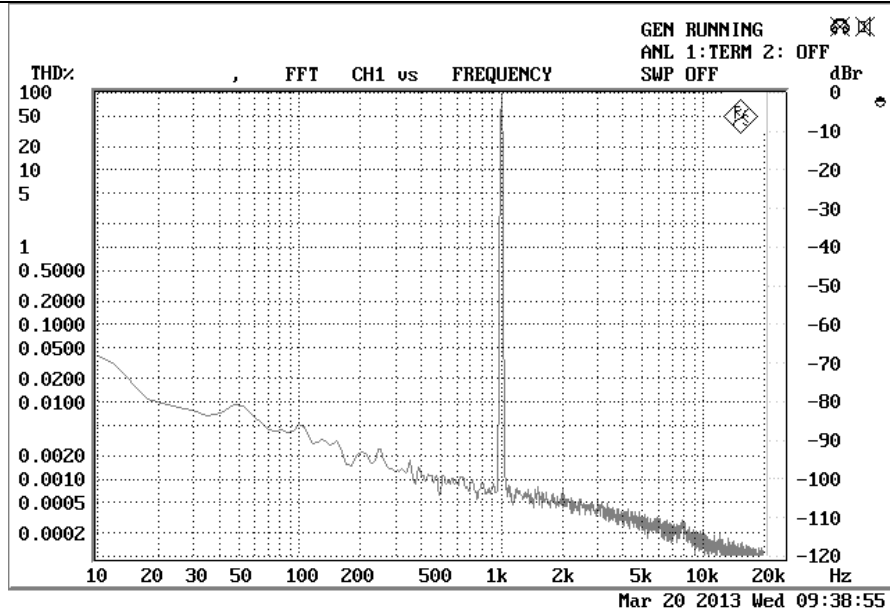
What you see (in the measurement results) is what you get.

The measurements are done after a burn-in of 48hours and with a calibrated input voltage of $350\mu\text{V}$ at 1kHz.

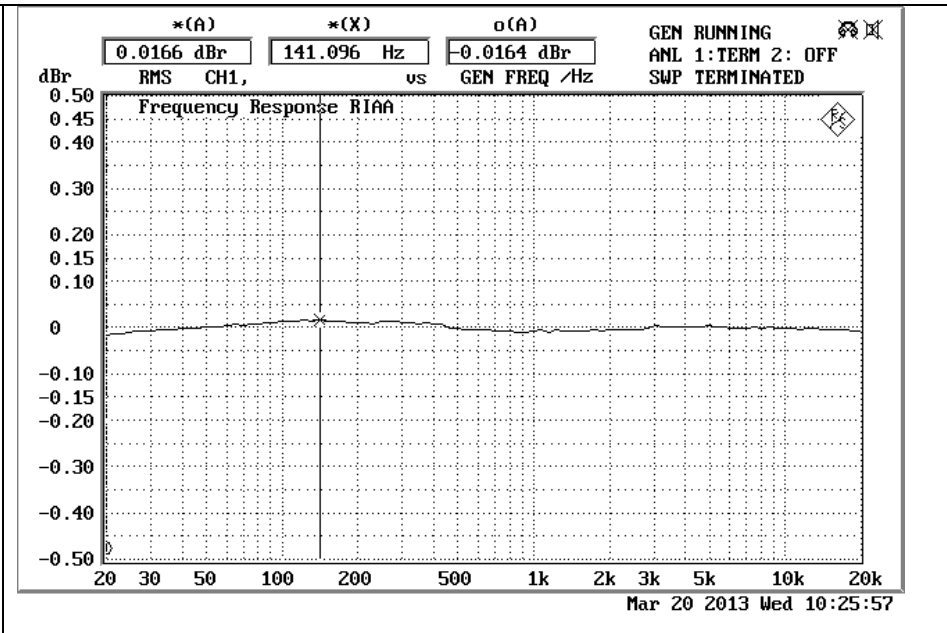
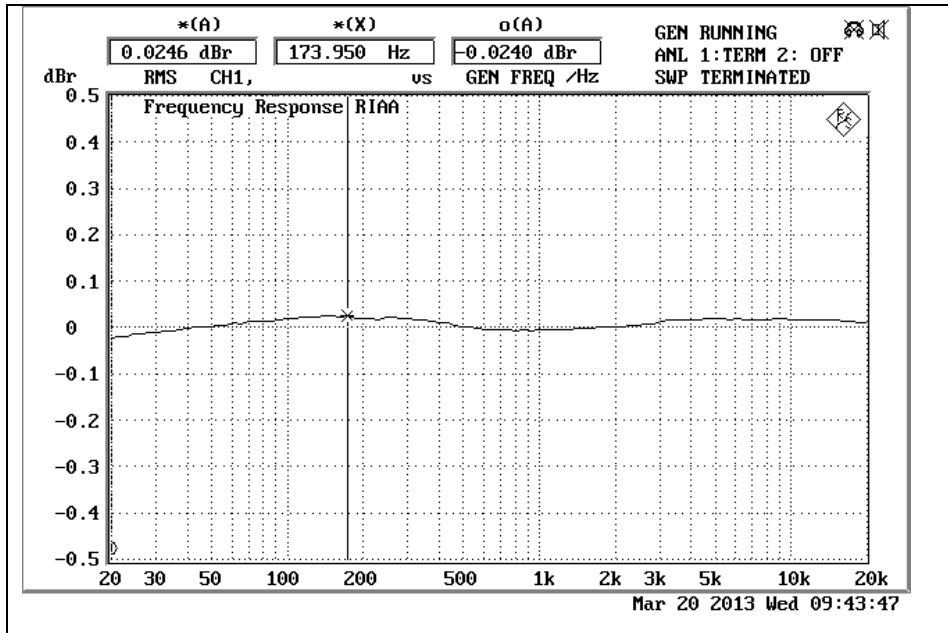
PHONO SN-005_GS

Left Channel

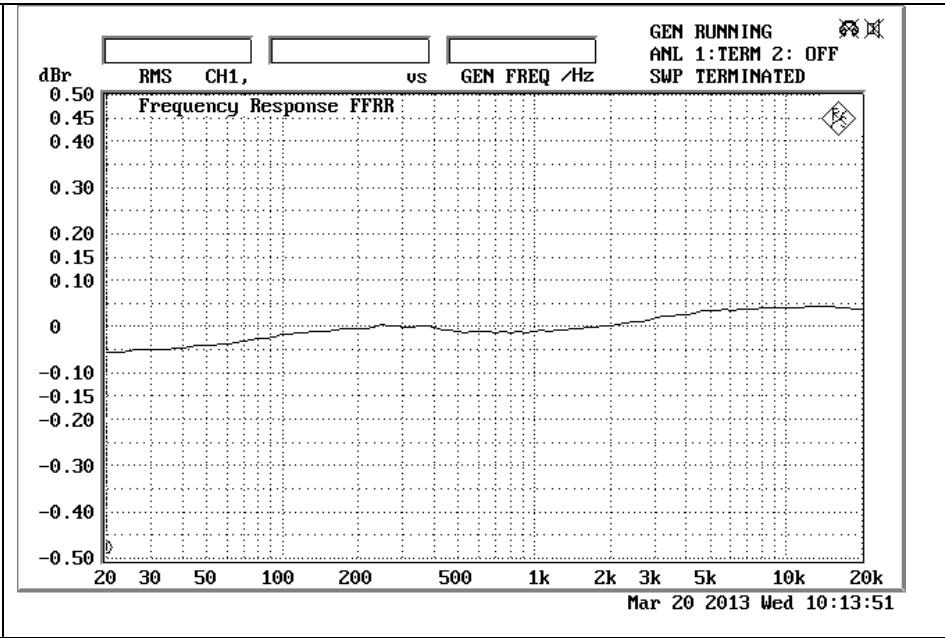
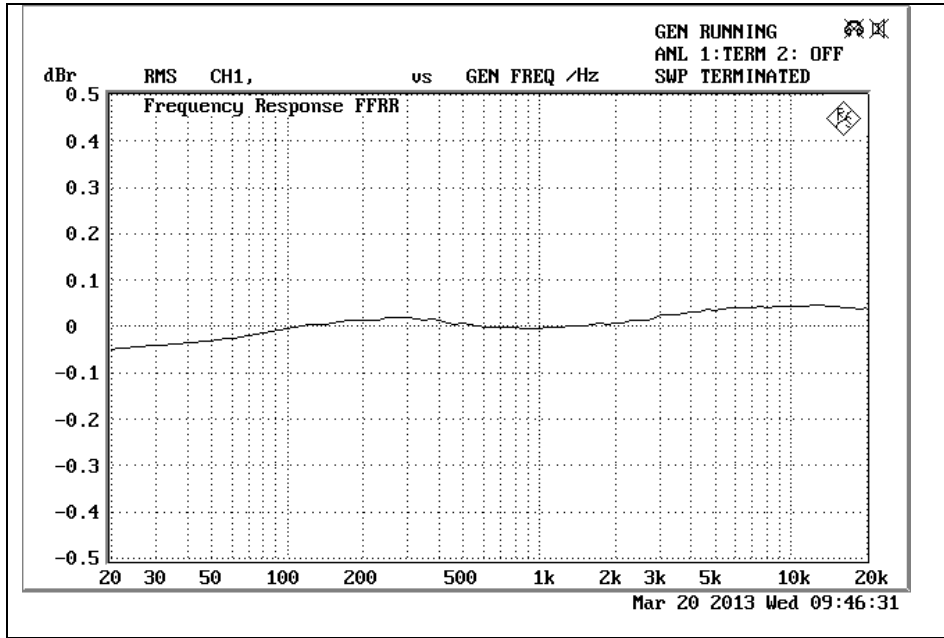
Right Channel



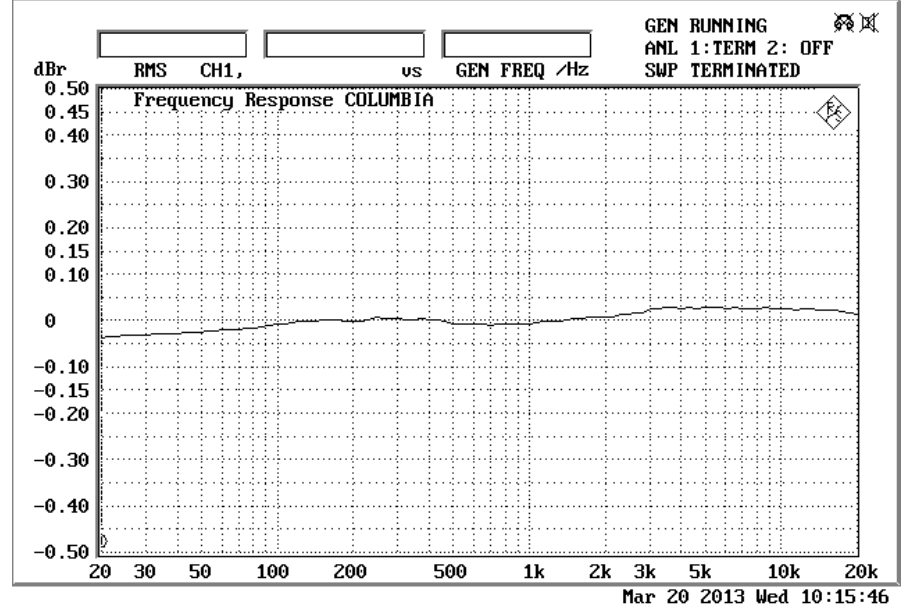
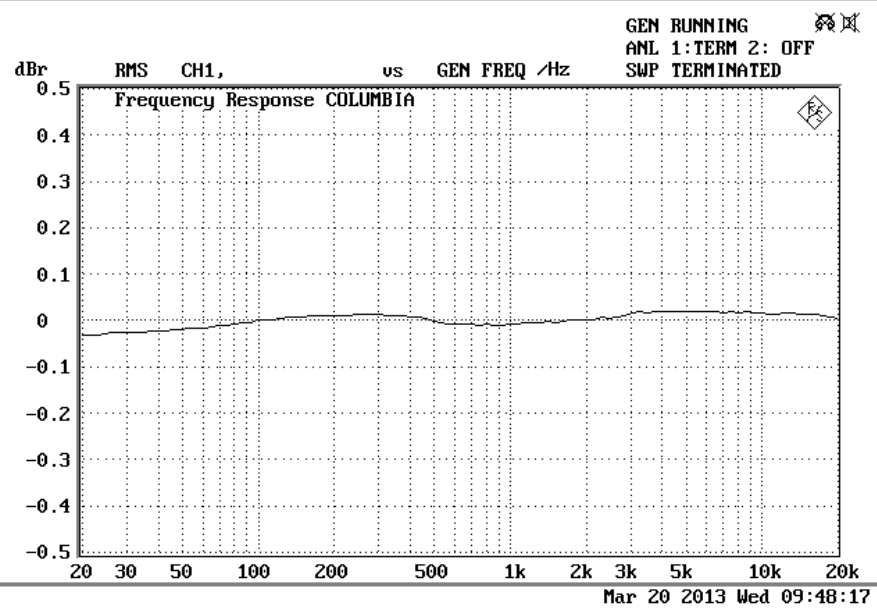
FFT 1kHz 350 μ V



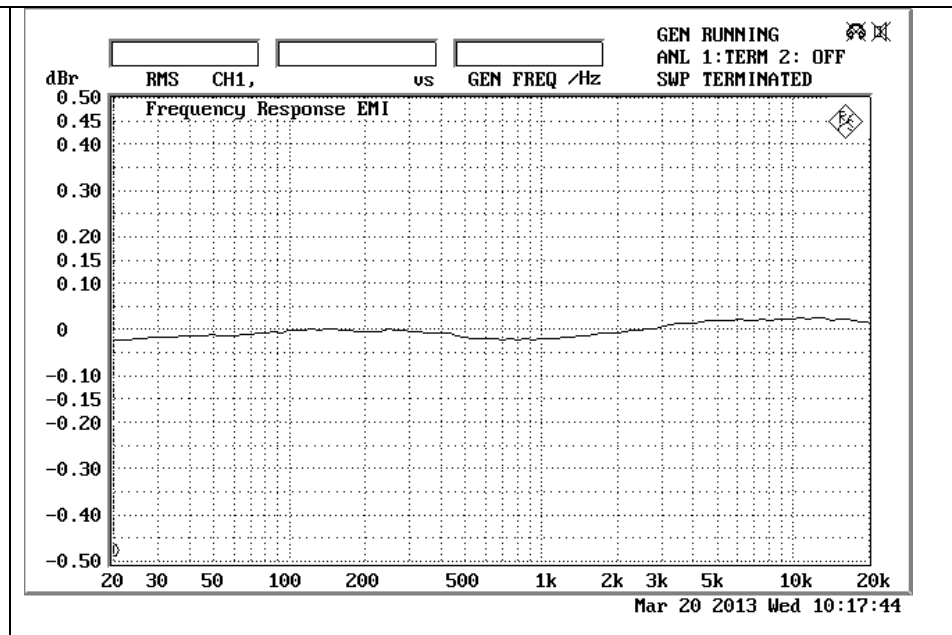
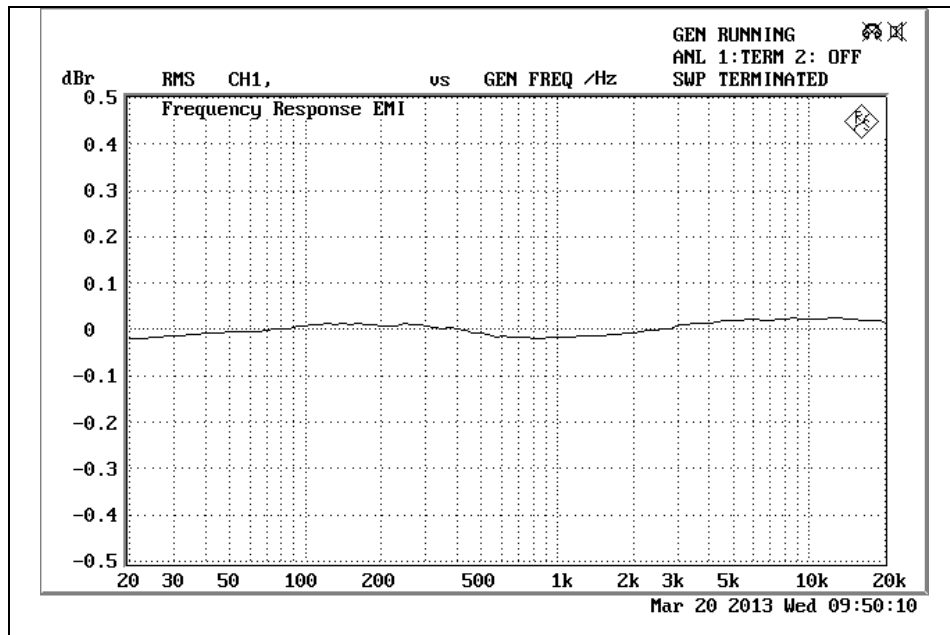
Frequency Response RIAA, **accuracy +/-0.025dB**



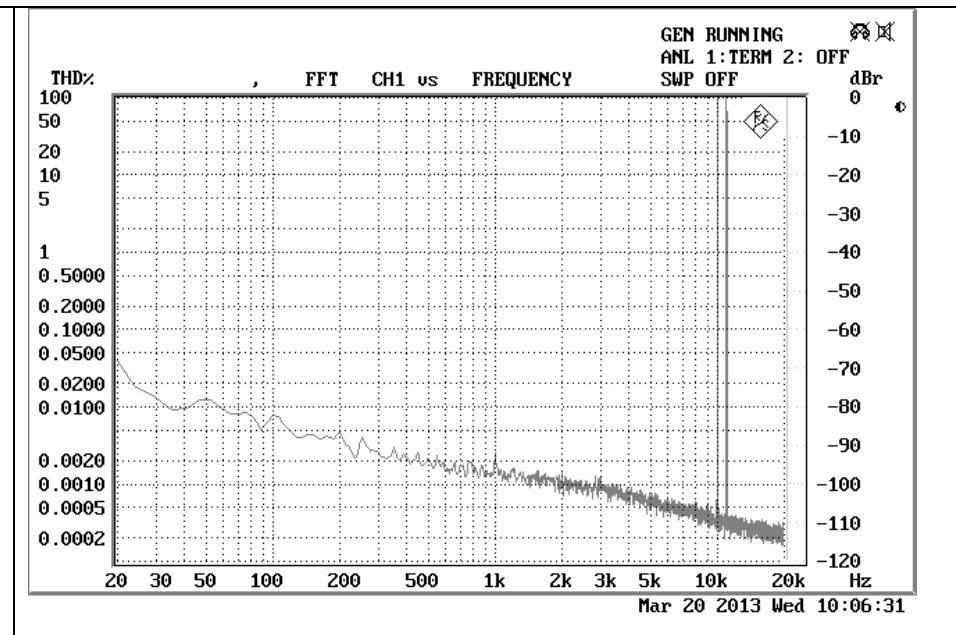
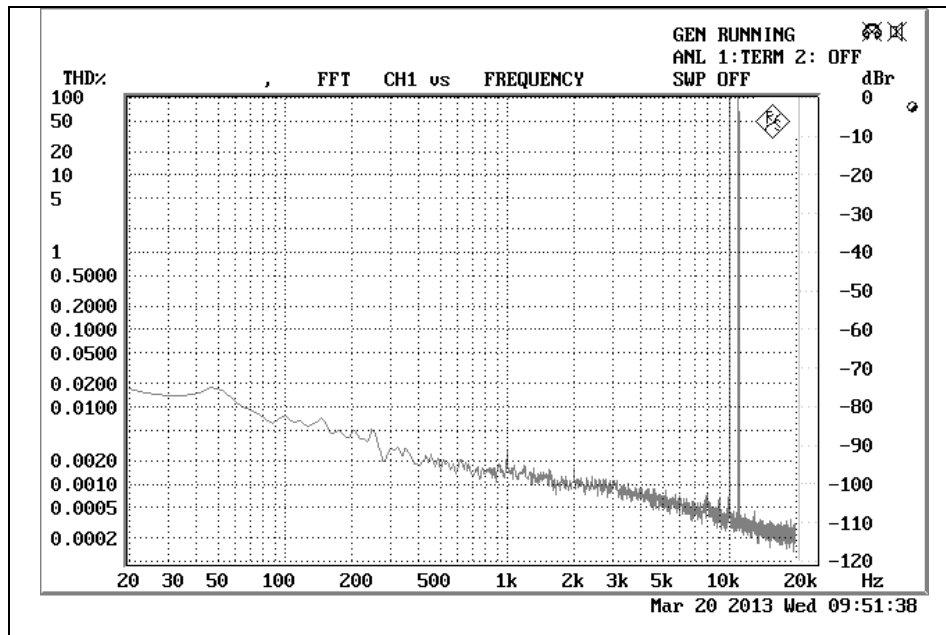
Frequency Response FFRR



Frequency Response COLUMBIA



Frequency Response EMI



Intermodulation Distortion



WARRANTY

The warranty period of the Trinity PHONO is 2 years.

- Within the warranty period, any material and production defects will be rectified according to the following conditions:
- The warranty period begins with the purchase of the product and only applies to first buyers.
- A warranty claim is only valid if defects originating from material or manufacturing defects occur, but not as the result of natural wear and tear. In case of justified claims that occur during the warranty time, we will either repair the affected component free of charge or replace it at our discretion. In so doing, we are entitled to also supply a successor model in the interests of technical progress. Any further claims, in particular compensation damage of any nature, are excluded.
- The warranty period is not extended by any work performed during the warranty period, neither for replaced nor repaired components.
- Any improper handling or interventions by persons not authorized by TRINITY Electronic Design GmbH will render the warranty claim null and void. This also applies to damage arising from improper connection or use.
- The warranty excludes transportation damage that must be claimed immediately from the forwarding agency (railway, post, carrier). Any scratches on the enclosure or other visible defects must be reported to the dealer within 3 days.
- The provisions of the German product liability law and comparable foreign regulations remain unaffected, provided they are inalienable. We retain the right to make technical changes in the interests of technical progress



SUPPORT

If you have any questions relating to installation, operation or options, we will be pleased to answer them.

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