

Phono Master

Resolution Series[®] 223



UNIQUE PRECISION IN PHONO LINEARIZATION, PREAMPLIFICATION, CLICK AND CRACKLE REMOVAL

- ♪ Immense improvement of LP and Shellac reproduction. Record collections gain a new life.
- ♪ The absolute ultimate in phono linearization and preamplification.
- ♪ The most accurate reproduction of vinyl LP's, EP's, 45rpm and Shellac records.
- ♪ Unique variable "non-RIAA" de-emphasis allows precise linearization of any recording ever made. Continuously variable controls allow precise restitution of any pre-emphasis curve.
- ♪ Astounding improvement in reproduction of vinyl treasures.
- ♪ Variable cartridge loading allows optimization of any MC or MM cartridge.
- ♪ Ultra-high precision RIAA record de-emphasis circuitry.
- ♪ Uncover rare vinyl treasures with the unique linearization controls.
- ♪ Tremendous headroom and reserves in signal handling capability.
- ♪ Outputs optimally interface to true balanced, pseudo-balanced or single-ended loads. Unit automatically adjusts for optimal performance with any type of line stage.
- ♪ The world's only true balanced symmetrical phono preamplifier.
- ♪ Phenomenal, new real-time de-click circuits in pure analogue mode attenuate obnoxious clicks and pops without side effects on the audio signal.
- ♪ Unique precision real-time analogue de-crackle circuits efficiently reduce disturbing crackles without any negative effect on the original signal.
- ♪ Proprietary circuits precisely remove hum frequencies, a relief on many an important but hum-plagued recording.
- ♪ Ultra-linear balanced line drivers: No more matching problems of cables and electronics.
- ♪ Entire unit uses discrete circuitry of proprietary enhanced Class A design: no signal-degrading IC's, transformers, hybrid circuits, tubes or op-amps.
- ♪ Modular construction guarantees easy updating and servicing.
- ♪ Hand-selected, high-precision matched components of DIN, IEC & MIL standard provide accuracy and long-term stability.
- ♪ Performance without equal as the technology, circuitry and manufacturing methods are proprietary to FM ACOUSTICS.
- ♪ The ultimate solution for restoration work, mastering studios, libraries and dedicated record collectors.

When a totally faithful phono reproduction of the original is required -the FM 223 *PhonoMaster* is the ultimate solution.

The *PhonoMaster* provides the extraordinary new click, pop and crackle removal circuits, a treasure for record collectors who own precious works in less than pristine condition.

TRUE BALANCED CARTRIDGE INTERFACE

By design, all phono cartridges are **balanced** sources. The term "balanced" describes a system in which the audio signal is transferred via two shielded symmetrical conductors, neither of which is connected to ground (see Fig. 1). (For general information on balancing consult Technical Bulletin No. 31).

In an **unbalanced** system one of the signal paths is carried by the shield or is exposing the signal to the ground carrier. Because of this, interference signals such as hum, RF, noise etc. are picked up by the shield and can thereby enter the audio circuitry. The lower the signal level and/or the more ambient interference present, the greater is the danger of degradation allowed by an unbalanced (single ended) interface.

To this day the interconnection of phono cartridges has been done "unbalanced" (a few pseudo-balanced phono preamps are available).

Considering the extremely-low signal levels of cartridges, it becomes obvious that a **true balanced** signal interface to the preamplifier is a **huge improvement** over presently available designs. Unfortunately, such an elegant system was always faced with a number of technical challenges. In the FM 223 these limitations have been overcome entirely.

The FM 223 is the only phono preamplifier which assure **true balanced** interconnection of cartridges*.

Fig. 1 shows a balanced interface. Such a balanced interconnection of the phono cartridge has major advantages:

- increased dynamics
- higher headroom
- elimination of non-musical signals (interferences)
- lower hum and noise
- etc.

The signal lines from the cartridge are directly connected to the true balanced input stages and have no connection to the shield. Thus, the shield can function optimally, conducting all interference signals directly to ground. The ground, of course, must be separate from the electric ground of the circuits (in many other so-called "balanced" products this is not the case).

*True balancing requires more than just XLR connectors on the preamplifier's inputs and outputs. It is the interference rejection ratio that defines the accuracy of balancing and with it the suppression of disturbing non-audio signals. This is one of the characteristics that exemplifies the tremendous difference between the FM 223 and other so-called "balanced" phono stages.

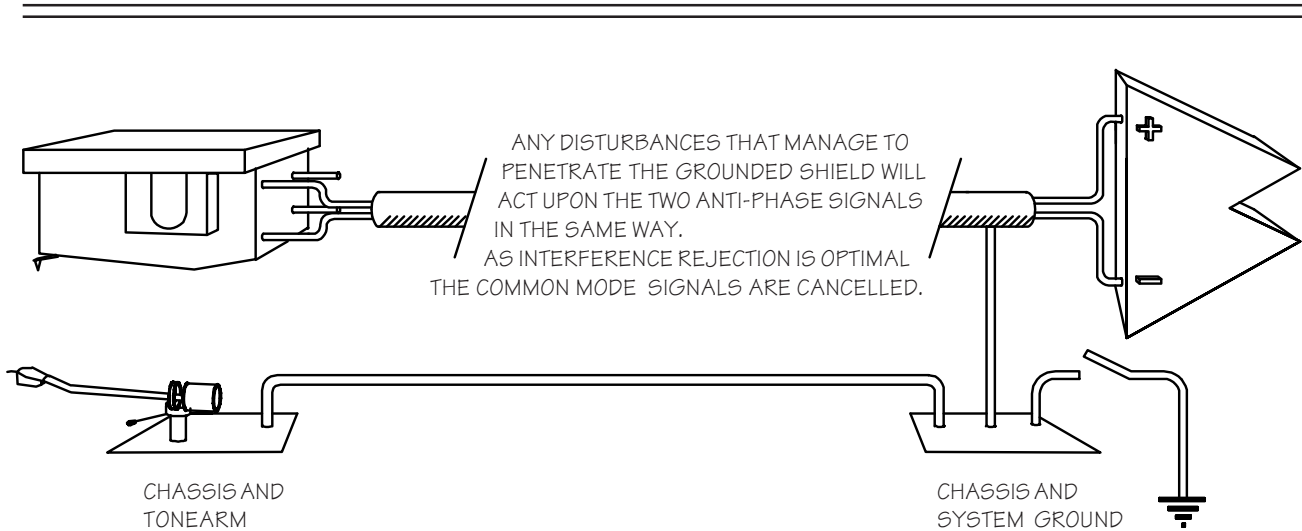
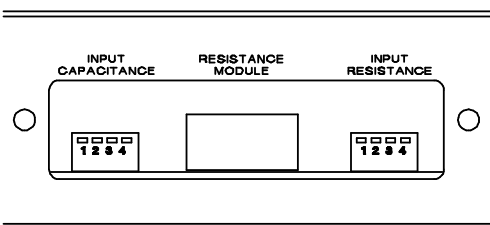


Fig. 1

THE INPUT STAGE OF THE FM 223 HAS AN EXTREMELY HIGH IMMUNITY (100 dB!) TO ANY NOISE AND INTERFERENCE THAT MAY BE PRESENT IN THE SHIELD AND GROUND SYSTEM

CARTRIDGE LOADING



In Phono preamplification all aspects require careful consideration. Cartridge loading is a touchy subject, as there are some preconceived ideas. However, this is highly important as the variations in the loading have a considerable influence on reproduction. The performance will be affected negatively if the impedance matching between the cartridge and the input stage of the preamplifier circuit is not optimal (the interconnect cable is a not to be neglected part of this interface!).

It would be handy if cartridge manufacturers would specify the detailed data required for calculation of the optimal cartridge loading (such as coil resistance, inductance and capacitance over the full frequency range, phase plots with tolerances, area and magnitude of resonances, etc.). With this it would be possible to provide information on optimal loading for each cartridge model. But as this is not the case, it is necessary to obtain the correct values of cartridge loading by listening tests (note that by far not every impedance stated by cartridge manufacturers in their literature is actually correct. It is always best to verify recommendations with actual tests). With the FM 223's unique cartridge loading system, it is for the first time possible to optimally fine-tune the performance of any cartridge.

Resistive Loading

A load resistance is required because electro-acoustic transducers must be damped to avoid ringing, overshoot and other negative effects. The loading also influences the preamplifier's noise level and the performance of its input stage circuitry as well as the frequency response. Unfortunately, many preamplifiers' noise performance suffers when the loading impedances are set to the relatively low values which are correct for MC cartridges, a design weakness of the respective phono preamplifier. Achieving low noise at low impedance is a real challenge and many manufacturers take the easy way out by fixing the MC input resistance to a higher value.

Some MC cartridge manufacturers even specify a loading resistance of 47 kOhm (the "standard" for Moving Magnet cartridges). While this may give a good theoretical noise specification for the preamp it does not provide the necessary damping for the MC cartridge. It simply is wrong.

One must realize where this fixed 47 kOhm input resistance comes from: it is a "compromise" setting that was accepted for loading of MM (moving magnet) cartridges. But this 47 kOhm input resistance is a theoretical figure and it is not the correct termination for all MM cartridges (whose inductance, capacitance and resonances vary from one type to another).

A 47 kOhm resistance is absolutely incorrect for MC (Moving Coil) cartridges. The optimal loading resistance for most (but not all) MC cartridges is between approximately 20 and 500 Ohm. As a rule of thumb the loading impedance should be 10-30 times higher than the coil resistance of the cartridge.

Preamplifiers having just fixed input resistance that do not allow variable resistance and capacitance loading are unable to extract the full performance from a cartridge.

Most preamplifiers lack this important feature of adjustable cartridge loading which is one of the reasons why other preamplifiers may work with one or two cartridges but give disappointing results with other cartridges. It's not the cartridge's fault: the listener is at the mercy of the fixed input loading of the preamplifier. Performance cannot be optimized.

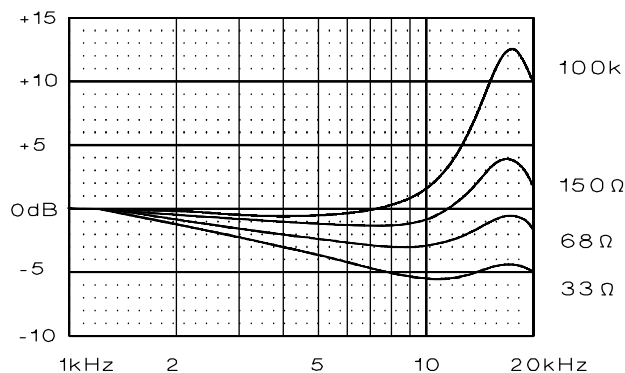


Fig.2 shows the effect of varying the resistive load on a MC cartridge.

The FM 223 provides the ultimate solution: it features switches for adjusting loading resistance as well as for fine tuning loading capacitance. Plug-in modules allow an infinite number of resistive loading combinations. Should the standard resistance module supplied (each module allows setting of four different input resistances) not provide the optimal loading for a certain cartridge type, the resistance module - located behind a protective panel on the front - can easily be exchanged.

Thanks to the plug-in module concept an unlimited number of resistance combinations in the range of 1 Ohm to 200 kOhm are possible; this for MC and as well as MM cartridges! One can optimize the loading for any cartridge ever made (or that will ever be made).

Capacitive Loading

The Capacitive Loading feature can be as important: multiple precision capacitors allow damping of cartridge resonance and help fine tuning the upper frequency response. Because it has not been available so far and its use is not yet widely understood, this feature may not attract much attention initially. However, it is of great help in optimizing performance of MC and MM cartridges.

Figs. 2 - 4 show the effects of cartridge loading on a typical MC cartridge. The curves speak for themselves and show how important correct loading is.

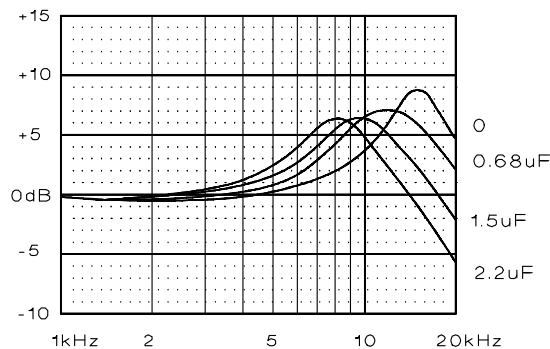


Fig 3. shows the effect of varying the loading capacitance on a typical MC cartridge.

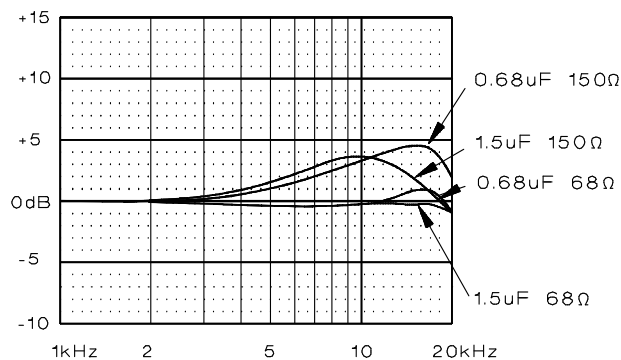


Fig 4. shows various combinations of resistance & capacitance loading on a typical MC cartridge.

The effects of loading are quite pronounced as can be seen from the above figures. There is no room here for getting into even further details of cartridge loading and its effect on overshoot and ringing, signal-to-noise ratio, etc.

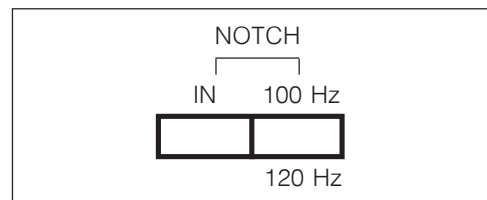
Suffice to know that the FM223 is the only preamplifiers that address all of these problem areas and provide the optimum solution for any cartridge.

NOTCH FILTER ON FM 223

Certain records contain disturbing hum frequencies. Apart from the fact that these quickly tire a listener, massive amounts of amplifier power is absorbed for reproducing this hum signal and the speakers will have to work correspondingly harder, thereby creating higher intermodulation distortion.

The FM223 includes two additional switches: one that activates this hum filter and one that selects either the 100 Hz (e.g. European) or the 120 Hz (e.g. American) hum frequencies (hum manifests itself mostly at the 2nd harmonic (the double of the 50 Hz or 60 Hz) AC mains frequency).

Whenever a record contains a hum or an ill-defined bass (which can be due to a hum frequency colouring the reproduction) a push of the "NOTCH" filter switch helps to solve the hum problem.



A NOTCH filter is a special filter that attenuates only one specific frequency while leaving other frequencies unaffected. However, it is difficult to achieve high attenuation at exactly one specific frequency and leave all other frequencies linear, especially so while remaining in the analogue domain.

This unique filter is only active at precisely the specific frequency while all other frequencies bypass this stage without being affected (see Fig. 5 on page 5). By switching between the 100 Hz and 120 Hz frequencies one can determine which filter is correct for the respective record.

When using this filter, frequently low- and mid-bass is reproduced with higher definition: a cleaning up of the original signal (a psycho-acoustic effect) can be achieved this way.

These ultra-precise notch filters eliminate hum frequencies without influencing any other frequencies and without having any negative effect on the audio signal.

For collectors and educated music lovers this is a great feature as, in fact, it is now for the first time possible to enjoy some major recordings of important performances that so far were pretty much unlistenable due to disturbing hum frequencies.

NOTCH FILTER

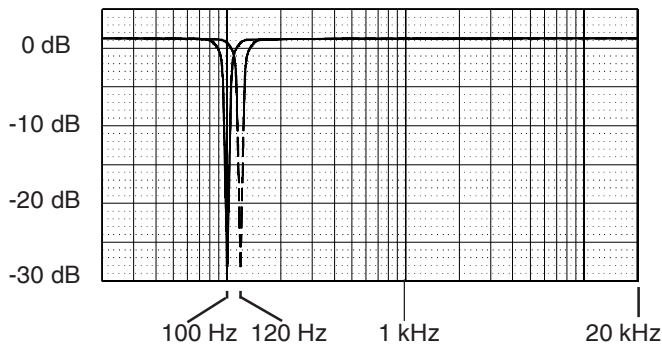
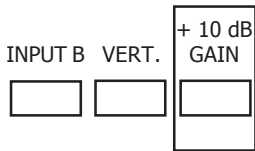


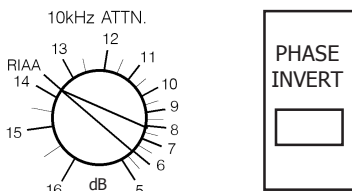
Fig. 5 Response with **NOTCH** filter activated at 100 Hz and at 120 Hz. Precise filtering of exactly the hum frequencies and no influence on any other part of the spectrum is apparent.

GAIN



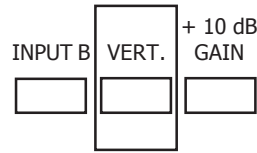
A +10dB gain switch located on the front panel allows an additional 10 dB gain for MC cartridges that have extremely low output voltage (< 0.2 mV) or in systems with insufficient overall gain.

PHASE



A precision phase inversion switch on the front panel performs 180° phase inversion of the main outputs. Unlike other phase inversion switches this is done without any additional circuitry. Both “in-phase” and “out-of-phase” signals pass exactly the same electronics. Thanks to this switch, phase accuracy can be assured and this without any coloration or change in performance.

NORMAL / VERTICAL OPERATION

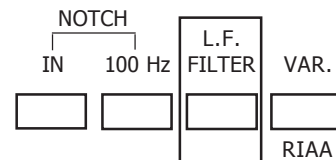


A special feature - the “Vertical” switch - guarantees utmost reproduction with monaural LP’s that were cut vertically (sometimes called “Hill and Dale Records”) and cylinders.

When not pushed in this switch optimizes the lateral information content of the record. Many 78 RPM discs and monaural LP’s are cut laterally.

Some mono discs, however, were cut vertically. So far these records could never be played back satisfactorily. With a flick of the “Vertical” switch the FM 223 allows optimal reproduction of such vertically cut records. Whatever the type of cutting, the FM 223 can extract every minute detail from the record grooves.

L.F. FILTER



In high quality sound reproduction, elimination of sub-audio frequencies can be very important. These low frequency signals, usually from pressing faults or record warps, can have a deteriorating effect on the audio quality and can consume huge amounts of amplifier power and put strain on the lower frequency driver.

The FM 223 employs a Linear-Phase filter which attenuates the sub-audio frequencies whilst having no effect on the audible signal.

If required the L.F. filter can be factory adjusted to comply with the I.E.C. standard L.F. response (i.e. -3 dB at 20 Hz, 6 dB / octave). However, in practical use, the 12 dB / octave linear phase filter, used as standard in the FM 223, is preferable.

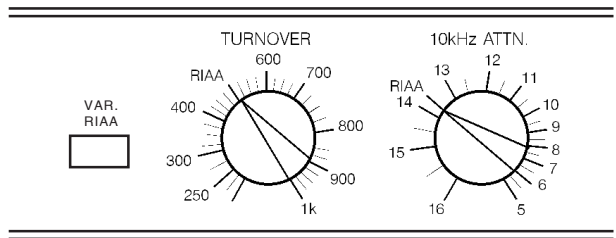
Revitalizing LP & Shellac Reproduction

UNIQUE VARIABLE RIAA DE-EMPHASIS

For music lovers the performance is every bit as important as the sound quality of a record. Many great performances are only available on LP's or on 78 RPM discs. On today's equipment these LP's or 78's are replayed wrongly and consequently their reproduction leaves something to be desired. Even reissues can sometimes suffer from similar problems. One of the reasons is that practically all other phono preamplifiers are limited by the fact that they can only replay the RIAA de-emphasis curve.

In the 1950'ies no "standardized" pre-emphasis/equalization curve existed. Different record companies used a wide variety of pre-emphasis "cutting" curves, until the RIAA curve was finally agreed to end of 1958 (in this respect it is interesting that in March 1964 the RIAA had to mail out a letter to its members to remind record companies about the "new" (then already 5 year old...) "standard" curve. Quite a number of members had failed to convert to the RIAA standard and continued to cut LP's with "their" pre-emphasis curve...).

Knowing this, it comes as little surprise to find LP's with "RIAA" printed on the cover which actually used other pre-emphasis curves. These non-RIAA conform LP's cannot be replayed correctly by today's audio electronics which are limited to the fixed standard RIAA de-emphasis curve. Many different de-emphasis curves are required to inversely match the original recording curve, (which sometimes even changed within the same company!).



With the FM 223's variable de-emphasis it is possible to accurately play back important LP's and 78's. With accurate equalization and true balanced Class A amplification stages an absolutely astounding amount of information can be extracted from these record grooves.

Fig. 6, on the top of page 8 shows the pre-emphasis curves for several typical records, in the centre the error when replayed with the standard RIAA curve and on the bottom the result when the correct de-emphasis curve is set on the FM 223. The corresponding correct knob setting of the "Turnover Frequency" and the "10 kHz Attenuation" on the FM 223 is also indicated.

The variable de-emphasis is not only useful for older records. Using this feature, records that lack in accuracy can be improved quite astoundingly. It is not just a matter of correcting frequency response errors but as much the correction of *phase errors* that are created by the wrong de-emphasis circuitry.

But even when the RIAA curve was adhered to, there were other limitations that had to be considered: the cutting lathes (where records are prepared for the vinyl press) used prior to 1968 were unable to perfectly cut the very high velocities present at frequencies above 12 kHz. Mastering engineers had to balance trade-offs: more noise (= less headroom) thereby achieving wider frequency response or reduced frequency response with lower noise (= higher headroom). Some mastering engineers somewhat attenuated the higher frequencies. This changed the phase and resulted in a slight lack of "airiness".* It is amazing how much of the sound made it on records of the golden years but LP's of this area can lack a bit in transparency.

With the continuously variable de-emphasis of the FM 223 - no switches used! - it is now possible to compensate for such limitations by fine tuning the de-emphasis (RIAA) curve. By varying the "10 kHz ATTN." control on the front panel the attenuation can be reduced to less (or increased to more) than the standard 13.75 dB of the RIAA curve. This feature will revive some records that previously sounded dull and lifeless, providing a wonderful musical experience.

And the opposite also holds true: in the late 70's and 80's new cutting lathes finally allowed the mastering of records with high-level high frequencies. As soon as this was possible, it was promptly overused and some records were mastered with quite excessive high frequency levels. By *increasing* the 10 kHz attenuation these records sound more acceptable.

On later versions of cutting lathes, Neumann incorporated an HF shelving filter. Some phono stage designers quickly decided to just fix this into their RIAA de-emphasis circuits thinking that this is the way all LP's were mastered. Well, that is just not correct: by far not everyone used Neumann cutting lathes and those that did often disliked this disturbing filter. Unbeknownst to today's "hi-fi" designers (most of whom were not born as yet), many experienced LP mastering engineers of the golden era just disabled this filter.

Less experienced mastering engineers were told to use Neumann machines that did contain the filter because of the danger of destroying the expensive cutterhead (with a slight bit too much high frequency signal there was the danger of burning the USD 12000 cutterhead... - and USD 12000 was a lot of money in those days). Rather than fooling around with the RIAA de-emphasis filter constants as these "hi-fi buffs" do, the proper solution is incorporated in the FM 223: by using the "HF attenuation" control the HF response can be optimized for each individual LP ever pressed whatever the characteristics of the mastering equipment!

Even a recording that lacks in "warmth" - not just "bass" - can be corrected by moving up the turnover frequency knob to a mildly higher setting. This way the entire frequency band above and below the turnover frequency is affected linearly. It is not just the harmonic content that is reproduced more realistically: the positive effect on depth and width information as well as the transparency is most captivating.

A tremendous research effort has achieved optimal performance of the enhanced Class A circuits in attaining the ultra-precise de-emphasis curves. The de-emphasis curves can now be calibrated perfectly for each brand and type of record. Unlimited variations in turnover frequencies and roll-off curves allow exact restitution of any pre-emphasis curve used.

It has to be realized, however, that the pre-emphasis curves were not "carved in stone" and sometimes engineers varied this pre-emphasis to their "gusto". The actual values do not always conform with the curves and data published by the record companies. Therefore, experimenting with the two controls will lead to optimal results. The best judge is a good ear assisted by the extensive information contained in the instruction manual.

The table on the right shows a few examples of typical Turnover Frequencies and Rolloff curves of earlier LP's. More settings are included in the FM 223.

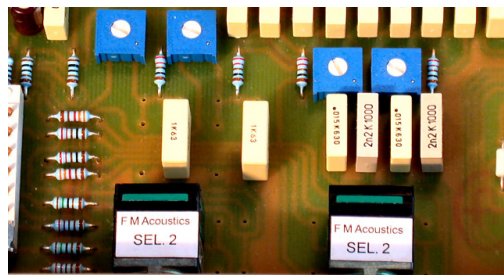
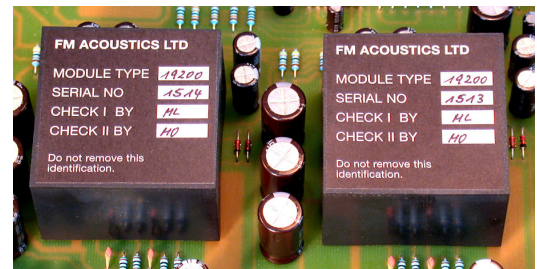
Label	Turnover Frequency	Rolloff at 10 kHz in dB	Speed
ANGEL	500	12.0	33
ATLANTIC	500	16.0	33
BLUE NOTE	400	12.0	33
COLUMBIA	750	16.0	33
HMV	300	5.0	78
LONDON	700	10.0	33
MERCURY	300-400	12.0	78
MERCURY	400	12.0	33
VICTOR	800	10.0	33
VOX	750	16.0	33

Years of research, hundreds of conversations, interviews and personal visits with senior record cutting engineers has allowed us to collect 85 different de-emphasis curves for various record labels.

It is amazing how much the sound of older records is improved with the FM 223. Once this has been experienced, it becomes clear why no other phono preamplifier is capable of retrieving the full information that is embedded in the record grooves.

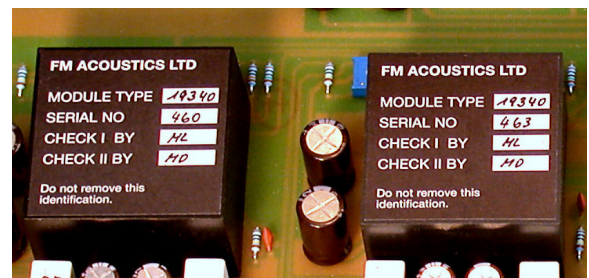
While older LP's may have crackle and pops some include stellar performances. They can now for the first time be replayed with absolute fidelity to the original.

The FM 223 employs FM ACOUSTICS' "HR" type modules on the true balanced symmetrical outputs. These new HR modules are the final result of a research-intensive multi-year development. They provide absolutely superb reproduction and reliability. Using intelligent sensing technology they optimally interface to any kind of line stage be it true balanced, pseudo-balanced or single-ended.

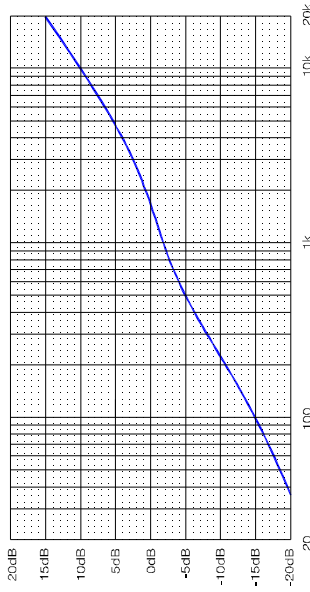


Advanced selection processes in combination with the most dedicated hand-craftsmanship and individual fine-tuning result in breathtaking vinyl reproduction. Dynamic contrasts, transparency, detail, absolutely accurate imaging, perfect delineation of harmonic characteristics are some of the ingredients for a uniquely musical experience.

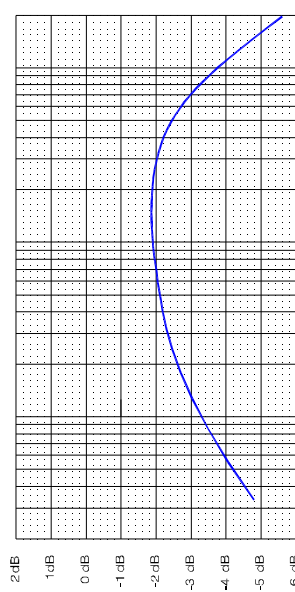
The new HR 19340 modules are used on the inputs. Their unique circuits reject unwanted signals such as hum, interference, noise etc. by an astounding 100 dB (!) making the FM 223 immune against noise, hum, RF and interference pick-up. This phenomenal interference rejection ratio is **not** achieved with non-optimal sounding op-amps but with fine-tuned, discrete enhanced Class A circuits guaranteeing ultimate resolution in the unique FM ACOUSTICS way.



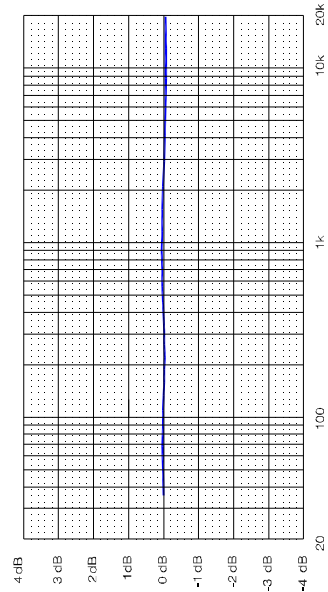
LONDON



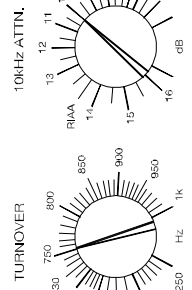
Recording Characteristic



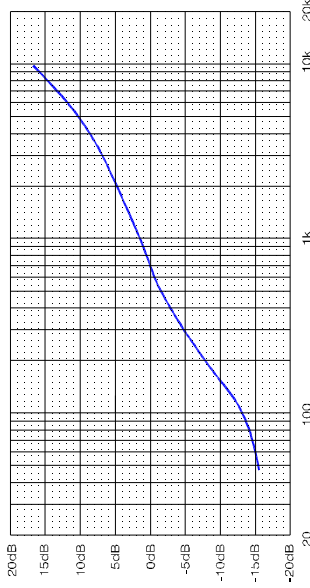
Frequency Response with standard RIAA Filter



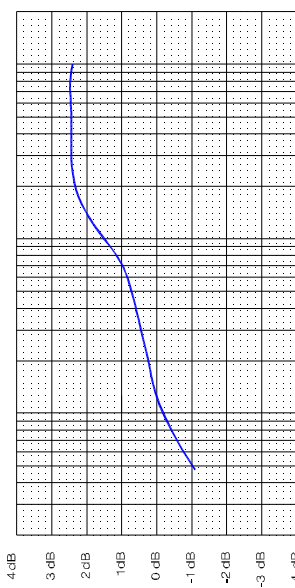
Frequency Response with FM 223 Linearization



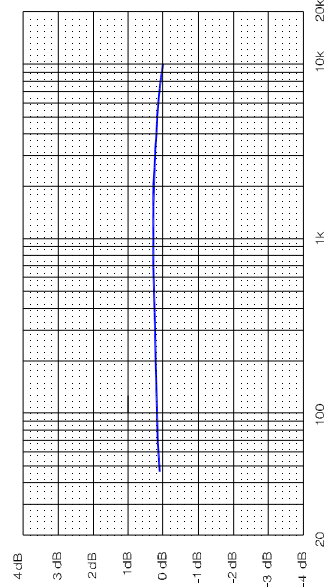
RCA ORTHOACOUSTIC



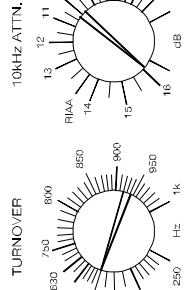
Recording Characteristic



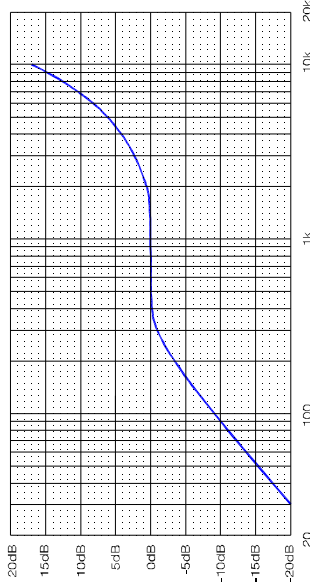
Frequency Response with standard RIAA Filter



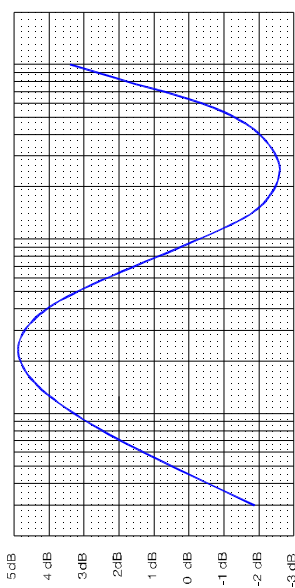
Frequency Response with FM 223 Linearization



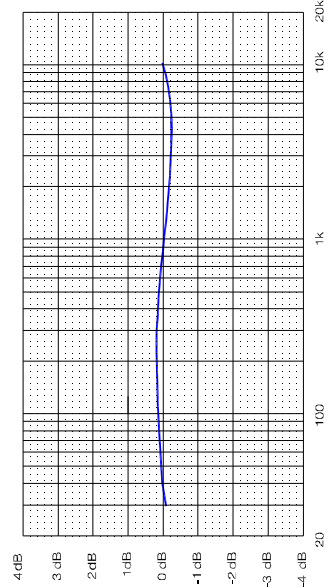
VERTICAL RECORDINGS 1953



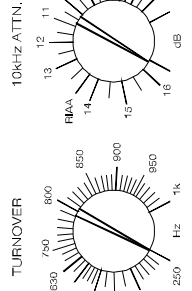
Recording Characteristic



Frequency Response with standard RIAA Filter



Frequency Response with FM 223 Linearization



UNIQUE DE-CLICK CIRCUITS & DE-CRACKLE CIRCUITS



Most exciting features - and not a small breakthrough at all - are these two phenomenal new circuits which are proprietary to FM ACOUSTICS.

A "de-crackle and de-click machine" has been a dream for Libraries, studios and record collectors for nearly a century. In the 1960ies and 70ies several electronic designers made great efforts. While a few units designed for studio use reduced some clicks, there were always other shortcomings. The massive signal processing used had a negative impact on sound quality.

A unit that really solves this in a way that is faithful to the original music signal has been sorely missing. So far, it had been deemed impossible to overcome the many obstacles without audible side effects. And indeed, this development was a tremendous challenge for our engineers; every approach resulted in some drawback or in the emergence of other unexpected problems, very much like what other designers had previously experienced. However, several audio professionals encouraged us not to abandon the project and research was continued unabated.

In 2006 a conceptual study for an entirely different approach led to complete dedication to this project. Once again, several unexpected hurdles had to be overcome, but the results were more promising. In 2008 the major breakthrough was achieved and since then all development time has been concentrated to optimize and fine-tune the circuits. Thousands of samples had to be analysed (no click or crackle is quite the same so the detector circuits had to be "trained" extensively to recognize them).

The reward surely is worth all these years of efforts. While not every single crack or pop can be completely eliminated (a deep scratch that heavily damaged the vinyl can, of course, not be "mended" but even then the amount of disturbance will be reduced massively).

This tremendous research effort is now paying off in that the entire field of record reproduction can enter a new era.

FM ACOUSTICS is very glad indeed to present this amazing click-, pop- and crackle-reduction system in pure *discrete analogue* technology. All the trade-offs of usual circuits (like digitizing the signal, employing delays or in-signal filtering etc.) have been eliminated.

To fully appreciate the scope of this development imagine the challenge; how can the circuits decide what is a musical impulse that must be reproduced and what is a scratch or pop that must be attenuated? How can the circuits differentiate between fine percussive instruments and crackle? How can the two circuits be combined to work and not influence each other? How can all of this be achieved in real-time without any negative influence on the audio signal? The task is monumental and - almost - unsolvable.

FM ACOUSTICS tireless research and its singular technology help the intelligent analyses- and audio-circuits to achieve this breakthrough.

Of course, it is possible to remove clicks in the digital domain, however, apart from generation losses due to a-d & d-a conversion and the additional circuitry required, the audible result of digital scratch removal is mostly a "dulling" of the sound. This dulling and the reduced resolution rends the reproduction lifeless.

In the *223 PhonoMaster* the signal remains pristine keeping the full emotional content while at the same time most of the scratches pops, clicks and crackle are attenuated or removed completely.

This truly exciting development that has been longed for by record libraries and thousands of record collectors is now reality.

In addition to its singular scratch and crackle reduction circuits in pure Class A analogue circuitry the *PhonoMaster's* multiple optimization and fine tuning possibilities allow far more information from record grooves to be extracted than ever thought possible.

With the *PhonoMaster* it is for the first time possible to truthfully replay all vinyl treasures - even if they are not in pristine condition.

The proprietary true balanced enhanced Class A circuits allow a listening experience that cannot be described other than as breathtaking. Every record (even acoustically recorded 78 RPM and shellac records) can be replayed with never-before-attained fidelity.

With the *PhonoMaster* record collections gain an entirely new life and value.

The FM 223 also offers other singular features based on advanced thinking and design criteria that, until now, never received serious consideration.

FURTHER FEATURES

- The FM 223 employs no overall feedback or feed-forward. The entire unit is built with FM ACOUSTICS' proprietary true balanced Class A stages. Freedom from hum, noise and interference can be guaranteed. Stability and signal accuracy are unparalleled and surpass anything that has ever been available.
- The FM 223 features two true balanced input stages. Both switchable inputs work optimally with any MC or MM cartridge.
- Tremendous reserves of headroom and output drive capability are engineered into the FM 223.
- The interference rejection reaches a phenomenal 100 dB (!) (the higher the rejection the more accurate is the signal symmetry (balancing). Just to put this in relation: "balanced" circuits of typical "high-end" products provide a interference rejection of 30-60 dB (a "dB" is a logarithmic measure which means that the FM 223 is 100 to 1000 times (!) better).

The FM 223's phenomenal interference rejection is achieved with totally discrete circuitry (no musically unsatisfactory op-amps, hybrid circuitry or IC's). It provides a standard of balancing never achieved before.

- The input impedance of the two switchable inputs is absolutely linear over the full frequency range and they have precisely the same sensitivity and level. A feature unique to the FM 223 is that this is the case with both balanced as well as single-ended sources and any mixture of them!
- The FM 223 input circuit automatically recognizes if the source is balanced or single-ended. Signals from single-ended connections are balanced right at the input of the FM 223.
- The FM 223 works optimally with all types of associated equipment. With the FM 223, performance variations and matching problems are a thing of the past.
- The back panel contains all inputs and outputs. Pretested XLR connectors are employed for true-balanced input and output connections.
- The unit can drive line inputs of practically any preamplifier/line stage (results, of course, depend on the performance of the respective line stage).
- The FM 223 allows connection to any balanced or single-ended equipment. It's circuits analyse the type of preamplifier/line stage and automatically adjusts for optimum performance. Provided the proprietary cables from P.I.T are used, every interface will be 100% correct whether it is true balanced, pseudo-balanced or unbalanced, whether it has high or low impedance.
- The combination of proprietary circuitry and stable outputs guarantees that the FM 223 can drive long cable lengths.
- To avoid negative influence from spurious resonances the FM 223 employs FM ACOUSTICS' proprietary resonance eliminating isolators which absorb potential resonances and vibration.



- Hermetically sealed, Swiss made high performance, relays are used. Four specially coated contacts guarantee perfect operation, even after millions of switching cycles. The hermetic seal assures that no environmental factors can have any negative effect on the contacts and therefore, on performance.

- The FM 223's mechanically damped chassis design isolates sensitive electronic components from induced resonances.
- Unit to unit consistency is assured by utmost care in selection and calibration and elimination of most cabling.
- The signal-to-noise ratio of the FM 223 is singular. It betters existing designs by a considerable margin and is within 1 dB of the noise figure that is the theoretical limit. No wonder experts call it phenomenal.
- Power is supplied from a separate power supply.
- Additional precision on-board stabilization is used.
- Proprietary control circuitry performs various tasks: Delayed switch-on is incorporated. During switch-on outputs are disengaged and the FM 223 checks itself. If everything is found to be perfect, the control circuitry frees the outputs. Within ten seconds of switch-on the preamplifier is fully operational.
- Hum, noise or electronic interference is non-existing (provided the proper CA -25000 series interconnect cables and correct grounding are employed).
- The FM 223 can handle over-voltage (up to 125% V^{nom}). Sensors also protect the unit (and the equipment connected to it) from extreme voltage swings that potentially could result in non-optimal performance, transients, dangerous LF signals and/or DC instability.

- A special thermal control system assures that the *Resolution Series*[®] 223 does not have any form of distortion or changing tonal characteristics when warming up. It reaches its optimal temperature within minutes; there is no hour long warm-up time required as sometimes is the case with audio equipment.
- *Precision Interface Technology*[®] interconnect cables are used to optimally connect both sources and load. Cables for special types of connectors are available on special order.
- No obsolescence: the FM 223 *PhonoMaster* uses modular technology. Service or changes can be performed efficiently. This guarantees of 100% correct performance as all calibration is performed inside the respective module at the factory, where the enhanced Class A modules have been precisely tested, burnt-in, and re-tested.



The FM 223 is absolutely transparent. It will leave the characteristics of the associated equipment unaltered. Aficionados will still retain the specific characteristics of their equipment while at the same time benefiting from all the performance improvements of the FM 223.

It is a fact that words can by no means describe the experience of listening with an Phonomaster. No other unit is anywhere near comparable.

The *Resolution Series*[®] 223 revives the entire field of record reproduction. New insights in musical performances can be gained thanks to its proprietary, ultra-transparent circuitry and its truly unique features.



ACCESSORIES

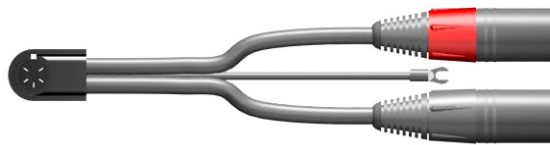
Order Number	Description
ACC 22018	Resistor Module 223: 180 / 90 / 45 / 35 Ohm (Supplied as Standard)
ACC 22022	Resistor Module 223: 1800 / 900 / 450 / 350 Ohm (MC)
ACC 22023	Resistor Module 223: 18k / 9k / 4.5k / 3.5k Ohm (MC)
ACC 22024	Resistor Module 223: 100k / 50k / 33k / 24k Ohm (MM + MC)
ACC 22028	Resistor Module 223: 3000 / 250 / 100 / 70 Ohm (MC)
ACC 22029	Resistor Module 223: 47k / 300 / 100 / 75 Ohm (MM + MC)
ACC 22031	Resistor Module 223: 47k / 180 90 / 60 Ohm (MM + MC)
ACC 22111	Power supply cable for connection of FM 223 to FM 266 (length = 0.6 m)
ACC 22112	Power supply cable for connection of FM 223 to FM 266 (length = 1.2 m)
ACC 22113	Power supply cable for connection of FM 223 to FM 266 (length = 3.0 m)
ACC 22026	Labels FM 223: for record coding; set of 240 pieces

Precision Interface Technology[®] PHONO INTERCONNECT CABLES

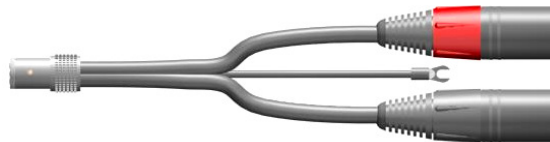
It is mandatory to use *Precision Interface Technology*[®] interconnect cables from the tonearm/turntable to the FM 223. The reason is simple: **no** other cable can guarantee the quality of true symmetrical signal transfer and - as important - extremely high rejection of interference signals. All other cables lower the interference rejection (some of them drastically) and thereby forfeit the huge effort that goes into achieving the true balanced signal preamplification in the FM 223. Only with the cables listed below can optimal interference rejection be guaranteed. This is why a P.I.T. phono cable must be ordered with every FM 223.



CA-25141	RCA/Phono M - XLR M	0.6m	True balanced phono interconnect (Phono-XLR)
CA-25142	RCA/Phono M - XLR M	1.2m	True balanced phono interconnect (Phono-XLR)
CA-25143	RCA/Phono M - XLR M	3.0m	True balanced phono interconnect (Phono-XLR)



CA-25151	5-P DIN angled - XLR M	0.6m	True balanced phono interconnect (angled DIN-XLR)
CA-25152	5-P DIN angled - XLR M	1.2m	True balanced phono interconnect (angled DIN-XLR)
CA-25153	5-P DIN angled - XLR M	3.0m	True balanced phono interconnect (angled DIN-XLR)



CA-25161	5-P DIN straight - XLR M	0.6m	True balanced phono interconnect (straight DIN-XLR)
CA-25162	5-P DIN straight - XLR M	1.2m	True balanced phono interconnect (straight DIN-XLR)
CA-25163	5-P DIN straight - XLR M	3.0m	True balanced phono interconnect (straight DIN-XLR)

Note: While P.I.T. line level and P.I.T. phono cables look similar, they are **NOT** the same. The **phono** interconnect cables have a central earthing wire. The P.I.T. **line level** cables do not require this earth wire. A phono cable has different requirements than a line level cable and for optimal performance must NOT be used as such (and vice versa).

Precision Interface Technology[®] **OUTPUT CABLES**

The choice of cable on the output of the FM 223 is of highest importance. While balanced cables all seem the same, they actually are not. For each interface only one type of cable is correct (because of the different types of balancing circuits employed in the diverse electronics). Only by understanding the circuit's requirements and choosing the correct cable can optimal system performance be guaranteed. Different types of line level cables for connection of the FM 223's output to a line stage are available. Each one is optimized for connection to the corresponding balanced, pseudo-balanced or unbalanced input of the line stage following the FM 223. Full performance can only be guaranteed when one of the three cable types below is used. This way optimal interconnection and interference rejection can be guaranteed.



CA-25041	XLR F - RCA/Phono M	0.6m	For connection to unbalanced equipment
CA-25042	XLR F - RCA/Phono M	1.2m	For connection to unbalanced equipment
CA-25043	XLR F - RCA/Phono M	3.0m	For connection to unbalanced equipment
CA-25044	XLR F - RCA/Phono M	5.0m	For connection to unbalanced equipment



CA-25091	XLR F - XLR M	0.6m	For connection to pseudo balanced equipment
CA-25092	XLR F - XLR M	1.2m	For connection to pseudo balanced equipment
CA-25093	XLR F - XLR M	3.0m	For connection to pseudo balanced equipment
CA-25094	XLR F - XLR M	5.0m	For connection to pseudo balanced equipment



CA-25101	XLR F - XLR M	0.6m	For connection to true balanced equipment
CA-25102	XLR F - XLR M	1.2m	For connection to true balanced equipment
CA-25103	XLR F - XLR M	3.0m	For connection to true balanced equipment
CA-25104	XLR F - XLR M	5.0m	For connection to true balanced equipment

Other lengths made to order.

Notice

In several countries fake copies of P.I.T. cables have been offered. The copyists (and actually even some other cable manufacturers...) fail to understand why different "balanced" cables are required. Most "balanced" circuits are not truly balanced. The copyists - who would have thought - do not understand this differentiation.

Visually a fake copy may appear similar to the original because the cable exterior and connectors look similar (differences are not obvious visually). However, fake cables may lack the identification number (a printed white tag around the cable near one of the connectors). Since April 2007 the original P.I.T. cables also have an individual Serial No. (printed on another white tag affixed to the cable). This coding system can be verified only by official FM ACOUSTICS distributors. If the cable does not come in the blue velvet pouch printed "Precision Interface Technology" with the type tag it could be a further alert.

While fake cables are somewhat cheaper it is not worth falling in this trap and ending up with non-optimal system interfacing, hum or interference just to save a few Swiss Francs.

SPECIFICATIONS

When choosing a product do not simply compare specifications sheets. Specifications are often misused, misunderstood, or utilised only to sell a product instead of indicating its actual performance capabilities. "Typical" specifications will not tell you much about the true value of a certain component. Only guaranteed minimum specifications as indicated below, together with carefully controlled listening tests, will permit to

The guaranteed specifications indicate the unique standard of the FM 266-MKII and show those performance aspects that can be measured. But words cannot describe the truly breathtaking difference between the FM 266-MKII and other preamplifiers. Only a controlled audition will reveal the facts. Specifications are minimum figures for every single FM 266-MKII that leaves the factory.

Circuitry

Proprietary, highest purity, discrete, enhanced Class A circuitry using hand-selected semi-conductors. These highspeed semiconductors are analysed individually and subjected to FM ACOUSTICS' exclusive selection process. Built with FM ACOUSTICS' hand-calibrated precision Class A modules.

Inputs

Two true balanced, fully symmetrical inputs with precision cartridge loading. Balanced discrete Class A circuitry, floating ground, non-inverting or inverting connection; works perfect with any balanced as well as single-ended connection. Single-ended sources are automatically converted to true balanced right at the input of the FM 223 as it automatically recognizes what connection standard is employed.

Input stage interference rejection

110 dB typically; 95 dB 20 Hz to 20 kHz.

Input impedance / Cartridge loading

Variable. Unlimited combinations for both balanced as well as single-ended sources. Resistance and capacitance load is set by recessed front panel DIP switches. Replaceable resistance module allows infinite combinations. Standard module:
MC cartridge: 180 / 90 / 45 / 35 Ohm
MM cartridge: 100 / 47 / 33 / 24 KOhm

Headroom

+24 dB ref 0 dBv (34 VPP, 12 V RMS)

Gain

MC input to output 1 kHz: 52 dB (62 dB with +10dB switch). If required, internally adjustable to other values.

Gain switch

+10dB additional gain

Input Sensitivity

at 1 kHz: 250 uV (79 uV with + 10 dB switch)

LF Filter

Sub-audio 12 dB/octave Linear-Phase Filter. No negative influence on audio signals.

Bandwidth

With internal RF filter: 1 Hz - 100 kHz

The frequency response of the FM 223 extends from less than 1 Hz to 400 kHz.

The actual frequency response of the pre-amplifier, however, is intentionally attenuated above 100 kHz with a linear-phase RF rejection circuit.

Hum and Noise

Equivalent input noise below full output
22 Hz - 22 kHz: -137 dBu

RIAA accuracy

In RIAA setting better than
+/- 0.05 dB over full frequency range.

Outputs

Electronically symmetrical, balanced, discrete Class A outputs can drive any balanced or unbalanced line stage. Automatically recognize what connecting standard is used and automatically adjust for optimal performance.

Output drive capability

+ 24 dBu (12V RMS) into 5 KOhm balanced load

Recommended load impedance

>600 Ohm

Stereo separation

70 dB

Distortion

At 1 V (+1.2 dBu) out: immeasurable,
at +10 dBu out : 0.005%
Up to clipping level no higher order harmonics

Power

Supplied from FM 205 power supply (included)
consumption: 12 W continuous

Mains voltage

FM 205: 100-240V, 50-60Hz

Operating temperature

0 to +40°C

Operating humidity

Long-term (non-condensing): 0 - 85%
Short-term: 0 - 95%
Continuous high humidity may somewhat shorten lifetime of certain components

Burn-in time at factory

500 thermal cycles, minimum 100 hours

Vibration test at factory

20'000 vibration cycles, minimum 30 minutes

Front panel

Laser milled, brushed and then hand-polished 9000 aluminium with special anti-wear lettering. Precision, self-cleaning long-life switches, gold-plated resistance module contacts, hand-selected and sealed close tolerance RIAA controls, "Power on" switch and indicator.

Back panel

Laser milled, hand-brushed and polished 9000 aluminium with special high resistance anti-wear lettering. All inputs and outputs are professional XLR-connectors. Chassis connected to mains earth wire. Groundlift and additional channel-lift switches eliminate potential system groundloops.

Connectors

Balanced inputs: female XLR 3-pin

non-inverting: Pin 1: ground
Pin 2: return (cold)
Pin 3: signal (hot)

inverting: Pin 1: ground
Pin 2: signal (hot)
Pin 3: return (cold)

Balanced Outputs: male XLR 3-pin

Pin 1: ground
Pin 2: return (cold)
Pin 3: signal (hot)

In the FM 223 sensors in the input and output circuits automatically adjust according to the connection standard used, be that true balanced, pseudo-balanced or single-ended.

Average Life expectancy

38 years (at 25°C ambient, 10 hours per day, 365 days per year)

Average Life expectancy

Minimum 10 years; guaranteed ex stock availability of 99% of all parts.

Dimensions

446 mm wide / 92 mm high / 280 mm deep

Weight

FM 223 incl. p.s.: 7.1 kg net / 9.4 kg packed

Applications

Reference phono mastering control centre for restoring work, libraries, mastering studios, true audiophile systems, record collectors, recording studios, laboratory, institutional and other professional applications.

IEC, DIN and MIL (military) standards of components used:

IEC 68 = 55/155/56	DIN 384-4
IEC 68 = 55/085/2	DIN 40040
IEC 144/IP 65	DIN 40046
IEC 40/100/56	DIN 40050 P 54
IEC 115-1	DIN 41332 TYPE IIIA
IEC 384-9	DIN 44112
IEC 384-8 IB	DIN 44356
IEC 384-2	DIN 45910 PART 1201
IEC 68:55/085/56	DIN 45921-107
IEC 68:55/200/56	DIN 44061
IEC 68:2-6	

MIL-R-STD 202 method 101, 103, 106, 213, 301
MIL-R-11804/2B/G
MIL-R-22097
MIL-R-10509
MIL-R-55182
MIL-R-22684
MIL-R-45204 TYPE 2
MIL-R-23285
MIL-C-19978 B
MIL-VG-95-295
MIL-S-23190 R.I.N.A. Nr. 5/206/85

"You've never heard it so good"



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