FUNK MTX-MONITOR

LUPENREIN

The company Funk Tonstudiotechnik, located in Berlin, is among the probably most underrated manufacturers in professional audio technology. It could not be less conspicuous in the market. The developer and company owner Thomas Funk has led his business with a passion for nearly 40 years and supplies, one could say in complete silence, audio systems for the highest demands, that are always at the leading edge of what can be achieved with modern circuit technology. The factory in Berlin, that produces everything by hand, has a test lab that would raise the pulse rate of every measurement technician (just ask my editorial colleague Fridemann Kootz). Whether in development or quality assurance - well-chosen precision test equipment is always used to fulfil the promise to the customer of a signal path that is as clean as possible and with the best possible parameter values.

Whereas many manufacturers that sound the marketing fanfares early for each new product proposed by their development department are probably much better known because of that, Thomas Funk prefers to retreat to his 'little den' to take the latest actions on the way to the highest level in terms of technical and sound matters. His test bench looks like the control centre of the European Space Organisation and is, if nothing else, a proof of how much detailed work and struggle goes into getting the last dB from Thomas Funk's equipment. He knows all the strengths and weaknesses of his test equipment and always has the right tool to hand to get into the depths of the last secrets of analog technology

He probably can't do anything different, which is why he doesn't produce any equipment that follows a brief market trend or takes up a product idea that has already proved successful. Even if that sounds like an advertising slogan: Funk Tonstudiotechnik stands for the values that, in past years, helped manufacturers and brands achieve a first-class reputation lasting for decades - long life, interference immunity, best technical basic data and audio quality, top-quality components, rapid and competent service, forward-looking technology, always at the peak of component development. Not for nothing do young audio colleagues scramble for equipment that was designed fifty or more years ago on the same principles. The subject of our test could also become such an 'all-time classic', the MTX Monitor amplifier, with the full designation 'V3b-4.2.1' that looks like a software update version, but where we can be sure that this device has everything, but no software. But, it makes it clear that analog devices can also be further developed. The MTX has existed for about 18 years and whenever something can be improved, such as when new better-performing components become available, an updated version is produced.

Conception

The manufacturer describes his device as a professional preamplifier and router, serving for monitoring, distributing, transferring and measuring stereo signal sources. Expressed more in market terms, it is a monitor-controller with a comprehensive set of functions. The monitor-controller is one of the items of studio equipment that must provide signal paths as transparent and interference-free as possible since, at this point in the production chain, as is easy to understand, if possible no compromises should be allowed. The main item, the 1HE, contains the full connection technology and all the controls, but can also disappear in a control cabinet and be controlled with an optionally available remote control. As the modern DAW (digital audio workstation) is today in many cases

optimised to have convenient centralised access to all the equipment used, the MTX monitor can, of course, also be used without a remote control. The MTX is essentially a mixing console with a master controller at the stereo output. It has numerous inputs and outputs whose signals can be distributed at their native level or mixed with very high quality. Originally analog mixing consoles included a monitor section that of course included the functions of a monitor-controller. Since mixing consoles are nowadays rarely used or serve as front ends or summing devices, the many monitoring functions provided by such a mixing console also disappeared. In most cases today a studio is built around a DAW and only few of these software giants include a dedicated monitor section that is provided, for example, in Cubase or Nuendo. External feeders such as tape machines, DAT recorders, CD players and even hard-disk recorders are today rarely, if ever, used since everything done with the signals takes place within the software. Each monitoring point that could be imagined in principle has to be implemented via a D/A converter. Whenever analog technology is used to a significant extent in a studio, extensive monitoring functions are needed and for this the monitor-controller fulfils an important duty if it is not built solely as a simple volume control. As indicated above, the signal paths of a monitor-controller should operate absolutely transparently to ensure distribution of the signal undistorted to the speakers or A/D converters. That is exactly the domain of Thomas Funk who has, in the MTX, implemented a signal-path quality that is really beyond any doubt, as can be readily appreciated in the section on Measurement Technology. The values that we have determined beat everything we have ever measured in a monitor-controller. To achieve this quality, the developer is, to some

degree, following unorthodox ways. The MTX works not with voltages but with currents. It has 16 input amplifiers, not just two, switched with relays. There are two amplifier buses in this equipment, one for dubbing and one for monitoring. The balanced inputs are all 20 kΩ, and the unbalanced ones 2 MΩ.

The connected devices have, as measurements have repeatedly established, input resistances of 10 kOhm or less. The capacitors employed form, with the input resistance of the receiver, a high-pass filter. The high-pass effect of the capacitor is nearly eliminated by the high impedance, so that also only small effects on the phase characteristic can be expected. Some colleagues will perhaps still remember the Nagra 4 tape machine. This had a circuit that, at levels just below maximum, mixed in K3 in anti-phase to achieve a dynamic range increase of 2 dB with the same distortion factor as a Telefunken M15. However, this did require accurate calibration of the type of tape. In the electronic matrix of the MTX, K2 is added on a similar principle, in antiphase to what happens in the operational amplifiers and before and after them. That brings an improvment in the distortion products by a factor of 10. In theory, one could achieve zero, but that doesn't work because each op-amp distorts differently and the generation of distortion cannot be completely identical.

The audio matrix, the volume and balance controls and most of the monitor functions work without contacts, which achieves a high reliability, accuracy and constancy of the audio parameters. The same criteria were applied to the integrated headphone amplifier, that can be set independently of, or linked to, the volume control of the speakers, for example via the remote control.

Overview

The MTX was brought out for the first time in 1998, which also explains the large number of analog inputs (8 x stereo). But today there are still cases of use with several tape machines used in dubbing, even if the DAW has taken command. But here too, use of the many analog inputs, such as for analog summation of eight stereo stems could be imagined. This system has four balanced +6 dBu stereo inputs (8 x mono) and four unbalanced stereo inputs with a working level of 0 or +6 dBu on Cinch/RCA connectors (8 x mono). The unbalanced inputs can be adjusted internally.
Any input signals can be mixed via the second signal bus for dubbing. The stereo output signal produced this way comes on two Cinch socket pairs in parallel. The MTX has two stereo monitor outputs that serve the monitor bus and are regarded as independent of the dubbing bus. What is summed and what is heard are entirely separate. The main monitor output is balanced on XLR connectors at +6 dBu working level; the second monitor output is unbalanced with a 0 or +6 dBu level and supplied on Cinch connectors. With an internal modification, both outputs can be fed in parallel, but as standard these outputs are used for switching between two pairs of speakers. With a parallel configuration it is, for example, possible to switch a sub-woofer in and out in a 2.1 system. With a separate 'SPK On' button, both speaker outputs can be simultaneously switched on or off in parallel operation.
The connections are completed by a very accurately calibrated unbalanced metering output with which external metering can be operated and supplied. Alternatively this output can also supply the selected monitoring signal for a special purpose without level control. The optionally available remote control can be used up to 50 m from the MTX Monitor.

The equipment supplied includes a cable of eight metres length. The remote control includes all the operating controls of the main equipment front panel with the exception of the controller for the headphone amplifier. If you want to control this using the remote control or the volume control of the main system, it is switched after the volume control with 'Post SP'.
There are eight selector switches that can be labelled, that are used to switch the input sources in stereo pairs for monitoring. Several input sources can be selected at the same time, such as for controlling several stereo stems, that are also at the same time on the dubbing bus for analog summing. Whether the switching is done alternating or alternating and summing can be selected internally. The dubbing bus is secured with a record button that has to be operated together with the input selector to switch signals in summation onto both Stereo Record Out outputs.
For calibration of the monitor system, bridging the level and balance control by a press button is provided. In this case a selected input pair at exactly 0 dB is supplied. To prevent this from accidentally happening when speakers are connected, with the dreaded consequences for the speakers and above all for the ears, the button has a timer, which means it must be pressed for two seconds before this function is activated.
The digital control of the volume control in the main system and the remote control is set up for a reproduction precision of +/-0.25 dB. Stop points facilitate finding a previously selected volume level. When using the steps between the stop points, the control accuracy is typically 1 dB in the range +6 to -50 dB. A clip LED is assigned to the level control (also on the remote control) that reliably monitors all amplifier levels of the selected configuration. If the clip LED comes on, either there is already an overload or there remains less than 0.5 dB in reserve. The switching threshold of the clip LED corresponds to an internal working level of +23.5 dBu. Overloads of the headphone amplifier caused by over-driving it are also indicated here. The clip detection is very linear with respect to frequency, with a very low deviation of typically 0.02 dB. For each channel, the currently monitored path is measured at three different points and comparators are used to decide which level to display.
At the summing amplifier, and so the input level directly, at the output amplifier after the level control and immediately before the level control.
That such comprehensive information about the properties of a clip indicator can be given counts as a further example of the importance of absolute accuracy in the development of the MTX in all those apparently 'secondary' points. Balance control is done with two buttons, for L & R in steps of 1 dB (0, +/- 6 dB), with the setting displayed in a line of 13 LEDs.

The control panel (main system and remote control) contains the usual functions, and some additional ones, that we'll now look at more closely. Much of it is, however, familiar and does not need lots of words to explain. We'll begin with the traditional functions: Mono, Mute, L+R, Alt SPK and Dim. Dim reduces the monitoring level (and that alone) by 20 dB, independent of the set volume for speakers and headphone. This function can also be activated using an external potential-free closing contact. 'Mute' switches, selectably, the left and/or right channel into mute; Alt SPK switches over to a second pair of speakers. With an internal modification it is also possible to act on both speaker pairs simultaneously (2M configuration). The unbalanced output can then be switched to or away from the balanced output, for example if it is wanted to be able to switch on or off a subwoofer operating with the speaker pair. With the button SPK On the selected monitoring configuration can be muted but the selection is still there. The Phase button, not mentioned so far, rotates the phase in the left channel by exactly 180 degrees, so accurately that signals with the same phase and level in the mono sum (Mono button on) disappear. In this way, based on the depth of attenuation of same-phase signals, a point can be made about the level accuracy and frequency linearity of both stereo channels. Since L-R represents the S channel (centre/side) at the same time, the content of the S channel can be monitored and heard. The button 'Aktiv' can be used to activate or deactivate a connected remote control. When the control panel is not active, it still displays all the operating conditions using the integrated LEDs.

Digital connection

As we have already seen, the MTX monitor is a purely analog device and, unlike other products of the genre, does not have one, or even several, built-in D/A converters for making digital signals directly available for listening. Funk Tonstudiotechnik is here following its own approach that assumes that each user has his own preferences regarding converters.
To be able to realise this, the manufacturer provides for connecting two alternative AES/EBU/AES3 digital routers of their own manufacture (AMS-2 or PAS-8). Both of these work, like the MTX, on the two-bus principle (monitoring independent of dubbing) and can be controlled from the MTX remote control by using the 'Digital' button. There is a control-signal output for this at the back, labelled 'Dig Rout'. S/PDIF signals can also be input to the digital router for processing, provided that the usual level of 400 to 500 mV is maintained.
The selected digital signal source is taken to the output and so to an external D/A converter. In parallel with that the signal is buffered to a second output, such as for measuring the level. This applies both to the dubbing and the monitoring matrix. The PAS-8 also has a digital insert point that can be switched into the monitor or record/dub path, for further processing such as conversion of sampling rates, format conversion or signal distribution. All inputs and outputs of the digital router are balanced floating with transformers.

The MTX automatically recognises the presence of a digital router and enables input selection in the remote control unit. Power supply and control is done using the 4-pole mini-DIN cable on the main MTX system. When a digital listening source is selected, the MTX automatically switches to input 1 so that the digital source can immediately be listened to. The analog dubbing matrix is not affected by this. As already mentioned, digital monitoring sources and dubbing signals can be selected mutually independently in the router. A configuration with several digital monitoring sources is of course easily achievable with the use of further D/A converters, since the MTX has plenty of analog monitoring sources available.

Measurement technology

Thomas Funk, developer and creator of all the devices under that name, has long been a friend of our house and many times a consultant in matters of analog measurement technology. In his almost unbelievable stock of, in some cases very specialised, test equipment there is also, to nobody's surprise, an APx555 from Audio Precision. That is the analyser that we consult again every month. That means that with the MTX monitor of the current generation, we must take great care not to mess things up. For Thomas Funk keeps on top of all parameters and knows where even our esteemed APx555 can't keep up with his systems. So we must watch out and the reader must hold tight because the following will include some technical data that some people could interpret as typos.

In the first pass with the measurements, we looked at the performance of the equipment from the first balanced input pair to the balanced main output. The volume control was positioned at the neutral click stop (unity gain or amplification 1) . The routing matrix just passes the signal through. The maximum input level is given as +24 dBu; we measured +24.4 dBu for 0.05% THD+N.
There is a comparable situation at the output. The maximum output level with 0.05% THD+N is at +24.26 dBu when the internal gain is set to the first step above unity gain. Now we cannot leave these limit values without comment, for if we look at the distortion values at a level a good decibel lower, i.e. +23 dBu, the THD+N has sunk to the impressively low 0.00018%. Over the whole path, please note. If we look at the THD (without noise) over the frequency range in Figure 1, we see that the measured value

below 1 kHz sinks to 0.0001%. Impressive. In the characteristic of THD+N over the level range in Figure 2, we marvel again, since here too, the system gives the best values that we have seen so far in active electronics. And that is although our Audio Precision in this respect in the range of low levels seems to have a slight weakness to the disadvantage of the MTX. Figure 3 shows THD+N in detail over the higher-level range. The level difference between input and output is at maximum 0.003 dB each channel.
But more important is the equality between the channels over the adjustment range of the volume trimmer. In the highest range of levels between 0 dB and -20 dB the maximum deviation is 0.006 dB; in many places it falls almost completely to zero. The important range between -20 and -40 dB has a maximum deviation of 0.03 dB and below that it can occasionally climb to 0.05 dB. Even at attenuations of 80 dB the channel difference remains well below 0.1 dB; if the DIM button is used, work with 0.05 dB can be done in this range also. In this configuration the noise is level at -101.1 dBu unweighted (20 Hz to 20 kHz). This results in a dynamic range of over 125 dB, never yet achieved.

For the time being, we modify the configuration and use one of the unbalanced inputs with Cinch sockets. Here the maximum input level is a plain +18 dBu. Internally the offset can be adjusted up to a maximum of +6 dB. However, this 'eats up' the maximum available gain, so that the output level then cannot exceed +24 dBu. The noise level sinks to -102.7 dBu and increases the maximum dynamic range to 126.7 dB after amplification. This situation remains unchanged even if the unbalanced record output is used. So, if short signal paths can be used, there is no occasion to worry about the unbalanced connection. In principle, unbalanced connections are even beneficial if interference suppression on the signal line is not highly important.
We'll stay with the dynamic range for a moment since it is worth considering another type of use. The MTX monitor permits an insert circuit, or record circuit. So we connected the following measurement sequence. Balanced input, unbalanced record output, back into the unbalanced input number eight and finally through the balanced monitor output back to the test instrument. This signal path was also set to unity gain. It turns out that the dynamic range only falls to 123.1 dB. So, the MTX monitor enables forming a mastering chain in which each looped-in processor, regardless of quality class, will always be the quality-determining component, never the MTX. The noise-measurement results, done to Quasi-Peak (ITU-R BS 468.4), show no deviation from the expected ratio.
Figure 4 shows the noise spectrum of the measurement over the balanced connections. A tonal disturbance can be recognised here, however at such a low absolute level that, technically, it can hardly be prevented. For reasons of performance, Funk does not use a switching power supply in the MTX monitor although they are used in his other equipment, and it remains unclear whether the measured interference spectrum is at all a result of coupling from the mains unit.
Figure 5 shows the dead-straight amplitude and phase characteristic over frequency. In this measurement a characteristic of our APx555 was apparent since the phase shift in the bass range is far above the data from Funk. The self-test of our Audio Precision showed identical frequency responses on top of each other. So, the phase shift should be chalked up to the test gear, not to the test candidate.
These systems also have their limits and that is the reason why Thomas Funk maintains a very diverse range of tools. The XLR inputs can be driven both balanced and unbalanced without changes to the relative levels. Also the servo balanced outputs can drive unbalanced or floating loads without a resulting level change or additional distortions.
The common-mode rejection at the input becomes somewhat worse if it is loaded with a one-side unbalance of 10 Ohms as required by the IEC measurement methodology. Figure 6 shows however, that even in the worst case it stays clearly below the very good 60 dB value. The cross-talk between two channels, from the balanced input to the balanced output, is shown in Figure 7. If the insert is switched in, the crosstalk rises over the broad band by just about 5 dB.

Next, the headphone amplifier. In the last issue, we announced in the test of the ADI-2 Pro from RME that we would in future give more thought to the testing of equipment in which the headphone amplifier is a central feature. We are starting that now in that we

have adjusted our load and with immediate effect will measure at 32 Ohms and 250 Ohms. The measurement at 32 Ohms is a good indicator for the capability of the driver at a high load as is (regrettably, it must be said) caused by some modern Hi-Fi headphones. But in-ear systems also often have very low impedance. On the other hand, the 250 Ohm load represents a very typical value for high-quality studio headphones. The load on the amplifier is then comparatively small.

With a 32 Ohm load, our test device achieves a maximum output level of +17.18 dBu, giving 0.98 Watt of power. We have taken the limit here to be 0.05% THD+N, and the clipping limit is very hard. One decibel below that the THD+N is below 0.0004%. When the load is 250 Ohm, the headphone output reaches its limit value at +23.64 dBu, resulting in an output power of 0.55 Watts. One decibel lower, the THD+N has already fallen to the spectacular value of 0.00016%. Figure 8 shows THD+N over the range of input level at 1 kHz at 250 Ohms. With the headphone gain turned right up, the noise with a 32 Ohm load is -97.6 dBu RMS unweighted (20 Hz to 20 kHz) resulting in an outstanding dynamic range of 114.8 dB. At 250 Ohms the device noise is -97.2 dBu RMS unweighted (20 Hz to 20 kHz) resulting here in a whopping dynamic range of 120.8 dB. The noise spectrum shown for 32 Ohms in Figure 9 is, with both loads, fully trouble-free up to 80 kHz. Figure 10 shows the amplitude and phase frequency responses of the headphone amplifier at 250 Ohms, with the level one decibel below the maximum output power. The dead straight frequency response shows no impairments, an indicator of a good ability to cope with pulses.

The conclusion from all the measurements is clear: the MTX monitor defines, in some respects, the bounds of what is currently possible in analog technology and must therefore count as a reference. To have such a winner in the test lab again after the ADI-2 Pro in the last issue, makes our hearts beat faster.

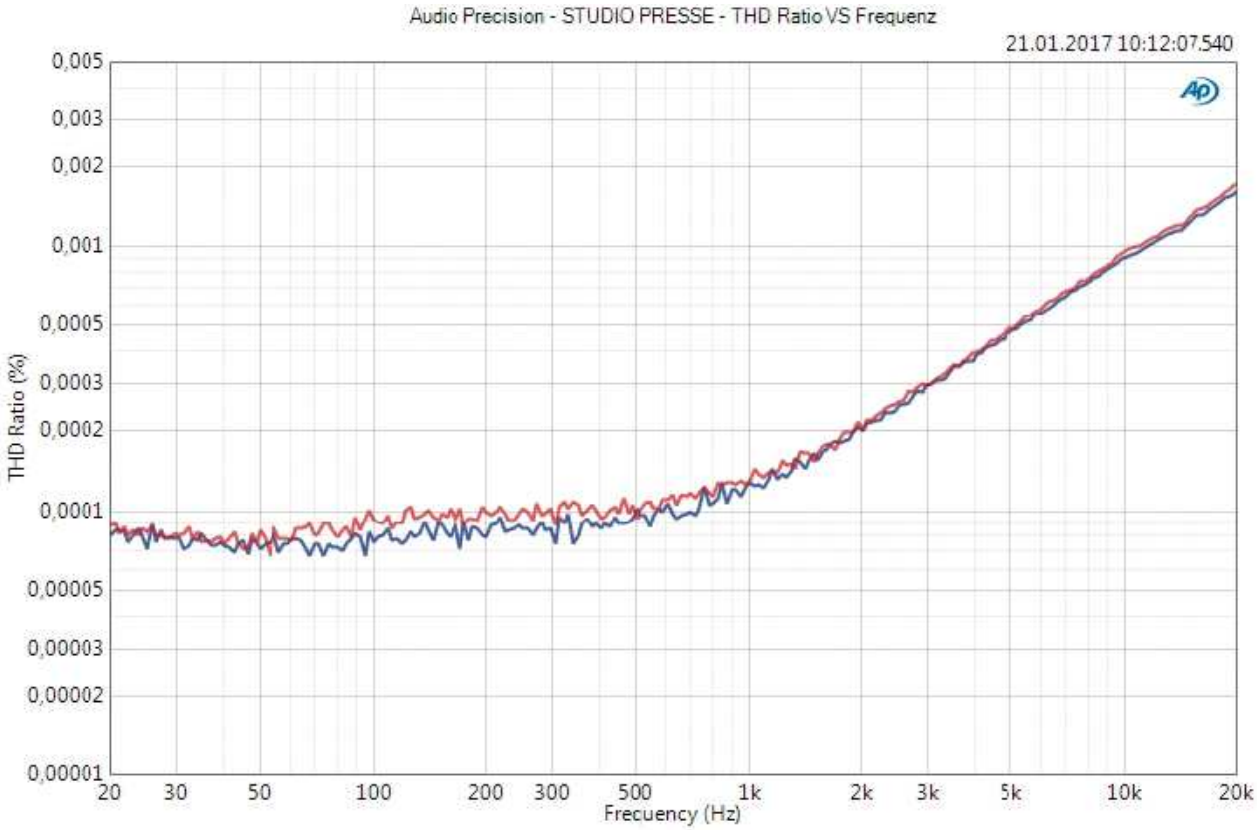

Figure 1: THD ratio vs. frequency, at +23 dBu level

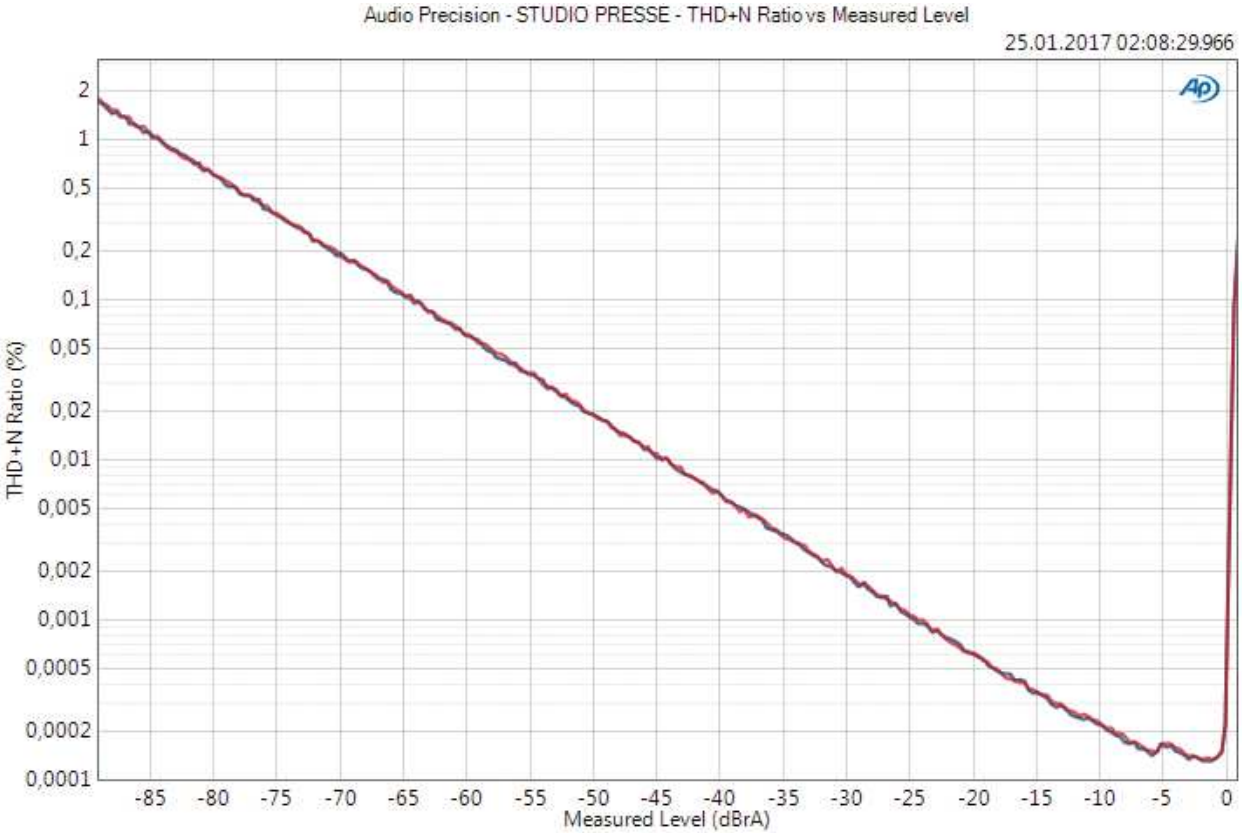

Figure 2: THD+N ratio vs. level; the step at -5 dBrA is due to the measurement-range switch in the Audio Precision

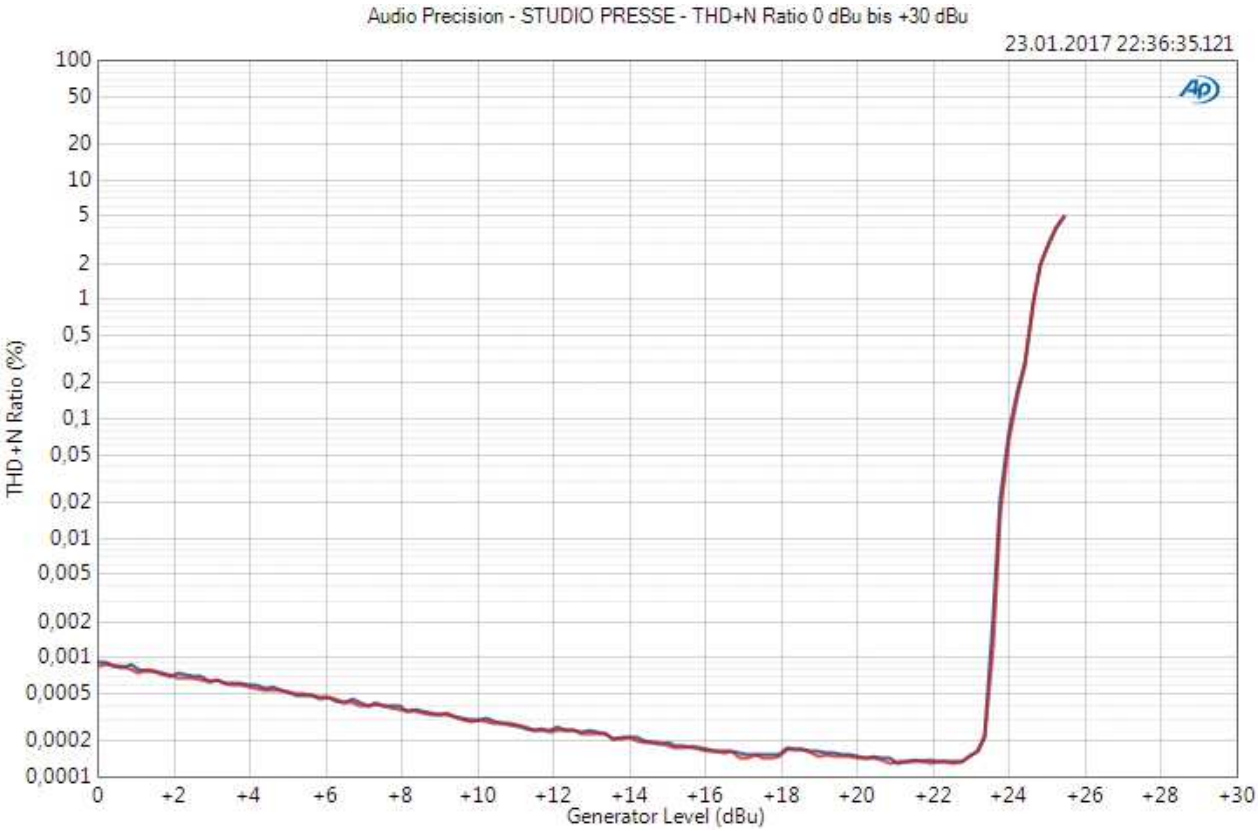

Figure 3: THD+N over the highest level range

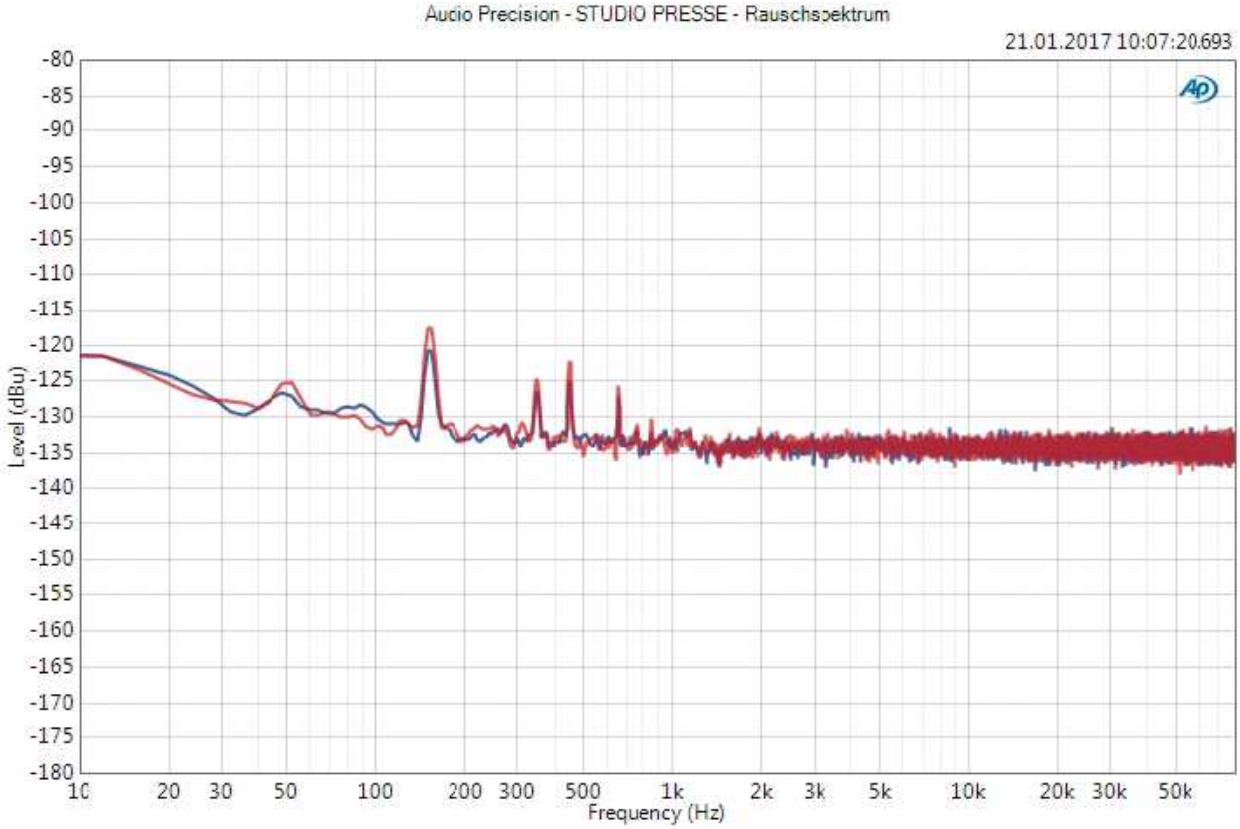

Figure 4: Noise spectrum with minimal interference spikes

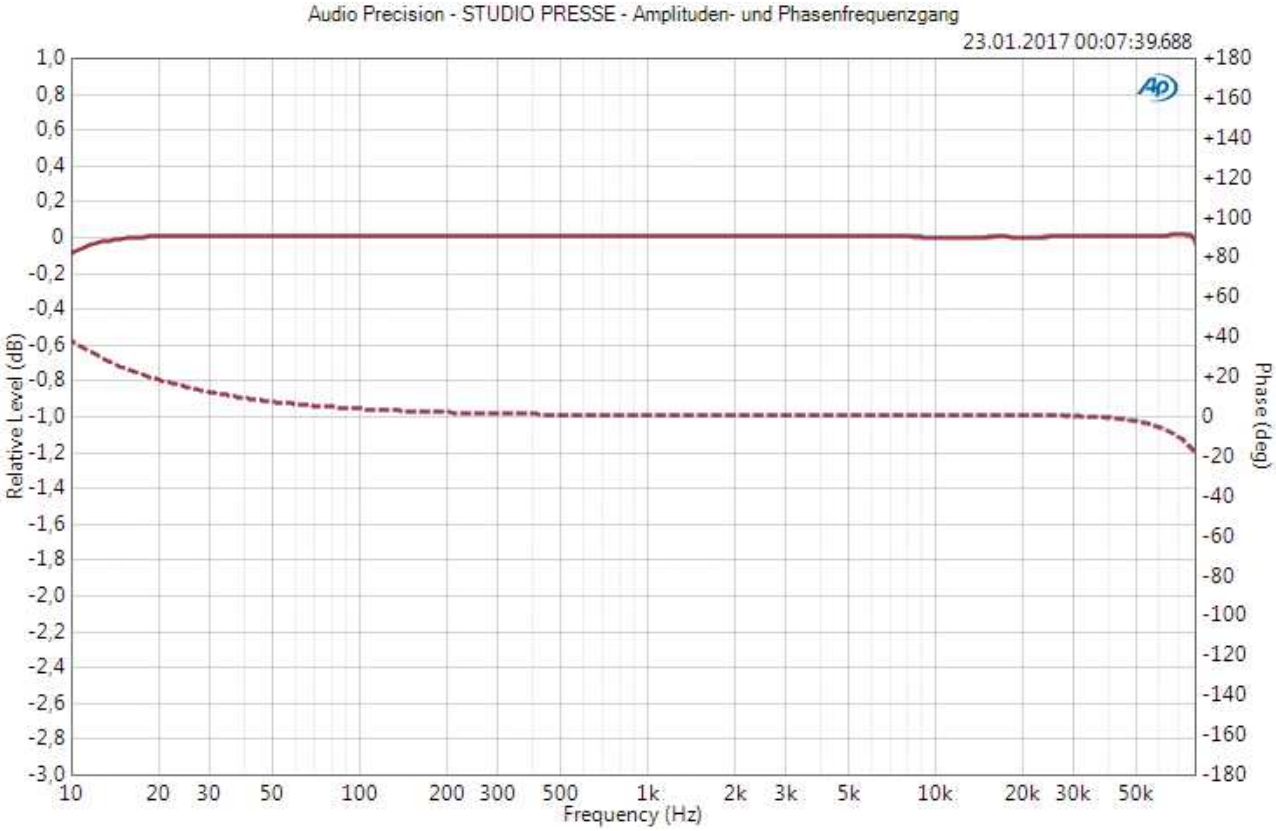

Figure 5: Line input to line output: Both amplitude (continuous) and phase (dashed) frequency responses are equal to the self-test measurement of our audio analyzer

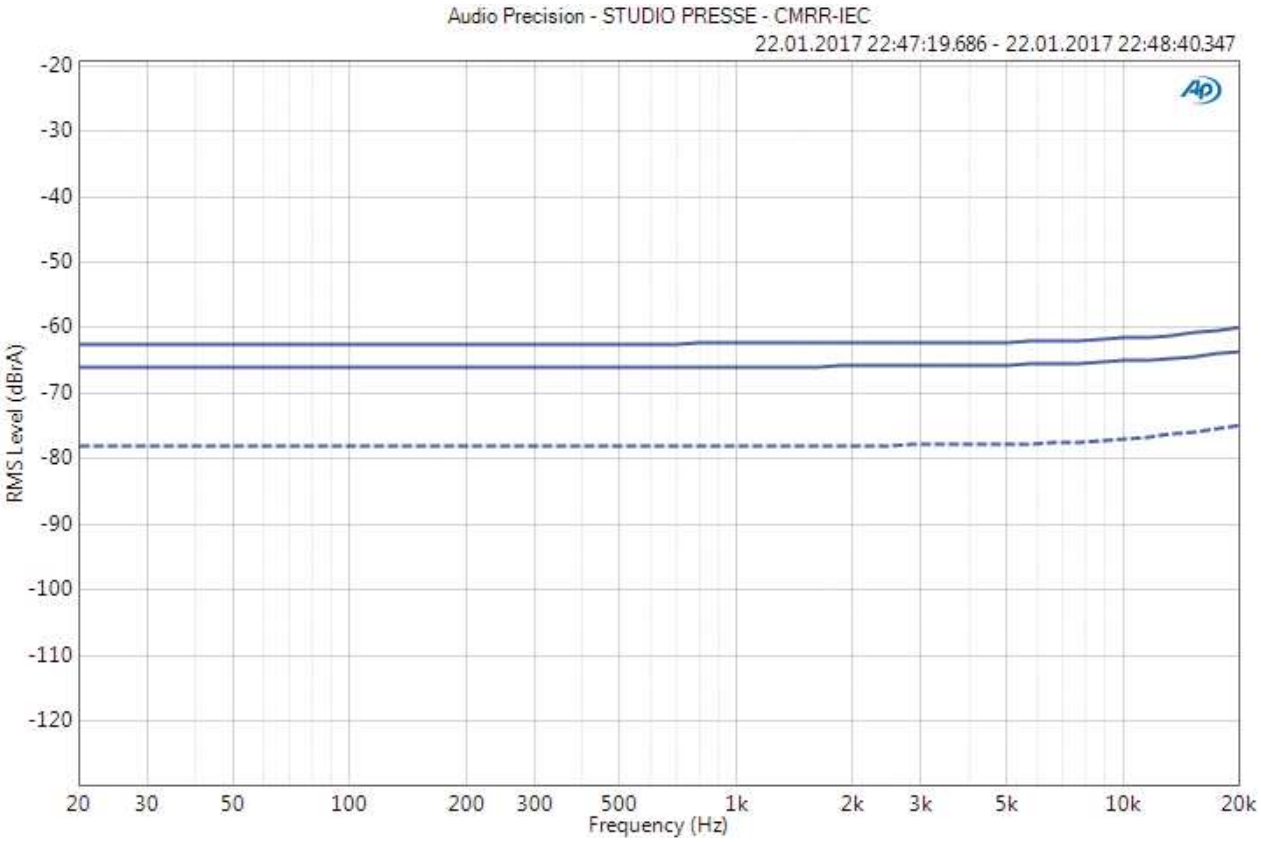

Figure 6: Common-mode Rejection Ratio (CMRR) at the balanced input without (dashed) and with (continuous) 10 ohm resistors in both signal cores

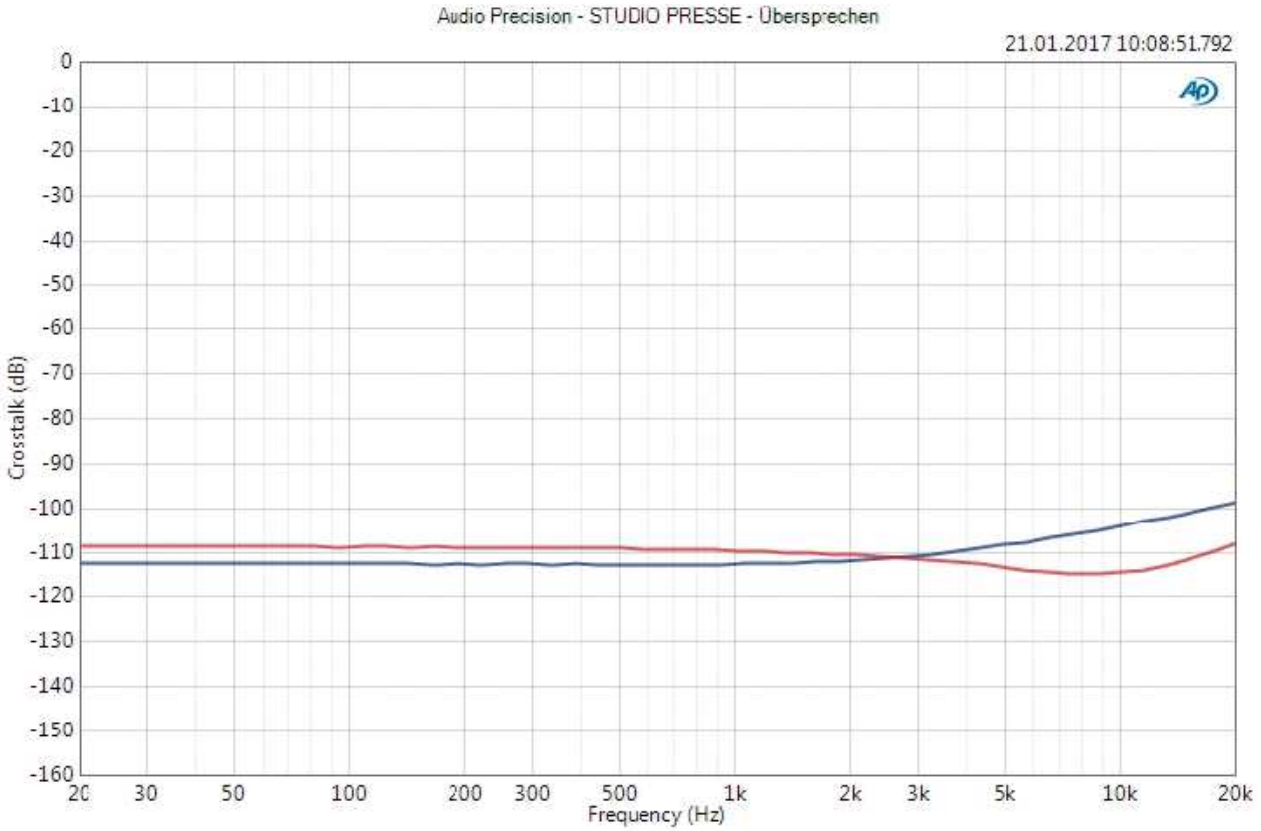

Figure 7: Cross-talk between left and right channels

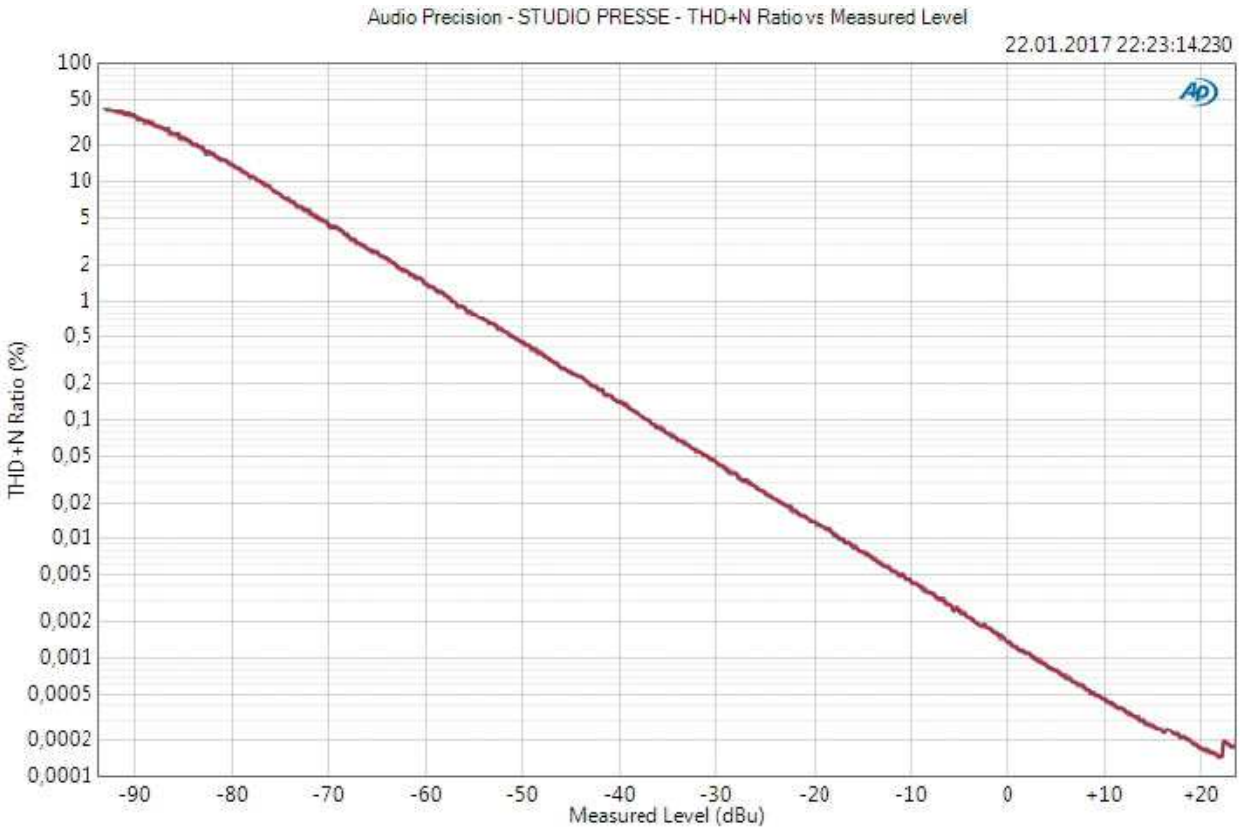

Figure 8: THD+N ratio over the range of level at the headphone amplifier, at 250 ohms

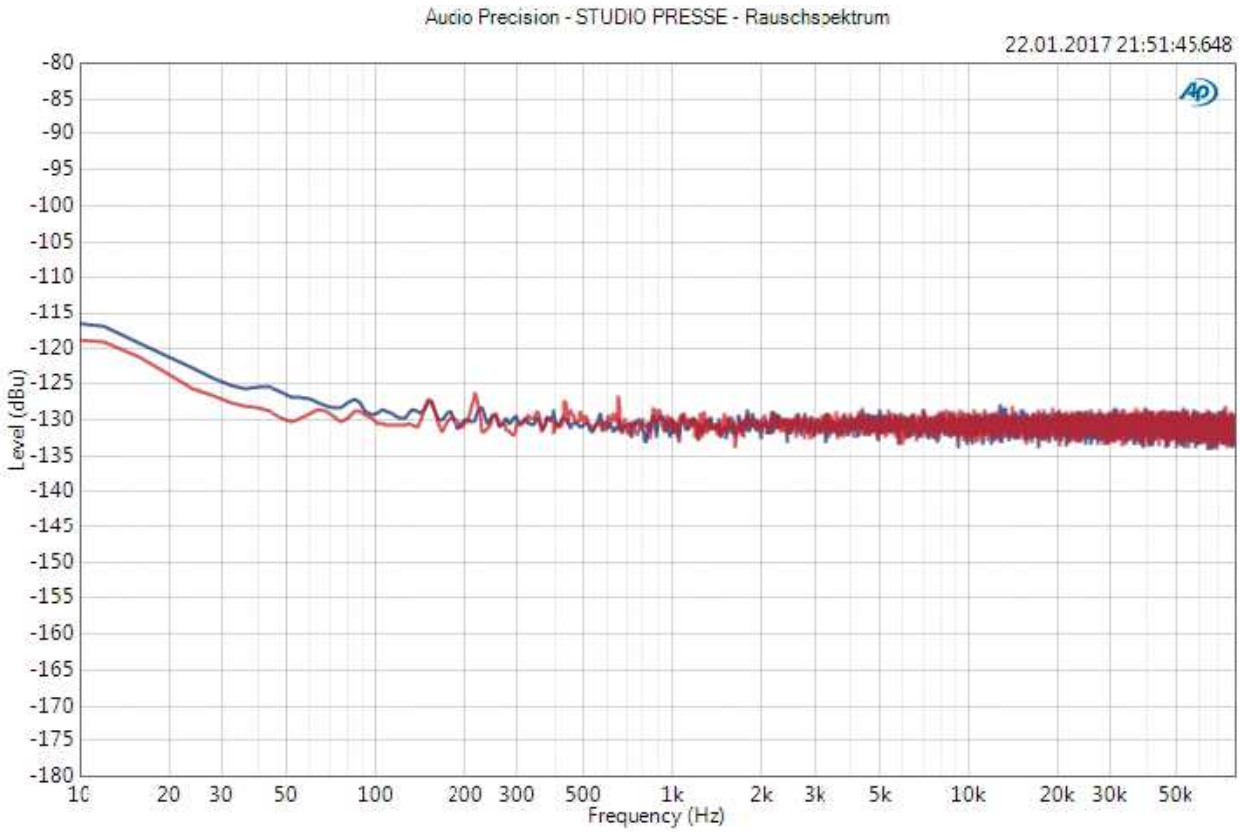

Figure 9: Interference-free noise spectrum at headphone output at full gain

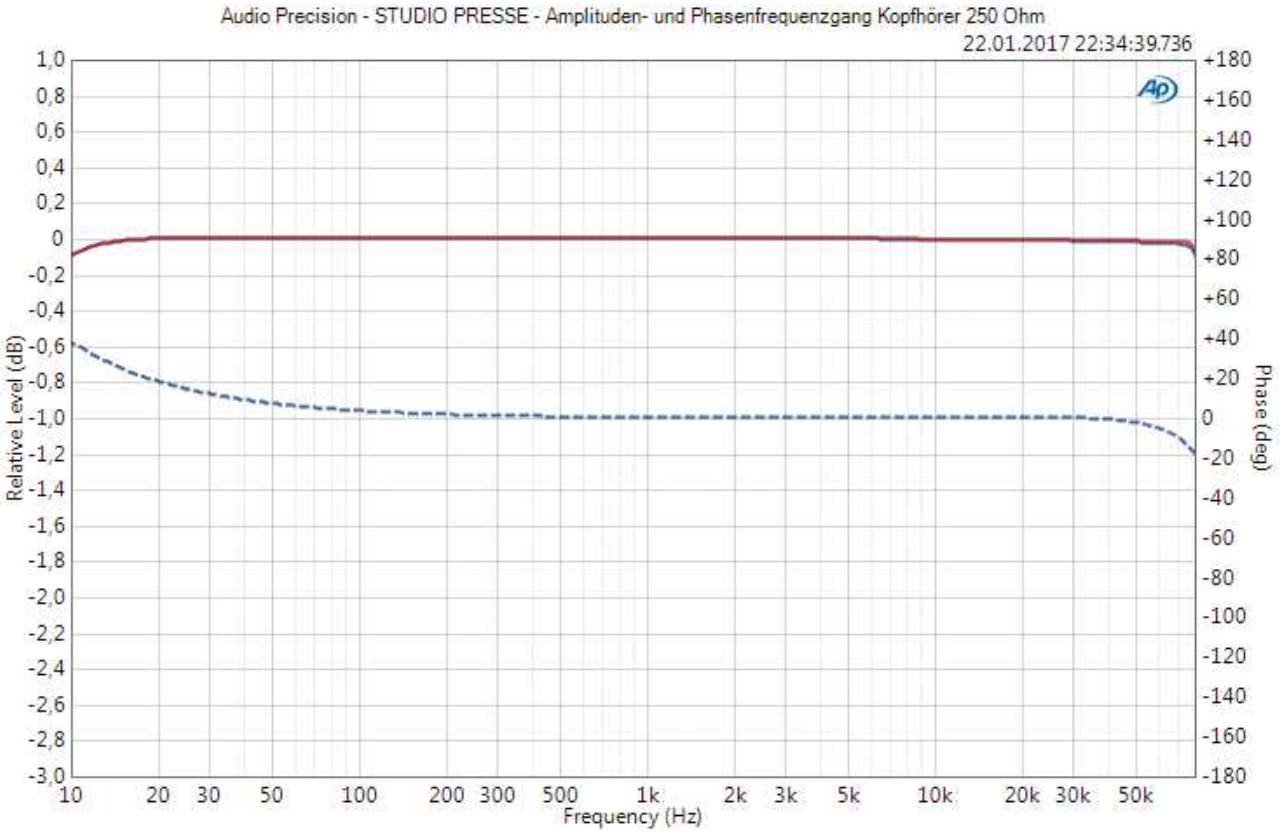

Figure 10: Perfect amplitude (continuous) and phase (dashed) frequency responses at headphone output, one decibel below full gain

In practice and listening

For the test we had an MTX and remote control but no digital router, so the statements about that are purely theoretical. The possibilities are, however, so clear that it would only be possible to determine whether the promised functions really do function, about which the editorial team has no doubt. To be able to work conveniently with the MTX, the front panel should be fairly well placed in the field of view since, with the horizontal format of a 1HE front panel, the controls are not so convenient to see as on the remote control that is usually placed directly in front of the user.

Nevertheless the arrangement on the front panel of the main system works well. Furthest to the left is the stepless level controller for the headphone amplifier next to the jack socket. Next to the right are the selector buttons for the input sources and they are both for the monitoring and the dubbing buses. The dubbing bus is accessible only via the additional Record button. The selection made here is shown by red LEDs over the selector buttons. The monitoring selection (one or more sources simultaneously) is indicated by an LED in the buttons. This gives a good overview. The positions of the monitoring functions, described in more detail earlier, need to become second nature to be able to work quickly and conveniently. Up to this point, the arrangement and labelling of the function buttons are clear enough to facilitate the learning process. However, the remote control provides a better feel for working with a monitor controller. It has a larger volume control and both controllers, the one on the front panel and the one on the remote control, provide an equally good sensitive touch. The system is set up for absolute precision of level and control, and makes its user very sure that all detected deviations of level result from the source, not the controller. The smooth operation of the volume control and extremely low distortion of the signal processing are thanks to the digital control of the analog level control via a separate microprocessor and sophisticated cascaded level-adjustment circuits.

In addition to the loudspeaker level, the balance control is implemented in the same amplifier stages. Further details are described

by the manufacturer in his comprehensive user manual. In use we would have the safe feeling that the MTX would be the last thing to be suspected if unexpected variations of level become apparent. If there is any doubt, the cause should be sought elsewhere. The combination of the 'Mono' and 'Phase' buttons enables the S channel to be conveniently monitored. I know this function from my Avocet II monitor-controller that has often given me good service in mastering. But how does one test a monitor-controller that, in the best case, has no expected acoustic traits and that is probably better than the monitoring section of one's own mixing console? Correct, one listens directly to the transducer output of one's reference transducer and compares the result with the existing monitoring configuration.

The sole snag in this is the absence of a direct switchover facility in comparison monitoring, since the speaker system must be directly connected to the monitoring output of the controller being monitored. So I had to take into account the time to swap the cabling, which causes a clear break in the listening. So I first listened to a music title in the existing configuration and then 'switched' to the other controller in three stages each time. It is already very thin ice when comparing two high-quality controllers with each other. No conspicuous differences could be expected, but there were some really minimal pointers that can be helpful in an assessment.

As expected, the MTX gave a very clear and accurate sound image. I think I can claim that in the lower frequencies the MTX is just a trace more defined and transparent and the middle frequencies come across very slightly clearer. Masked signal details are a shade clearer and the sound image seems overall more 'relaxed' with somewhat finer transients. I don't feel entirely happy with such an assessment since the differences are far from obvious.

However, I can say with a clear conscience that the MTX represents the absolute reference class, not only regarding measure-ments, but also in the sound quality and certainly needs to fear no competition in matters of complete transparency and image accuracy. 'Transparency' is understood here to mean 'invisible'. We can be sure of hearing an optimal transmission

path, with which above all the loudspeaker with its reproduction limitations is decisive in the matter of quality. A middle-rate listening system is scarcely in a position to do justice to this quality of signal.
It is easy to get over the fact that the MTX has no insertion points in the dubbing path (also see Measurement Technology) since there are plenty of analog inputs and in this case that makes a lot of sense. Finally some remarks about the headphone amplifier that, as expected, should not be understood as 'functional decoration'. I did some listening tests with my Audeze LCD-2 headphones and was quickly convinced that Thomas Funk wants to supply the best possible quality here also. It is not just any old headphone amplifier, but it too can be ranked in the reference class. As regards reproduction accuracy it can even be said to stand out clearly in contrast to the headphone amplifier of my reference transducer. Anybody who has an MTX monitor needs no further thought about acquiring a headphone amplifier of mastering-grade quality.

Summing up

With the MTX monitor, Thomas Funk is approaching the limits of what is currently possible in analog technology. So far we have tested no other active electronics that could offer such top values. To that extent, this system can be regarded as the absolute analog reference. With its parallel dubbing bus, the MTX monitor is significantly above the functionality of a monitor-controller. For transmitting or mixing signals absolutely loss-free, a technically better solution won't be found anywhere else.

The monitoring is also of this quality and you can be sure there is nothing available that could exceed this measured quality. The absolute level and phase accuracy is exemplary and will make every user sure that deviations will be due to the source, not the monitoring path.
The very sober appearance of the MTX should not deceive one away from thinking that this is a masterpiece of studio technology with no room for doubt. A look inside is a visual delight for all developers; the controls are arranged intelligently and clearly grouped, and the functionality fully developed down to the smallest detail. Even visually secondary matters have been developed with great care so as to offer no weak points.

Given all that, the price for this system at 2,580 euro plus tax is entirely competitive when making a market comparison with other top controllers. The remote control in the grey plastic housing with a black front is in the price list at 375 euro plus tax. Depending on the ergonomics of the workstation, I see it as very much to be recommended for a good 'operating feel'. For completeness, here are the prices of the recommended digital routers: 859 euro for the PAS-8 and 729 euro for the AMS-2 DAR, each of these before VAT.
My dear colleague Dieter Kahlen tested the MTX-V2 in 2005, with a similarly outstanding evaluation. That it has been possible to exceed these results again with the V3b-4.2.1 would surely gladden him. Finally, to go back again to the arc over the headline 'Flawless': Masterly work from a developer with a passion, who always wants to know exactly. Simply great!

From "Studio Magazin" issue 1/2017
Editor: Fritz Fey; Friedemann Kootz
Photos and measurements: Friedemann Kootz
Translation: Oliver Walter