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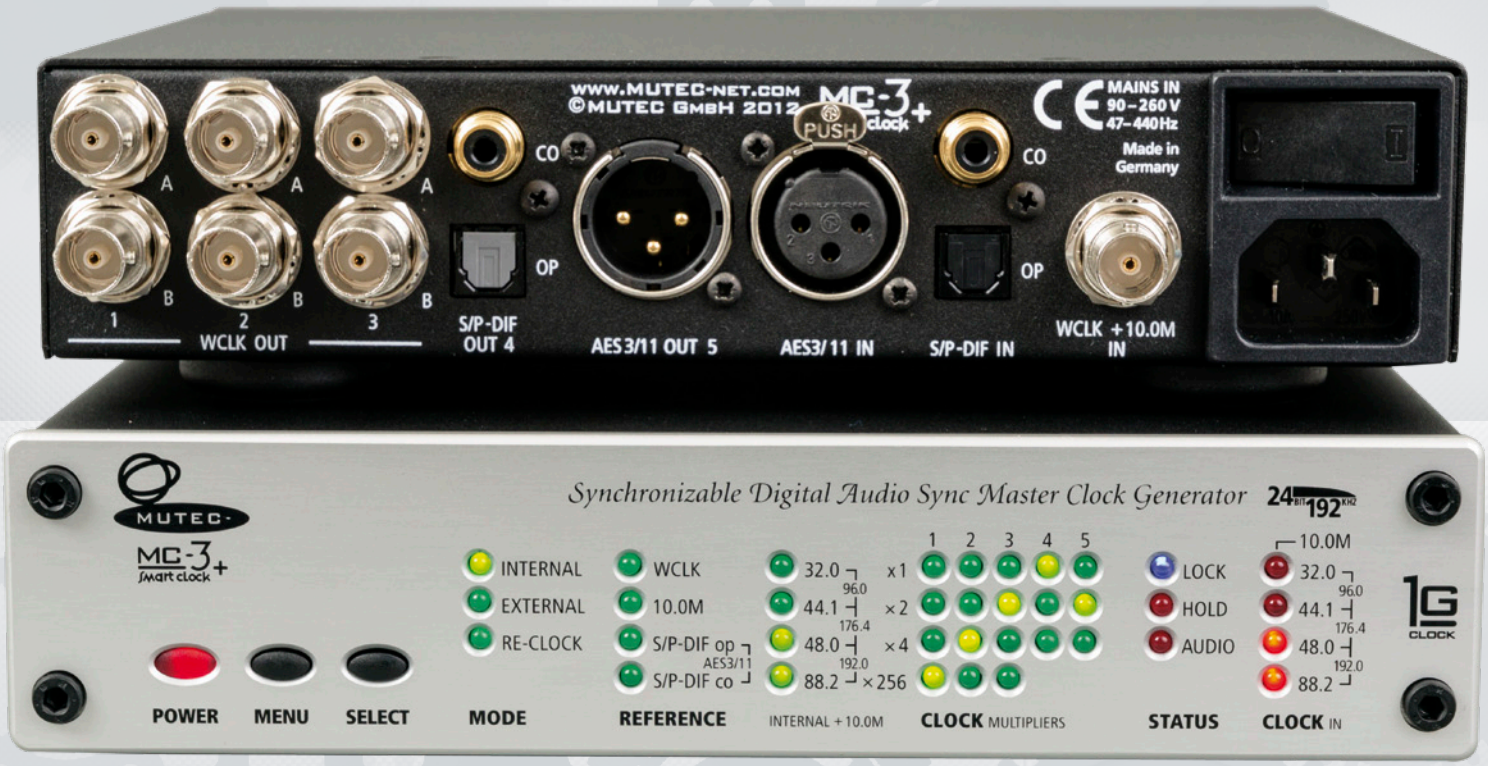
TESTBERICHT: LYNX HILO

INTERVIEW: KLAUS JANKUHN



FRITZ FEY, PHOTOS: FRIEDEMANN KOOTZ

TICK TACK

MUTEC MC-3+ SMART CLOCK

Probably everyone knows that a clock signal is the A and O and by principle an inherent sound quality-determining factor for an intended operation of digital PCM systems which are applied to all rules of the theory. Nevertheless, there is much controversy about whether and how an external or internal clock can contribute to or improve the quality of an A/D and/or a D/A converter system, an aspect that is brought to bear. ‘Quality improvement’ is actually the wrong choice of term because a clock generator can either run (nearly) perfectly precise or lead to a deterioration. The less distorted or jitter afflicted the clock is, the closer is the transmission to the theoretical ideal. More fundamentally considered, audio signals can only be passed on without so-called „clicks and pops“ if all involved devices run on the same system clock. In a digital audio network a device, the master, supplies the clock. In a particular case it may also be a device that does nothing else but generate the clock to which all other devices, the slaves, synchronize. But even with such a basic principle, there still exists the danger that one quickly slips into esotericism, ascribing miracles to specific clock generators while ignoring the real technical coherences. It actually is ‘only’ about the development of a process to produce a constant system clock as deviation-free and faultless as possible.

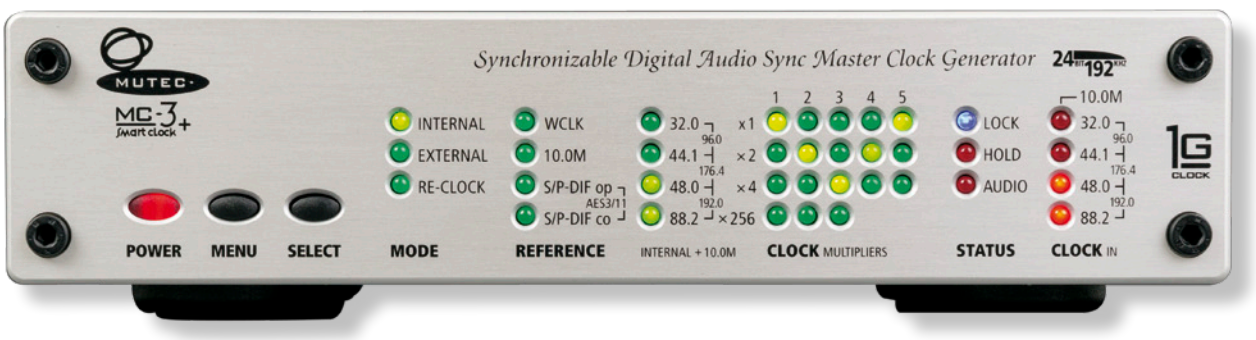
For a very long time, the Berlin-based digital specialist Mutec has dedicated itself with its products to the production, conversion or distribution of digital audio and clock signals. Until today Mutec thereby avoided to foreground acoustical factors and rather delivered more technically 'clean work' at the current state of technology. This is fully intended as a compliment. With the MC-3+ Smart Clock, the manufacturer now presents a master clock that generates on one hand a particular ultra-low-jitter clock signal by a new process, that on this quality level enables on the other hand an up to now peerless re-clocking of synchronous or asynchronous digital audio sources. The reasoning basis for a statement about 'sound quality' is the Mutec-developed 1G-Clock technology that offers a clock signal quality at the boundaries of what is technically feasible, therefore claiming the right for itself to set the resulting sound of converters into the focus.

Mutec's 1G-Clock

With a base clock in the 1 GHz range, Mutec makes use of an extremely high clocked DDS-frequency-synthesis process (Direct Digital Synthesis) that proceeds on an elaborately determined 'special frequency' which also varies in the range of the base clock. As the company found out, the DDS process generates the by far lowest jitter and noise values at exactly this frequency. If one deviates from this frequency, the jitter measurement values deteriorate significantly. As reasonably well conceivable even to non-developers, such a construct reacts sensitively so the manufacturer had to use specially selected components for the DDS's loop-back filter. By using the latest extremely low-noise voltage sources that particularly offer a very low noise down to the low-frequency range, too, the MC-3+ is actually on an extremely current technological state. Nevertheless, an outstanding audio quality can not only be explained by a high base clock alone. A lot more, the circuitry concept had to be tuned very precisely particularly in the context of the DDS process, the clock base and the further clock distributor stages. The components suitable for this purpose were only found in the course of extensive testing.

Overview

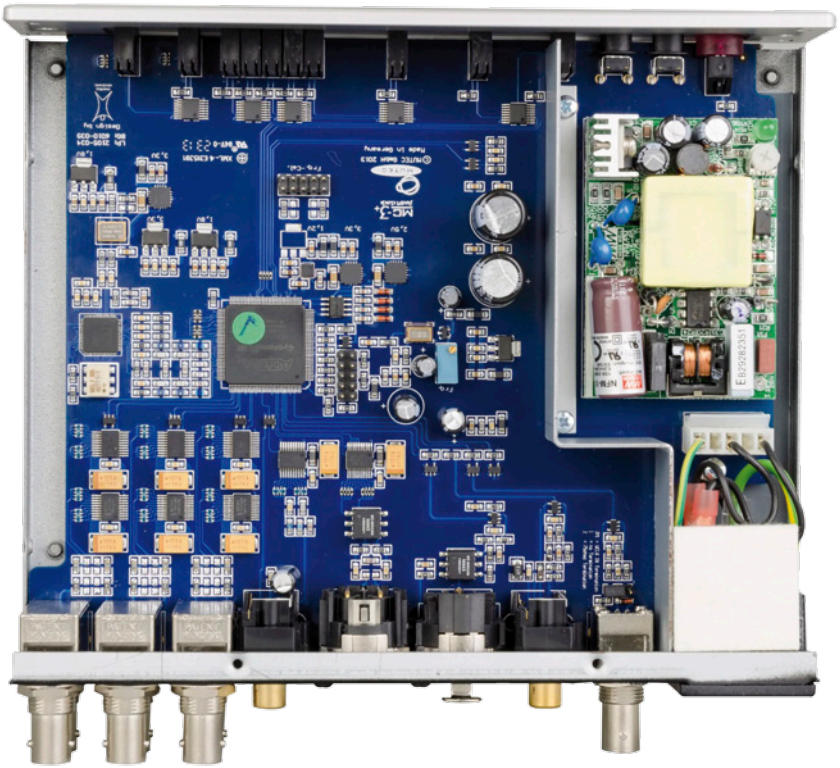
The MC-3+ Smart Clock is Mutec's first device which follows a new design line with an in many ways optimized casing design and a colour scheme, too. The proven menu navigation from other device developments in the Mutec portfolio was however thankfully retained. As with most Mutec products, the electronics are housed in an enclosure of a half 19 inch size. For the operation, the menu structure follows a logical arrangement of in groups combined function LEDs, controllable with only two buttons ('Menu' and 'Select'). However, before we delve into the details, some basic observations on the device have to be made. Although the possibilities of this master clock generator and distributor are actually more or less self-explanatory by the front panel labeling and the rear interfaces: the MC-3+ is, as already described, a clock generator/distributor that thanks to the use of new technologies provides a high quality clock signal. However, it also offers the possibility of re-clocking a digital audio signal by scanning it with a high resolution and then (if one may say so) 'marrying' the audio data with a newly generated, almost jitter-free clock signal to obtain an optimal sonic representation of the audio source. In the function of a clock distributor, the device can synchronize to external references such as a Word Clock or a 10 MHz signal of so-called 'atomic clocks' and GPS receivers or to an AES11 or S/P-DIF audio signal. In the re-clocking operation, the MC-3+ receives digital audio signals in the AES3 or S/P-DIF format. The output interfaces at the rear correspond to the arrangement of the front panel function LEDs. It includes three BNC-WCLK output pairs that are labeled with A and B for a better overview or wiring documentation. The S/P-DIF output is outlined by a coaxial and an optical connection. Output number five is the AES3/11-XLR socket. On the front, all five outputs are outlined by five rows of clock multiplier LEDs which means that different multiples of a basic frequency can be output up to a 256fold for older Pro Tools systems (the so-called Super Clock). On the input side, an XLR jack is provided for AES3/11 signals (depending on the application). Additionally, an S/P-DIF input with a coaxial or optical connection, and a BNC-WCLK input



exist for externally supplied clock references (WCLK or 10 MHz). The capture range covers 25 to 200 kHz, 10 MHz and both Super Clock frequencies. Finally, one can also use the MC-3+ as a 'format converter' for digital audio and clock signals. Among the possibilities are AES3/AES11/S/P-DIF, WCLK/AES11 and 10M/WCLK/AES11, each in any combination and direction.

Operation

To understand the menu structure, we take a look at the front panel. It starts on the left with a mains operating light (the power switch is located on the back). Next to it follow the 'Menu' and 'Select' buttons, the only available controls. The LED display area is divided into five functional groups that virtually show the actual operating mode in an existing installation so you can always think in contexts that are related to practice. The first, 'Mode' labeled LED group determines the basic operating mode of the MC-3+. Here you will find three 'Internal', 'External' and 'Re-Clock' marked LEDs. By pressing the 'Menu' button, the last after the power up active LED position of the first group starts to flash, indicating that this group is now released for 'Select'. With 'Select' you now dial up gradually to the desired position. After about three seconds, the selected function will be automatically confirmed by a permanent light, unless by pressing the 'Menu' button you jump again to the next function group whose last active LED begins to blink while the previous selection is immediately confirmed. Pressing the 'Select' button again, the last selected function group is directly addressed anew. This also applies to the 'Menu' button that enables you to jump only between the functional groups. Depending on the function selection, only those functional groups are displayed that provide a meaningful setting. In the group 'Reference' you choose the timing references for the internal or the external synchronization and those for the re-clocking operation of synchronous and asynchronous audio sources. All options supported by the device are at your disposal in various combinations: WCLK, 10M, S/P-DIF optical and coaxial as well as AES3/11. In addition, audio formats can be combined with external WCLK or 10 MHz references albeit this is only relevant for the asynchronous re-clocking mode. For internal referencing, the next group 'Internal +10M' allows the choice of seven different base clock rates (32 /44.1 /48 /88.2 / 96 /176.4 and 192 kHz). The subsequent clock multipliers for the five outputs at the rear offer the output of the single, double or fourfold of the base clock rate plus x256 as Super Clock. Since only the BNC outputs can provide Super Clock, this LED is absent with S/P-DIF and AES. In addition to the clock multipliers, three LED indicators can be found in the 'Group' status for 'Lock', 'Hold' and 'Audio'. No changes are possible in this group, only the status of the device for the incoming reference, the self-generated clock or the digital audio signal is indicated. The same applies to the last group 'Clock In'. Here, the clock rate of the incoming reference clock, the self-generated clock signal or the digital audio signal is indicated. Depending on the setting of the clock multipliers, WCLK frequencies from 32 to 768 kHz plus 11.2896 MHz (44.1 x 256) or 12.2880 MHz (48 x 256) Super Clock can be generated. For AES3/11 and S/P-DIF relevant frequencies the range is 32-192 kHz. Two functions should finally be mentioned: by simultaneously pressing 'Menu' and 'Select' in succession (in that exact order) all LEDs except the operational and 'Lock' LEDs extinguish. In this case, also the control buttons have no more function and are protected against accidental or unauthorized access to the device functions which can be very helpful e.g. in a broadcast or live situation. Pressing both buttons again and keeping them pressed simultaneously for about four seconds, the user interface is unlocked again and all LEDs light up according to the setting. The second function relates to the possibility of resetting the operating system



to the factory setting. To this end, you keep the 'Menu' button pressed during the power up.

Installation and Wiring

It should be understood that for a functioning synchronization bond, all involved devices have to be connected carefully and with the shortest possible cable runs. For the transmission of Word Clock signals, unbalanced BNC cables with an impedance of 75 ohms are required. I found the hint in the manual that these cables are normally referred to as RG-59U or RG59B/U. In addition, make sure that the WLCK inputs have a 75 ohm terminating resistor. Most WCLK input channels feature a switchable resistor (including the MC3+ via internal jumper). For devices without a 75 ohm terminating resistor, one uses an additional BNC T-piece allowing the connection of a physical connection resistor. However, this should not be used to loop through a WCLK signal so as not to violate the signal integrity. Is there no alternative connection option, all WCLK inputs except the last device in the chain should not be terminated. Nevertheless, the manufacturer refers that it is not recommended to connect more than three devices in series with a WCLK output. Balanced XLR cables with an impedance of 110 ohms are recommended to connect AES/EBU or S/P-DIF interfaces. In our experience, however, most XLR studio cables anyway fulfill these requirements. S/P-DIF connections are made via unbalanced Cinch/RCA cables with 75 Ohm impedance. When connecting an optical cable (Toslink plastic), by the manufacturer's reference a length of 10 metres should not be exceeded. 'True' glass fiber optical cables allow even greater distances.

Re-clocking

Besides the fact that all externally referenced modes always lead to a regeneration of the output clock signal, the MC-3+ additionally provides the already mentioned re-clocking or re-timing function of an incoming digital audio signal. In this application, it is primarily an optimization in sound of the DA converter's reproduction. All three digital audio inputs (S/P-DIF coaxial and optical, as well as AES3) can be accessed in this mode. The re-timing produces a phase-synchronous, completely re -generated clock signal of the highest quality that is embedded in the output signals with the sampling rate of the digital audio input signal. To our knowledge, the asynchronous re-clocking is currently only possible with the MC-3+ Smart Clock. In this mode, additional functions are available. If you select one of the available digital audio inputs, two further options are offered by pressing the 'Select' button again: the selected input plus WCLK or the selected input plus 10 MHz. Choosing these re-clocking options, allows the re-clocking of the digital audio signal based on an external WCLK or 10 MHz reference. In this case the reference signal has to be supplied at the BNC input. In any case, the digital audio or Word Clock output signal contains the same basic frequency as the input signal. It is phase-locked but not phase-synchronized to the external reference clock source. In the functional group 'Clock In', the clock rate of the digital audio input signal is displayed and the Word Clock outputs are multiplied by using the clock multipliers in their rate.

Preamble

When the audio professional hears the term 'jitter', he starts to jitter like the just quoted spectre itself. In August and September 2008, my colleague Friedemann Kootz had already commented in great detail on this topic, so I should not go here into this subject in full again. Who wants to read about all the details again, finds both posts on our website in the 'Freizone'. Formulated simply, jitter means an inaccuracy of the clock, in other words, an unwanted phase modulation of a pulse signal. There not only exists one form of 'jitter' but several types of this phenomenon. To eliminate them entirely, the developers go quite different ways. In any case artifacts in the (converted) analog audio signal can arise by a jitter afflicted timing that, in contrast to the standard analog world, really sounds not musical: intermodulation, non-harmonic distortion, lack of phase synchronization of stereo signals which can significantly affect the spaciousness or signal depth. But also a blur of impulse, a weak localization or signal dissociation in a mix can happen. The question of the worthiness of an external clock over the internal has already been answered clearly negative in some publications. In my experience it is more relevant whether the circuit design of a converter and its chip peripherals is likely to improve the signal quality by an external clock. Unpredictable in a particular case, many factors are responsible for the expected positive impact of an at most jitter-free external clock signal. But you should always expect that even good converters can benefit sound-wise from external clock generators.

Hearing

I considered very long and hard whether I could find a way of factual evidence in the given time that does not culminate in the fact that you simply have to believe me my listening experiences. So far I have not discovered any method that could really endure this. So it remains, at least for the moment, at a hearing test, the results of which I describe as concisely as possible. Of course, there are methods of measurement that eject the jitter as an 'absolute value' but it is still not clear in this way which sound effects in particular are associated with it. For my listening test I

figured out a very simple, clearly manageable, autarchic setup that consists of an AES signal as a source, an (due to reasons of fairness) unspecified D/A converter, and a Mutec MC-3+ Smart Clock. Although the rewiring of the AES3 source directly to the converter or via the 'detour' through the re-clocking path of MC-3+ always took a few seconds and a correspondingly long listening break, the perceived differences were so significant that I readily see in the position to determine exactly the tonal implications. As a source I used the CD material from my test components that I know for a very long time and which already formed the basis for many listening tests. Among them was a recording of a symphonic concert which was recorded with only two microphones at one position (Denon One Spot Recording) and some more modern pop titles that are either characterized by sharply defined transients or musically overloaded structures which react very sensitively to transmission situations of all kinds, e.g. speakers or converter listening tests. I listened to each 'direct' and 're-clocked' signal over a relatively long period of time in order to memorize specific sound features with every listening session: dimensionality, localization, transient response and so on. Part of the classical recording is a bassoon solo in which, under good listening conditions, the key sound of the instrument can be perceived in the background. When I first listened to the re-clocked 'version' of this recording I was pretty amazed. This key noise was suddenly so concise as never before, the stereo stage appeared 'relief-like' or more three-dimensional while the instrument groups moved all in a much clearer perceivable position, presenting themselves more defined and thus more 'frontal'. The basses became more 'physical' and the strings' sound structure appeared to contain more 'details', all this was combined with a 'deeper' perceived spaciousness. That I had to discover these tonal differences consecutively in order to specify them more precisely, already points out that I do not talk about scales of improvement. But all sonic details together generate an effortlessly perceivable spacing towards the standard recording. With the pop songs I noticed especially the sharper reproduction of the transients. Overall, pulses appear more powerful, rim shots showed a finer structure in their dynamic process. Basses had a richer, more 'growling' overtone spectrum and a deeper spatial sound image was here clearly perceivable again. Especially small, rather hidden spatial details could be noted in a more contoured and more detailed way. You hear them in the internally clocked version, too, but only when the re-clocked version had quasi 'pointed with its finger' on it. With all the elation about the perceived differences, it however remains to be noted that these effects are not likely to be so obvious with every converter combination as some devices, due to their circuit designs, remain 'resistant' to a 'better' clock signal. At least, it can be assumed that an extremely clean external clock does not degrade the sound. In more complex studio installations with many converter channels, the external clocking is certainly a good decision. How this topology actually affects the sound depends on the particular case. To put it another way, I absolutely entrust to try it out to you.

Conclusion

Considering complex circuit details on the basis of new technologies, Mutec approached the topic 'clock signal' with its MC-3+ Smart Clock significantly closer to the theoretical ideal. Beside the aspect of mere considerations about an installation or a system, our test device not only comes up with extremely extensive and fully-equipped features. The audiophile requirement also gets one's money more than worth to achieve a sound quality with re-clocked audio signals that would not be possible with any other post-processing means. The processing of the MC-3+ is above reproach. Its operating structure's design is very logical and practical while the technical functionality is meticulously implemented at the highest quality level. And finally the best - its absolutely unbeatable price. The manufacturer quotes a suggested retail price of 749 Euros including German tax. Hardly any argument can be urged against an optimal system clock at this price level. My personal summary: this gizmo stays in my studio...

MUTEC

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Optimize the sound quality of your studio with our new MC-3+ Smart Clock.

Extensive beta tests by experienced studio professionals show that particularly the re-clocking of an audio signal by means of the integrated innovative 1G-Clock technology clearly elaborates subtle signal details. The results are a significantly more accurate representation of individual instruments and an impressive, authentic spaciousness which add a clear transparency to your productions. Moreover the 1G-Clock technology helps to improve the quality of existing clock generators by distributing clock signals redundantly to increase the operational safety of studio installations to a maximum.

MC-3+ Smart Clock

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