



TEST.

MUTEC REF10 SE120

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With the presentation of the REF10 SE120, a 10 MHz reference clock generator, MUTEC claims nothing less than the technological as well as audiophile top position within this device category for itself. Strong words – we want to see if this is followed by corresponding sonic deeds.

When I read this announcement in MUTEC's press release, I was skeptical and curious at the same time. Skeptical, because I had reviewed the "normal version" of this clock generator, the REF10, intensively some time ago. The qualities of the REF10 and especially the sound experience achieved had really excited me at that time and I could not imagine how at first sight rather slightly improved phase noise values should still top this. Curious, because I found Mr. Peters, managing director of MUTEC, as an extremely competent partner from many discussions, to whom the otherwise often usual marketing blah-blah-blah is quite foreign. He prefers to argue with hard technical facts. As so often curiosity prevailed, and the end of the story was that both the REF10 and the new REF10 SE120 ended up in my listening room. But what are the differences between the REF10 and REF10 SE120? Both devices are externally and technically identical except for the oscillator used. Already during the development of the REF10, MUTEC had realized how important the choice of the central oscillator is, and that its quality determines the technical and acoustical end result of a reference clock generator to a considerable extent.

The "tuning" version of the REF10 SE120 therefore offers an even more elaborately manufactured and selected oven-controlled crystal oscillator (OCXO). With the help of highly specialized and cost-intensive measuring technology, individual specimens of the oscillator are selected from larger production quantities. These have



The black knob is used to turn off the clock outputs that are not needed. On the right hand side the blue LED is permanently lightning when the oscillator warm-up process is completed

extremely low phase noise values of at least -120dBc measured at 1 Hertz offset from the carrier frequency of 10 Megahertz and clearly surpass the basic REF10 model (-116dBc at 1 hertz) in this key aspect metrologically unambiguous.

But what is this phase noise all about and why is this value so important for a clock in the audiophile world? Intuitively, we know that low noise in a system is better than high noise. Walter Schottky explained the physical phenomenon as a measurable irregular current fluctuation. If we amplify this fluctuation and make it audible via a loudspeaker, we hear the typical noise that we commonly understand as noise and which also gave the phenomenon its name. But this rather analog understanding of noise has only a partial connection with the term



The clock outputs of the REF 10 SE120: 2 x BNC 50Ω and 6 x BNC 75Ω



The 75Ω outputs in detail

used in modern electronics. Here, noise is generally characterized much more as any unwanted signal that interferes with the main signal. It can interfere with any parameter such as voltage, current, phase or frequency. In the case of an oscillator, we are primarily interested in the frequency stability of its signal. Here we distinguish between the long-term stability and the short-term stability. The long-term stability refers to the amount by which the absolute clock frequency drifts over a longer period of time. Causes can be for example aging processes or temperature fluctuations of components. Even if this is important for telecommunications or studio applications, for example, it has, according to MUTEC, no influence on the quality of the reproduction of digital audio material.

The decisive factor is the short-term stability, which is described by fluctuations of amplitude and phase in a very short time range. The phase noise is a measure for the short-term stability of the oscillator in the frequency domain and is given in decibels of carrier (dBc) for a certain offset from the carrier frequency. A value that decreases with increasing distance from the carrier frequency. For example, MUTEC specifies as standard for the REF10 SE120 a phase noise of -120dBc measured at 1 Hertz offset and -148dBc measured at 10 Hertz offset from the carrier frequency of 10 Megahertz.

Sounds very abstract, but phase noise has a sibling more familiar to us audiophiles and that is called jitter. Jitter is also a measure of the short-term stability of an oscillator, but this time in the time domain. Phase noise and jitter are linked. One can say that with increasing phase noise of an oscillator, generally the jitter effect increases as well. And we all know that low jitter values are decisive for the sound quality of digital audio devices. And now you are at it again. Let's keep in mind: Changes in the short-term stability of an oscillator are described by phase noise and jitter. Especially important here is the measured value at 1 Hertz offset from the carrier frequency of 10 Megahertz. Surprisingly, just this value is sometimes not indicated at all, or very hidden only. This may have to do with the fact that, for technical reasons, this value is always worse than the one that can be measured at of 10 Hertz offset from the carrier frequency of 10 Megahertz.

For a standard device, the REF10 SE120 has undoubtedly outstanding measurement values. MUTEC is particularly proud of the fact that the development of the REF10 has already created a basis, from the power supply to the mainboard, which is so good that the brilliant values of the new oscillator used in the REF10 SE120 can actually be routed to the outputs without any loses in performance. Convincing technical justification or not – for me the question remains, whether the further improvement of the REF10 SE120 compared to the REF10 leads



The two 50Ω BNC outputs in detail. The difference between 50Ω BNC sockets (outputs 1 and 2) and 75Ω BNC connectors (output 3) can be identified easily in regards of their different white isolation material thickness

to an audible gain in sound quality. I am set on a hard head-to-head race between the two clocks, in which I will work out the finest differences between the two clock generators by switching back and forth several times between them.

Accordingly, I carefully prepare my listening test. As always, my tried and tested music server with XEON processor and Windows Server 2019 in Core Mode, tuned with Audiophile Optimizer, is used as the audio source. JPLAY Femto, MinimServer, JRiver26 and Roon Core are installed on the server as music management software. My two cascaded MUTEC MC3+USB are interconnected on the USB path to my PS Audio DirectStream DAC and are to draw their clock from either the REF10 or the REF10 SE120.



The inner life of the REF10 SE120 from left to right: large dual toroidal transformer, lush filter capacitances, sophisticated voltage stabilization, oscillator circuitry and extensive power input filtering

I prescribe the two REF10 clocks and the two MUTEC MC3+USB a warm-up period of several days. The clock generators are placed upside down on the shelf, that means with their rears facing forward, in order to be able to switch the cables between the devices as quickly as possible. MUTEC kindly supplied two matching, identical cables with 75Ω specification out of their own production. The right cable with the correct termination impedance is eminently important at a clock rate of 10 Megahertz. Mismatches can ruin everything. I advise against exotic cables without exact specifications at this critical point. All clock outputs that are not needed are switched off with the rotary knob on the front panel to reduce unnecessary interferences as far as possible. On both of my MUTEC MC3+USB the operating mode "externally referenced re-clocking mode" is set. Therefore, the two green LEDs "EXTERN" and "RE-CLK" light up under "Mode" and under "Status" the two upper blue LEDs "MAIN REF" and "RE-CLK REF". To be absolutely sure, I first play some music and remove the clock cables for test purposes. The two MUTEC MC3+USB don't make a sound anymore and I am sure that the clock is really set by the REF10.

First pass: I listen to the REF10 again, having read up on it beforehand, with which pieces of music I had listened to it during the first review. It is like meeting an old friend again. Immediately, this extraordinary sound experience is there again: velvety, transparent and always highly musical. On "Galicia Flamenco" with Gino D' Auri (Flamenco Passion - FIM XRCD) the instruments gain the substance again and seem much more colorful. In the first movement from the "Divertimento K. 136" by Mozart with the Academy of St. Martin in the Fields conducted by Neville Marinner (Decca Legacy Volume Four - FIM UHD), the strings again have that fascinating velvety quality. Especially with this recording, the sound of the strings can quickly become quite exhausting in certain system constellations but there is no trace of this with the REF10, despite the subjectively higher intensity of the musical performance.

Second run: I am not at all prepared for what awaits me after the first plug-in to the REF 10 SE120. Let's start with the midrange, which is so important for the overall musical experience. The gain here is sensational with the REF10 SE120. In the track we have just heard, "Galicia Flamenco", the instruments suddenly sound much rounder and become almost tangible. Hard strummed guitar strings no longer just bang, but the finest differences in articulation behind them become audible. In the "Piano Concerto in A Minor" by Edvard Grieg with Radu Lupu as soloist (Grieg: Piano Concerto In A Minor - Radu Lupo/London Symphony Orchestra/André Previn - Decca Legacy Volume One - FIM UHD 89), every piano stroke is now full of micro-dynamics and seems to be



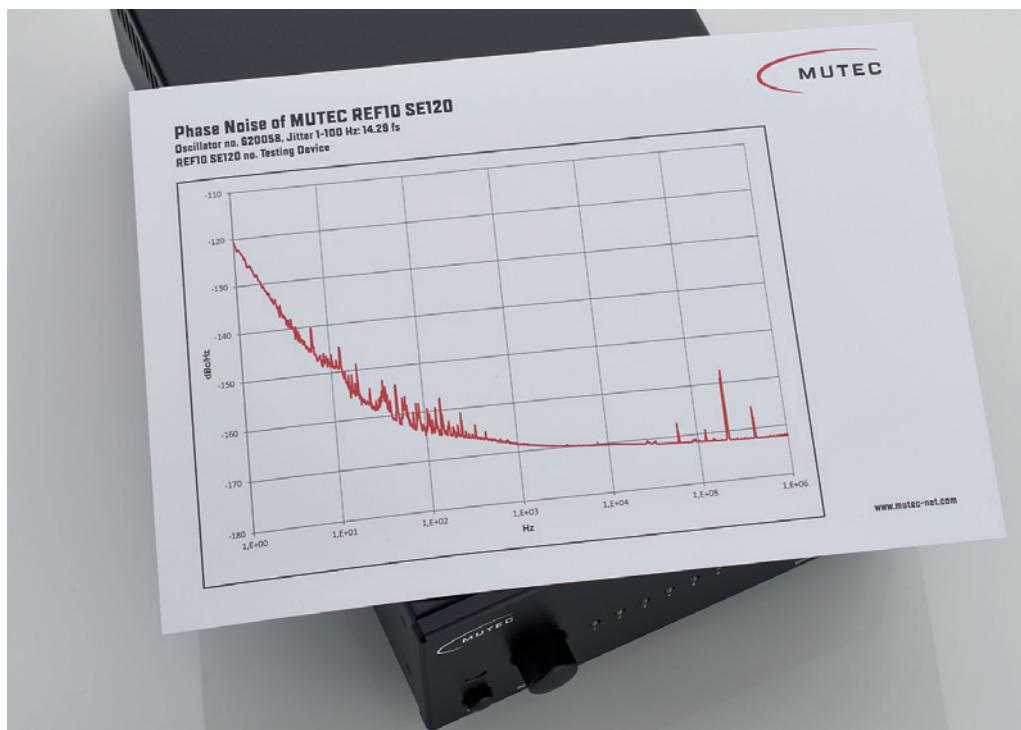
The heart of the REF10 SE120: the super low-noise, hand-crafted and individually selected, oven-controlled crystal oscillator

virtually sharpened. It is clear at any time whether a key is pressed softly and sensitively or whether in staccato passages the fingers are quickly pushed off the keys. All instruments sound more polished overall, more three-dimensional and thus ultimately somehow more "real". This effect continues in the lows and highs without a break. Thus, in the string sonatas by G.A. Rossini for two violins, cello and contrabass (Rossini: 5 Sonate a Quattro - Salvatore Accardo - LIM UHD 049), the strings always sound velvety and smooth up to the highest pitches as if from one cast over the entire tonal range.

At the same time, there is a striking airiness around the individual instruments in the orchestra. In a piece like "España" by Emmanuel Chabrier (Chabrier: España - London Symphony Orchestra/Ataulfo Argenta - Decca Legacy Volume Two - FIM UHD 90), which lives from the rich and at the same time subtle orchestration and rhythm, it becomes possible to recognize the smallest musical by-lines, which were quite obviously previously concealed. Because the individual instruments are now much more clearly placed in the orchestra and more precisely staggered in space, the spatial impression is considerably improved. The gain is not so much in the absolute depth, but rather in the perceived reality. There is no doubt in my mind: the REF10 SE120 is superior to the REF10 in all respects. It doesn't even take much effort to hear it, so clear and unambiguous are the differences between the two devices. You will not believe it: I have not switched back to the REF10 once!

Third time through: I took advantage of a visit to a good friend to listen to the REF10 SE120 in his system as well. Here, too, a MUTEC MC3+USB is interconnected, this time between an Auralic Aries network player and PS Audio DirectStream DAC. Also, in this constellation the just described sound impression of the REF10 SE120 can be heard effortlessly.

Fourth run: Back at home I exchange the two MUTEC MC3+USB in the USB line against the USB Hub tX-USBUltra with external clock input from SOtM. Furthermore, the SOtM switch sNH-10G gets its clock from the REF10 SE120. I would like to know now, if the REF10 SE120 can show its potential with third party devices. Because there is no doubt that MUTEC devices form a perfect symbiosis. The special thing about this constellation is that the clock signals now have no reference to the audio sample rate frequencies and are not directly involved in the signal conversion. Already the SOtM devices at that time, the positive influence of an external clock could nevertheless be heard without great difficulties. The "normal" REF10 does not quite come up to the SOtM clock in this constellation. I attribute this to somewhat less fine resolution and spatiality in "España". Dirk Sommer had



The measurement protocol shows the excellent course of the REF 10 SE120's phase noise

already noticed something similar. I am not sure if this is due to the fact that the SOtM clock reference signal is a sine wave and not a square wave as the REF10 supplies, and that the SOtM devices are simply better tuned to each other. But you can hang the REF10 SE120 in the chain.... and to my surprise, this comparison is now clearly in favor of the REF10 SE120!

Fifth round: I call Oliver Göbel from Göbel Audio GmbH and tell him about the REF10 SE120. Oliver Göbel in his listening room operates a true reference system with the complete electronics of CH Precision consisting of the D1 SACD & CD player, C1 digital-to-analog converter, L1 mono preamplifier and two M1 2-channel power amplifiers, in order to be able to present his loudspeaker creations at best. The special feature of the C1 DAC is that it is not only equipped with the optional slot for Ethernet streaming, but also with a slot for the connection of an external 10 Megahertz reference clock. This is exactly the reason why Dirk Sommer and I had already tried out the REF10 at Oliver Göbel's studio. Our visit at that time had not remained without consequences. Since then, a REF10 has also been in service at his listening room. At first, Oliver Göbel was just as skeptical as I was, but a listening appointment was quickly arranged, and Dirk Sommer is happy to join.

We place the REF10 SE120 next to the REF10 on the shelf. It is important to Oliver Göbel that it is possible to switch between the two clocks as quickly as possible. The brand-new Divin Marquis loudspeakers, which are "small" by Göbel's standards, are used as speakers. The "Violin Concerto in G Major, KV 216" by W.A. Mozart with Marianne Thorsen and the Trondheim Solistene is played (Mozart: Violin Concertos - Marianne Thorsen & Trondheim Solistene - 2L original 2006 edition). This sonically quite excellent recording of the Violin Concertos 3,4 and 5 is one of my personal favorites, which I always like to listen to and know very well. I am sitting in the best seat in the listening room and Oliver Göbel switches from the REF10 to the REF10 SE120. Already after the first few bars I can't suppress a little grin. There it is again, this almost magical realism in the reproduction that fascinates me so much about the REF10 SE120. Even with a completely different system, unknown to me, it is immediately audible. My eyes go to Oliver Göbel, who of course knows his chain and his listening room perfectly. I can tell from his facial expression that he, too, has noticed the changes immediately.

We listen through his music library for a while. For Oliver Göbel, the improved tonality and fine dynamics, such as the keystroke on a piano, are the salient features, Dirk Sommer concentrates on the improvements in spatial



The 75Ω clock cables from MUTEC

imaging, and I focus on whether the differences between the two clocks are tonally in the same direction as in my own system. Interestingly, all three of us hear clear improvements, but focus on different sub-areas. There is not the slightest doubt about the exceptionally convincing performance of the REF10 SE120.

The REF10 SE120 impressively demonstrated to me how sensitive the human ear is to the tiniest errors in timing (jitter). If I had one wish, it would be to have a digital signal chain in which all components take their clock from the REF10 SE120!

STATEMENT

The REF10 is already great. But the REF10 SE120 is something very special – it takes the audio experience to a new level. Rarely does an unconditional recommendation come so easily to me!

LISTENING EQUIPMENT

Computer	Intel Xeon E3-1225 3,2 GHz, 4 GB RAM, Windows Server 2012R2 und 2019 with AudiophileOptimizer 3.0, JPLAY USB Card, HDPLEX 400W ATX Linear-PSU und HDPLEX 200W PSU
	Intel Core i5 2,5 GHz, 6 GB RAM, Windows 10 Pro and Windows Server 2019 with AudiophileOptimizer 3.0, G-Technology 4 TB G1 USB-C Drive with HDPLEX 200W PSU
Software	JRiver Media Center 26, JPLAY 6.2, MinimServer, JPLAY Femto, JPLAY femtoServer, Roon Server
LAN Switch	SOtM sNH-10G i
10-MHz-Clock	SOtM SCLK-OCX10
USB	2 x MUTEC-3+ USB, SOtM USB Hub tX-USBUltra
D/A Converter	PS Audio DirectStream DAC
Pre-amp	Erno Borbely, Omtec Anturion
Power amp	Omtec CA 25
Loudspeakers	Outsider Jota plus Velodyne Subwoofer Management System SMS-1
Cable and accessories	Van den Hul, JCAT Reference USB, JCAT Reference LAN, Analysis Plus Digital Oval Yellow, AudioQuest Eagle Eye Digital Cable, SOtM dBCL-BNC, Audioquest Niagara 5000

MANUFACTURER'S SPECIFICATIONS

MUTEC REF10 SE120

Interfaces	2 x 10 MHz reference clock BNC output, 50 Ω terminated, unbalanced
	6 x 10 MHz reference clock BNC output, 75 Ω terminated, unbalanced
Signal Format of all Clock Outputs	Square wave, 10.000 MHz, 2 Vpp, 50:50 duty cycle
Phase noise	≤-120 dBc/Hz @ 1 Hz, ≤-148 dBc/Hz @ 10 Hz, ≤-162 dBc/Hz @ 100 Hz, ≤-167 dBc/Hz @ 1000 Hz, ≤-170 Noise floor
Jitter Performance	≈ 15 fs (1-100 Hz), measured at the output of the REF10 SE120
Weight	4350 g
Dimensions:	196 x 84 x 300 mm (W x H x D, without connectors and case feet)
Price:	5,500 Euro (REF10: 3,600 Euro)

MANUFACTURER

MUTEC

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