

The Ultimate DIY Sound System Is at Hand

Based on my latest listening tests, I believe that the ultimate DIY sound system is indeed at hand.

The system consists of the following elements:

1. The music source in the form of a laptop PC and a low jitter USB to S/PDIF converter.
2. The DSP unit
3. The amplifiers
4. The loudspeaker(s)

In my system I have chosen the following:

Music Source

I am using an Apple Air 11inch laptop with the Mutec MC 1.2+ USB to S/PDIF converter.

I am playing CD's directly rather than converting them to mp3 or storing them.

DSP unit

I have chosen the Hypex DLCP. I have built my own input and output boards and put everything into a 19inch 1U rack unit.

Amplifiers

I have chosen Hypex amplifiers (two NC400 mono kits) and used their UcD180OEM and UcD400OEM amplifier modules with their SMPS400A180 and SMPS1200A400 power supply units. I created two stereo amplifiers using Ghent Audio cases.

Loudspeakers

My system is a 3-way system, perfect for the DLCP.

For subwoofer I am using my commercial subwoofer from Martin Logan Dynamo 700W with built-in amplifier.

The mid-range is the Wavecor WF223BD02 chassis without any baffle, suspended using three leaf springs.

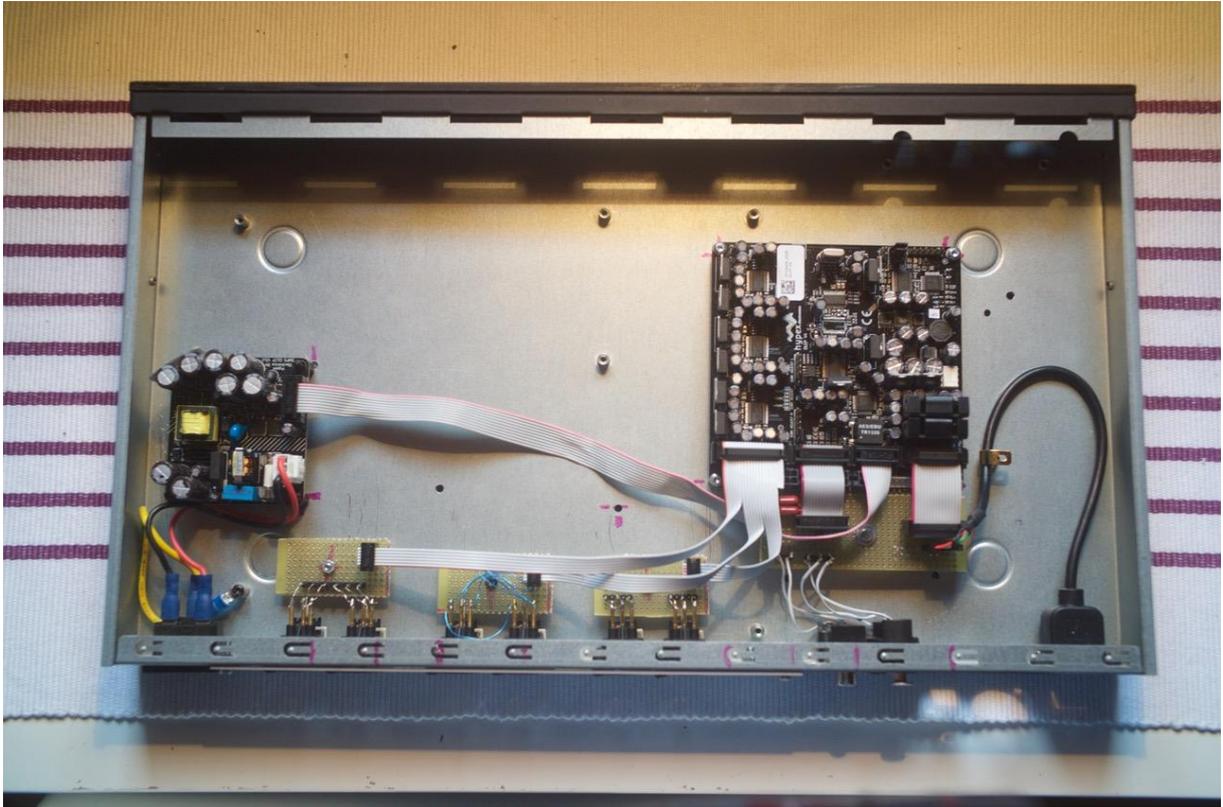
The tweeter is the Wavecor TW030A12 mounted on a small baffle.

The only further improvement could be the use of the Afi-USB interface and reclocking unit. Presently I do not see the need for a €1200 additional expenditure.

Alternatives:

If one does not want to do as much construction work as I did, the best alternate in my mind is the purchase of the PowerBox 4400 pro from magixLX521 (Dr. Brenner)

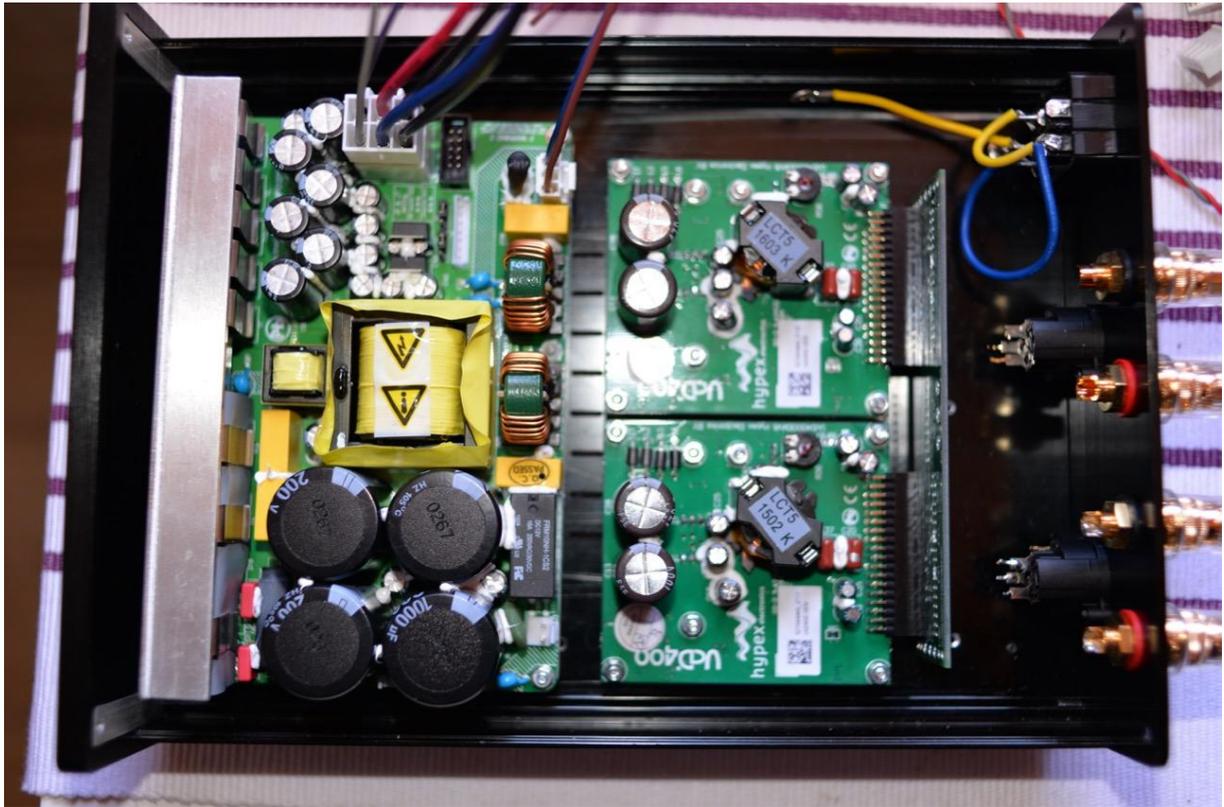
Picture Gallery



The DLCP inside



The DLCP back panel



The Ucd400 stereo amp



The Ucd180 stereo amp



The overall system

The music system is on the computer table on the right behind the pedestal.

The left main speaker sits on an antique piece of furniture, giving a very solid base. The right one sits on a pedestal.

The equipment rack has the Mutec on top.

Below that is the DLCP (full rack 1U).

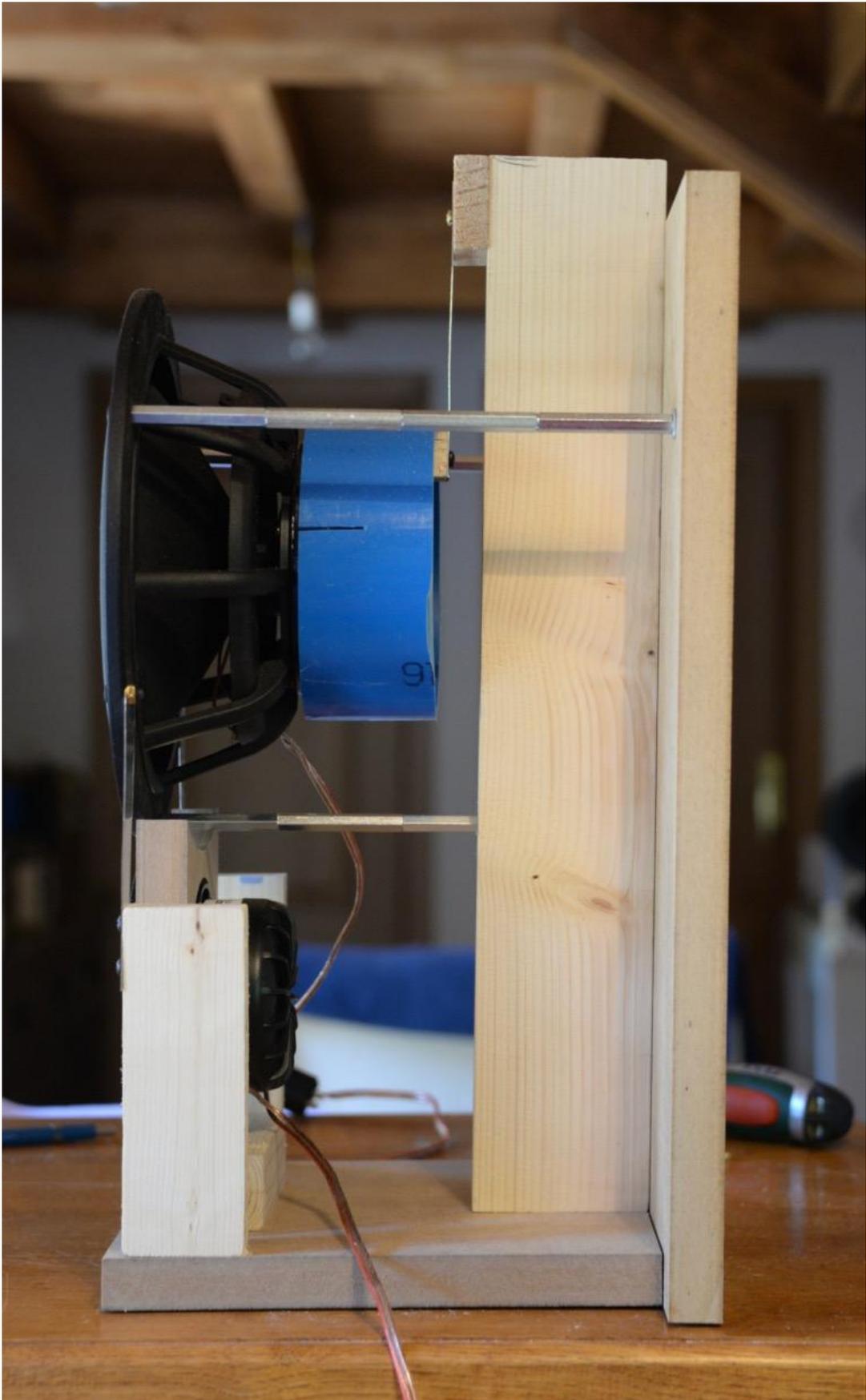
In the middle are the two NC400 mono kits.

On the bottom shelf on the left is the UcD400 stereo amp, and on the right is the UcD180 stereo amp.

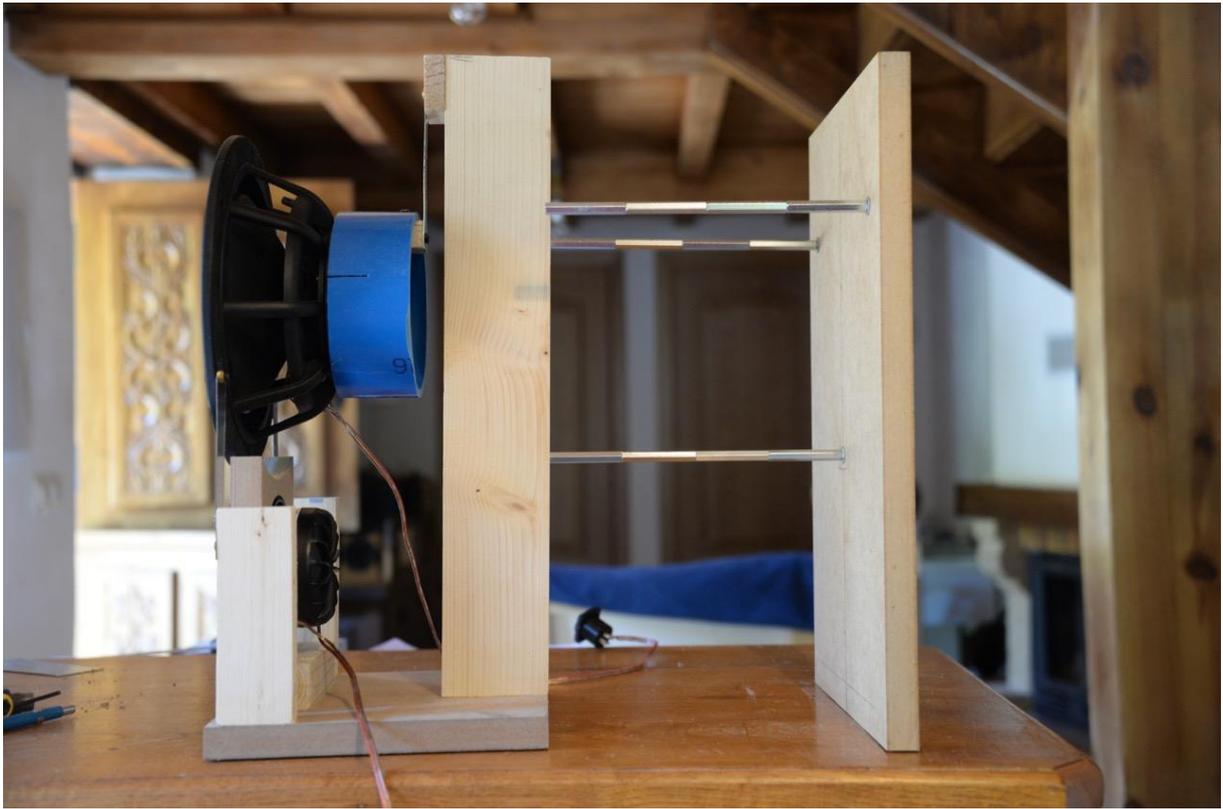
The single sub sits right in the middle against the rear wall. This is the best position for my system.



Main speaker with three leaf springs using
Wavecor WF223BD02 and TW030A12



side view with back-plate still attached



side view with the back-plate pulled out

SO WHERE ARE WE NOW?

The biggest open question still remaining is the old debate of analog versus digital.

Obviously the use of digital offers many advantages, but it is also apparent that our ears are extremely sensitive, once you have restored your hearing from the damage done by mp3 music reproduced from devices like the iPod and the use of poor headphones.

Recent developments in DACs and clocks bring us very close to the ideal, but now still at a very high cost.

I.e. MSB in California has, what they call, a Femto 33 clock, with extremely low phase jitter, but costing \$20,000 or more.

MSB and also MOLA-MOLA have DACs with distortions and noise down to the theoretical limit.

Apparently there are two components (or vectors) in order to create an almost perfect sound reproduction:

1. Distortion from the music source to the loudspeaker, including the loudspeaker itself.
2. Phase jitter in the whole signal chain

Discussions about cables, etc. do have some justification, but do not always justify the very high cost of top of the line systems.

But it is important to pay attention to every single element of the overall sound system.

The use of DSP also poses some challenges:

On the one hand they offer the opportunity to improve frequency and transient response of the speaker drivers, even correction for room acoustics using both IIR and FIR digital filters. Obviously they are also needed for the crossovers in an active system.

But if they are not properly implemented, the use of IC DACs (needing 6 to 8 channels) can limit the achievable distortion level, and the use of clocks with poor phase-jitter make the use of re-clocking an exercise in futility.

The use of very high performance DACs would raise the cost to almost astronomical levels.

In summary:

My preferred system:

1. Open baffle dipole 3-way system with 6 channels of Class-D amplification
2. High quality DSP (digital input, 6 balanced outputs)
3. Single or dual standalone subwoofer
4. Computer as music source with low phase jitter USB to digital conversion

My preferred choice for the amplifiers and the DLCP is Hypex, a company based in the Netherlands.



Who are Hypex? Hypex Electronics is a specialist supplier of power amplifier subassemblies for the audio industry. The company is best known for its 'UcD®' range of high-performance class D amplifier modules and is the leading force behind the acceptance of class D as a true high fidelity technology. What we do: Power conversion, Linear and non-linear control theory, Pulse Width/Density Modulation techniques, Transistor-level analogue circuit design. The company's two-tier research program focuses primarily on achieving new theoretical understandings in these subjects to shape the long-term future of audio amplification and secondly on novel, practical improvements of existing circuit concepts. Product development is split between general-purpose power amplifier/supply modules and turnkey projects for selected customers. Areas where we can offer added value to customers include design for manufacture, AD/DA conversion, active loudspeaker design and DSP algorithms for loudspeaker and system control. Who we do it for: Hypex UcD® modules are used in a variety of performance-critical applications including: Active loudspeakers for production and mastering studios, Multichannel amplifiers for home theatre systems, Power amplifiers for the audiophile market, Live sound Electronic musical instruments.

Company history: Hypex was founded in 1996 by Jan-Peter van Amerongen as a supplier of plate amplifiers for live sound loudspeakers.

The products drew the attention of hi-fi speaker manufacturers, resulting first in a line of active subwoofer amplifier subassemblies, shortly followed by multichannel units with active cross-over filters for the studio market. 2003 saw the start of a complete migration to class D. For this purpose the newly invented 'Universal Class D' technology was selected. Realizing the market potential, Hypex decided not only to use UcD® in end-user products, but also to offer it to the market as general-purpose amplifier modules. The UcD180/400/700 modules have quickly established themselves as the new standard, both in terms of measured and subjective performance. In 2005, Hypex took the strategic decision to move from being a technology user to being a technology source and hired UcD's inventor, Bruno Putzeys, to be its chief of R&D. Hypex now serves many big name audiophile brands which previously couldn't find class D amplifiers meeting their stringent sound quality requirements. Standard products now span the range from 20W to 3kW and a line of switch-mode power supplies to match, along with dedicated 100V systems and DSP platforms for active loudspeaker control have been introduced.

The choice for the loudspeaker chassis is Wavecor.

If you are not familiar with Wavecor, it has its roots in high-end Danish engineering, thanks to Allan Isaksen, its general manager and chairman, and Per Madsen, director of technology. Allan started his career at Vifa A/S, Denmark in early 1983 as a newly graduated acoustics engineer. After designing several Vifa drivers, he was appointed as engineering manager at Vifa in 1987. In 1990, Vifa appointed Allan as its director of sales and engineering with responsibility for all marketing, sales, and engineering activities.

In 1999, Allan relocated from Denmark to the

GuangDong province of China, where he established the Chinese production base for Vifa/Scan Speak, Vifa Loudspeakers (PanYu). After Vifa and Peerless merged into Danish Sound Technology (DST), the China production company was renamed DST Loudspeakers (PanYu), which Allan led as general manager until he founded Wavecor in 2005. Per Madsen also started his career at Vifa A/S Denmark in 1988 as a technical trainee. After graduation in 1991, he was employed as R&D engineer at Vifa A/S, where his area of responsibility was mechanical driver parts. Later, he continued working on driver acoustics and designed some of the more popular drivers at Vifa/ScanSpeak A/S over the years. In 2002, Per transferred to the DST Loudspeakers (PanYu) production facility in China for an engineering manager position. After DST was taken over by Tymphany (USA) Per continued working there as Engineering Services group manager until he decided to join Wavecor as director of technology in 2006.

Operating out of Panyu, China, Wavecor has become an important speaker driver manufacturer that redefines value and innovative engineering in speaker transducer design.

Their design philosophy is focus on excellence in sound quality, both objective (measurements) as well as subjective (listening tests). With features such as copper clad aluminum voice coils, vented formers, linear suspensions, faraday rings, neodymium magnets, aluminum heat sinks etc., Wavecor drivers are very efficient, high thermal tolerance (power handling) with excellent frequency and transient responses.

The new Wavecor TW030WA12, is a 30-mm cloth

waveguide loaded tweeter intended for home audio applications. The TW030WA12 is the 8-Ω version and the latest addition to Wavecor's 30-mm tweeter lineup.

Wavecor's corporate background information is basically the interesting synergy between a China speaker manufacturer and two experienced Danish engineers, both formerly with Vifa. Features for the Wavecor TW030WA12 tweeter include a 30-mm wide surround precision-coated cloth diaphragm optimized for high-frequency cut-off above 20 kHz, internal chambers below the dome and surround, a copper-clad aluminum voice coil winding with a vented voice coil former, flexible lead wires for large excursions with crossovers below 3 kHz, black anodized motor parts for enhanced cooling, and gold plated terminals. Its most differentiating feature is a waveguide faceplate for increased sensitivity and directivity.

The first ever Wavecor 8.75" mid/woofer is now available. It is launched in 4 Ohm as WF223BD01 and in 8 Ohm as WF223BD02. Wavecor's 8.75" transducers were designed as high performance bass/midrange units for monitors and high-end hi-fi speakers.

They offer deep bass performance and dynamic and detailed midrange. Ideal for three-way constructions, they additionally offer designers the rare opportunity of working with 8" two-way solutions if paired with a suitable tweeter like for instance some of the Wavecor 30 mm units. Key features include a balanced drive motor structure, copper cap on center pole, cone made of a paper/glass fiber mix, rigid die cast alu chassis with extensive venting plus a vented voice coil former and center pole with dual flares.

This driver uses a large motor with 1.5" voice coil and built-in alu field-stabilizing ring plus low-loss suspension. Loudspeaker wire terminals are gold plated to ensure a reliable electrical connection.

Wavecor Balanced Drive Technology

The Balanced Drive line of loudspeaker transducers is yet another example of Wavecor paying attention to every detail.

Instead of following the common way by designing loudspeaker drivers "as usual", Wavecor have spent significant research time further optimizing one of the most important parts of a loudspeaker transducer: The motor.

The motivation for the work is the continuous search for better sound and in this project the target is to reduce the harmonic distortion generated by non-symmetrical motor structures.

All members of the BD (Balanced Drive) product line offer the same improvements and symmetrical motor structure.

Wavecor on speaker design:

"Don't believe what you see!
. hearing is believing"

"At Wavecor we claim, just like any other speaker unit manufacturer would do, that our drivers have no or very little sound of their own. In other words that the electrical signal you feed into them is converted perfectly into an equivalent acoustical signal.

Of course, we all know that no speaker is perfect and that any speaker will change the input signal in some way before delivering it to the air as audible sound. In this respect speakers are not different from other kinds of audio equipment like amplifiers, CD players, cables, etc. Every piece of equipment will change the sound signal in some way – more or less, depending on how well the equipment was designed and made. However, some speakers come closer to perfection than others and some even come really close. Wonder what makes the differences? One argument we deal with in the speaker business is how to define and measure how good a speaker unit sounds. How do we judge if a speaker unit is good or less good?

Most manufacturers of speaker units use a purely “scientific approach” when developing their products. In other words, they let their measuring equipment tell them whether a speaker unit is good or bad. In today’s speaker driver industry, by far the most common way of telling how good a speaker unit is would be to measure the SPL frequency response (magnitude). The closer the frequency response comes to a straight horizontal line, the better the speaker unit is considered to be.

Besides measuring the SPL response, driver manufacturers may make impedance measurements and measure the harmonic distortion, and possibly perform a few other measurements. If all measurement results are good, the unit is deemed “good” and released for sales and production. It turns out that the most common measurements made on speakers are in the frequency domain – maybe because that’s the easiest measurements to make and interpret.

At Wavecor we believe it's a mistake to pay overly much attention to the frequency domain performance as our ears and our experience tell us that the time domain probably is the most important for how natural a speaker is perceived to sound.

It is a fact that most of the even highly recognized names in the international speaker unit industry develop their products as described above.

Based purely on measurements and none or very little efforts spent on trying to listen to their products and trying to optimize how they sound - using the human ear as the measuring instrument.

This is unfortunate because in reality, even with today's sophisticated measuring equipment, there still remains rather poor correlation between the measured data and how the sound is perceived by the human ear.

In other words: The measurements we have available are unable to tell everything about how a speaker sounds.

It does not mean that measurements are not important. They are very important! A speaker with a very uneven frequency response will never sound good.

A speaker with very high harmonic distortion will never sound good either. However, a speaker with flat frequency response and low distortion may or may not sound good. It will depend on other parameters as well, some of which we are not yet able to measure, except if using the human ear. Again, we have to look into the time domain for differences causing the speaker to sound as it does.

Wavecor is one of the very few speaker unit manufacturers in the world that gives the highest priority to how our drivers sound. We do make all the known scientific measurements and pay great attention to the results. We optimize each and every parameter. However, at the end, our ears will make the final decisions.

If we have to choose between two design directions, where one for instance linearizes the frequency response, and the other improves the sound judged by our ears, we will always pick the choice that makes the better sound. Here we are.

With Wavecor is one of very few manufacturers of speaker units that actually spends a lot of time listening to our drivers and optimizing the sound.

The results we obtain are significant. Compared to drivers developed in the "normal, purely scientific" way, Wavecor drivers offer a higher level in natural sounding. And natural sounding is really what it is all about. Wavecor advantages are mainly audible in the time domain rather than frequency domain.

Try to listen for yourself – you will understand what we mean! Wavecor drivers are built for High Resolution Playback, which means that Fine Details and Textures are reproduced without loss and that Dynamics are preserved without compression.

The resulting characteristics are precise presentation of Space and Acoustics Of Recording Venue, unheard Transparency, and sharp and precise Focus.

You will not discover all of the main qualities of Wavecor drivers by measuring only but you most certainly will when you start listening."

The preferred main speaker version uses three leaf springs for better front to back motion. The mid-range unit is the Wavecor WF223BD02 loudspeaker chassis.

The system is stable when in the vertical position.

But it is not entirely stable when handling it or worse turning it over. Then the leaf springs can be damaged.

From my days in developing high-speed centrifuges with a flexible shaft, a damper is always needed to hold the shaft rigid until the first resonance has been passed.

A back-plate will be attached to the back of the unit. It has three spacers, which during construction and handling will hold the mid-range driver solidly to the back-plate. This way the leaf springs will never be bent out of shape.

Once the main speaker has been placed in position on a pedestal, the back-plate will then be detached (removing five screws) and will be put aside.

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