CAR & HiFi

INTERNATIONAL

2/22 · 4,80 €

European Edition

Featured brands

- Audio System • Brax • ESX
- Ground Zero • Helix • Kenwood
- Match • Nextbase • Phoenix Gold

Best topics

- 2DIN moniceiver with wireless smartphone connectivity
- 12 channel DSP amplifier • BMW speaker set
- High end speakers triple feature • Compact powered subwoofer

Car Audio going strong

Car Audio is doing quite well, that's for sure. The best proof was the car audio show CarMediaWorld, which took place in Salzburg, Austria, at the end of April. The industry showed up in large numbers and the mood was excellent, if not euphoric. Many new and very interesting products were presented, and despite the adverse circumstances, we were pleased to see numerous international trade visitors. This strengthens my hope that 2022 will be a very good car audio year. You can already look forward to many innovations that will come in the course of the year.

Elmar Michels
Editor-in-chief

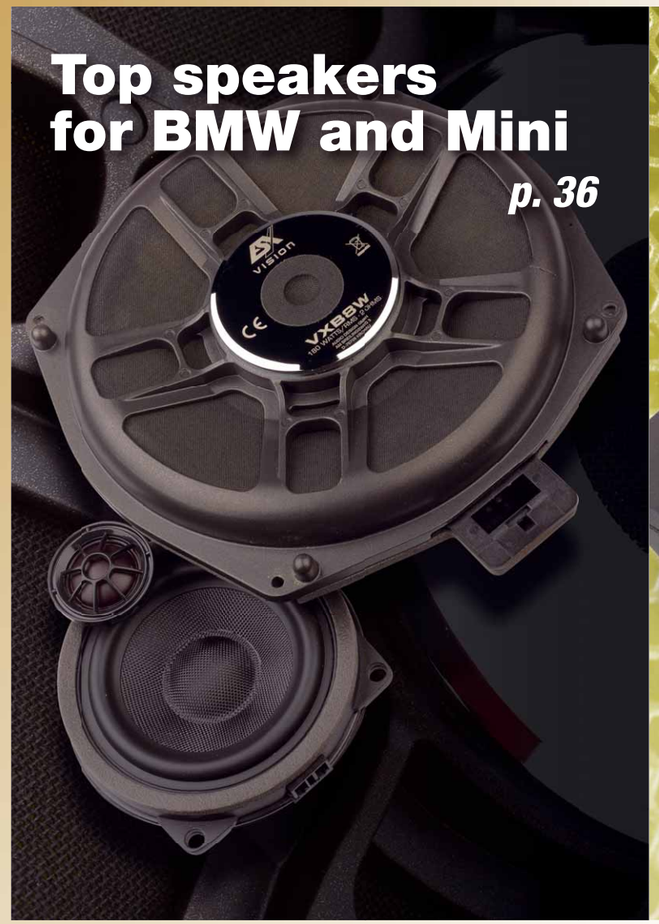
CAR&HiFi INTERNATIONAL

Free download

Visit www.carhifi-international.com
for our free archive containing this issue and all older ones.
All issues are also available on readly.com.

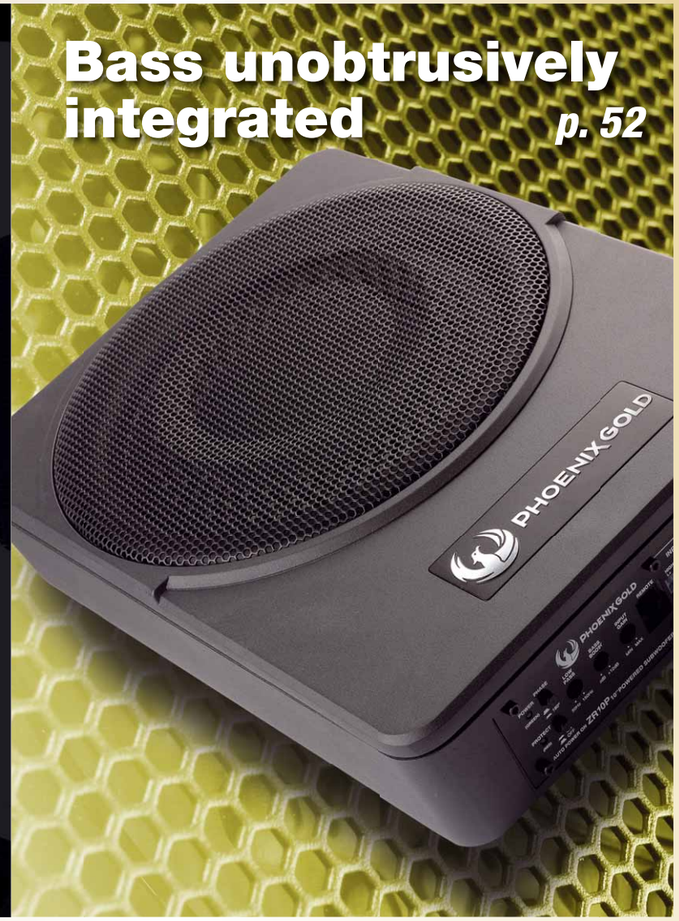
12-channel DSP amplifier with extreme power density

p. 14



Top speakers for BMW and Mini

p. 36

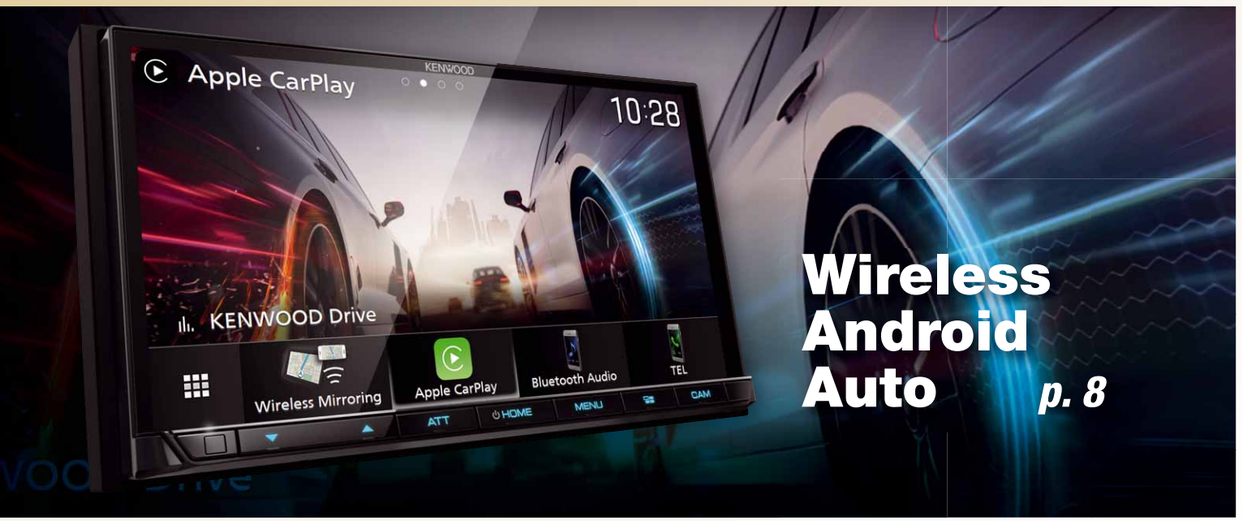


Bass unobtrusively integrated

p. 52

Superlative two-channel amplifier

p. 28



Wireless Android Auto

p. 8

Tests

Categories

DSP PRO MK3

When it first appeared, the Helix DSP PRO was the choice for demanding active systems. With the finest hardware and HighRes-capable frequency range, it set standards. Now Helix has given the PRO a thorough overhaul as the DSP PRO MK3, including a new coprocessor platform and two DSP cores. The finest AKM converters, 10 DSP channels and 8 high-level inputs up to 32 volts make the DSP PRO MK3 outstanding.

• ***www.audiotec-fischer.com***

Hifonics ZXT Zeus Extreme amplifier

Five times concentrated mono power: These new Hifonics amps have more than earned the „extreme“ in their product name! The ZXT Zeus Extreme series comes with five monoblocks that bring tremendous power to the car via Ultra-Class D-Power. Its heavy aluminum heat sink with die-cast aluminum frame contains proven, highly efficient Ultra Class D technology and a well thought-out interior. Integrated fans, clipping LEDs and solidly screwed RCA sockets offer the functionality that sound pressure fans in particular want to rely on when they devote themselves to their high-sounding hobby. In terms of dimensions and output, the five mono power plants offer the right model for every system concept.

• ***www.audiodesign.de/english/***

Mercedes footwell woofer

The new 8" footwell woofers AX 08 MB UNI Evo from Audio System are suitable for W205/213, A238, C238/253 and X253 models. Installation is 100 % plug & play thanks to the integrated crossover and vehicle connector. The woofers work with paper membranes and have a neodymium drive. Thanks to the 2 ohm voice coils, the amplifier delivers optimal performance.

• ***www.en.audio-system.de***

Universal for all vehicles with 2-DIN radio

Kenwood DMX8021DABS with wireless smartphone connection

Wireless Android Auto

Kenwood's moniceiver DMX8021DABS is a new in-house development and comes with everything you could want in the digital age.

Source selection

Basic settings

Both Car Play and Android Auto work wirelessly

The predecessor, DMX8020DABS, was already shining with its exemplary, partly wireless smartphone connectivity and has since occupied the top position in its class in our best list (see CAR&HIFI 3/2021). Kenwood further optimized the communication in the DMX8021DABS. While the 8020 already supported Apple Car Play via Bluetooth and WiFi connection, only wireless mirroring was possible for Android phones. To use Android Auto, the connection via USB cable was necessary. This is different with the new 8021 – now, Android users can also enjoy the convenience of using the full range of Android Auto functions without the hassle of a cable connection. Setting up the WiFi connection between the radio and smartphone is extremely simple. The two only have to be introduced once via Bluetooth. The WiFi connection is established automatically, and Android Auto is ready for use on the Kenwood's touchscreen. Navigation apps like Google Maps, Waze, or others can be used just as safely as telephony, messenger, streaming services, and much more via the capacitive 7-inch touchscreen. The same applies to iPhone users with Apple Car Play.

USB-C

Like its predecessor, the DMX-8021DABS does without a mechanical drive. This allows the housing to be ultra-short with an installation depth of just 8.5 cm, leaving enough space in each double DIN slot for the rear wiring, as the Kenwood offers a variety of connection options. The USB-C jack deserves special mention. USB-C offers several advantages over the large USB-A ports. The plug is symmetrical, so it doesn't matter which way you plug it in. The data rate is high, and the charging current is up to three amps, so cell phones are quickly full again when the battery is low. To be able to connect USB-A devices such as flash drives, a corresponding adapter is included in the box.
Another highlight is the possibility of connecting up to four (!) cameras to the Kenwood. In addition to three conventional camera inputs, Kenwood's Dashcam Link is available for displaying and controlling the DRV-N520 drive recorder. Video output is also available, as are six powerful preamplifier outputs, an analog AV-in for minijacks, and an HDMI input.

DSP

The DMX8021DABS has a lot to offer to sound enthusiasts. It supports Hi-Res FLAC and WAV files with a resolution of up to 192 kHz/24 bit. The integrated digital signal processor also enables extensive audio settings. The highlight of the equipment is the digital delay correction. Here, you can adjust the distance to the speakers to the centimeter on five channels. The Kenwood then automatically calculates the resulting time delay in milliseconds. The operation of the thirteen-band equalizer is also well solved. You can set each band individually or paint the desired target curve with your finger. You can set the crossovers with selectable frequency and slope and switch various sound effects in several stages.

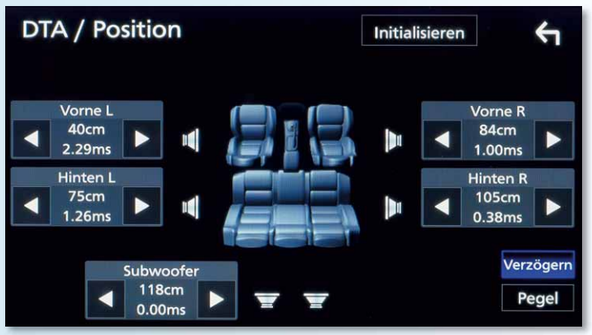
Digital radio

Kenwood also relies on DAB+ digital radio for the new DMX8021DABS. „Seamless blending" ensures extra radio convenience. The Kenwood can switch seamlessly between FM and DAB+ when reception conditions change and the station being listened to is broadcast in both ways. Although the transmission is somewhat delayed, the DMX8021DABS switches almost inaudibly without interruption or volume change. This is made possible by a digital buffer.
If DAB+ and FM tuners already work excellently with good reception, their perfect interaction ensures Kenwood radios are among the best recommendations for ambitious radio listeners.

Home screen with ...

... configurable widgets

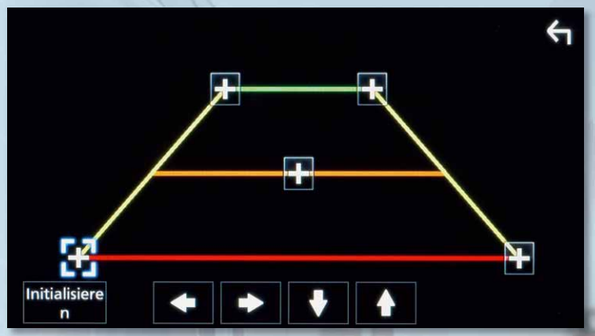
Audio menu



Centimeter-exact runtime correction

Levels can be controlled separately

High- and low-pass filter



Adjustable parking aid lines

Whether Android or iPhone – the Kenwood understands both very well

Operation

The touchscreen of the DMX-8021DABS responds promptly to every finger tap. This also applies to the use of Android Auto and Car Play. There are no noticeable „thinking seconds“ for data transfer between the devices here. This and the seven buttons on the lower edge of the device make operation intuitive and fluid. The large display's readability is excellent, and you can adjust the viewing angle in four steps. All menus are clear and well arranged. The graphics in the audio settings are particularly pleasing. Whether equalizer, crossovers, or runtime – you can see what you are doing and what effects the respective settings will have.

Graphic equalizer

Supreme adds harmonics to highly compressed music

In addition, the car radio can also be remote-controlled via a smartphone. All you need is the Kenwood Remote Control S app, available free of charge for Android and Apple iOS. The Kenwood Portal app can also wirelessly transfer your pictures from the smartphone to the DMX8021DABS as a wallpaper or slideshow.

Conclusion

The Kenwood DMX8021DABS makes wireless contact with both iPhone and Android phones thanks to Bluetooth and WiFi. Thus, Car Play or Android Auto are available on the car stereo right after getting into the car, even if the phone remains in the pocket.

With this, numerous other functions, and sophisticated usability, the DMX8021DABS follows in the big footsteps of its predecessor and marks the top in its class.

Dipl.-Phys. Guido Randerath

Who is JVCKENWOOD?

JVCKENWOOD Corporation was formed in 2008 from the merger of Victor Company of Japan Limited, known under the brand name JVC, and Kenwood Corporation. Originally Japanese, the brands JVC and Kenwood are well known all around the globe, offering much more than car audio. Besides numerous audio products JVC's and Kenwood's portfolio covers video (including dashcams), communication, non consumer electronics products but also professional video solutions and health care.

Specifications

Amplifier power (W)	15
Output voltage (V)	4,5
Output impedance (ohm)	675
USB	
THD+N (%)	0,01
SNR (A)	92
Tuner	
THD+N (%)	0,05
SNR (A)	62
Crosstalk (dB)	53
Monitor size (in)	7.0
Touchscreen	•
Dual Zone	–
Dolby Digital / Pro Logic decoder	–
param./graph. EQ bands	– / 13
Crossovers	HP / LP
Time alignment	•
Pre-outs	6
AV-in / AV-out	• / •
Digital out	–
Camera-in/nav-in	4 / –
USB front/rear	– / •
iPod control	•
Bluetooth HFP/A2DP	• / •
Misc.	CarPlay, Android Auto

Kenwood DMX8021DABS vehicle compatibility

In cars with double DIN slot. For many other models, installation and connection adapters are available as accessories.

Kenwood DMX8021DABS

Price	600 – 700 Euro
Contact	JVCKENWOOD Europe, The Netherlands
Internet	www.kenwood.eu

Rating

Sound	20 %	★★★★½
Bass	4 %	★★★★☆
Neutrality	4 %	★★★★★
Transparency	4 %	★★★★★
Spatiality	4 %	★★★★☆
Dynamics	4 %	★★★★★
Image	20 %	★★★★★
Sharpness	3,3 %	★★★★★
Brightness	3,3 %	★★★★★
Contrast	3,3 %	★★★★★
Color reproduction	3,3 %	★★★★★
Viewing angle	3,3 %	★★★★★
Reflection	3,3 %	★★★★★
Lab	15 %	★★★★★
• USB	7,5 %	★★★★★
Distortion	3,75 %	★★★★★
Signal to noise ratio	3,75 %	★★★★★
• Tuner	7,5 %	★★★★★
Frequency response	1,88 %	★★★★★
Crosstalk	1,88 %	★★★★★
Distortion	1,88 %	★★★★★
Signal to noise ratio	1,88 %	★★★★★
Practice	45 %	★★★★★
Handling	10 %	★★★★★
Features	20 %	★★★★★
Reception test	10 %	★★★★★
Processing	5 %	★★★★★

Top Class

★★★★★

CAR&HiFI INTERNATIONAL Germany 2/22

Price/performance: very good

„The best moniceiver in its class.“

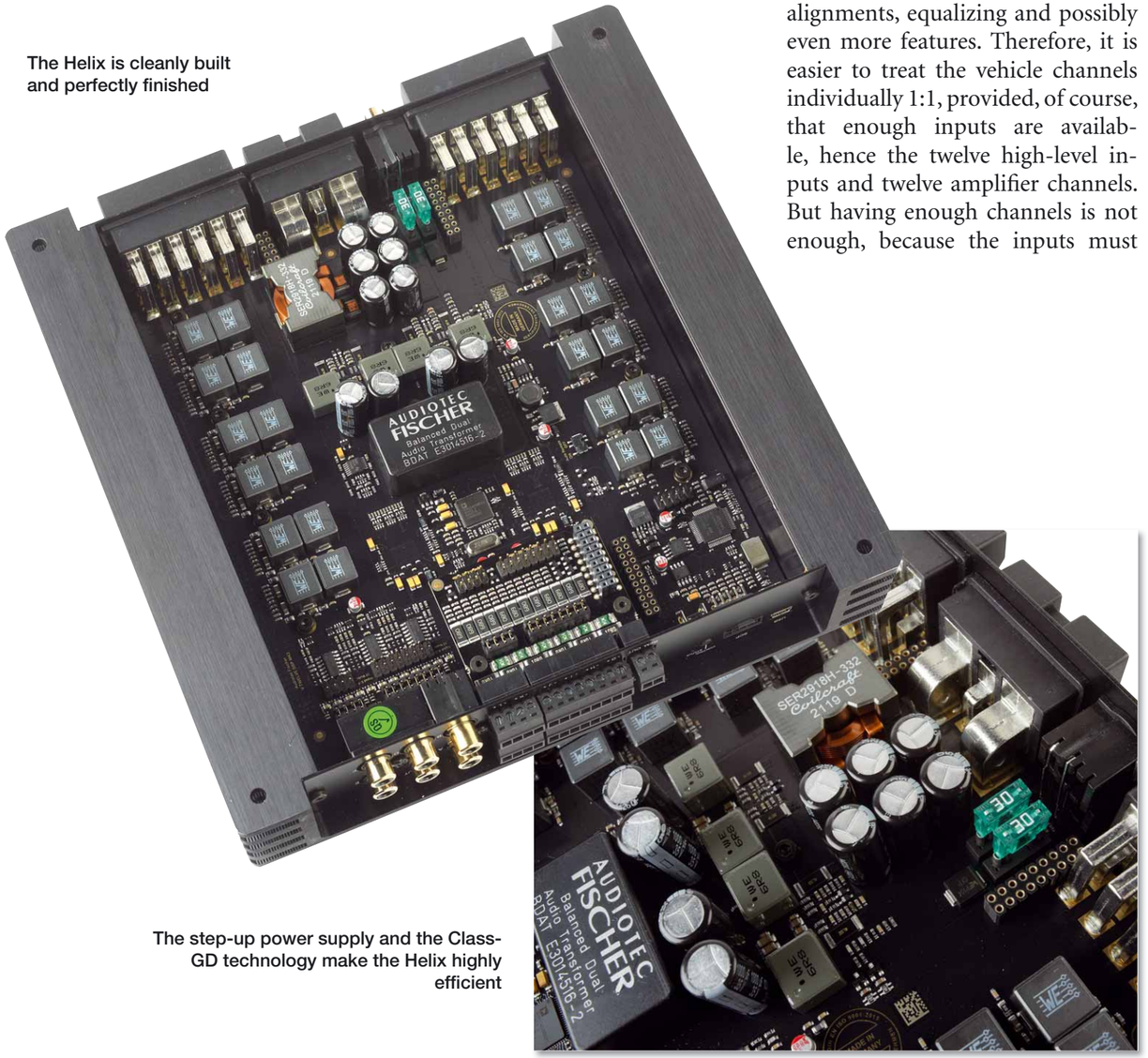
Helix V Twelve DSP MK2 - 12-channel power amplifier with 14-channel DSP

12-channel DSP amplifier with extreme power density

When it comes to retrofitting large factory equipment, you need the right features in addition to many channels.
The brand-new Helix V Twelve DSP MK2 sets out to show how it is done.

With the V Twelve DSP, Helix has taken the concept of the multi-channel power amplifier to the extreme. With two additional processed outputs, it can provide no less than 14 DSP channels to drive any car audio system. The new V Twelve MK2 does the same; channels and power have remained untouched. The MK2 is rather a gentle upgrade with small innovations like the SCP control connection for remote controls and accessories, which Helix has upgraded to a universally usable interface, with future applications in mind. The basic idea of a twelve-channel power amplifier lay in upgrading the sound of the largest factory equipment, because eight channels are not enough for the fully active top sound packages. Even if you could get by with fewer channels at the back of the retrofitted hi-fi system, it gets tricky on the input side if you cannot take all the channels provided by the vehicle. Sure, you can theoretically add up the vehicle channels to generate a complete stereo signal for the retrofitting system, but with twelve channels, that is anything but trivial. The premium sound packages actively control the speakers and already include filtered frequency ranges, time alignments, equalizing and possibly even more features. Therefore, it is easier to treat the vehicle channels individually 1:1, provided, of course, that enough inputs are available, hence the twelve high-level inputs and twelve amplifier channels. But having enough channels is not enough, because the inputs must also be able to handle the signal from the factory amplifier. First, in the Helix, the ADEP.3 circuitry takes care of bypassing any speaker diagnostic circuits that may be present, thus preventing any error messages or the original system from shutting down right away. The more powerful the factory amplifier is, the higher the voltage it generates at its outputs; the inputs of the V Twelve DSP MK2 must be able to handle this voltage without overdriving. We can expect a maximum of 12 volts from a car radio; a small amplifier with 100 watts at 4 ohms generates a maximum of 20 volts. With a 200-watt amp we end up with about 28 volts, which the inputs must be able to handle. The inputs of the V Twelve DSP MK2 can be adjusted by jumpers in two ranges; one is up to 4 volts at the RCA input and 16 volts high-level, the high setting allows 8 or 32 volts. With 32 volts, the V Twelve DSP MK2 is way ahead of the market; whoever wants to retrofit a really big sound equipment will hardly be able to get around it. The diagnostic and adjustment features of the V Twelve DSP MK2 are also unique. On the hardware side, there is an ACO platform with the powerful 32-bit processor; on the software side, the DSP PC-Tool provides the best options worldwide. The ISA input measurement function allows the overview of what comes in at the twelve channels. Basically, which type of signal is present and where it can be measured and corrected, if necessary, without the need for expensive measuring equipment. The channel sensitivities are set in the advanced gain set-up either individually or in groups, depending on the mentioned jumper position the appropriate setting values result. Thus, a weaker input signal (e.g., for tweeters) can be assigned a higher sensitivity than a stronger signal. This helps to make the best use of the dynamics and the calculation depth of the DSP. As a bonus, there is a leveling meter that includes a clipping warning. When it comes to vehicle integration, the V Twelve DSP MK2 also offers a number of unique features. Extensively configurable prioritization of inputs by high-level, digital, and HEC/Aux allow automatic source switching while preserving vehicle tones. Delayed on/off switching, momentary muting when switching and the power saving function for some CAN bus vehicles; everything is available and individually adjustable. The rich accessories also speak for the V

The Helix is cleanly built and perfectly finished



The step-up power supply and the Class-GD technology make the Helix highly efficient

Helix V TWELVE DSP MK2

Dimensions
(L x W x H in mm) 220 x 220 x 44

Inputs
- 6-channel RCA
- 12-channel High-level
- 1 x digital S/PDIF (optical)
- Sensitivity 16 V (32 V via jumper)

Ausgänge
- 2-channel RCA (3 V)
- Remote-out

DSP-Software (V 4.80b)

Equalizer

Inputs:
- param., 5 bands per channel

Virtual channels:
- param., 30 bands per channel

Outputs:
- param., 30 bands per channel, +6 – -15 dB
- 20 – 20k Hz, 1-Hz increments, Q 0,5 – 15
- Shelf 25 – 10k Hz, Q 0,1 – 2
- Allpass filters 1st or 2nd order, f and Q adjustable

Crossovers

Outputs:
- 20 – 20k Hz, 1-Hz increments
- Bessel, Butterworth, Chebychev, Linkwitz, User, 6-42 dB/Okt.

Time and level
- Samplerate 48 kHz, 7 mm increments (0,02 ms)

Inputs:
- 0 – 5,20 ms, 256 samples

Virtual channels:
- 0 – 354 cm (10,40 ms), 512 samples

Outputs:
- 0 – 708 cm (20,81ms), 1024 samples
- Phase 0, 180° (fullrange), 0 – 360° (22,5° increments)
- Adjustable level increments 0,1– 1 dB

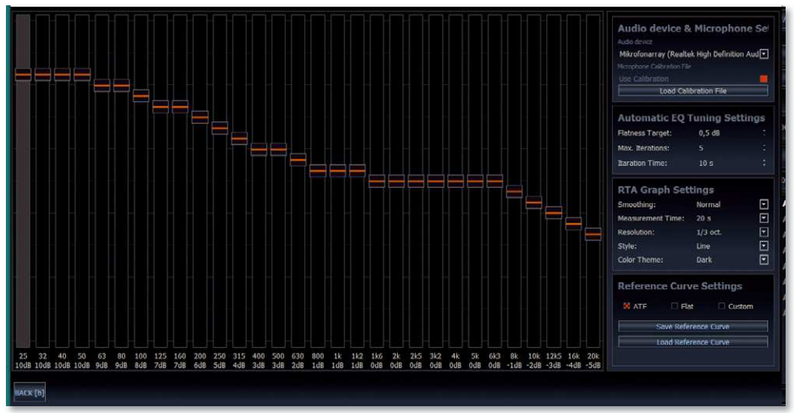
Features
- 10 Setups with fast switchover
- User-defined routing of in- and output ports
- Control connector for programmable remote controls and accessories
- Start-stop capability up to 6V
- Signal-dependent switching to digital or Aux inputs
- Automatic putting through of all vehicle tones
- Power-Save-Mode
- ADEP.3 error protection circuit for factory radios with speaker recognition
- RTA real-time frequency curve measurement (with optional microphone)
- FX menu with dynamic bass, center and front processing
- ISA for measuring, summing and correcting inputs
- Time Machine for taking back and restoring adjustments
- Device Monitor (temperature and voltage control)
- ATM automatic time alignment with custom signal
- Automatic input gain adjustment with custom signal
- Import of setups and data from other devices
- VCP (optionally activated), virtual channels, routable, with EQ, time alignment and FX processing

Optional accessories
- Wired remote control (programmable)
- Display remote control director with memory, USB, etc.
- WIFI Control for wireless programming
- Measurement microphone MTK1
- HEC Extension Cards

Twelve MK2; the selection of three remote controls from the simple-level remote control with source selection over the innovative one-button-for-all solution conductor up to the display unit director with its own microprocessor makes it a no brainer. The slot for HEC expansion cards allows upgrading with a whole range of modules for wired or wireless hi-res music streaming, wireless DSP programming, additional inputs and outputs, and so on. And last but not least, a measurement microphone comes with the set that allows acoustic frequency response measurement with the already integrated RTA, just like the ISA but without an additional measurement system.

Just like the software, which is completely programmed in house, the hardware is also a complete in-house development, which incidentally is also "Made in Germany", meaning that development and production take place in the house of the parent company, Audiotec Fischer, located in Schmallenberg. A look inside the V Twelve DSP MK2 reveals that a lot of engineering work has gone into it. An innovative step-up mains adapter ensures maximum efficiency in the provision of the internal operating voltage, the self-developed and unique Class-GD control dynamically adjusts this voltage at low and medium powers, which again allows for an increase in efficiency. Therefore, the V Twelve DSP MK2 builds extremely small for its twelve amplifier channels. The visual impression, the feel quality and the general level of processing are simply outstanding.

In the ISA (input stage analyzer), the inputs can be measured and directly corrected by time and equalizer



The configuration options of the RTA acoustic frequency response measurement have become even more extensive, making microphone calibration now even easier

DSP features

The DSP functions are, of course, controlled via the in-house DSP PC-Tool, which is the most comprehensive and powerful tool on the market. Besides 30 EQs per channel, time alignment of both inputs and outputs and of course freely programmable crossovers, there is the VCP (virtual channel processing) with the possibility to process channel groups as virtual channels between inputs and output channels. For example, a three-way front system with six output channels for right and left sides can be managed by the virtual channels front left and right. The time alignment of the individual loudspeakers, the crossings of tweeter, midrange and woofer are carried out at the output channels, here also peculiarities of the installation situations are corrected. The sound-decisive equalizing, however, can be conveniently performed in the virtual front channels, for the entire front system and across all crossover frequencies. The virtual channel can also be used to "shift" the entire three-way side via time alignment or to level it via the gain control. The FX sound effects now also affect the virtual center and rear

In the advanced gain set-up, the sensitivity of the inputs can be adjusted separately; the maximum possible is automatically detected and the current input level is displayed along with a clipping warning

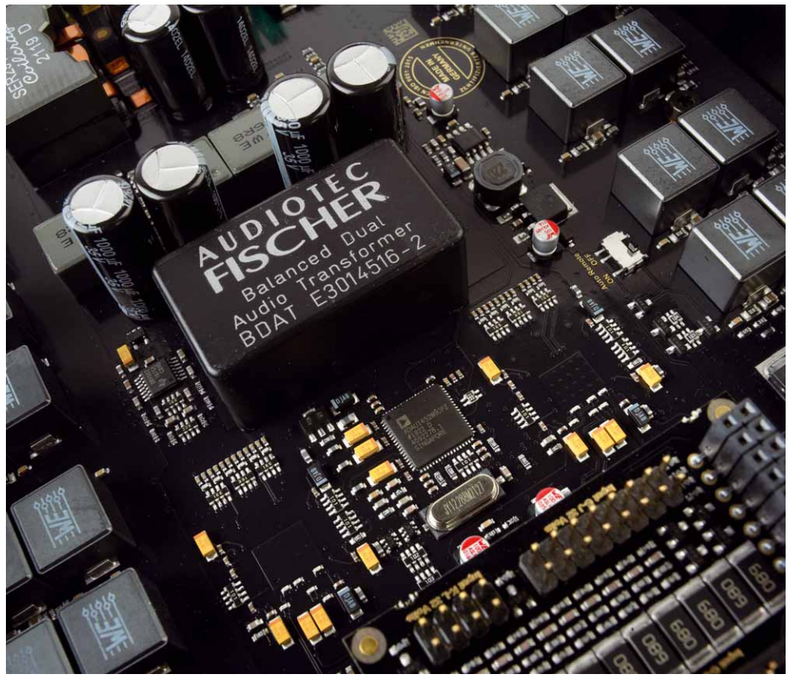
As an alternative to the normal routing of the 12 channels, virtual channel processing can be used to combine channel groups and equalize them across the crossover frequencies

channels, which means that two-way centers can also be perfectly controlled.

Under the FX section (effects), algorithms for optimizing the center and bass can be activated. The real center is a blessing by itself; a center channel signal is calculated by specially programmed audio processing. Thus, the real center is not a stopgap solution like a mono sum or a reversed sum of left and right. For center there is the clarity expander, which affects the midrange reproduction, e.g., for voices. Bass processing includes the SubXpander, which adds low tones to music by creating subharmonics to existing frequencies. In addition, there is a dynamic bass boost, which boosts the bass depending on the playback volume. This helps quite nicely with factory systems that have limited loadable woofers and subwoofers, for example. There are adjustment controls for all FX functions, with which you can specifically influence the extent and function.

The twelve output channels just fit next to each other. Bandpass crossovers, 31 EQ bands, phase and time and channel level are each available per channel

Furthermore, the latest measurement functions of the PC-Tool are supported. The well-known RTA (real-time frequency response measurement with optional microphone) has been improved with some new features; there are now even more setting possibilities concerning the measurement, e.g., a microphone calibration. If desired, the RTA can automatically adjust

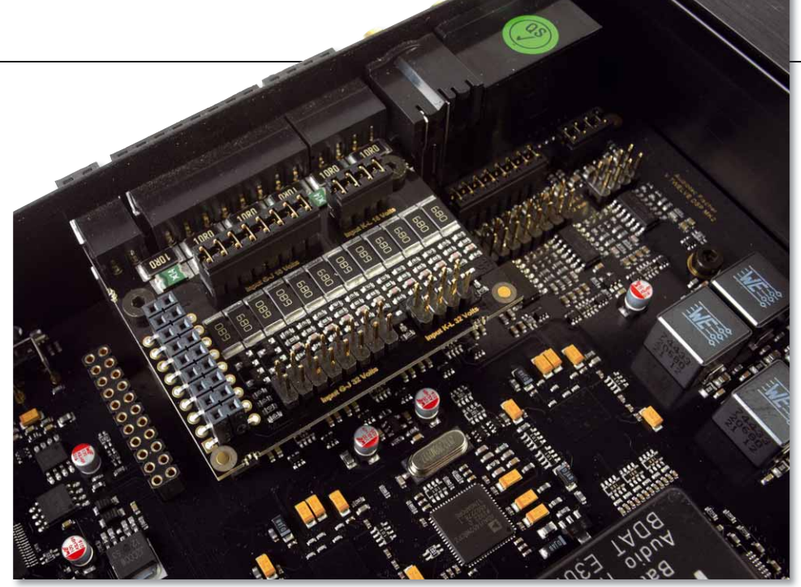


The storage coils are located in the angular housing while the DSP chip ADAU1452 sits underneath

the EQs, tolerance thresholds and the number of adjustment attempts can be set here. This ensures that a usable result is always obtained even when using relatively inaccurate microphones. The ISA can also be used to measure sums of several inputs, thus tracking down hidden all-pass filters that remain inconspicuous in individual measurements. This electrical measurement of the inputs saves the installer a lot of time in troubleshooting and tuning of the DSP, because at the same time as the measurement, the input EQs (and the input time) can be set with immediate success control. Furthermore, there is the ATM (automatic time measurement), which allows a fully automatic runtime measurement and adjustment of the entire system. The advantage here is that the measurement signal is played back as a sound file like a piece of music via the head unit; this is possible in all type of vehicles. The measurement is then carried out using the company's own in-house programmed measurement signals and a great deal of audio processing. The time of all the loudspeakers in the system is compared with a reference loudspeaker and then calculated.

Measurements and sound

The lab performance of the V Twelve DSP MK2 can be summed up in one word: outstanding. It scores top marks in every discipline and delivers squeaky-clean results. The distortion values are fantastically low at both 4 and 2 ohms, and in return there is plenty of power with 76 watts at 4 ohms and almost 130 watts at 2 ohms. So you can get over the fact that the V Twelve DSP MK2 is not bridgeable, especially since there are enough speakers and subwoofers with suitable coil configurations on the market. Incidentally, the extremely successful tuning of the operating frequencies and filtering is also noticeable, so that the Helix, in contrast to many other digital amplifiers, emits little high frequency, as a glance at the oscilloscope confirms. The sound is also convincing all along. A clear and audible sound leaves no doubt about the truthfulness of the performance. Precise and dry bass drums deliver punch and fun. The reproduction of female as well as male voices convinces even critical listeners; the musical actors have enough air to breathe and unfold freely in the listening room. One can just as easily concentrate on the finest details as simply let oneself be carried along by the music, the V Twelve DSP MK2 always sounds balanced and capable of reaching long distances, which speaks for a performance at the highest level.



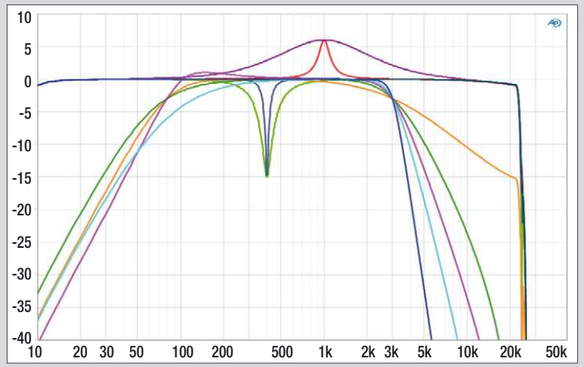
A total of 4 jumpers allows sensitivity adjustment of the 12 inputs

Conclusion

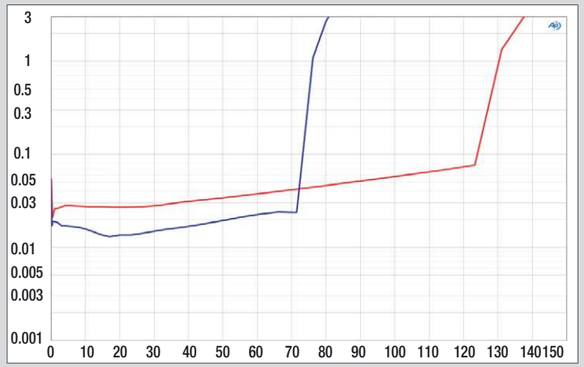
The Helix V Twelve DSP MK2 is a unique tool for retrofitting premium vehicles. Especially for the largest and most powerful factory trims, people are grateful for the twelve channels and top-notch integration capabilities. The powerful DSP functions and excellent engineering leave no wishes unfulfilled in terms of sound. In this combination, there is no other option than the V Twelve DSP MK2.

Elmar Michels

CAR&HIFI Laboratory



Frequency range up to 22 kHz, cleanly programmed crossovers with different characteristics (high- pass 80 Hz) and different slopes (low- pass 3 kHz)



The 4-ohm power takes place under 0.025 %, which is very solid. The 2-ohm output also distorts very little and delivers a taut 130 W

Specifications

Channels	12
Power 4 ohms	12 x 77
Power 2 ohms	12 x 134
Power 1 ohms	–
Bridged Power 4 ohms	–
Bridged Power 2 ohms	–
Sensitivity max. mV	var.
Sensitivity min. V	var.
THD+N (<22 kHz) 5 W	0,015
THD+N (<22 kHz) Half Power	0,025
Signal-to-noise ratio dB(A)	97
Damping factor 20 Hz	84
Damping factor 80 Hz	85
Damping factor 400 Hz	81
Damping factor 1 kHz	80
Damping factor 8 kHz	20
Damping factor 16 kHz	6

Features

Low pass	10 – 20 k Hz
High pass	10 – 20 k Hz
Band pass	10 – 20 k Hz
Bass boost	-15 – 6 dB/10 – 20 k Hz
Subsonic filter	via HP
Phase shift	via DSP
High-level inputs	•
Automatic switchon (Autosense)	• DC or signal
RCA output	•, 6 CH processed
Start/stop capable	• (< 6 V)
Dimensions (L x W x H in mm)	220 x 220 x 44
Others	14-channel DSP

Helix V TWELVE DSP MK2

Price	1500 Euro
Contact	Audiotec Fischer, Germany
Internet	www.audiotec-fischer.com

Rating

Sound	40 %	★★★★☆
Bass	8 %	★★★★★
Neutrality	8 %	★★★★★
Transparency	8 %	★★★★★
Spatial imaging	8 %	★★★★★
Dynamics	8 %	★★★★★
Lab	35 %	★★★★★
Power	20 %	★★★★★
Damping factor	5 %	—
Signal-to-noise ratio	5 %	★★★★★
Distortion	5 %	★★★★★
Practice	25 %	★★★★★
Features	15 %	★★★★★
Build quality electronics	5 %	★★★★★
Build quality mechanics	5 %	★★★★★

Absolute Top Class

★★★★★

CAR&HIFI INTERNATIONAL Germany 2/22

Price/performance: very good

"Perfectly tailored to upgrading multi-channel premium sound packages from the factory."

ESX QM-Four-PP
– Mini power amplifier with four channels

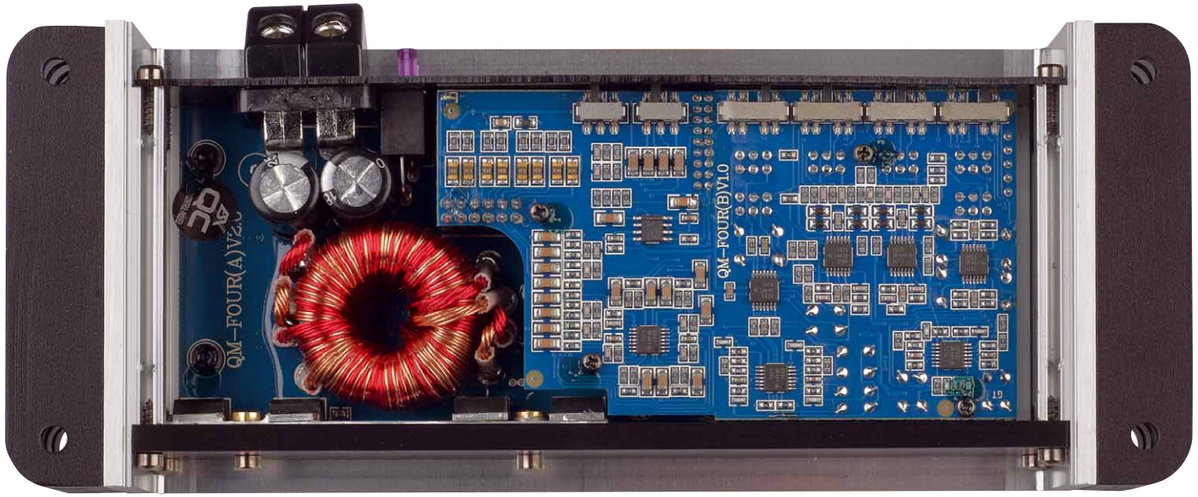
Plug&play Amplifier

As a booster for the factory radio, ESX has offered the tiny QM-Two with two channels for some time. The QM-Four-PP is a four-channel amplifier that brings along another innovation.

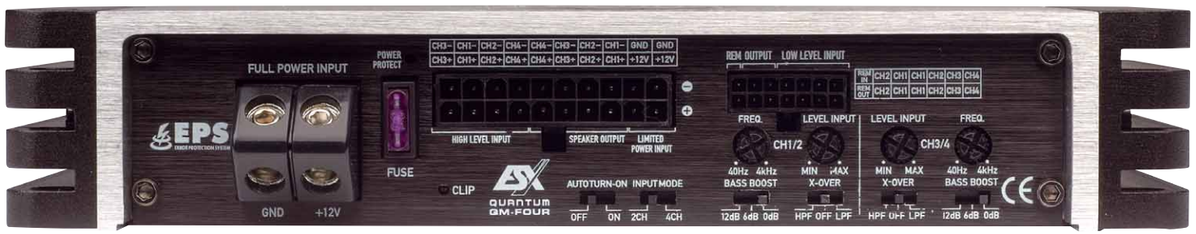
Connected in a flash and instantly better sound, that's the concept of QM-Two and QM-Four. This is not about high-end sound but about the most uncomplicated sound upgrade possible, which already works with the original speakers. Of course, it can also be upgraded with retrofit speakers. For this purpose, there is a 4 x 50-watt power boost. With 2-ohm speakers, it is even 4 x 80 watts. The PP in the name of the QM-Four-PP stands for Plug&play, of course. But if you expect a traditional ISO wiring harness, you will be proven wrong. ESX goes with the times here, and so the QM-Four-PP comes with a quad lock wiring harness, which is more and more represented in vehicles of all brands. The harness is included in the price and only docks to the speaker half of the quad lock connector. It is long enough to reach into the trunk because that is the preferred installation location for the power amp. With this, ESX also considers the development that more and more often, the vehicle battery is installed in the rear instead of in the engine compartment. Thus, the QM-Four-PP is installed in the trunk, where it goes with short cable lengths to the battery. Per the wiring harness, the speaker signal is provided from the front, amplified, and then returned to the original speaker wires.

This concept allows the QM-Four-PP not to turn out micro-small; instead, we deal with a full-fledged four-channel power amplifier. The QM-Four-PP comes with a complete feature set. First, there is the EPS against error messages due to speaker detection, for which VW radios, among others, are notorious; this is integrated into the quad lock wiring harness. You can also feed the QM via RCA jacks with a signal if you want. For this, a small harness is supplied, including a stereo output for a further retrofit power amplifier. Of course, the QM-One is predestined here, which takes care of a subwoofer – or you can take an active subwoofer. This gives us a full-fledged, small hi-fi system with the QM-Four-PP for front and rear speakers and subwoofer support. The crossovers are designed accordingly; there is a choice of high-pass or low-pass.

In a typical application, this allows the door speakers to be high-pass filtered and thus protected from low frequencies, which the subwoofer takes over. This then adds an extra boost to the sound. Technically, we are dealing with a modern amplifier design. Only the power supply works as usual with a transformer and buffering. Here we also find the only power transistors and diodes. The amplification with the four obligatory Class-D low-pass coils hides under the signal board. The complete amplification is accomplished with two inconspicuous chips that sit in the middle of the board without a heatsink. Each of the two amplifies two channels and is bridgeable. Two conductive paths to the aluminum housing do the cooling – the black heatsinks btw. are purely decorative to maintain the ESX family look.

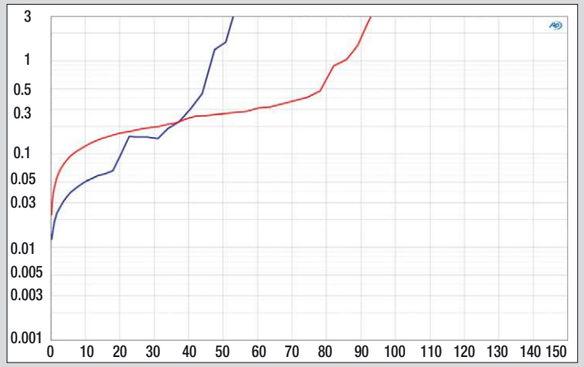


The power supply with power terminals, transformer, and MOSFETs on the housing are on the left. On the right, the signal board

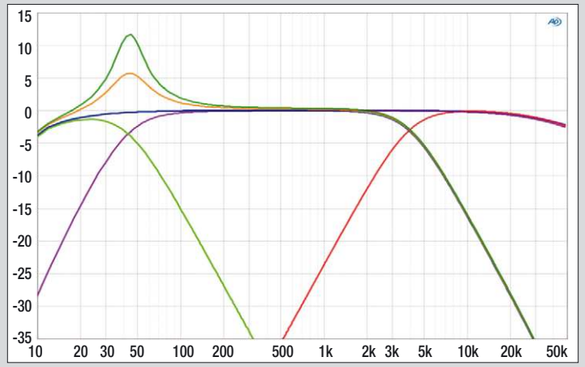


All signal and speaker connections are bundled in two Molex connectors

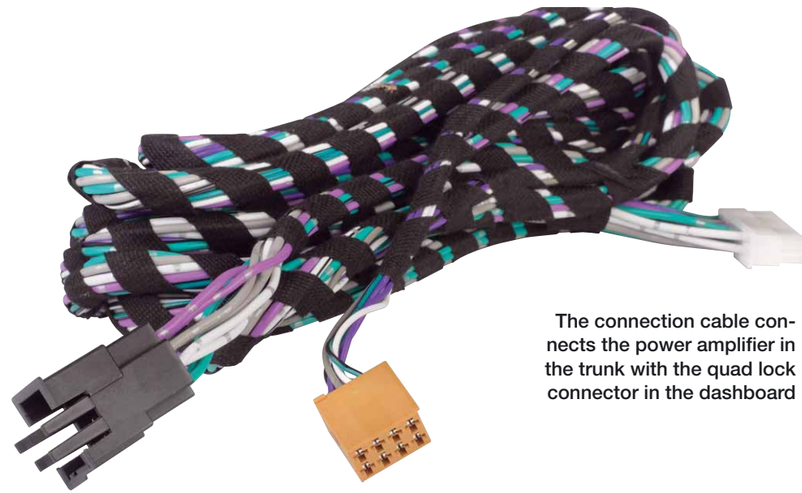
CAR&HIFI Laboratory



With high-pass or low-pass, the QM-Two-PP is ready for its factory-system application. The bass boost is switchable to 6 or 12 dB



The QM-Four-PP does not distort too much



The connection cable connects the power amplifier in the trunk with the quad lock connector in the dashboard

Measurements and sound

The QM-Four-PP achieves almost 4 x 50 watts into 4 ohms. That is easily enough for the desired sound boost compared to the good 10 watts of a factory radio. If you work with 2-ohm retrofit speakers, you'll reap 83 watts per channel. The distortions are not record-breakingly low but within the green range. Soundwise, the small QM can really show off. The sound is fat and powerful. The music is played back with zest so that the fun doesn't fall by the wayside. More demanding music can also be listened to well, even details flash up here, and the atmosphere is right in live recordings.

Conclusion

The QM-Four-PP is an excellent solution for an uncomplicated sound upgrade. Since everything needed for quad lock vehicles is already included, it can be considered an awesome offer.

Elmar Michels

Specifications

Channels	4
Power 4 ohms	47
Power 2 ohms	83
Power 1 ohms	0
Bridged Power 4 ohms	166
Bridged Power 2 ohms	0
Sensitivity max. mV	220
Sensitivity min. V	5,7
THD+N (<22 kHz) 5 W	0,034
THD+N (<22 kHz) Half Power	0,150
Signal-to-noise ratio dB(A)	89
Damping factor 20 Hz	78
Damping factor 80 Hz	77
Damping factor 400 Hz	76
Damping factor 1 kHz	71
Damping factor 8 kHz	–
Damping factor 16 kHz	–

Features

Low pass	40 – 4 Hz
High pass	40 – 4 Hz
Band pass	–
Bass boost	0, 6, 12 dB/45 Hz
Subsonic filter	via HP
Phase shift	–
High-level inputs	•
Automatic switchon (Autosense)	• DC
RCA output	•
Start/stop capable	• (7,2 V)
Dimensions (L x W x H in mm)	216 x 84 x 39
Others	EPS, remote control

ESX QM-Four-PP

Price	280 Euro
Contact	Audio Design, Germany
Internet	www.esxaudio.de/english

Rating

Sound	40 %	★★★★½
Bass	8 %	★★★★☆
Neutrality	8 %	★★★★★
Transparency	8 %	★★★★★
Spatial imaging	8 %	★★★★★
Dynamics	8 %	★★★★☆
Lab	35 %	★★★☆☆
Power	20 %	★☆☆☆☆
Damping factor	5 %	★★★☆☆
Signal-to-noise ratio	5 %	★★★★☆
Distortion	5 %	★★★★☆
Practice	25 %	★★★★☆
Features	15 %	★★★★☆
Build quality electronics	5 %	★★★★☆
Build quality mechanics	5 %	★★★★★

Top Class

★★★½☆

CAR&HiFi INTERNATIONAL Germany 2/22

Price/performance: very good

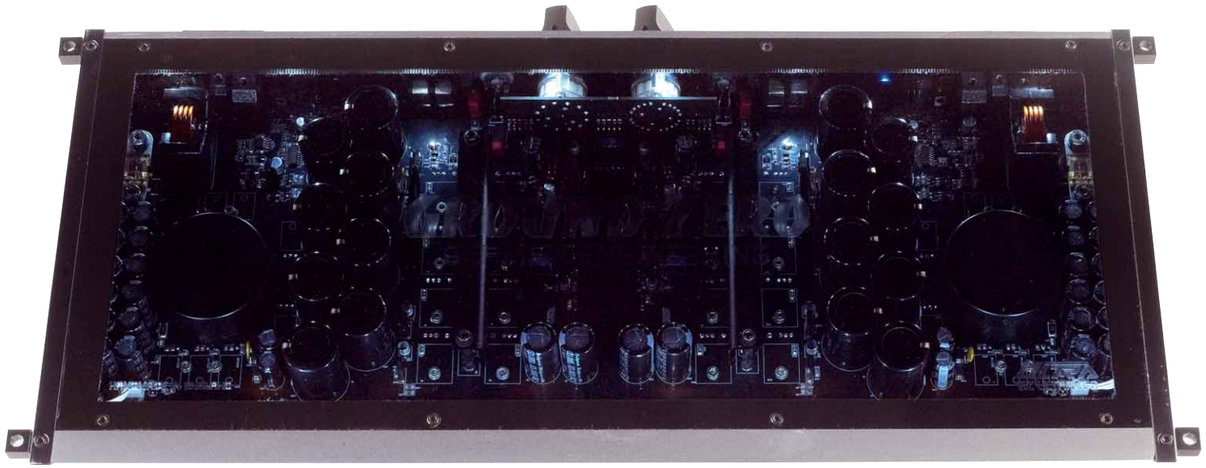
"Plug&play well done for quad lock vehicles."

GZ ULTRA A-2 - new reference amplifier from Ground Zero

Superlative two-channel amplifier

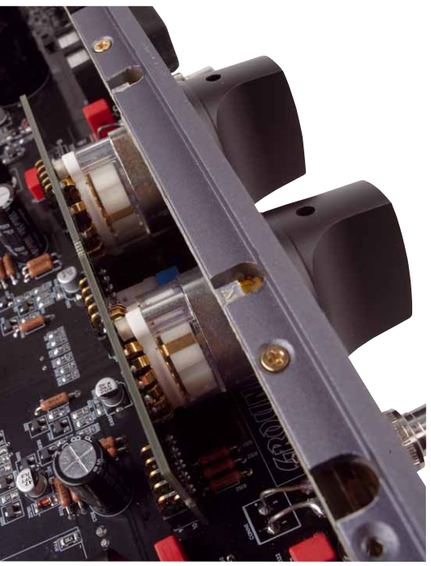
With the ULTRA A-2, Ground Zero wants to break all records. Developed with immense effort, this amplifier should not be less than the best of all times. We are curious.

The two channels are totally symmetrical on the PCB, thus achieving the highest possible signal fidelity



The ULTRA A-2's interior can be illuminated by LEDs, making interesting installation themes possible

Ground Zero presented a completely new and surprising over-the-top high-end series for 2022 called Reference Ultra. Located above the previous Reference there are currently two loudspeakers and an amplifier called ULTRA. The loudspeakers are a 6.5" midbass driver and a tweeter, which emit a noble two-way system. However, this is about the amplifier GZ ULTRA A-2. And it has the talent. At a price of just under 6,000 euros, you'll get two amplifier channels in a huge and massive cast housing weighing over 8 kilograms, which completely stands out from the previously known Ground Zero design. The ULTRA A-2 is delivered in a noble wooden case from good old Germany and with an individual test and measurement certificate from England. The amplifier is then also Made in England, by one of the world's most renowned amplifier developers in the industry. The highlight is the water cooling - ultra cool in the literal sense! Of course, the amp also works without water cooling, but if you want, you can look around for the appropriate parts in computer shops. Thanks to standardized connections and 12 volt technology, that's no problem at all. And water cooling is always useful, the coolant with its high heat capacity helps to keep the temperature of the heat sink and thus the parts connected to it constant – in turn, the amplifier thanks with performance.



No pots: two switches from Swiss company Elma control gain and bias levels

Construction

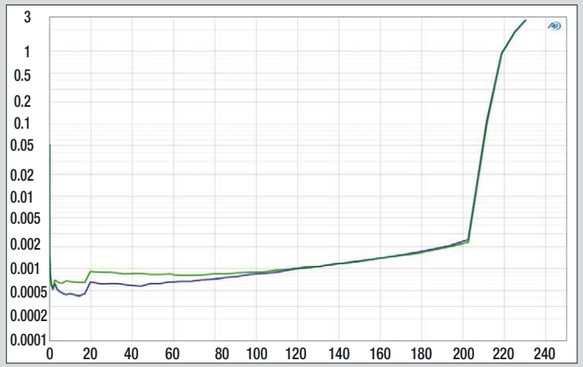
It certainly doesn't have to be mentioned that the ULTRA A-2 is extremely valuable and elaborately made. Real high-end and everything at its finest - just the way it should be. The consistent double-mono structure known from Ground Zero is not surprising. The layout of the large circuit board is completely mirror-symmetrical except for the switches in the signal input that are common to both channels. Channel separation (in a single housing) probably doesn't get any better. In general, there are indications on every corner that the entire amplifier is made solely for the sound, regardless of the costs. Great attention is paid to even the smallest details in order to really get the last little bit out of it. Of course, there are components of the finest quality. Even the rail capacitors are custom made for Ground Zero by the Cologne-based specialist Mundorf. Furthermore, only the best Toshiba transistors are used for the power supply. OTAs with high-impedance current output have proven to be the best solution in terms of sound as operational amplifiers. Class A drivers are used at the back and Sanken transistors with temperature control for maximum linearity are installed in the final amplification. Ground Zero has come up with something very special with the two large controls on the front panel. These are responsible for bias and gain, with the gain control is used to adjust the input sensitivity to the source - of course with every power amplifier. We know the bias regulator from the Ground Zero Reference series, it enables the bias current to be regulated and thus the operating point of the amplifier circuit to be set. This is far from self-evident and is usually set by the developer. This decides which area of the characteristic of the circuit is used, this is where the „amplifier classes" A or AB and others come from. Because the characteristic curve is not linear, this working range is not irrelevant, here you can decide whether high linearity or performance is also set. The highlight of the two controllers of the ULTRA A-2 is that they are not pots, but switches. The avoidance of potentiometers shows once again how uncompromising Ground Zero is with the ULTRA A-2. Basically, a potentiometer is an adjustable resistor in which a sliding contact is moved over a resistance path. This is not a real high-end, as it is difficult to control, subject to errors and wear and tear. Instead of potentiometers, the ULTRA A-2 has what are probably the most complex and expensive individual components on the amplifier, namely rotary switches from the Swiss manufacturer Elma, a two-way switch for the bias (low or high) and a four-way switch for the sensitivity (1, 2, 4, 8 Volt). The switches snap into place with a rich „click" of the large gold contacts, and thus switch resistors or voltage dividers. These tens of individual resistors are extremely tightly toleranced for the highest precision and have much lower voltage and temperature coefficients, resulting in extreme signal fidelity.

Two connections per side provide optional water cooling

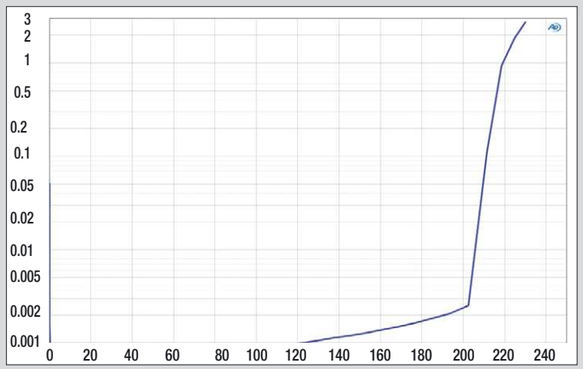
Measurements and sound

During the laboratory run, it quickly becomes apparent that all the effort put into the ULTRA A-2 is not a PR gimmick, but is reflected in the fact

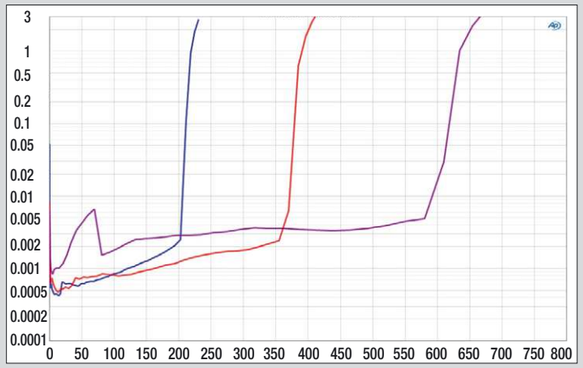
CAR&HIFI Laboratory



Comparison of bias low (green) and bias high:
With low to medium power, the high position produces even less distortion than the low position



First measurement in standard display: no curve?
Yes, but below 0.001 %



After scaling the vertical axis starting at 0.0001%, you can see that the ULTRA A-2 produces an order of magnitude less distortion than usual

that this Ground Zero simply works sensationally well. Would you like an example? In the first distortion measurement against power according to our standards, an almost empty diagram on the screen of our measuring computer first caused astonishment and then incredulous looks. The reason for the „blank" graph was that the ULTRA A-2 produced so little distortion that the line was an order of magnitude below the usual range. Only when we added a zero after the decimal point (from 0.001% to 0.0001% THD+N) did the complete measurement curve appear. The frequency response measurement is very similar: a completely straight line and overall boring because the ULTRA A-2 has no crossovers or filters. Only after spreading the representation does it become apparent that the curve drops by a tiny 0.7 dB at 10 Hz and at 80 kHz - wow! The bias switch has an effect at low power levels, in the high position there is minimally less distortion, so we measured 0.0005% THD+N at 5 watts, which decreases again towards 10 watts. We determine a signal-to-noise ratio of 115 dB (1kHz, 5W @ 4ohm, A-wgt.). These are dream values, but they do not mean that the ULTRA A-2 cannot push watt power. On the contrary, thanks to the extremely generous design of its components, it can even drive 1 ohm loads. Despite the bias switch, there is no pure class A

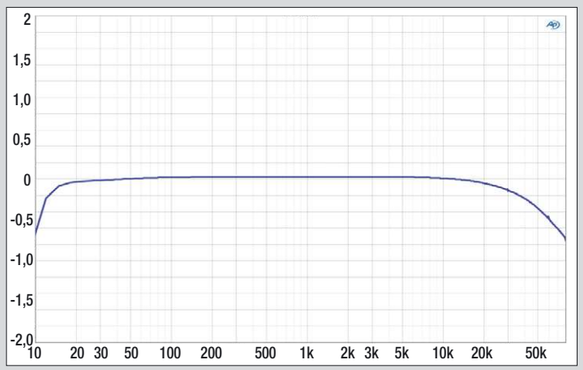
Eight Sanken transistors per channel are located under the PCB

Each channel has it's own 50A fuse and a shielded transformer. Rail capacitors are custom made by Mundorf

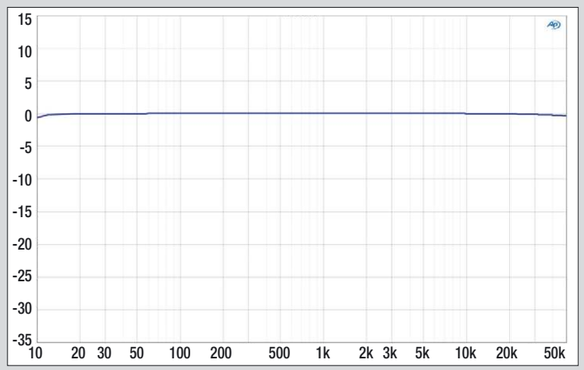
operation. Of course, the ULTRA A-2 always goes into AB operation at high power levels, so that the switch position becomes irrelevant at high power output. The idle current shows that there is still a lot of regulation. It is almost impossible (in a reasonable amount of time) to measure the same thing twice. Bias high then sometimes means 2 x 2.8 A at rest – depending on the temperature and regulation. With the ULTRA A-2, it might be worth warming it up a bit – it probably sounds better the longer it runs.
The ULTRA A-2 received no less great recognition in the listening test than in the laboratory test. The sound is so neutral, open, transparent and perfectly balanced that you hardly ever get to hear it.

First class wire terminals and RCA sockets and four status LEDs are nice, but mainly the two switches catch the eye

CAR&HIFI Laboratory



The GZ ULTRA A-2 draws a line from 10 Hz to 80 kHz. Simple recipe: no filters, no pots, no deviation



After spreading the Y-axis, a minimal drop of 0.7 dB can be seen at the edges. The A-2 works very broadband and linear

Unique design, more than 8 kg and optional water cooling – Ground Zero's ULTRA A-2 is more than distinctive

The music comes out of the speakers in it's entity and as a whole is great to great. The staging matches the recording perfectly and opens up quite naturally, everything sounds three-dimensional and the sound experience is outstanding. The large Ground Zero gives natural instruments a sound that has been worked out down to the last detail with rich colors and brilliant overtones. Even the finest musical details can be heard as if that were the most natural thing in the world. With silence it is still and with transients the entries seen to come out of nowhere. Again outstanding, no matter what kind of music you feed the ULTRA A-2 with. Spectacularly produced sound effects or wallowing in a homely live atmosphere, both are possible and delivered in perfection. It seems almost impossible to push the power amplifier to its limits, even with lots of bass at high volume it keeps track and sends most dynamic impulses to the loudspeakers. All in all, this is a performance at the highest level that doesn't have to hide from anything.

Conclusion

Superlative amplifier? Certainly. Anachronism with two analog channels on 50 centimeters? Certainly. The bottom line is that the GZ ULTRA A-2 is an amplifier for music lovers who are just as uncompromising in their demands as the manufacturer is in development. It is certainly one of the best car audio amplifiers ever built – a milestone that will be remembered for a long time.

Elmar Michels

Specifications

Channels	2
Power 4 ohms	219
Power 2 ohms	389
Power 1 ohms	632
Bridged Power 4 ohms	778
Bridged Power 2 ohms	1264
Sensitivity max. mV	2200
Sensitivity min. V	7,7
THD+N (<22 kHz) 5 W	0,001
THD+N (<22 kHz) Half Power	0,001
Signal-to-noise ratio dB(A)	115
Damping factor 20 Hz	1491
Damping factor 80 Hz	1491
Damping factor 400 Hz	1491
Damping factor 1 kHz	1491
Damping factor 8 kHz	1118
Damping factor 16 kHz	894

Features

Low pass	–
High pass	–
Band pass	–
Bass boost	–
Subsonic filter	–
Phase shift	–
High-level inputs	–
Automatic switchon (Autosense)	–
RCA output	–
Start/stop capable	– (9,4 V)
Dimensions (L x W x H in mm)	500 x 222 x 81
Others	Bias control

Ground Zero ULTRA A-2

Price	5995 Euro
Contact	Ground Zero, Germany
Internet	www.ground-zero-audio.com

Rating

Sound	40 %	★★★★★
Bass	8 %	★★★★★
Neutrality	8 %	★★★★★
Transparency	8 %	★★★★★
Spatial imaging	8 %	★★★★★
Dynamics	8 %	★★★★★
Lab	35 %	★★★★★
Power	20 %	★★★★★
Damping factor	5 %	★★★★★
Signal-to-noise ratio	5 %	★★★★★
Distortion	5 %	★★★★★
Practice	25 %	★★★★☆
Features	15 %	★★★☆☆
Build quality electronics	5 %	★★★★★
Build quality mechanics	5 %	★★★★★

Absolute Top Class

★★★★★

CAR&HiFi INTERNATIONAL Germany 2/22

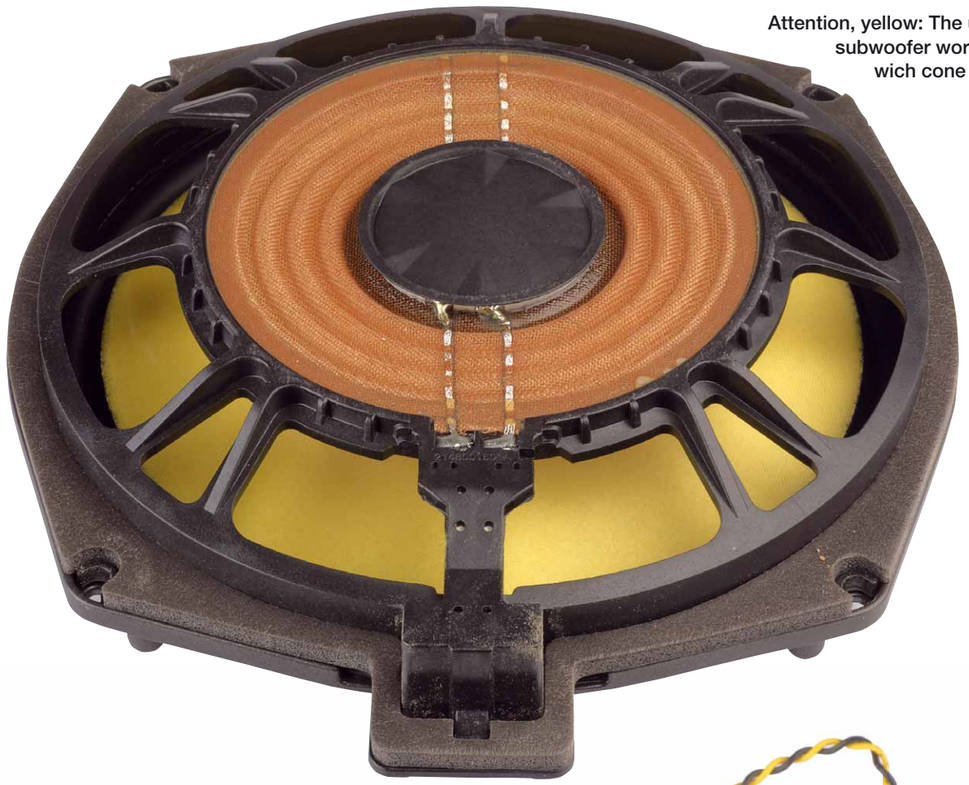
Price/performance: appropriate

"Uncompromising amplifier for the highest demands."

ESX VXB8.3C – semi-active three-way system for BMW and Mini

Top Speakers for BMW and Mini

Within ESX's Vision series, we have found relatively inexpensive speaker sets so far. Now comes the VXB, an elaborate system with which ESX is getting more serious.

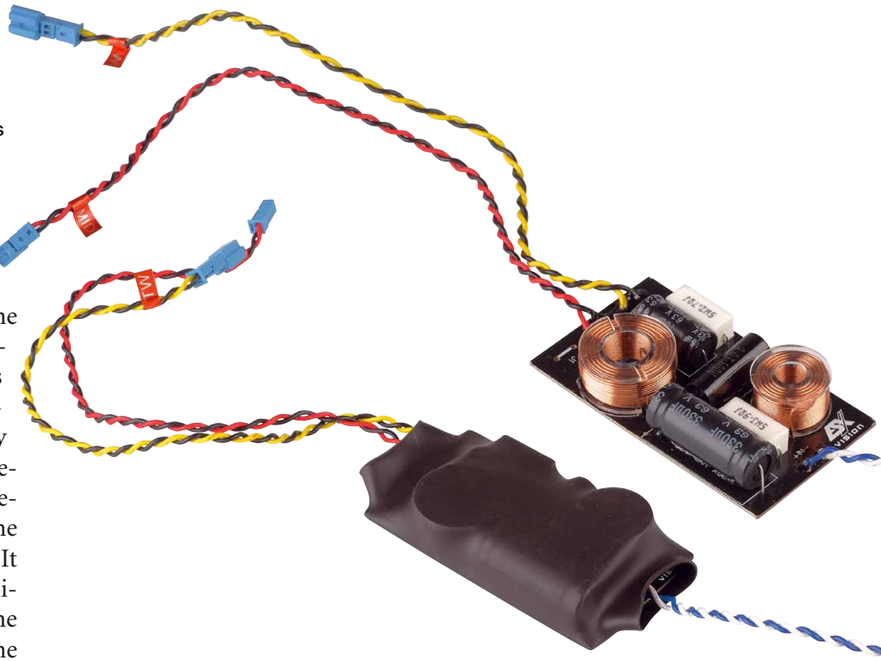


Attention, yellow: The ultra-flat under-seat subwoofer works with a Kevlar sandwich cone

The 25-mm fabric tweeter fits into the original door mirror triangles. All plug connections are made with BMW plugs

Of course, there are also vehicle-specific speaker sets from ESX, namely for BMW/Mini and the Fiat Ducato. BMW and Mini drivers can now enjoy the newly developed set VXB, which is optionally available as individual door speakers and under-seat woofer or as a complete set. The door speakers are called VXB4.2C and are intended as front speakers, but they also fit several models' rear doors. The woofer set VXB8W is made for active operation with a retrofit amplifier. We have both together as VXB8.3C, which thus results in a partially active three-way system running on four amplifier channels. All components are, of course, plug&play. The individual speakers fit into the original mounts, and all components have BMW vehicle plugs, so nothing has to be changed on the vehicle for installation.

The components' elaborate build quality is immediately noticeable when unpacking the VXB8.3C. The tweeter – a refined 25 mm dome tweeter can be considered normal, but the 4" door speaker raises eyebrows. Instead of a plastic diaphragm, it has one made of sturdy fiberglass fabric, and despite the petite dimensions, ESX relies on die-cast aluminum for the frame. The motor unit is also a real winner. It has to be the expensive neodymium as a magnet material due to the higher energy density, too. Also, the finish with the chrome-plated pole plates is quite something. The absolute highlight of the VXB set, however, are the woofers. With the 8" for the under-seat housings, ESX did such a good job that they belong to the finest in the market. Also equipped with sturdy die-cast baskets, they delight the engineer's heart with many great details. Thanks to the front motor, the entire construction is ultra-flat, yet the cone assembly has so much room for excursion that it is impossible to bring it to the stop – the limiting element here is the spider. The motor of course also works with neodymium, which fills the air gap for a stately voice coil with a diameter of 2 inches. The diaphragm caps it all off. It's yellow color signals Kevlar, which acts here as a covering for a rigid foam core. This core can be shaped during manufacture into the form needed for the subwoofers.



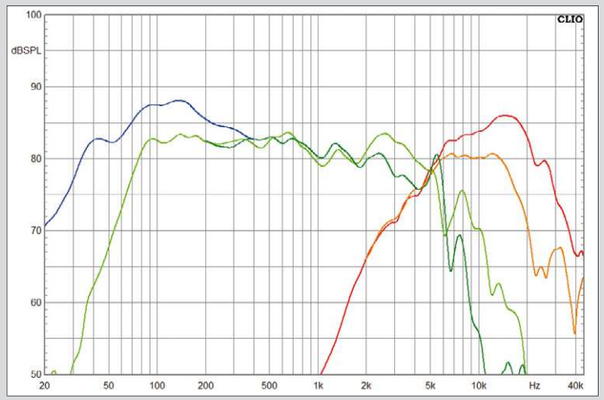
The door system's crossover crosses tweeter and midrange and also protects the 4" drivers from low frequencies

Both the door speaker and the under-seat subwoofer feature elegant aluminum die-cast baskets and neodymium drives

Measurements and sound

Let's start this chapter with the impedances. ESX has done everything right here because the door speakers are 4-ohm speakers, while the woofers are equipped with 2-ohm coils. This makes sense because the woofers require significantly more amplifier power than the small 10-series systems. If you use a four-channel power amplifier to drive the VXB, thanks to the lower impedance, the woofers automatically draw more power out of the amplifier, while the doors are optimally supplied at 4 ohms. This way, speakers and also the amplifier are optimally utilized. In front of the microphone, the door system shines with an excellent frequency response. Both the 4" midrange driver and the tweeter perform great. The issue of distortions

CAR&HIFI Laboratory



The VXB8.3C performs flawlessly in the lab. All three drivers run without fault. Despite a high-pass filter in front of the system, the 4" runs below 100 Hz. The upper cutoff frequency also allows broadband use.

is also very pleasing, as there are hardly any. Even the small midrange manages massive SPL levels until the distortion „leaps". The VXB runs cleanly, and it can play loud. Sonically, this fits exactly into the picture. We have fun speakers of the highest order in front of us. The ESX plays ultra-crisp and is very dynamic. Percussion is at the top level, and the woofers really get going. Their performance is just right in terms of both bass and cleanliness of sound – no additional subwoofer needed! All in all, the VXB system doesn't make any mistakes. You can also enjoy jazz or classical music with it. What is always right is the desire to make music.

Conclusion

The VXB8.3C is not cheap, but it is worth the money. With the elaborate build quality and its powerful sound, it impresses with ease.

Elmar Michels

Specifications

Basket diameter	200 mm
Installation diameter	33 mm
Installation dept	100 mm
Magnet diameter	29 mm
Tweeter diaphragm	25 mm
Tweeter cabinet	43 mm
Slope woofer/tweeter	–/6, 6/12 dB
Tweeter protection	–
Tweeter level adjustment	–
Fitting in*	E-, F und G series
Other	–
Nominal impedance	2 Ohm
DC resistance Rdc	1,90 Ohm
Voice coil inductance Le	0,68 mH
Voice coil diameter	50 mm
Cone area Sd	269 cm²
Resonance frequency fs	50 Hz
Mechanical Q Qms	6,38
Electrical Q Qes	0,78
Total Q Qts	0,70
Equivalent volume Vas	19,7 l
Moving mass Mms	51,9 g
Rms	2,56 kg/s
Cms	0,20 mm/N
B*l	6,30 Tm
SPL 2v, 1m	92 dB
Amplifier power recommendation	60 – 250 W

ESX VXB8.3C

Price	700 Euro
Contact	Audio Design, Germany
Internet	www.esxaudio.de

Rating

Sound	55 %	★★★★★
Bass foundation	11 %	★★★★★
Neutrality	11 %	★★★★★
Sound stage	11 %	★★★★★
Spatiality	11 %	★★★★☆
Dynamics	11 %	★★★★★
Lab	30 %	★★★★½
Frequency response	10 %	★★★★★
Max. SPL	10 %	★★★★☆
Distortion	10 %	★★★★★
Practice	15 %	★★★★½
Installation	5 %	★★★★★
Crossover	5 %	★★★★☆
Build quality	5 %	★★★★☆

BMW speakers

★★★★½

CAR&HiFi INTERNATIONAL Germany 2/22

Price/performance: very good

"Top system for BMW and Mini"

HX 100/130/165 Phase Evo3 – new top systems from Audio System

Refined Composite Systems

Audio System doesn't believe in constantly coming up with new fancy names for the speakers. The series designations are fixed, and the Evo level is counted up. The top systems, "HX Phase," are now available in the Evo3 version.

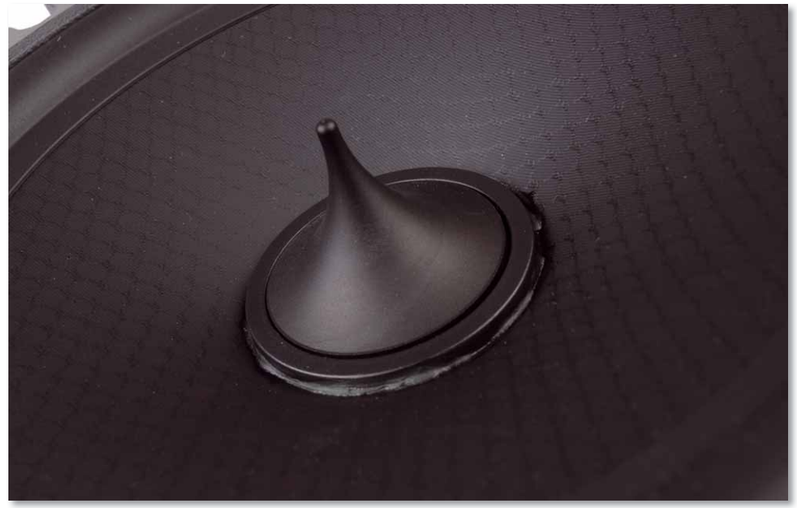
The HX-Phase family with a 3.15“ midrange driver and bass-midrange drivers in 4“, 5.25“, and 6.5“

In 2019, Audio System introduced the Evo2 evolutionary stage of the HX Phase premium loudspeakers. The Evo3 is now brand new and far more than „just“ a further development. The family consists of three component systems of 100, 130, and 165 millimeters. Furthermore, all drivers are also available individually so that active systems can be conveniently put together without paying for the expensive crossovers.

The 6.5“ Evo3 was equipped with a neodymium motor and thus draws level with the smaller ones

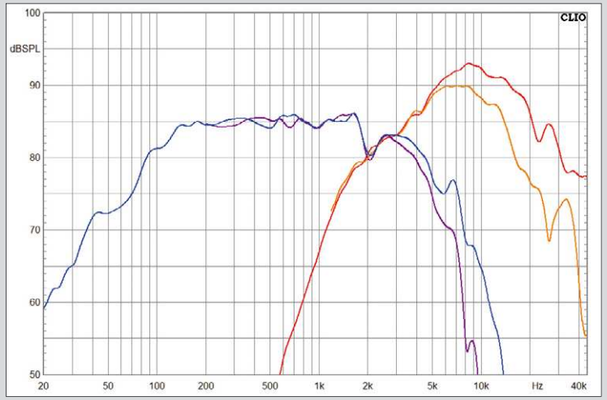
For three-way systems, there is also the matching midrange driver namely the EX 80 Phase Evo3, which has the same design features as the other cone drivers. There is also the ALU-EGG HS 30 Phase, an aluminum housing for the tweeter that allows it to be installed on the A-pillar or the dashboard.

Our three sets, HX 100 Phase Evo3, HX 130 Phase Evo3, and HX 165 Phase Evo3, come with the same tweeter and crossover. The prices are also the same, as it is no less costly to build a 4" than a speaker with slightly larger components. What remains the same in the Evo3 is the HS 30 Phase tweeter, which is immediately noticeable for its sheer size. It‘s a real hunk with a mounting diameter of 54 millimeters and a mounting depth of 27 millimeters, but it rewards the installation effort with tangible benefits. Its giant 31-millimeter cone displaces a lot of air by tweeter standards. Together with the very generous rear chamber, there are decent dynamic and level reserves, especially for two-way systems. The crossover is basically well known, but it received a new assembly and now features a tweeter protection. However, in the noble FWHX, this is achieved not with a semiconductor-based PTC element, but in the form of a light bulb. This has the advantage that it is no problem to return from protect to the original state, and in addition, the attenuation of the tweeter is very „analog“ and stepless, resulting in a pleasant soft clipping. As one of many switching options, the light bulb can also be bypassed. Also switchable are the three level resistors of the tweeter and the three differently sized capacitors of the high range.

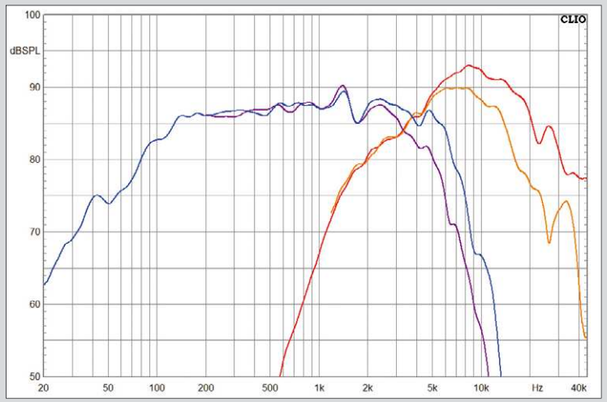


The characteristic feature of the HX Phase Evo3 is the distinctive, tapered phase plug

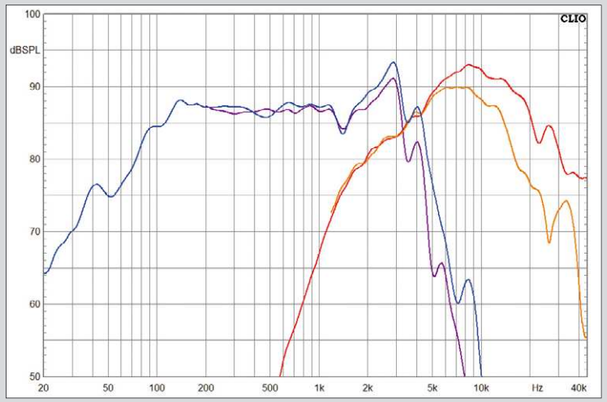
CAR&HIFI Laboratory



The HX 100 Phase Evo3 requires the available level reduction for the tweeter. The 4" runs linearly from 120 Hz



The HX 130 Phase Evo3 runs nicely balanced from 120 Hz, and the neodymium motor provides the 5.25" with 87 dB into 1 W



The HX 165 Phase Evo3 slips up at 3 kHz, and the 6.5" woofer is no sub-bass wonder either

Thus, many crossover frequencies and SPLs can be realized. All this is done with first-class, thick and contact-safe jumpers. In the low-frequency branch, you can choose between 6 and 12 dB slope by switching the in-parralel capacitor. Independently, a RC circuit can be switched in for impedance linearization. Thus, the FWHX not only works with our three compos, but it can also drive dual woofer systems.

Completely new in the Evo3 version are the cone drivers. Only the frame of the 6.5" has remained; everything else is entirely new. The most prominent feature is the new phase plug, which no longer has the familiar „bullet“ shape but is tapered. As always with phase plugs in cone diaphragms, it has nothing to do with the phase but instead acts as a heatsink and a kind of shorting cap on the pole piece. The voice coil dimensions are pretty modest; the 4" and 5.25" coils are 25 millimeters in diameter, the 3" has 19 mm, and the 6.5" is also only equipped with a 32 mm coil. This is precisely the same as its predecessor and indicates that Audio System still places the highest value on SQ and is not jumping on the SPL bandwagon. The

The tweeter features an extra large dome and an equally large rear chamber

The small midrange driver also has all the HX-Phase features

smaller drivers up to the midrange get new beautiful aluminum die-cast baskets, which look great and are airy and stable at the same time. With the motors, they rely entirely on neodymium for all drivers, which has been significantly upgraded here. There are no shorting rings in the motor; that‘s what the phase plugs are for. And finally, we welcome a new diaphragm generation for all drivers. Here we move away from aluminum to less hardness but more internal damping. It‘s hard to say precisely what the diaphragm material is, but it‘s heading toward a high-tech paper compound with a fiber front – the pendulum swings back in the direction of paper.

Measurements and sound

The neodymium provides brutally strong motors, and there is generally relatively soft suspensions of the cones to ensure low resonance frequencies. The measurements

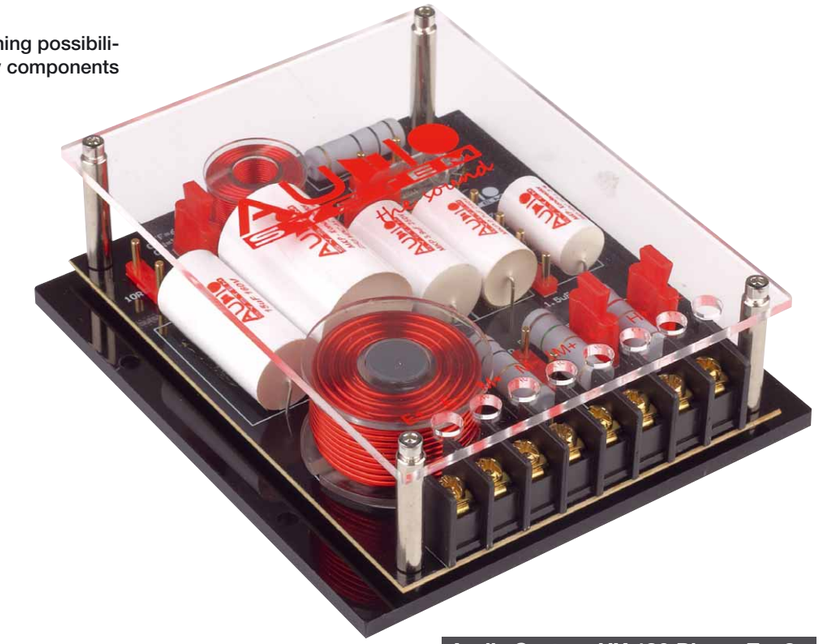
Specifications	
Basket diameter	104 mm
Installation diameter	95 mm
Installation dept	57 mm
Magnet diameter	55 mm
Tweeter diaphragm	31 mm
Tweeter cabinet	54 mm
slope woofer/tweeter	6, 12/12 dB
Tweeter protection	Light bulb (switchable)
Tweeter level adjustment	-4, -3, -2, -1, 0, +1 dB
Grille	–
Other	Adjustable crossover freq, slope, midrange, tweeter level
Nominal impedance	4 Ohm
DC resistance Rdc	3,34 Ohm
Voice coil inductance Le	0,24 mH
Voice coil diameter	25 mm
Cone area Sd	55 cm²
Resonance frequency fs	74 Hz
Mechanical Q Qms	8,82
Electrical Q Qes	0,41
Total Q Qts	0,39
Equivalent volume Vas	3,1 l
Moving mass Mms	6,4 g
Rms	0,34 kg/s
Cms	0,72 mm/N
B*l	4,96 Tm
SPL 2v, 1m	85 dB
Amplifier power recommendation	30 – 100 W

Audio System HX 100 Phase Evo3	
Price	675 Euro
Contact	Audio System, Germany
Internet	audio-system.de

Rating		
Sound	55 %	★★★★★
Bass foundation	11 %	★★★★★
Neutrality	11 %	★★★★★
Sound stage	11 %	★★★★☆
Spatiality	11 %	★★★★☆
Dynamics	11 %	★★★★★
Lab	30 %	★★★★½
Frequency response	10 %	★★★★★
Max. SPL	10 %	★★★★☆
Distortion	10 %	★★★★☆
Practice	15 %	★★★★★
Crossover	10 %	★★★★★
Build quality	5 %	★★★★★

Absolute Top Class
★★★★★
CAR&HiFi INTERNATIONAL Germany 2/22
Price/performance: very good
"Refined systems with high-end ambitions"

The FWHX offers many switching possibilities and high quality components



attest to the tweeter‘s extended frequency range, which is remarkable for the large dome. Less surprising are its extremely low distortion – it doesn‘t have to strain, after all. The mid-bass drivers also perform very well, except for the 6.5". This one has a relatively „un-ironed“ diaphragm resonance at 3 kHz because its frequency coincides with the overshoot range of the crossover‘s 12 dB low-pass. The 4" and 5.25" run without fault, and the distortion behavior of all low-midrange drivers is also ok.
Sound-wise, you dive into a new world with the HX Phase Evo3. The Audio Systems sound pleasantly musical and perfectly balanced across the board. The reproduction of timbres succeeds brilliantly, and it seems easy to elicit the typical sound from voices and instruments. It gets really tight and ultra-crisp in the bass range. Precise bass hammers reach the ear unfiltered, and any bass sounds are reproduced with

Audio System HX 130 Phase Evo3

Specifications	
Basket diameter	132 mm
Installation diameter	120 mm
Installation dept	61 mm
Magnet diameter	65 mm
Tweeter diaphragm	31 mm
Tweeter cabinet	54 mm
slope woofer/tweeter	6, 12/12 dB
Tweeter protection	Light bulb (switchable)
Tweeter level adjustment	-4, -3, -2, -1, 0, +1 dB
Grille	–
Other	Adjustable crossover freq, slope, midrange, tweeter level
Nominal impedance	3 Ohm
DC resistance Rdc	2,79 Ohm
Voice coil inductance Le	0,17 mH
Voice coil diameter	25 mm
Cone area Sd	83 cm²
Resonance frequency fs	61 Hz
Mechanical Q Qms	11,41
Electrical Q Qes	0,28
Total Q Qts	0,27
Equivalent volume Vas	7,3 l
Moving mass Mms	9,1 g
Rms	0,31 kg/s
Cms	0,75 mm/N
B*l	8,93 Tm
SPL 2v, 1m	87 dB
Amplifier power recommendation	30 – 100 W

Price	675 Euro
Contact	Audio System, Germany
Internet	audio-system.de

Rating		
Sound	55 %	★★★★★
Bass foundation	11 %	★★★★★
Neutrality	11 %	★★★★★
Sound stage	11 %	★★★★☆
Spatiality	11 %	★★★★☆
Dynamics	11 %	★★★★★
Lab	30 %	★★★★½
Frequency response	10 %	★★★★★
Max. SPL	10 %	★★★★☆
Distortion	10 %	★★★★☆
Practice	15 %	★★★★★
Crossover	10 %	★★★★★
Build quality	5 %	★★★★★

Absolute Top Class
★★★★★
CAR&HiFi INTERNATIONAL Germany 2/22
Price/performance: very good
"Refined systems with high-end ambitions"

As for accessories to the tweeters, there are aluminum enclosures

excellent precision. The 4“ holds back with its small cone, though the 5.25" and 6.5" are also happy about subwoofer support, which is probably a matter of course in this class. In terms of bass, the 5.25" keeps up with the 6.5", only in terms of SPL, the largest speaker naturally keeps its nose in front. All in all, the HX Phase Evo3 has become quite a bit more audiophile – beautiful listening at Audio System? No problem.

Conclusion

The HX Phase in the new Evo3 version is, more than ever, a speaker series on the highest level. If you have the money, you get excellent stuff in terms of drivers and crossover.

Elmar Michels

Audio System HX 165 Phase Evo3

Specifications	
Basket diameter	166 mm
Installation diameter	145 mm
Installation dept	67 mm
Magnet diameter	75 mm
Tweeter diaphragm	31 mm
Tweeter cabinet	54 mm
slope woofer/tweeter	6, 12/12 dB
Tweeter protection	Light bulb (switchable)
Tweeter level adjustment	-4, -3, -2, -1, 0, +1 dB
Grille	–
Other	Adjustable crossover freq, slope, midrange, tweeter level
Nominal impedance	3 Ohm
DC resistance Rdc	2,72 Ohm
Voice coil inductance Le	0,29 mH
Voice coil diameter	32 mm
Cone area Sd	133 cm²
Resonance frequency fs	65 Hz
Mechanical Q Qms	5,92
Electrical Q Qes	0,37
Total Q Qts	0,35
Equivalent volume Vas	8,7 l
Moving mass Mms	16,9 g
Rms	1,16 kg/s
Cms	0,36 mm/N
B*l	7,09 Tm
SPL 2v, 1m	87 dB
Amplifier power recommendation	30 – 100 W

Price	675 Euro
Contact	Audio System, Germany
Internet	audio-system.de

Rating		
Sound	55 %	★★★★★
Bass foundation	11 %	★★★★★
Neutrality	11 %	★★★★★
Sound stage	11 %	★★★★☆
Spatiality	11 %	★★★★☆
Dynamics	11 %	★★★★★
Lab	30 %	★★★★½
Frequency response	10 %	★★★★★
Max. SPL	10 %	★★★★☆
Distortion	10 %	★★★★☆
Practice	15 %	★★★★★
Crossover	10 %	★★★★★
Build quality	5 %	★★★★★

Absolute Top Class
★★★★★
CAR&HiFi INTERNATIONAL Germany 2/22
Price/performance: very good
"Refined systems with high-end ambitions"

PRODUCTS OF THE YEAR 2022

„The market provides many good car entertainment devices, but only a few are so good that they simply inspire.“ - CAR & HiFi editorial team

In 2022, the editors of the renowned CAR & HiFi magazine have once again chosen their products of the year. This year's fivefold award for Audiotec Fischer stands out in particular - Some of the most innovative **HELIX** and **MATCH** products as well as the **CONDUCTOR** received the desired award in the categories „Innovation“, „Premium Upgrade“, „OEM Upgrade“, „BMW Loudspeaker“ and „Subwoofer“.

AUDIOTEC FISCHER

INNOVATIVE CAR AUDIO

www.audiotec-fischer.com

Phoenix Gold ZR10P – compact underseat subwoofer

Bass unobtrusively integrated

After we had two real bass boomers in the editorial department in the last issue, this time Phoenix Gold shows that there is another way.

With the ZR10P, Phoenix Gold offers a subwoofer whose task is to bring a little bass into the car, but inconspicuously and without loss of space. Because not everyone wants to drive a full-blown bass box in the trunk, which also takes up space when the music is not playing. So it makes sense to look for a different type of subwoofer that ideally is easy to install and has enough bass for everyday use. There is space for hidden installation, e.g. in the double trunk floor, in the side panel or under the front seats. Here, the ZR10P can be accommodated in many vehicles thanks to its height of just 8 centimeters (3.15"). With its optional low- or high-level inputs, it easily makes contact with head units, whether they are retrofitted or original ones, and the subwoofer is switched on and off automatically. A small wired remote control is also included, with which the bass level can be adjusted. The controls for one-time adjustment on the device include the obligatory low-pass filter for adapting the subwoofer to the vehicle loudspeakers and a bass boost. There is also a polarity switch, with which the correct polarity can be heard in a flash. The case of the ZR10P is made of sturdy cast aluminum and houses a rather impressive bass speaker. With a nominal diameter of 10 inches, this is one of the larger for an underseat woofer, so the output can be expected to be correspondingly lavish. The flat aluminum membrane has a golf ball-like embossing that serves to stabilize it. And of course there is also a small amplifier in the housing. A classic analog mono amplifier is spread out on the orange circuit board, mostly in SMD construction. This is not rocket science, but a design that has been perfected for decades. And since we're not dealing with Class D, we don't have to worry about electromagnetic interference.

The woofer's cone is treated with embossings that remind of a golf ball

Super flat woofer thanks to it's planar membrane that makes the shallow frame possible

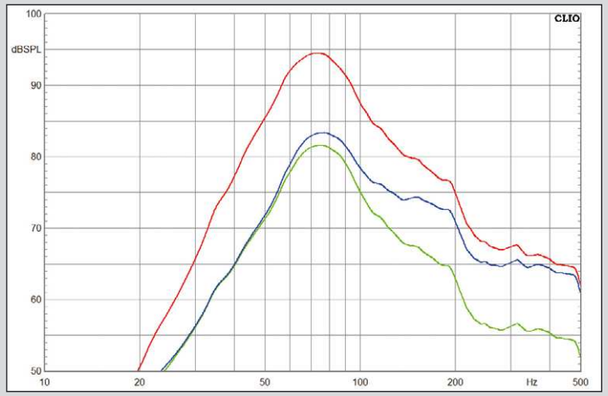
Features include low pass, bass boost and a polarity switch. Inputs can handle RCA or hihg level signals

Measurements and sound

The amplifier then shows itself from its best side in the lab. For a compact active subwoofer, the amplifier produces little distortion, but there is plenty of power. With a good 120 watts, the ZR10P is one of the

The amplifier is a well known class AB design, but it provides more than enough power

CAR&HIFI Laboratory



The ZR10P shows an appealing frequency response for the small size. Low-pass and bass boost set few accents, the boost essentially makes it louder

The ZR10P comes in a compact aluminum case only 3.15" high in order to fit even under the front seat

more powerful underseat woofers on the market. The acoustic output can also be heard. The only point of criticism is the bass boost, which is quite unspecific at high frequencies, so that we effectively have the third „volume control“ (after gain control and remote control). Otherwise, the small woofer does a good job in front of the microphone, it works from about 55 Hz upwards – not bad for a small 5 liter case. In terms of sound, it‘s clearly going in the crisp direction. The Phoenix Gold easily manages to clearly separate bass hits that follow each other in quick succession. The depth is perfectly adequate for a bass supplement to the original speakers. The sub delivers the decisive bass boost for a clear plus in listening pleasure – that‘s exactly what it‘s made for. Conclusion The Phoenix Gold ZR10P is clearly one of the better underseat woofers on the market. It‘s not a bargain, but for the money you get a well-made speaker and powerful aluminum-clad amplifier in a well-playing package.

Elmar Michels

Specifications

Dimension w	24,5 cm
Dimension h	8,0 cm
Dimension d	34,0 cm
Box type/volume	cb 5,5 l
Reflex port (d x l)	–
Weight	5,2 kg
Nominal diameter	10"
Nominal impedance	2 Ohm
Voice coil diameter	50 mm
Power @ nom.imp.	121 W
Sensitivity RCA max	130 mV
Sensitivity RCA min	2,9 V
THD +N (<22 kHz) 5W	0,05 %
THD +N (<22 kHz) Halblast	0,15 %
SNR (A-wgt)	83 dB

Features

Low pass	50 – 150 Hz
Bass boost	0 – 12 dB / 55Hz
Subsonicfilter	fix 25 Hz
Phaseshift	Polarity switch
Low-level input	•
High-level input	•
Auto turn on	•, DC
Start-Stop capability	• (6,8 V)
Remote control	•, Gain
Misc.	–

Phoenix Gold ZR10P

Price	350 Euro
Contact	AAMP European Division, UK/Sweden, Germany
Internet	www.phoenixgold-eu.com

Rating

Sound	30 %	★★★★★
Bass	7,5 %	★★★★½
Pressure	7,5 %	★★★★½
Purity	7,5 %	★★★★★
Dynamics	7,5 %	★★★★★
Lab	40 %	★★★★★
Frequency response	10 %	★★★★½
Max SPL	10 %	★★★★★
Amplifier powerl	20 %	★★★★★
Practice	30 %	★★★★½
Features	10 %	★★★★½
Build Quality electronics	10 %	★★★★½
Build Quality mechanics	10 %	★★★★★

Compact Class

★★★★½

CAR&HiFi INTERNATIONAL Germany 2/22

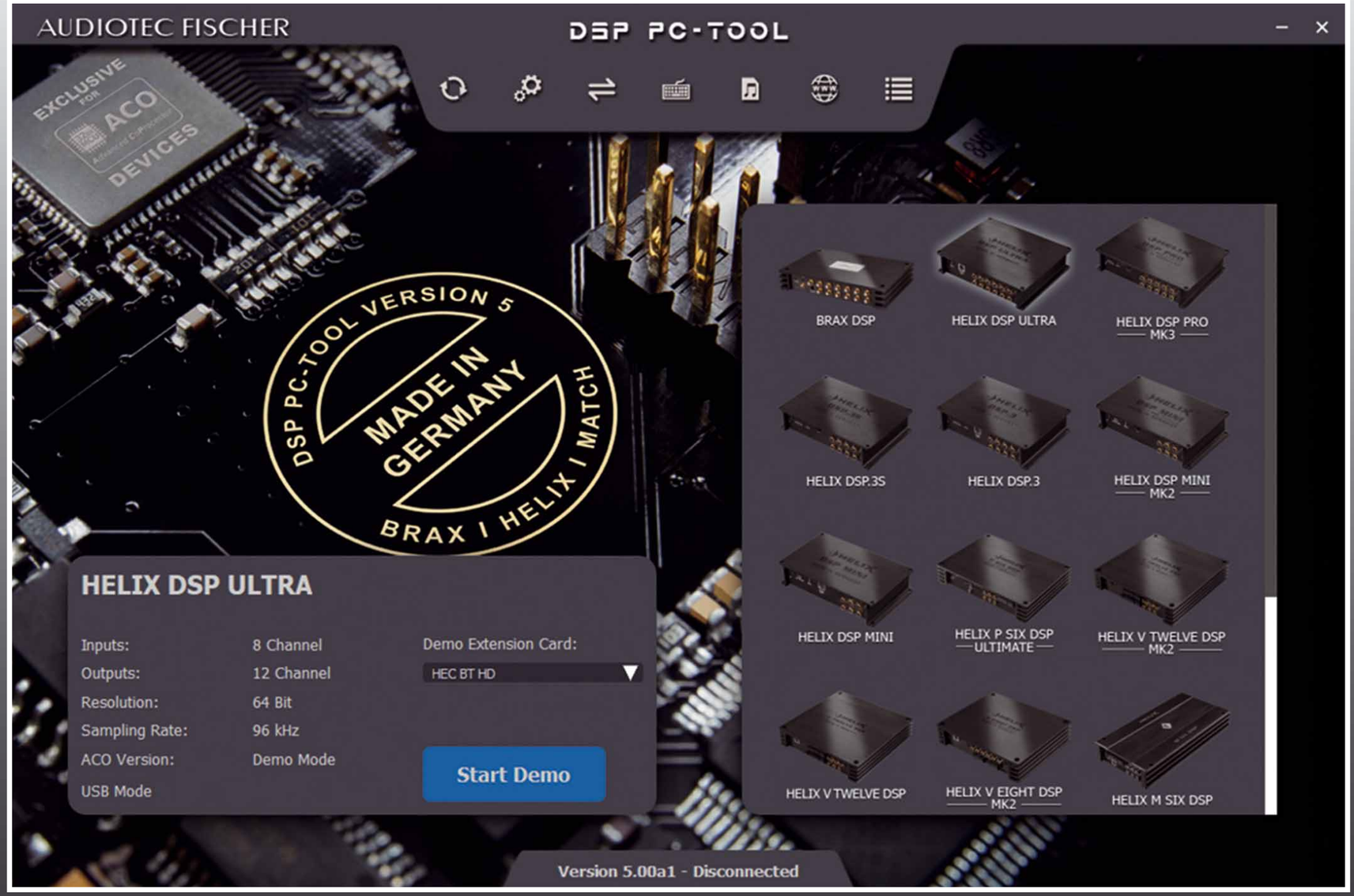
Price/performance: very good

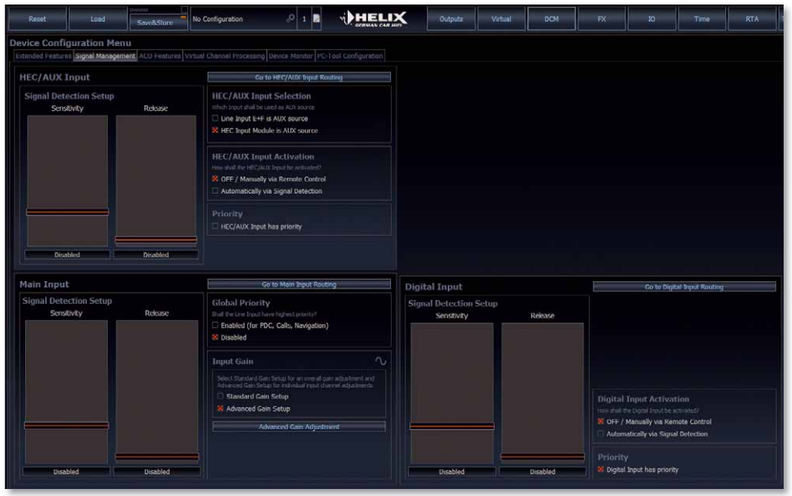
"Small, quite powerful subwoofer."

New version of the DSP software from Brax/Helix/Match

DSP PC-Tool 5

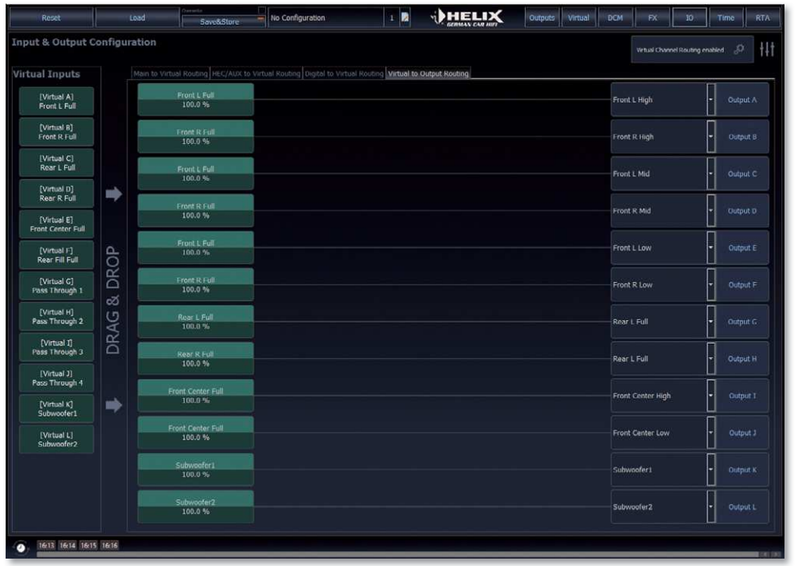
The DSP PC-Tool is the DSP software from Audiotec Fischer. It works with DSP products of Brax, Helix and Match brands. The extensive program now goes into version 5; a good enough reason for us to introduce its functions and novelties.





All sources can be prioritized under signal management. Switching is performed on signal input, whereby the switching sensitivity can be adjusted

The programming software is the heart of a DSP, since without it nothing works, and its quality is authoritative for the failure or success of a projected audio system. The DSP PC-Tool has always been the most powerful and comprehensive software on the market and has now been again extended with version 5. In general, Audiotec Fischer constantly publishes updates that bring new functions, so that users can enjoy new features virtually in real time. The PC-Tool 5 thereby serves all stand-alone DSPs and DSP amplifiers from Brax, Helix and Match that are equipped with the ACO platform; these are all available since the introduction of the Helix DSP Mini in 2018. This is great because even owners of hardware purchased years ago can get all updates as a free download — a truly exemplary service. For the dealer and installer, it has the advantage that one program is suitable for a large number of installations. Once you have become accustomed to the program, it is easy to use. The user interface is always the same; depending on the device, the number of channels and the supported features are automatically adjusted.



If VCP is activated, first the inputs are routed to the virtual channels, then the virtual channels are routed to the outputs

Integration

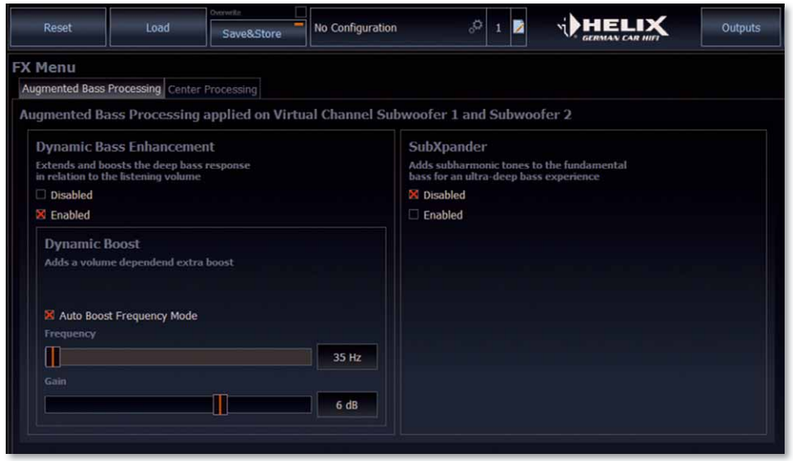
Before we can start tuning the sound, there must be sound coming out of the system, which some vehicles do not make easy for the installer. Some things depend on the DSP hardware, such as how many volts of input voltage the inputs can handle. This determines whether a DSP can handle power-boosted factory equipment or whether it will only work on a car radio. The in-house ADEP is also a hardware matter; here a loudspeaker is simulated by a low input impedance, which is needed for vehicles that run a loudspeaker diagnostic on start-up. Some VWs also use Class SB amplifiers, their various amps can cause distortion and therefore need to be tricked out. On various vehicles the factory system does not shut off completely right away; to combat this "lag" there is a power save mode in the DSP PC-Tool that prevents the retrofitting system from staying on long enough to drain the battery. The far-reaching source management functions are completely indispensable. In the PC-Tool, the user can decide which his main source is (typically the car radio). For all additional sources like aux, digital inputs, Bluetooth or various extension cards, the priorities and the switching thresholds can be adjusted. This way, the desired source is always automatically switched on and car sounds, navigator announcements or phone calls can still come through. Nice touches like on/off delays, including remote control integration, reliably help to keep switching clicks or unwanted noises at bay. All this is set and selected in the PC-Tool; software and hardware are deeply interlocked and can therefore be used variably in a variety of modern vehicles.

In the output tab, bandpass crossovers, EQ bands, phase/time and channel level are each available per channel

Audio functions

Every DSP has audio functions; logically, that is what it is there for. But here, too, the PC-Tool is way ahead. This starts with self-evident things like cleanly programmed filters. Where Linkwitz is on it, Linkwitz is in it. Even a user-defined filter with adjustable quality is available; it is used, for example, to help mini subwoofers by setting a subsonic filter with overshoot. The bandpass crossovers go up to 48 dB/octave, which is generous, and there are also plenty of equalizers, typically 5 on the inputs and 30 on each output. Besides being parametric EQ, individual bands can be switched as shelf EQ for broadband frequency response alignments. There is also an all-pass filter, which is necessary for some vehicles to clean up the input signal. A delay correction is available three times; its step size and range again depend on the hardware. No matter if milliseconds, centimeters or inches; the PC-Tool is international. More about the unique self-measurement later.

As an alternative to the normal routing, virtual channel processing can be used to combine groups together and equalize them across the crossover frequencies



FX effect tools: Here the augmented bass processing with dynamic boost with frequency and maximum boost

The routing is of course free: all inputs can be mixed to the outputs as desired and with percentage accuracy, including additional sources like digital input, Bluetooth, etc. In addition to this standard routing, a number of products support VCP (virtual channel processing). Here, a virtual channel layer can be inserted between inputs and outputs, which opens up great possibilities. In the case of fully active systems, this allows the individual loudspeakers such as left/right tweeters, mid-range woofers, center, subwoofers, etc. to be adjusted in the output area so that they function perfectly in their installation environments. Time and adversities in the frequency response are corrected and the crossovers are adjusted. Several outputs can now be combined at the virtual channel level, for example tweeter, mid-range, and the left woofer becomes the virtual front left. At the virtual channel level, there are now again a total time for front left and 30 EQ bands available. In this way, the system sound can also be tuned across all crossover frequencies without having to turn the individual loudspeakers. This also works for multi-way centers and all other groups available in the VCP. Another special feature of the PC-Tool is the FX section, which refers to effects programmed entirely in house. There are the sections bass and center, which help the sound through smart algorithms. Augmented bass processing helps small subwoofers or factory systems (BMW and Mercedes) to get going; it consists of a subsonic filter, bass boost and a limiter and works dynamically, i.e. volume-dependent. This enables it to get the maximum out of the available material without overloading the loudspeakers. Centre processing generates a center signal from an existing stereo; an extremely useful feature that really works here thanks to smart programming. As usual, the user can switch on, operate various features or leave everything in automatic mode. If there is a virtual channel level, the FX effects work here; this allows, among other things, a multi-way center, which is then processed as a virtual channel.

The ISA (Input Stage Analyzer) features single or combined measurment of the input channels. Time alignment and equalizing can be applied immediately

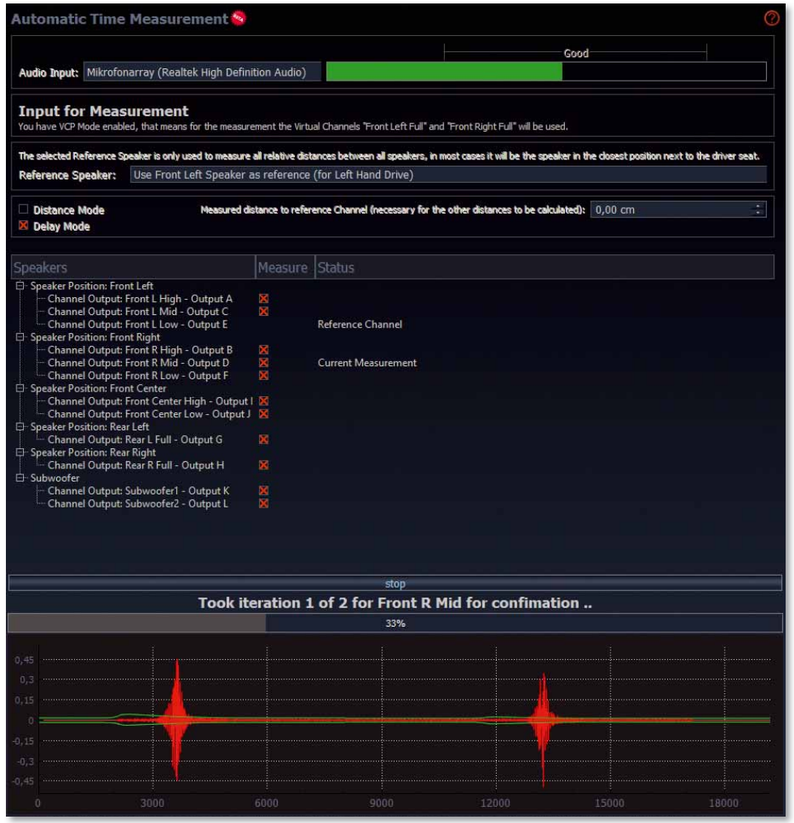
Measurement functions

The measurement capabilities of the PC-Tool are now very advanced. It starts with a self-diagnostic called device monitor, where internal temperature and operating voltage can be tracked over time. Far-reaching aid with input sensitivity settings is provided by the Gain Setup software, represented as advanced gain set-up on some models. Here, the sensitivity limits for all input channel pairs can be independently adjusted, including level display and clipping warning. Also available for the inputs is the ISA (input signal analyzer), a measurement tool that not only determines whether a signal is present but can also measure its frequency response at the same time. As in the input mixer, different inputs can be summed, so you can also track down factory all-pass filters that otherwise remain undetected. And as a bonus, the ISA also provides correction elements in the form of a delay correction of the inputs and EQ bands, which can also be used as shelf or all-pass. Through a final measurement, the success of the project is immediately monitored.

Advanced Gain Setup offers individual input gain settings, the device's maximum values are presented automatically. The actual signal level is detected and there is a optical warning in case of clipping

The other measurement functions are acoustic measurements with a microphone; the in-house microphone set can be used, but it also works with any other USB microphone. For those seeking perfection, a calibration curve matching the microphone can be uploaded. The first acoustic measurement is the automatic measurement of the times with ATM. Here a reference loudspeaker (ideally the one closest to the microphone, e.g. front left tweeter) is defined, which is measured each time together with the loudspeaker to be determined. The ATM then measures the time difference between the two and everything continues with all speakers installed. Again, an algorithm programmed in house is used, along with a self-generated double pulse as the measurement signal. This double pulse is very energetic, so it also works in the interference-rich car environment and is even suitable for subwoofers. By playing this measurement signal through the head unit, all possible delays of the original system are automatically taken into account, resulting in correct DSP settings in the end. The last measurement func-

tion is the RTA (real time analysis), i.e. a continuous frequency response measurement with pink noise, where the installer can follow the results. Here the new version 5 of the PC-Tool brings great innovations. As usual, there is an extensive settings menu in which measurement and display accuracy or even the target curve can be defined. The user has far-reaching possibilities to adapt the system to his needs, a resolution of 1/6 octave and a measuring time of 20 seconds act as standard. The entire system, individual loudspeakers or any combination of loudspeakers can be measured to optimize crossovers or the transitions between the loudspeakers of an active system, for example. As before, the user sets the desired crossover frequency and slope, only to discover during the measurement that the ideal slope is never actually reached. This is where the new TuneEQ function comes into play, which not only automatically adjusts the frequency response to the target curve via equalizer. What is new is that the crossover setting is calculated into the target curve, so that the automatic calibration includes the desired filter slew. For example, just measure the tweeter to be adjusted with the high-pass 2.5 kHz/24 dB; the system then precisely adjusts its frequency curve including the 24 dB slope to low frequencies. The ingenious thing is that all EQ parameters frequency, gain and Q are calculated depending on a given deviation (e.g. 0.5 dB). This is a tremendous computational effort, since the bands overlap and therefore influence each other. The same is then done analogously with the corresponding mid-range and you get almost perfectly symmetrical filter edges, which then also add up optimally for a perfect transition. The highlight is that you can adjust the TuneEQ function to suit again. You can release any number of the existing 30 EQ bands for TuneEQ; with the rest you can then possibly manually rework or shape the frequency response via Shelf. Thanks to the automatic mode, the crossing of each individual loudspeaker takes place within minutes, which is a huge relief for the installer. And the entire thing also works in the virtual channel layer of the VCP; here you can, for example, work on the sound with a self-created target curve quite easily. Overall, the PC-Tool does not yet replace a professional measurement system, but it is steadily getting closer to it. In the meantime, a complete car audio installation can also be done only with the PC-Tool, and better and more comfortable than ever.



ATM (automatic time measurement) uses two custom signals. An input level display makes it easy to apply the correct signal strength

User interface

First and foremost, one has to praise the overall presentation of the PC-Tool, it is clearly and logically structured, nicely done visually and offers a lot of tools at. Second, the extensive configurability pleases, which allows the user to customize pretty much everything as he would like. Starting with the window size or the integration of the RTA measurement into the output or VCP window up to the setting of gain control and EQ step widths. Different displays can be switched back and forth, the EQs can also be dragged and dropped or linked relatively or absolutely. There is also an extensive set of keyboard shortcuts. The remote controls can be configured, regardless of whether under wired remote control URC, Conductor, Director or Wi-Fi control. Wireless programming is now also possible with the high-resolution Bluetooth module BT HD. And nice features like the (also partial) export and import of DSP settings from one device to the other are gladly welcomed by the professional installer. The same goes for undoing settings of the time machine.

RTA measurement of a mid-range woofer: Original curve (red) and result with 24-dB crossing (white). You can see the correction via TuneEQ in green and, at the bottom, the EQ bands 4 – 24 are accordingly adjusted. We measured with an accuracy of 1/6 octave and standard smoothing; finer is possible if desired

Conclusion

The DSP PC-Tool 5 is more than just a collection of DSP features. In the audio area it has an extremely competitive range of functions and the measurement functions makes the installers life easier. Once again, we must praise that already purchased DSP products, when possible, all enjoy new features and ongoing updates, which are, of course, free. With the total package DSP PC-Tool 5 we have a tool in front of us that shines with an entire range of unique features and provides from vehicle integration to custom sound in a leading way.

Elmar Michels

RTA measurement of the mid-range woofer and tweeter together after single adjustment via TuneEQ. The target curve was reached with a maximum deviation of 0.7 dB

Next issue August 14, 2022

Coming soon

CAR&HiFi INTERNATIONAL 1/21

Imprint

- Editor and Publisher:
  Michael E. Brieden Verlag GmbH
  Gartroper Straße 42, D-47138 Duisburg
  Tel.: +49 (0)203 4292-0
  www.carhifi-international.com
- Editor-in-Chief
  Elmar Michels
  e-mail: michels@brieden.de
- Editorial management
  Dipl-Phys. Guido Randerath
- Test and editorial team
  Elmar Michels, Dipl.-Phys. Guido Randerath, Michael Bruss
- Test equipment management
  Michael Rochow
- Reader service
  Michaela Erkens
- Ad processing
  Heike Pens
- Advertising management print + online
  Responsible for content according to § 10 Absatz 3 MDStV (German Law):
  Michael E. Brieden, e-mail: info@brieden.de
- Photography
  Stephan Schlüter
- Art direction, graphics and layout
  Claudia Hurtienne, Heike Jans, Anna Wagner