

CAR & HiFi

INTERNATIONAL

3/22 · 4,80 €

 **HELIX**
P SIX DSP
ULTIMATE
MADE IN GERMANY

European Edition

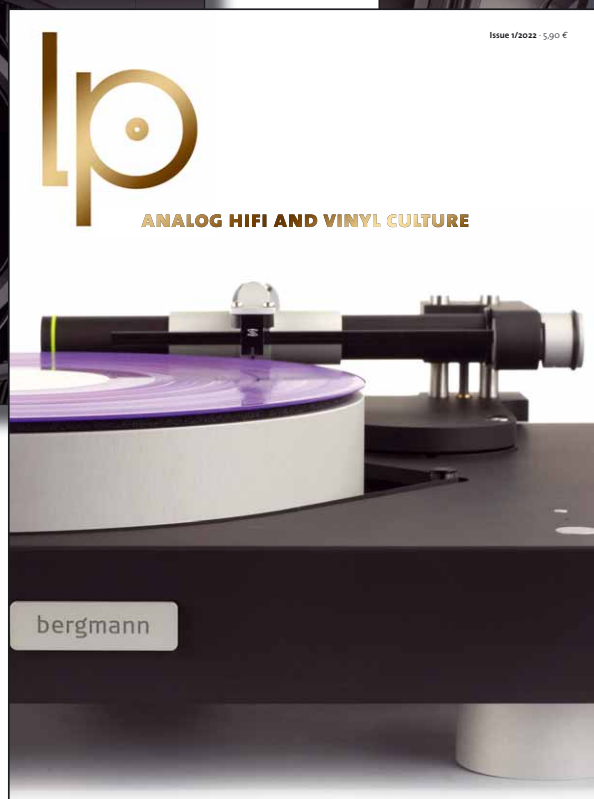
Featured brands

- Audio System • Blaupunkt • ESX
- Ground Zero • Helix • Hifonics
- Phoenix Gold • Seta Audio

Best topics

- Retro radio in the design of the 90s
- Powerful DSP/amplifier
- High End component system
- Flat but powerful subwoofers
- 5 digital amplifiers in test

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Now available

MUSWAY

THE DSP EXPERTS



Also controllable
via smartphone
with the new
MUSWAY TUNEST app

All 12 channels
are bridgable!



M12 NEW

12-CHANNEL CLASS D AMPLIFIER WITH 16-CHANNEL DSP
@ 4/2 Ohms 85/120 Watts RMS per channel*
@ 4 Ohms bridged 240 Watts RMS per channel pair*
12 x High Level Input 8 – 24 V RMS with EPS
6 x RCA Low Level Input 2 – 6 V RMS
1 x RCA AUX Input/Stereo 2 – 8 V RMS
1 x Optical Input/Stereo (PCM, 192 kHz / 24 bit)
4 x RCA Pre-Amplifier Output (configurable via DSP)
12 x Loudspeaker Output amplified
Dimensions: 340 x 48 x 171,5 mm
* depending on the application



The State-of-the Art DSP Power Amplifier!

“12 amplifier channels and 16 DSP channels, no aftermarket device has more to offer...”

Elmar Michels, Car&HiFi 2/2022



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TECHNIK FÜR KLANGBEGEISTERTE

Retrospect and outlook

CAR&HIFI INTERNATIONAL has been around for over a year now. And this year 2022 is the first with our regular publication three times a year. We want to continue this in the future, so that next year you can look forward to the latest tests of the most exciting devices in the car entertainment circus that will

be featured in this magazine. Until then, Until then, have fun with lots of music in your car!



Elmar Michels
Editor-in-chief



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



CAR SPECIFIC

GZCS DSPA-4.60ISO

- 4-channel amplifier with built-in DSP
- 4-channel ISO-harness
- 8-channel DSP with 4-channel line output
- 2x Analog Devices SigmaDSP
- Auto-on function & turn-on delay
- Ready for start-stop vehicles
- Realtime setup (via PC or APP*)
- One-page graphical user interface
- Frequency response 20 Hz - 20 kHz (-3 dB)
- Input sensitivity 1.5 - 13 V
- 4 x 45 W RMS @ 4 ohms ≤ 1% THD+N
- 4 x 60 W RMS @ 2 ohms ≤ 1% THD+N
- 4 x 70 W max @ 2 ohms ≤ 10% THD+N

- Wireless music streaming with interface GZDSP BTS 4-8XII (available optionally)

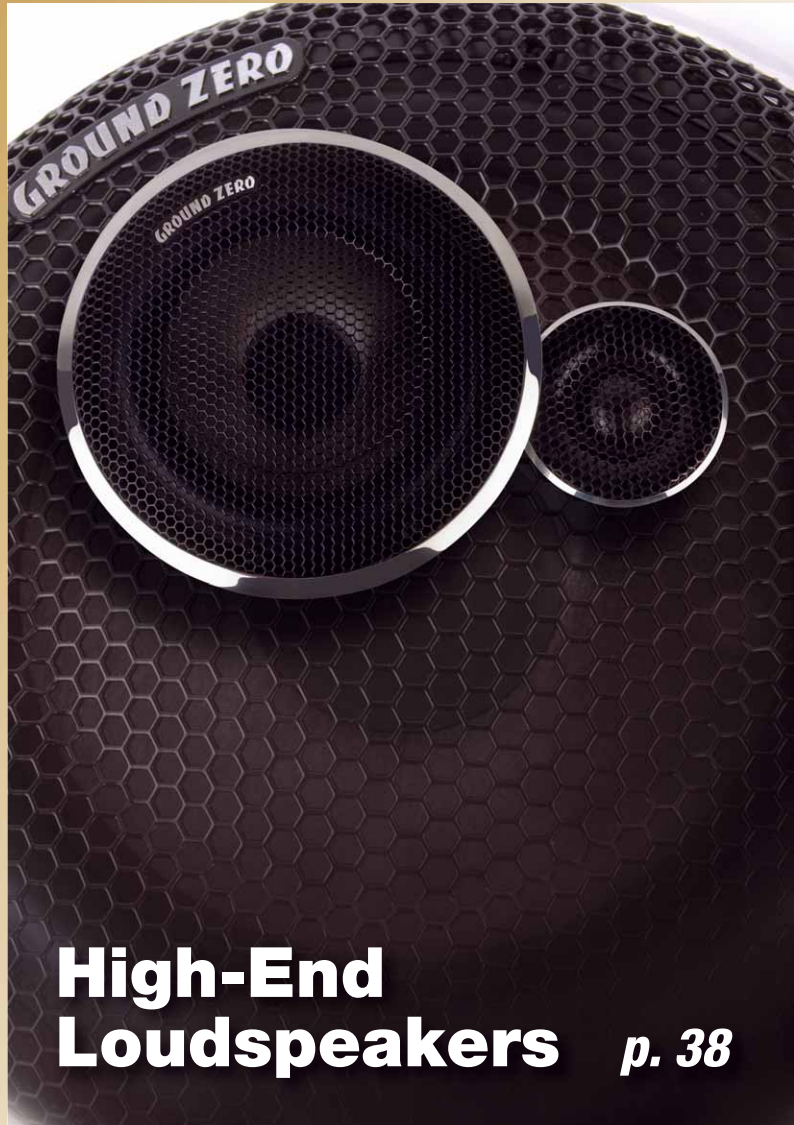


- Remote control socket for wired remote GZDSP REM 4-8XII-S (available optionally)





Top-class 6.5" components *p. 46*



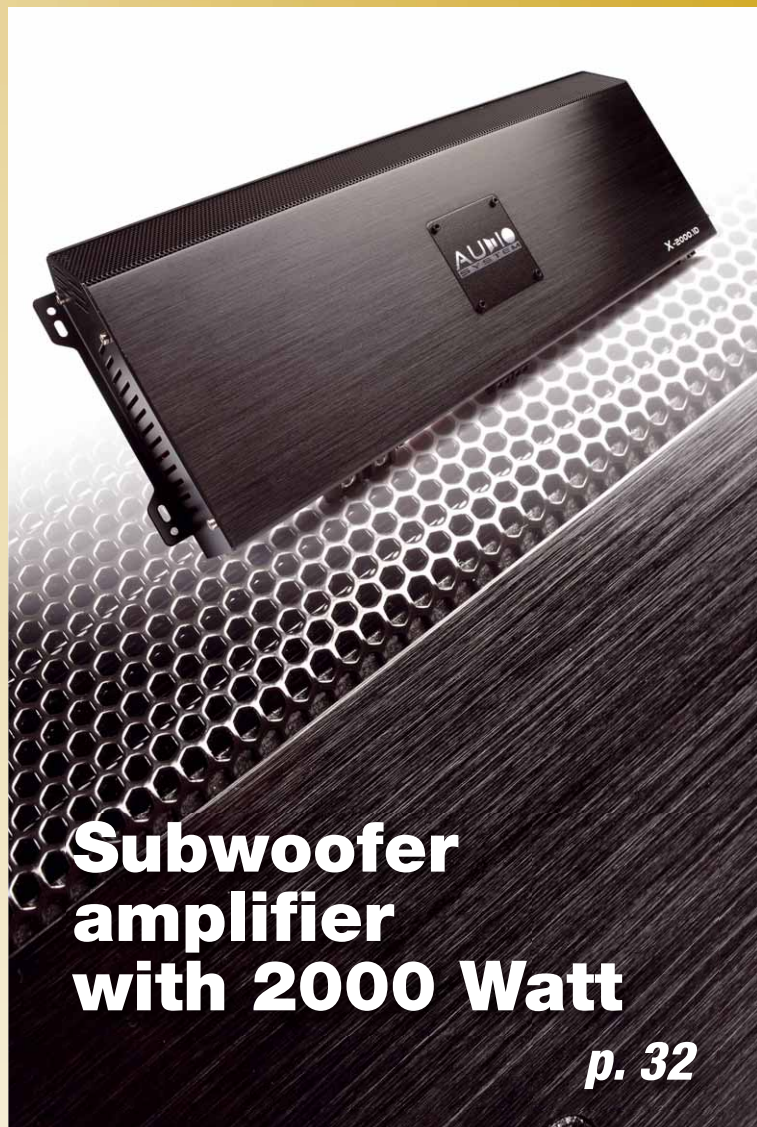
High-End Loudspeakers *p. 38*



Retro Radio *p. 8*



Bass unobtrusively integrated *p. 52*



Subwoofer amplifier with 2000 Watt *p. 32*

Tests

Retro Radio

Blaupunkt Frankfurt RMC 82 DAB: Modern Technology with a 90s Look 8

Premium DSP amplifier

Helix P SIX DSP Ultimate – 12-channel DSP with 6-channel amplifier 14

Compact Amplifiers from Hifonics

Hifonics ZXS900/1 + ZXS550/2 + ZXS700/4 – digital compact amplifier series 24

Subwoofer amplifier with 2000 Watt

X-2000.1 D – powerful bass amplifier from Audio System 32

High-End Loudspeakers

GZ ULTRA T-30 + K-165 – new top line from Ground Zero 38

Top-class 6.5" components

ZR65CS – ZR series speakers from Phoenix Gold 46

Sound Magic

Seta-Audio SCT – Sound tuning of factory loudspeakers 52

Flat subwoofers with power

ESX VXP84 + VXP104 – powerful subwoofer drivers with a low mounting depth 58

Categories

Editorial	<u>3</u>
News	<u>6</u>
Imprint	<u>66</u>
Coming soon	<u>66</u>

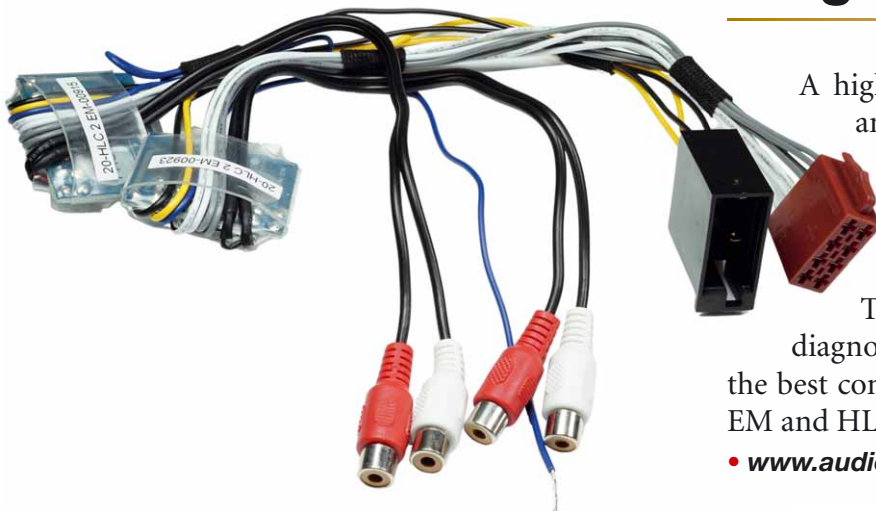
► Amplifier series

Phoenix Gold presents three new amplifiers within the ZR series: the four-channel power amplifier ZR6004 and the two mono amps ZR10001 and ZR20001. The ZR Series Class-D amplifiers feature a fantastic design suitable for a variety of different installs. Featuring our high-quality circuit board design, the ZR amps use a high-grade connection terminal to ensure the best possible connection for massive power delivery to all your components.

• www.phoenixgold-eu.com



► High-low adapter



A high-low adapter is useful if you want to use an amplifier with standard RCA inputs on a factory radio. The HLC2 and HLC4 adapters from Audio System with 2 and 4 channels are now also available without a plastic housing as easy mounting versions with welded electronics.

The functions such as remote signal, loudspeaker diagnostic circuit and the good sound quality thanks to the best components are a matter of course with the HLC2 EM and HLC4 EM.

• www.audio-system.de

► Ducato subwoofer

With the QXF201A, ESX is expanding its range for the Fiat Ducato with an active subwoofer system. Class A/B amplifier, 20cm woofer, bass level remote control, power cable connector and stereo cinch audio cable and features such as bass boost, low-pass filter and automatic switch-on function are among the attributes. Thanks to the supplied metal bracket for mounting below the cup holder, the up to 200-watt power dwarf is perfectly placed and ready to play in no time.

• www.esxaudio.de/english/





VISION

ULTRA CLASS D POWER

**THE NEW HIGH POWER SPL
DIGITAL AMPLIFIERS
WITH UP TO 13.000 WATTS RMS**



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Ultra Class D 4-Channel Amplifier
4 x 200 / 350 Watts RMS @ 4 / 2 Ω



VX 2000 PRO

Ultra Class D Mono Amplifier
1 x 800 / 1.500 / 2.200 Watts RMS @ 4 / 2 / 1 Ω



VX 3000 PRO

Ultra Class D Mono Amplifier
1 x 1.200 / 2.200 / 3.300 Watts RMS @ 4 / 2 / 1 Ω



VX 5000 PRO

Ultra Class D Mono Amplifier
1 x 1.800 / 3.300 / 5.000 Watts RMS @ 4 / 2 / 1 Ω



VX 8000 PRO

Ultra Class D Mono Amplifier
1 x 2.500 / 4.800 / 8.000 Watts RMS @ 4 / 2 / 1 Ω



VX 13000 PRO

Ultra Class D Mono Amplifier
1 x 3.000 / 6.500 / 13.000 Watts RMS @ 4 / 2 / 1 Ω



ESX is a brand of Audio Design GmbH
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Tel. +497253 - 9465-0 · Fax 946510
www.esxaudio.de - www.audiodesign.de

SPL
PRO SERIES

Universal for all vehicles with a DIN radio**Blaupunkt Frankfurt RMC 82 DAB:
Modern Technology with a 90s Look**

Retro Radio

- ▶ The Frankfurt RMC 82 car radio was available from 1992 to 1994, when it was the dream of many car hi-fi enthusiasts. Now Blaupunkt brings a remake of this legend with modern technology.





The brand new Frankfurt RCM 82 DAB mimics the 90s perfectly

When I first held the Frankfurt's test sample in my hands, I assumed someone was pulling a prank. Why should I test a 30-year-

old cassette radio? And more importantly, how? As if I still had the old test procedures and cassettes at hand. A note to our young readers:

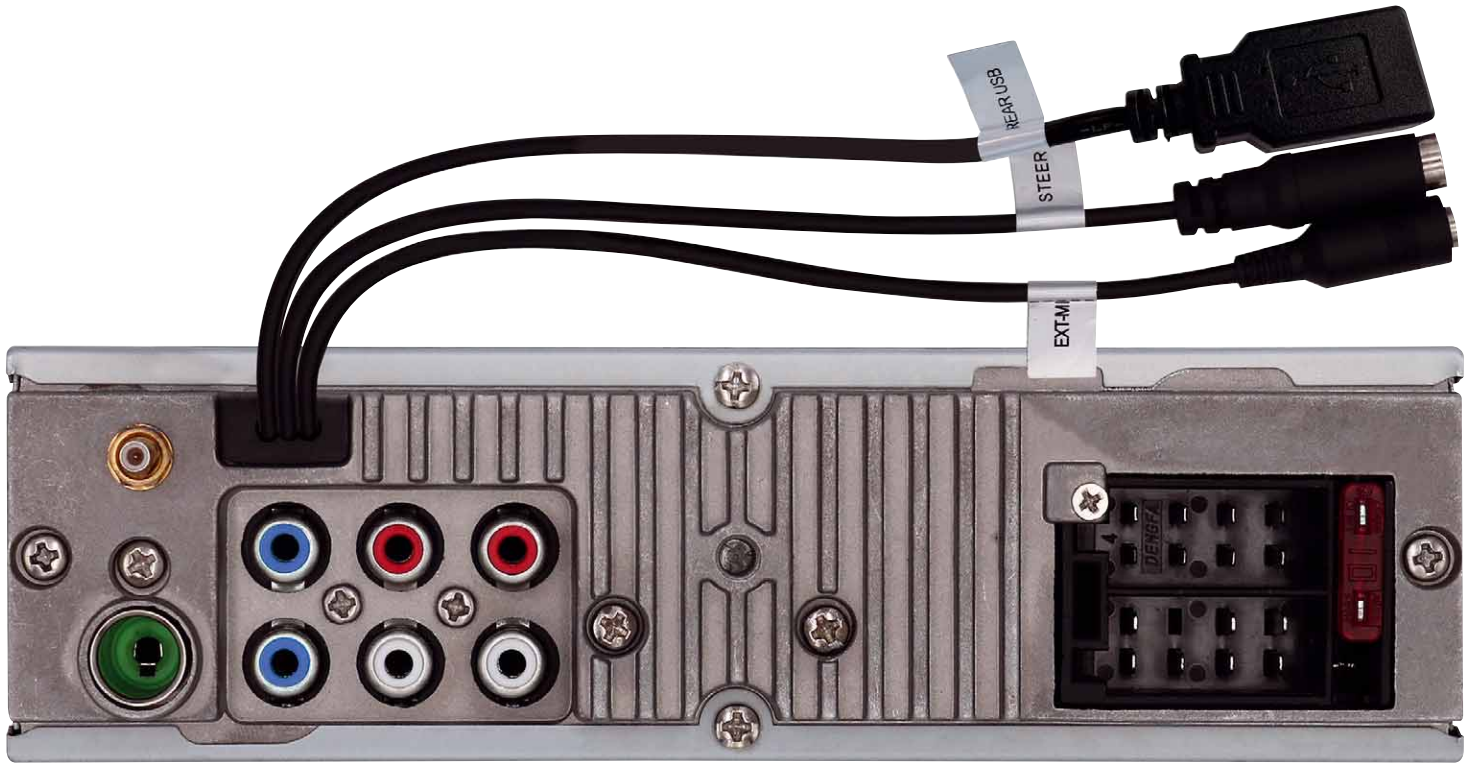
cassettes are the things that earlier generations used to record the radio program, and which constantly produced tape messes that had to be wound up again using a pencil.

Ingeniously done

At second glance, and with the addition of the name „DAB,“ it becomes evident that this is by no means a 30-year-old classic but a modern radio with the corresponding technology. The look of the front is inspired by the original in every detail. The button arrangement is identical. However, the functionality and labeling cater to today's media.



Connection diversity: USB



The six RCA outputs can be controlled by high-pass and low-pass filters

The „cassette slot“ is a flap behind which a USB port, an aux-in, and a card slot hide. The orange trim strip below the display is an ingenious

detail. Here was the orange key card for theft protection, typical for Blaupunkt at that time, on the 1992 model.

Modern media

The Frankfurt's entertainment offering certainly didn't remain in the nineties. It receives radio programs via analog FM and AM and digitally via DAB+. It connects to smartphones via Bluetooth and USB. Besides the USB interface in the „cassette slot,“ another one is on the back. Both also work with iPhones. Analog sources can be fed in via a mini jack. The micro-SD slot is also available for music playback.



Connection diversity:
SD



The "cassette compartment"...

Bluetooth

When the smartphone is paired, you can stream music wirelessly via Bluetooth. With „Navi Mix“ activated, navigation announcements from the cell phone can also mix into another playing music source, e.g., DAB+. Hands-free calling is, of course, also possible. The necessary microphone is located in the front of the car ra-

dio. Alternatively, you can connect an external microphone, which the Blaupunkt automatically recognizes.

Audio

Separate preamplifier outputs for external power amplifiers are available for the front, rear, and subwoofer. Using high-pass and low-pass filters, you can supply them with

the appropriate frequency ranges. In addition to the usual bass and treble controls, a 14-band equalizer is available for adjusting the sound. You can vary the respective filter quality (width of the control range). A loudness functionality is available. Via USB and Micro-SD, you can play the formats MP2, MP3, WMA, FLAC, M4A (AAC), APE, and WAV.

Test results

Compared to a more contemporarily designed car radio, the Blaupunkt Frankfurt has a lot of buttons. This may seem unusual to some, but you quickly learn to appreciate it. Most of the functionality can be accessed directly by simply pressing a button without struggling with more or less complex menus. And a rotary control is still the best for volume control.



Connection diversity:
analog sources



... contains micro SD, USB, and Aux-In

The new Frankfurt performs absolutely up to par in our lab and practical tests. The measurement values are impeccable, as are the sound, the reception, and the functionality.

Conclusion

The Blaupunkt Frankfurt RMC 82 DAB is an ultra-modern car radio visually modeled on the legendary classic from 1992 down to the last detail. Anyone who wants to equip their youngtimer from the 90s with today's media in style will find the appropriate solution here.

Guido Randerath

Specifications	
Amplifier power (W)	15
Output voltage (V)	2.5
Output impedance (ohm)	740
USB	
THD+N (%)	0,042
SNR (A)	86
Tuner	
THD+N (%)	0,036
SNR (A)	60
Crosstalk (dB)	43
RDS	•
Station memories	20
MP3/WMA/AAC	• / • / •
Mute/GAL	• / -
Loudness	•
Treble/bass pots	•
param./graph. EQ bands	- / 14
Pre-outs	6
Crossovers	HP / TP
Time alignment	-
Removable front	-
Remote Control	optional
AUX front/rear	• / -
USB front / rear	• / •
iPod control	•
Bluetooth HFP/A2DP	• / •
Other	DAB+

Blaupunkt Frankfurt RCM 82 DAB vehicle compatibility

All cars with a DIN slot. Installation and connection adapters are available in the aftermarket for many other models.

Blaupunkt Frankfurt RCM 82 DAB

Price	500 Euro
Contact	Evo Sales GmbH, Germany
Internet	www.blaupunkt.com

Rating

▶ Sound	35 %	★★★★★
Bass foundation	7 %	★★★★★
Neutrality	7 %	★★★★★
Transparency	7 %	★★★★★
Spatiality	7 %	★★★★★
Dynamics	7 %	★★★★★
▶ Lab	20 %	★★★★★
• USB	10 %	★★★★★
Distortion	5 %	★★★★★
Signal-to-noise ratio	5 %	★★★★★
• Tuner	10 %	★★★★★
Frequency response	2,5 %	★★★★★
Crosstalk	2,5 %	★★★★★
Distortion	2,5 %	★★★★★
Signal-to-noise ratio	2,5 %	★★★★★
▶ Practice	45 %	★★★★★
Operation	10 %	★★★★★
Features	20 %	★★★★★
Reception test	10 %	★★★★★
Build quality	5 %	★★★★★

Top Class



CAR & HiFi

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Price/performance: very good

„Modern technology with a 90s look.“

Helix P SIX DSP Ultimate - 12-channel DSP
with 6-channel amplifier

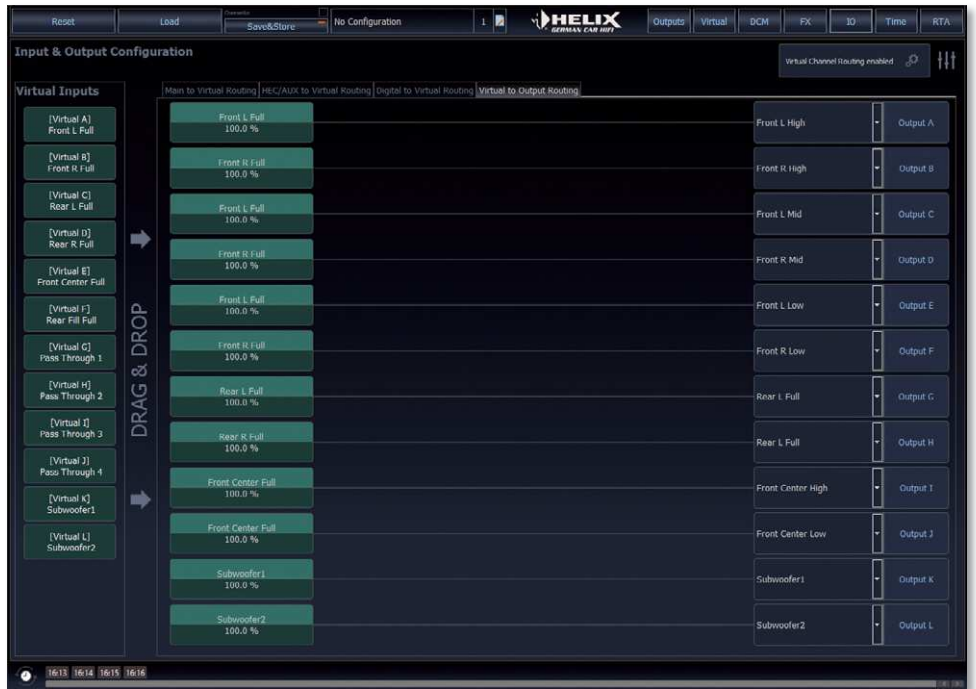
Premium DSP amplifier

Digital technology for the highest demands

- ▶ With the P SIX, Helix may not have opened a new amplifier genre, but it has shown that Class-D amplifiers can be more than efficient and practical. Now comes the P SIX DSP Ultimate, a brand-new upgrade that has been improved in every way.

 **HELIX**
P SIX DSP
— ULTIMATE —
MADE IN GERMANY

The new P SIX DSP Ultimate is only recognisable as a new model at second glance. It comes in the same, noble black aluminum housing as the MK2, only that above the “Made in Germany” logo instead of “MK2” now reads “Ultimate”. In Schmallenberg, Sauerland, they are very proud that many products are manufactured in house, and they are even particularly proud of the P SIX DSP Ultimate, because it represents the flagship of the in-house DSP amplifiers. Back in 2015, Helix placed the P SIX DSP at the very top of the market. Clearly, “digital” Class-D amplifiers were the future, only that most approaches went in the direction of all-in-one, small and practical. The P SIX, however, was intended to play on the level of the best analogue amplifiers, only with modern, efficient technology – a DSP amp for high enders. A lot has happened since then and it was time to update the P SIX. For some



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

time now, Audiotec Fischer, the parent company of the Brax, Helix and Match brands, has been a development partner of Texas Instruments.

This involves the amplifier ICs, which are jointly being advanced further and further. The latest generation of these marvels manages



The 6 processed outputs are distributed over 4 RCA sockets and the digital optical output. The inputs feature 6 x RCA, 6 x high-in and digital, either optical or coax

HELIX

P SIX DSP

ULTIMATE

MADE IN GERMANY

Helix P SIX DSP Ultimate

Dimensions
(L x W x H in mm) 260 x 190 x 50

Inputs

- 6-channel RCA
- 6-channel High-level
- 2 x digital S/PDIF (optical + coax)
- Sensitivity Low: 4/16 V, High: 8/32 V (via jumper)

Outputs

- 4-channel RCA (3 V)
- S/PDIF (optical, stereo)
- Remote-out

DSP-Channels

- 12 Outputs + 8 virtual channels

DSP-Software (V 5.00)

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 96 kHz, 3,5 mm increments (0,01 ms)

Inputs:

- 0 – 5,20 ms, 256 samples

Virtual channels:

- 0 – 708 cm (20,82 ms), 2048 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), automatical adjustment including filter slopes
- 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
- 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

to deliver enormous power, but without the usual 10% distortion that chip manufacturers like to write into the data sheet. The usual applications for amplifier chips are smartphones, Bluetooth speakers or soundbars, nothing to do with building a noble car hi-fi amplifier. So a lot of development work has gone into the P SIX DSP Ultimate, e.g. also in the mounting and fixing of the chips, which is extremely important for optimal heat dissipation and thus performance. However, the most important innovation of the P SIX DSP Ultimate might be the upgrade to the current coprocessor platform ACO. Not only is a powerful 32-bit processor used; it is also integrated into the audio work by Helix. This is because Helix programs quite a few features itself, which go far beyond the standard functions of the signal processor. Sound effects like the FX functions or even the (in)measuring functions are not possible without the help of a powerful coprocessor.

Software

All DSP products of the Brax, Helix and Match brands are controlled by the DSP PC tool, which is now available in version 5 free of charge. 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 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.

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 EQs, tolerance thresholds and the number of EQs to be used can be set here. Version 5 also allows the adjustment of individual speakers with their crossovers, creating perfect acoustic filter slopes that then also add to a clean SPL summation when the speakers play together.

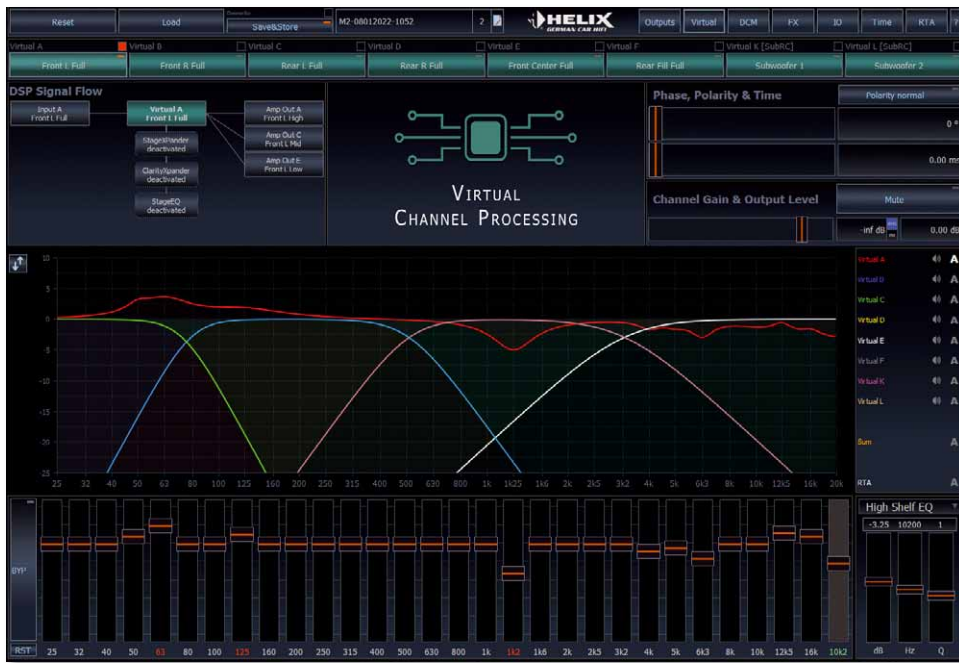
The ISA can also be used to measure sums of several inputs, thus tracking down hidden all-pass filters that remain inconspicuous in individual measurements. This electrical measurement of the inputs saves the installer a lot of time in troubleshooting and tuning of the DSP, because at the same time as the measurement, the input EQs (and the input time) can be set with immediate success control. Furthermore, there is the ATM (auto-

matic 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.

The current version also includes the advanced import function of setups, which is now also available for the inputs. This makes life easier, especially for professionals, because it allows previously created setups to be transferred in whole or in part to the fresh unit. For example, the existing subwoofer settings of an existing setup can be placed on any two channels with a click. The transfer of high pass, low pass, EQ, gain and name from any channel to any channel is possible for inputs and outputs – practical for power users. Very praiseworthy are the numerous integration features like power save mode for CAN vehicles or bypass circuits for diagnostic programs of some factory radios and a freely configurable source management with automatic switching of sources and vehicle sounds. The in-house ADEP.3 system is capable of bypassing the speaker diagnostics of some vehicles, thus bypassing error codes or even disabling channels.



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



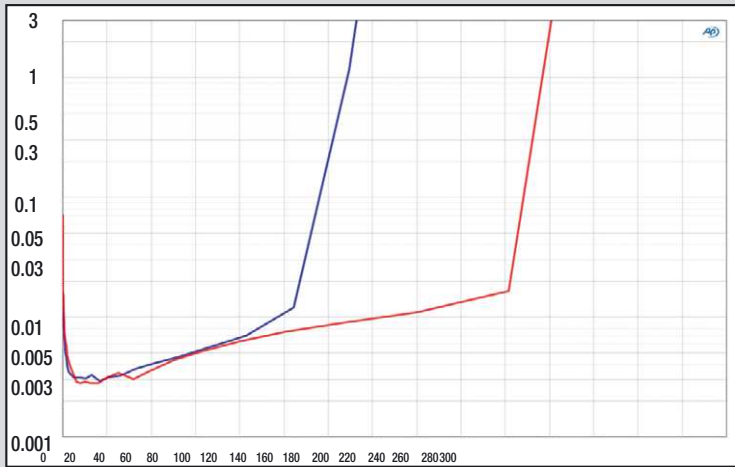
As an alternative to the normal routing, virtual channel processing can be used to combine groups together and equalize them across the crossover frequencies

The third powerful innovation concerns the DSP itself. Of course, the P SIX DSP Ultimate must be able to do everything that technology can offer. The hi-res frequency range up to over 40 kHz requires a sampling rate of 96 kHz (i.e. a doubling of computing power compared to 22 kHz/48 kHz), 12 DSP channels and also the in-house Virtual Channel Programming with additional virtual channels that also need to be calculated; all this requires a second DSP chip. The P SIX DSP Ultimate thus belongs to the few dual-core DSPs on the market, in this case with the Analog Devices team ADAU1462 and ADAU1452. The model was of course the Helix DSP Ultra, which is not 1:1 in the P SIX, but almost. For comparison: The V Twelve DSP processes 14 DSP channels + VCP, but is not capable

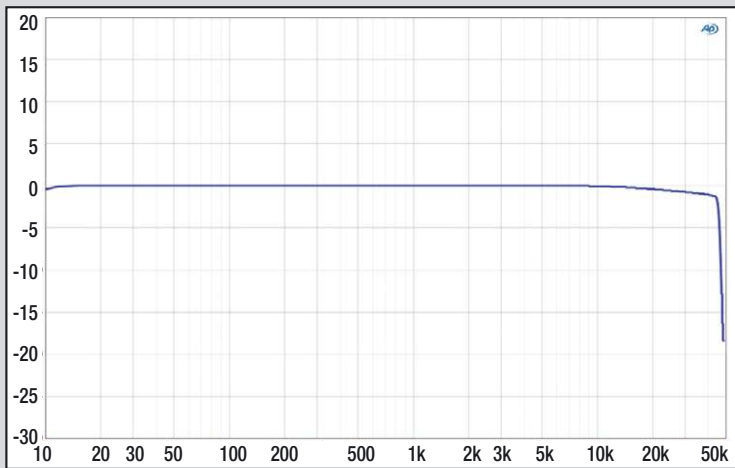
P SIX Ultimate in action, flanked by the appropriate partners P TWO and P ONE



CAR & HIFI Laboratory



The P SIX DSP Ultimate is one of the most powerful multi-channel power amplifiers. With approx. 130 and 220 W at 4 and 2 ohms, it has plenty of power, which is also accompanied by extremely low distortion



The P SIX DSP Ultimate shows an audio frequency range of up to more than 40 kHz thanks to the high sampling rate of the DSP and the high PWM frequency of the Class-D power amplifiers

of handling hi-res frequency range. The Helix DSP PRO MK2 can do 10 channels and hi-res, but is not capable of handling VCP (the DSP PRO MK3 with everything will be dual-core).

The well-known step-up power supply has also been improved with a new circuit concept; we now have to deal with a synchronous step-up converter, which works even more efficiently. The concept of the signal-dependent regulated internal operating voltage, which switches the voltage down when the signal is weak in order to save power and produce less heat, has also been adopted, which increases efficiency.

All analogue inputs can be adjusted in sensitivity with jumpers, which allows an optimal adaptation to the source and reaches up to 32 volts at the high level input to adapt even top factory systems. And digitally speaking, the P SIX Ultimate is also richly equipped. At the input there is either an electrical or an optical input available, at the output there is an optical S/PDIF for the processor channels K and L, which then drive a subwoofer amplifier, for example. This is also the concept of the P SIX DSP Ultimate: Instead of using a single DSP amplifier to power the entire system, the P SIX DSP Ultimate works together with the matching P TWO and P ONE two-channel and mono amplifiers as the control center of a high-end system. The result is a truly high-end audio system in which power and performance are beyond reproach.



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



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 - Ideal für Neufahrzeuge
- Kein Eingriff in die Fahrzeugelektronik
 - Keinerlei Umbaumaßnahmen
- Kein Austausch von Komponenten
 - Alles bleibt original
- Überarbeitung der originalen Lautsprecher
 - 2 Jahre Garantie
- Etabliert in unseren eigenen Highend-Lautsprechern

vorher

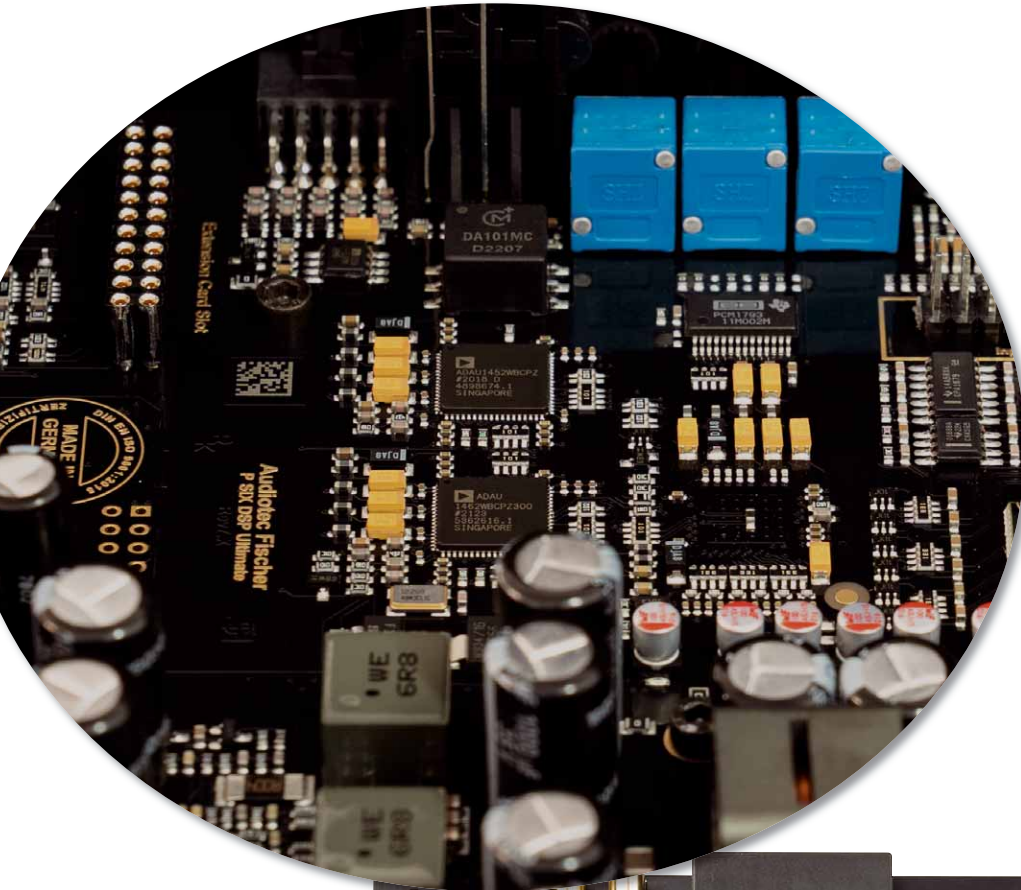


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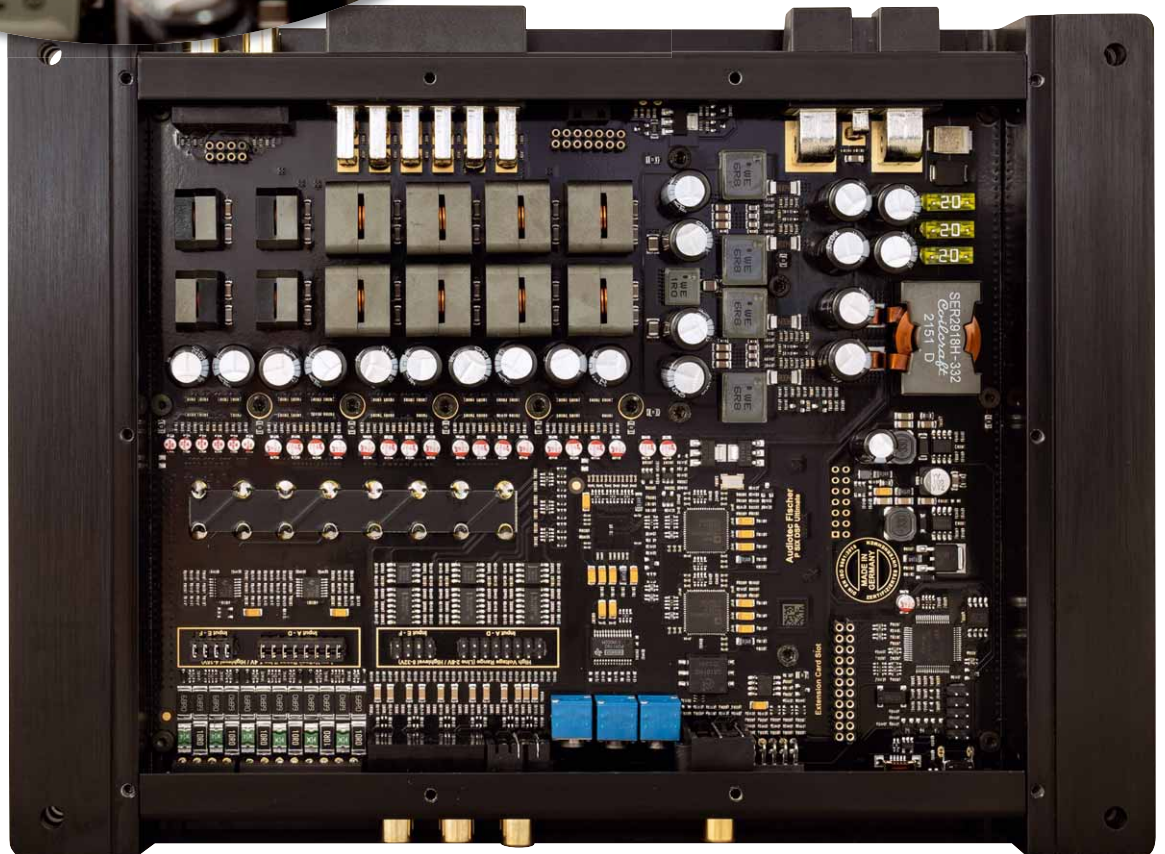


• SETA • AUDIO

• www.seta-audio.de • info@seta-audio.de



Everything on the board is new. A highlight is the DSP department, which now has two processor chips



Measurements and sound

During the measurement, we clearly state that the P SIX DSP Ultimate is one of the best amplifiers ever created. Whether analogue or digital, the P SIX DSP Ultimate is at the very highest level. With a channel power of 129 watts at 4 ohms and 219 watts at 2 ohms, it is one of the most powerful full-range amps ever with more than four channels. This is almost twice as much as a multi-channel all-in-one solution - the TI chips say hello! But that is not enough; it also delivers an extremely clean performance. Only 0.003% THD+N at 5 watts and 0.005% at half-load are extremely good values. The signal-to-noise ratio is also top notch for such a sophisticated amplifier, and even the damping is impressive. And in terms of sound? Beyond any doubt. There is no music genre and



The P SIX DSP Ultimate differs only in the lettering from its predecessors

no passage, no matter how difficult, that the P SIX DSP Ultimate cannot master. It pleases with brute power as well as with breathtaking dynamics. Then it serves acoustic sounds with the finest details, which are perfectly reproduced in the room. Troubleshooting is pointless. Rather, the P SIX DSP Ultimate belongs to those amplifiers that also convey the mood and atmosphere of the music, so that one easily forgets to listen to a canned sound. Maybe even too good or too spectacular? In any case, not common at this level.

Conclusion

With its outstanding features, the P SIX DSP Ultimate basically has no competition. It is a top-notch 6-channel DSP amplifier in its own right or the perfect control centre for a full-blown audio system with high-end aspirations.

Elmar Michels

Specifications

Channels	6
Power 4 ohms	6 x 129
Power 2 ohms	6 x 219
Power 1 ohms	0
Bridged Power 4 ohms	0
Bridged Power 2 ohms	0
Sensitivity max. mV	830
Sensitivity min. V	3,3
THD+N (<22 kHz) 5 W	0,003
THD+N (<22 kHz) Half Power	0,005
Signal-to-noise ratio dB(A)	96
Damping factor 20 Hz	118
Damping factor 80 Hz	118
Damping factor 400 Hz	115
Damping factor 1 kHz	106
Damping factor 8 kHz	15
Damping factor 16 kHz	4

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	0, 180°/LZK via DSP
High-level inputs	•
Automatic switchon (Autosense)	• DC or signal
RCA output	•, 4 CH processed
Start/stop capable	• (6 V)
Dimensions (L x W x H in mm)	260 x 190 x 50
Others	12-channel DSP

Helix P SIX DSP Ultimate

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

“Class-D amplifier with DSP for high-end demands.”

Hifonics ZXS900/1 + ZXS550/2 + ZXS700/4 –
digital compact amplifier series

Compact Power Amplifiers from Hifonics

- ▶ Hifonics continues to expand its amplifier program. With the ZXS series, three new amplifiers are entering the race to win over buyers of compact digital amplifiers.



ZEUS

HIFONICS

ZX5 550/2 · 2 x 275 WATTS

ZEUS

HIFONICS

ZX5 700/4 · 4 x 175 WATTS

HIFONICS

ZX5 900/1 · 1 x 900 WATTS



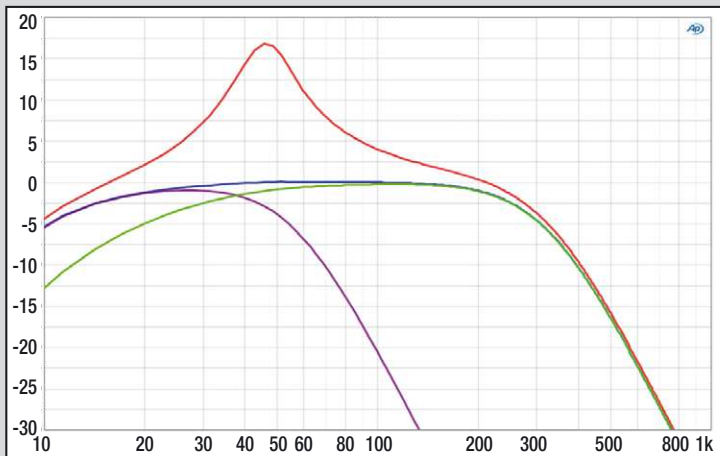
Modern, highly integrated design: mono amplifier with large Class-D inductor (center)

Hifonics has taken longer than other brands to jump on the bandwagon of compact digital amplifiers. For this reason, all the more amplifiers from this segment have recently been added to the Hifonics product range. We tested the Pluto series, a small mini-amplifier, in the

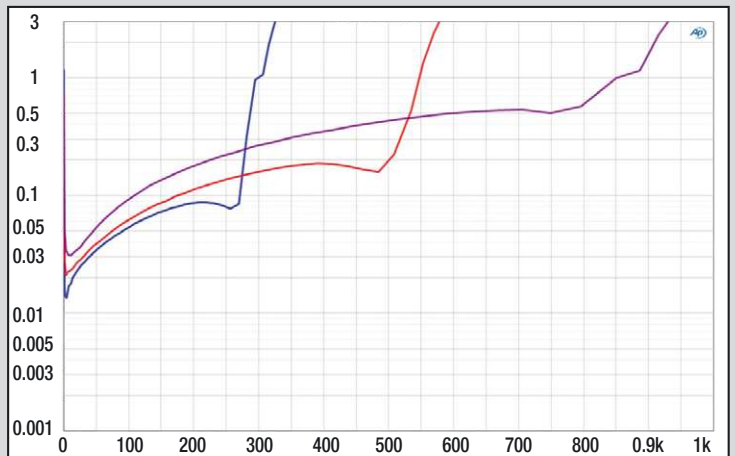
last issue. On the other hand, Hifonics offers its ZXR amplifiers, which score with massive power and still compact dimensions. Here come the new ZXS amplifiers, positioned right between Pluto and ZXR. They are in the middle in terms of size and power, which also applies to

the prices. So if it doesn't have to be quite so blatant power, the new ZXS are the first choice because, with 135 watts per channel, even the four-channel power amplifier is anything but weakly equipped and also an amplifier for advanced users. Of course, the two-channel and

CAR & HI-FI Laboratory



The ZXS900/1 comes with a (flat) subsonic filter and a (high) bass boost. We would have done that the other way around



Power burst with the ZXS900/1: With moderate distortion, there are 300, 550, and at the kink, almost 900 watts for the sub



The mono amp features a lot of controls. Subsonic filter, bass boost and low pass can be adjusted

mono models have even more power, and all three offer a great deal of power for money. Hifonics has saved a bit on the features, at least in the two- and four-channel models. They provide only the basic filters: There is no bandpass, for example. The connection and integration options are very good for all three ZXS. The amps have the EPS for vehicles with loudspeaker diagnostics, and there are automatic switch-ons either according to DC offset or signal. The amplifiers are start-stop capable and do not interfere with radio reception (in the case of the ZXS550/2 with half an eye closed). Hifonics did not save on the internals at all. Here things are modern and quite generous. All three ZXSs are equipped with powerful transformer power supplies, whose control is located on daughter boards to save space. ZXS550/2 and ZXS700/4

Specifications	
Channels	1
Power 4 ohms	306
Power 2 ohms	547
Power 1 ohms	877
Sensitivity max. mV	200
Sensitivity min. V	4,6
THD+N (<22 kHz) 5 W	0,015
THD+N (<22 kHz) Half Power	0,074
Signal-to-noise ratio dB(A)	82
Damping factor 20 Hz	1118
Damping factor 40 Hz	2236
Damping factor 60 Hz	2236
Damping factor 80 Hz	2236
Damping factor 100 Hz	4472
Damping factor 120 Hz	4472

Features	
Low pass	50 – 250 Hz
High pass	–
Band pass	15 – 150k Hz
Bass boost	0 – 18 dB/45 Hz
Subsonic filter	15 – 30 Hz
Phase shift	–
High-level inputs	•
Automatic switch-on (Autosense)	•, DC or signal
RCA output	–
Start/stop capable	• (7,1 V)
Dimensions (L x W x H in mm)	230 x 112 x 44
Others	EPS, remote control

Hifonics ZX5900/1

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

Rating

▶ Sound	20 %	★★★★★
Bass foundation	5 %	★★★★★
Bass pressure	5 %	★★★★★
Accuracy	5 %	★★★★★
Dynamics	5 %	★★★★★
▶ Lab	55 %	★★★★★
Power	40 %	★★★★★
Damping factor	5 %	★★★★★
Signal-to-noise ratio	5 %	★★★★★
Noise	5 %	★★★★★
▶ Practice	25 %	★★★★★
Features	15 %	★★★★★
Build quality electronics	5 %	★★★★★
Build quality mechanics	5 %	★★★★★

Upper class



CAR & HiFi

INTERNATIONAL

Germany 3/22

Price/performance: excellent

„Very much performance for the money with a compact design.“



Modern, highly integrated design: 2-channel amplifier with large transformer for power supply and two Class-D inductors

have additional boards for signal conditioning. The signal amplification is located on the bottom side of the board; modern Class-D driver chips do their job here. You can see the filter coils made of thick wire on the mono power amplifier and

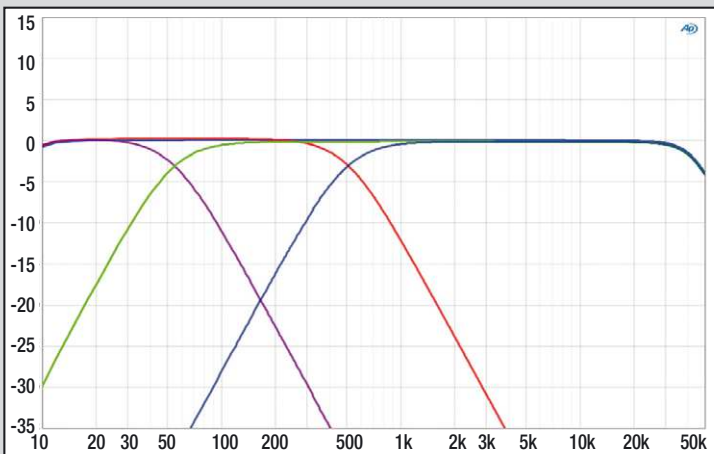
the two-channel power amplifier. The four-channel power amplifier is equipped with flat wire coils with ferrite on the outside. Signal input comes via Molex connectors, for which harnesses with RCA jacks and high-level harnesses are included.

The EPS for diagnostic factory radios is also integrated into the latter.

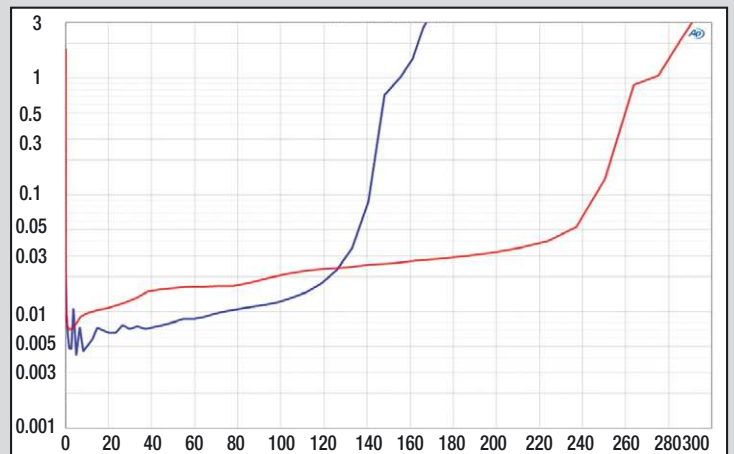
Measurements and Sound

The ZXS900/1 does excellently in the lab. There are no weaknesses but plenty of power. We already measu-

CAR&HIFI Laboratory



With the ZXS550/2, the crossovers only range from 50 to 500 Hz, which is the minimum requirement



As the smallest of the series, the ZXS550/2 manages nearly 160 and 280 watts per channel with minimal distortion. A terrific performance!



Not much controls to work on the 2-channel amp. There is auto turn-on and a high-pass or low-pass pot next to the remote control input

red over 300 Watts at 4 Ohm, which is sufficient for regular subwoofers. At 2 and 1 Ohm, the ZXS delivers 550 and almost 900 watts, respectively - kudos for this very compact design. But the multi-channel amps are also well fed, as the ZXS700/4 proves with a whopping 120 watts per channel at 4 Ohm, which is double that of a „standard“ amplifier. At 2 Ohm, it produces more than 200 watts, so it can even be used to drive a subwoofer via bridge mode. Of course, this also applies to the ZXS550/2, which can deliver 550 Watts to a 4-ohm subwoofer and produces a considerable 2 x 160 Watts at 4 Ohm. This distinguishes the ZXS amplifiers from their smal-

Specifications	
Channels	2
Power 4 Ohm	158
Power 2 Ohm	277
Power 1 Ohm	0
Bridged Power 4 Ohm	554
Bridged Power 2 Ohm	0
Sensitivity max. mV	210
Sensitivity min. V	5,0
THD+N (<22 kHz) 5 W	0,004
THD+N (<22 kHz) Halblast	0,010
Signal-to-noise ratio dB(A)	97
Damping factor 20 Hz	121
Damping factor 80 Hz	121
Damping factor 400 Hz	118
Damping factor 1 kHz	106
Damping factor 8 kHz	14
Damping factor 16 kHz	3
Features	
Low pass	50 – 500 Hz
High pass	50 – 500 Hz
Band pass	-
Bass boost	-
Subsonic filter	-
Phase shift	-
High-level inputs	•
Automatic switch-on (Autosense)	•, DC or signal
RCA outputs	-
Start/stop capable	• (7,2 V)
Dimensions (L x W x H in mm)	194 x 112 x 44
Others	EPS, remote control

Hifonics ZX550/2	
Price	250 Euro
Contact	Audio Design, Germany
Internet	www.audiodesign.de/english

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 % ★★★★★
Noise	5 % ★★★★★
▶ Practice	25 % ★★★★★
Features	15 % ★★★★★
Build quality electronics	5 % ★★★★★
Build quality mechanics	5 % ★★★★★

Upper class
 ★★★★★

CAR & HiFi
 INTERNATIONAL Germany 3/22

Price/performance: very good
„Very much performance for the money with a compact design.“



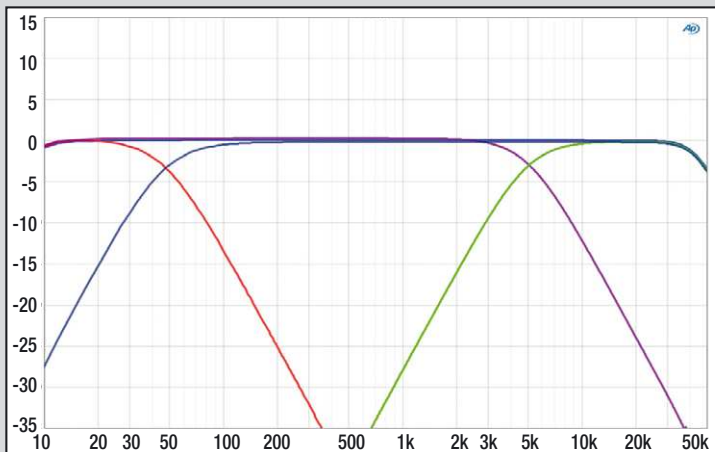
Modern, highly integrated design: 4-channel amplifier with large power supply (left) and Class-D inductors with outer magnetic capsules

ler Pluto siblings: with the ZXS, twice as much power is available across the board! Sound-wise, the ZXS are more grown-up, too. ZXS700/4 and ZXS550/2 pull through very nicely in the bass; even with loud bass, nothing softens, and the pressure is right. In general, the amps play

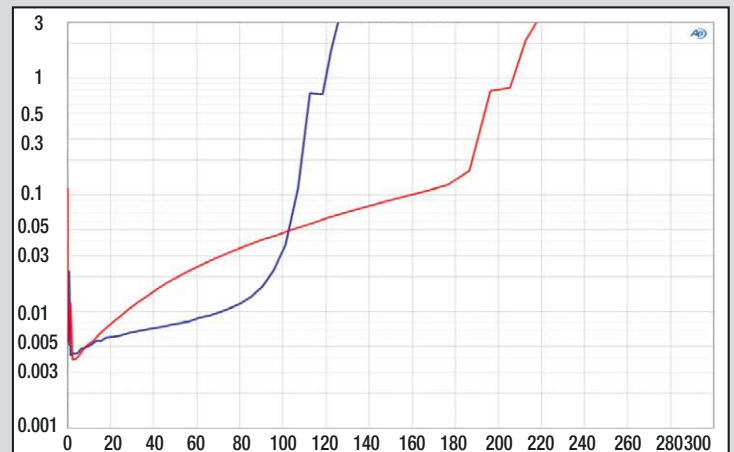
very dynamically, and the reserves are also sufficient for larger volume peaks. The detail resolution in the high range is almost better, and the spatial reproduction is also precise. With the ZXS900/1, we have another case of „unbelievable what comes out of the box.“ But no wonder

regarding the power density of 750 watts per liter of cabinet volume. It quickly becomes apparent that Hifonics means business. The ZXS900/1 pushes every subwoofer so powerfully that delicate minds can become anxious. It produces clean bass up to the highest volumes, which is an ab-

CAR & HIFI Laboratory



The ZXS700/4 can realize crossover frequencies up to 5 kHz and thus filter everything up to the tweeter



The ZXS700/4 operates with very low distortion, especially at 4 ohms. With 120 and 210 Watts, there is also plenty of power for small loudspeakers



The signal input is done via a pair of two-channel connectors, which are included as low and high-level versions. The two- and four-channel amplifiers have only one control for the high or low pass frequency

solute pleasure. It also builds up fat pressure with synthetic low basses so that every bass freak has tears of joy in their eyes.

Conclusion

With the ZXS, Hifonics manages a very well-fitting precision landing. Even though they are not the smallest digital amplifiers, the ZXS are compact enough to fit everywhere. In return, there is more than enough power even for high-end demands. Very impressive and not even expensive.

Elmar Michels

Specifications	
Channels	4
Power 4 Ohm	118
Power 2 Ohm	207
Power 1 Ohm	0
Bridged Power 4 Ohm	414
Bridged Power 2 Ohm	0
Sensitivity max. mV	210
Sensitivity min. V	5,0
THD+N (<22 kHz) 5 W	0,005
THD+N (<22 kHz) Halblast	0,009
Signal-to-noise ratio dB(A)	100
Damping factor 20 Hz	115
Damping factor 80 Hz	115
Damping factor 400 Hz	112
Damping factor 1 kHz	102
Damping factor 8 kHz	13
Damping factor 16 kHz	3
Features	
Low pass	50 – 5k
High pass	50 – 5k
Band pass	–
Bass boost	–
Subsonic filter	–
Phase shift	–
High-level inputs	•
Automatic switch-on (Autosense)	•, DC or signal
RCA outputs	–
Start/stop capable	• (7,3 V)
Dimensions (L x W x H in mm)	230 x 112 x 44
Others	EPS, 2 or 4CH in

Hifonics ZX5700/4

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

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 %	★★★★★
Noise	5 %	★★★★★
▶ Practice	25 %	★★★★★
Features	15 %	★★★★★
Build quality electronics	5 %	★★★★★
Build quality mechanics	5 %	★★★★★

Top Class
 ★★★★★

CAR & HiFi
 INTERNATIONAL Germany 3/22

Price/performance: very good
 „Very much performance for the money with a compact design.“

X-2000.1 D – powerful bass amplifier from Audio System

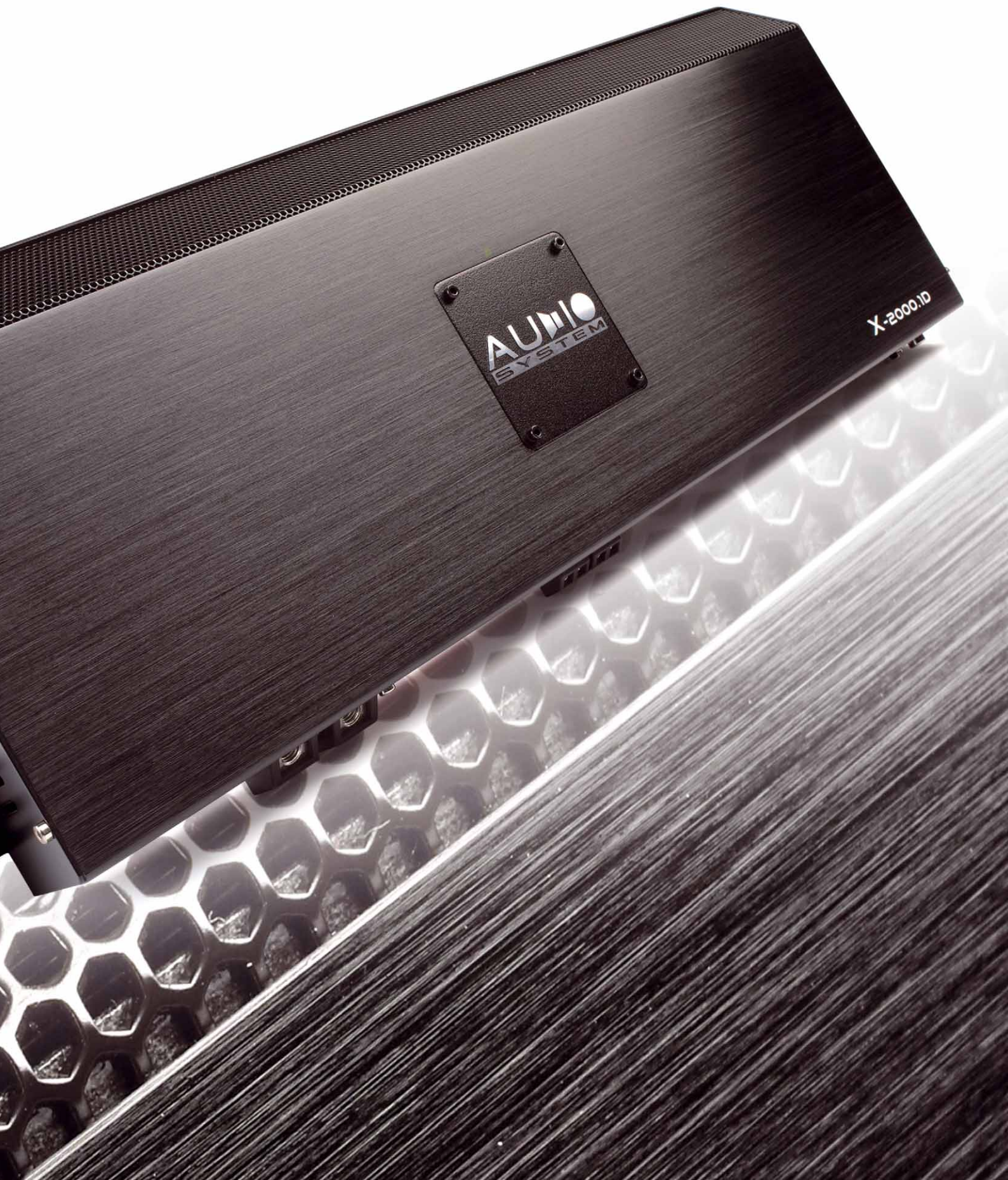
Subwoofer amplifier with 2000 Watt

- ▶ With the X-2000.1 D, Audio System presents a potent bass amplifier that can drive even the most enormous subwoofers. We test the behemoth and find out how much power it packs.

The X-2000.1 D is just under 50 centimeters long and weighs a respectable 5 kilograms, but it is not the largest amplifier in Audio System's product range. That title belongs to the H-3000.1, which adds another kilowatt compared to our „X2k“. However, the X-2000.1 D is

supposed to fit into the X-series, and there are some compact digital amplifiers as well as full-grown Class-AB amplifiers like the X-170.4 and the X-330.2, which come into question as playing partners for our X-2000.1 D. Thus, the X-2000.1 D is a dignified, almost old-fashioned piece of

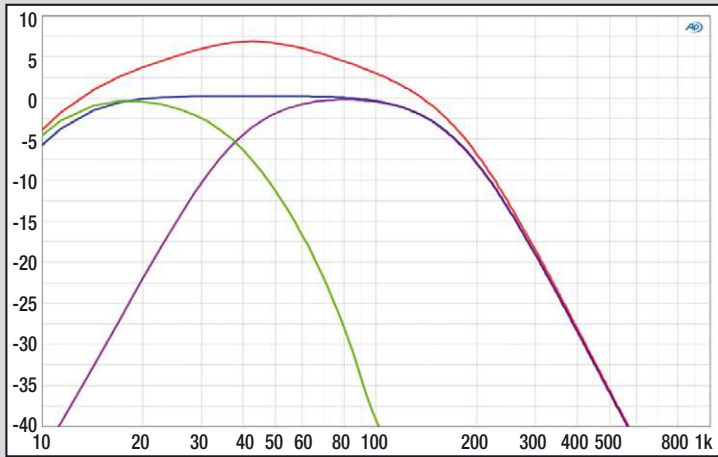




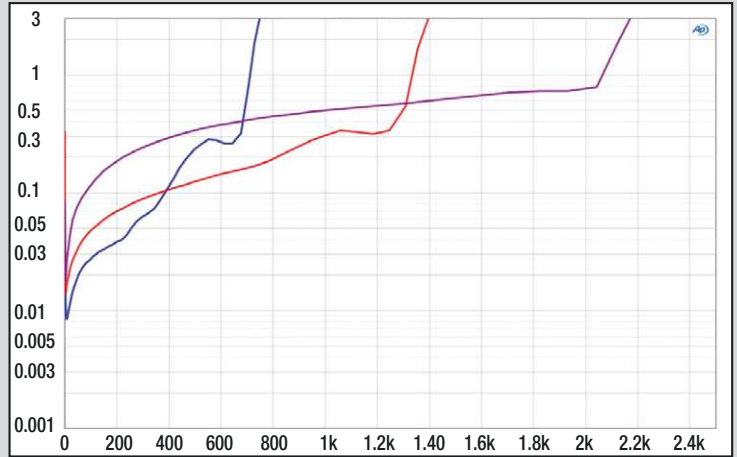
AUDIO
SYSTEM

X-2000.1D

CAR & HIFI Laboratory



The X-2000.1 pleases with cleanly working filters, also the subsonic scores with a steep 24 dB/oct. slope



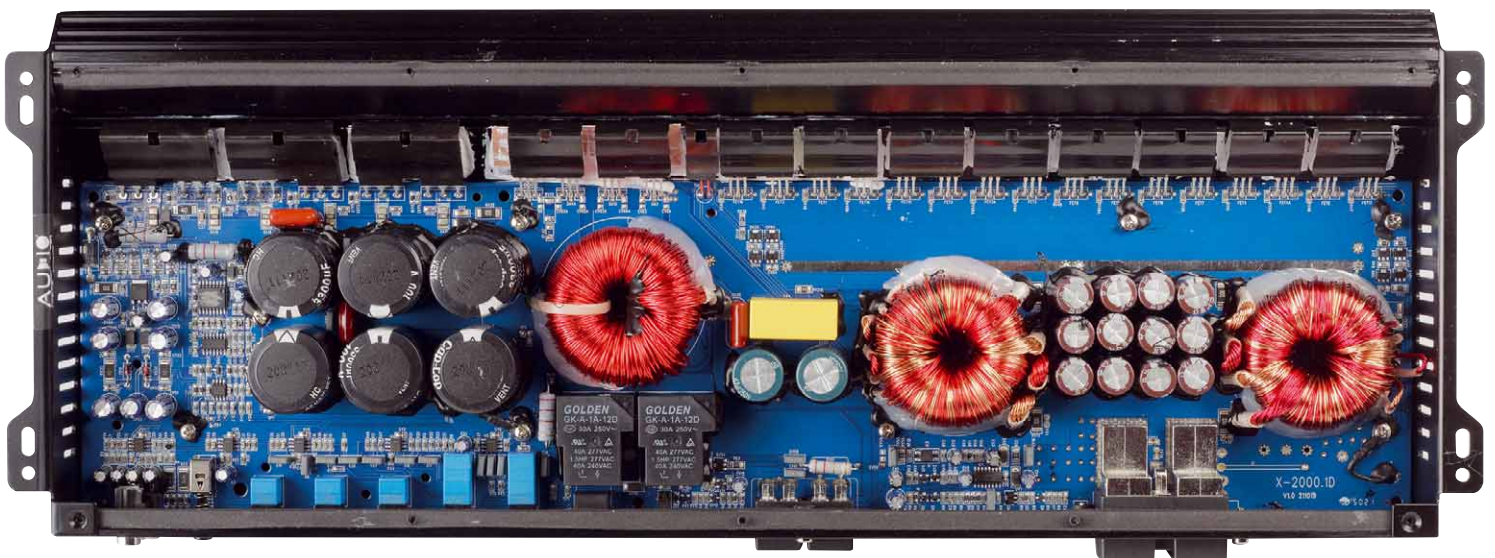
The X-2000.1 D can produce up to over 2000 watts into 1 ohm. However, the lower the load, the more distortion it produces

amplifier technology, which gets its power quite simply out of the material it uses. With its endless row of MOSFETs along the heatsink, the X gives an almost analog feel, although it uses, of course, and as bass amplifiers have been for decades, a „digital“ Class-D circuit. The Class-D low-pass coil on its own is the size of a child's fist, and behind it, two hefty protection circuit relays ensure that the amplifier is disconnected from

the subwoofers in case of emergency. Even larger coils reside near the two power supply transformers, which are supplied with current from massive 70 square millimeter terminals. The power supply alone needs 16 transistors to provide more than 2 kilowatts. Buffering is done with six times 3300 microfarads, so power peaks are no problem. The actual amplifier circuit needs only a few square centimeters on the board

– there is only one channel to be controlled.

The feature set is complete; the X-2000.1 D has everything you need for a subwoofer: low-pass, subsonic, phase control, and a decent boost. In addition, there is a level remote control in the scope of delivery and an input that can be switched to high level along with automatic on and off.



22 high power MOSFETs team on the heatsink. The transformers and the filter coil are gigantic



Massive terminals and comprehensive filter equipment do not fill the side of X-2000.1 D by far

Measurements and Sound

On the test bench, the Audio System produces little distortion for a bass amp; everything is fine in this respect. The SNR is relatively moderate, but this is to be expected from such a component monster. The real excitement comes with the power, and on this playfield, the X-2000.1 D doesn't waste much time. Already at 4 ohms, we measure over 700 watts; at 2 ohms, it's already 1330 watts, with which every subwoofer is satisfied. After switching the load resistors to 1 Ohm, the Audio System fires them up with 2067 watts of continuous power. The 2-kilowatt mark is cracked – goal achieved. In the listening test, you must be prepared for powerful bass thunderstorms with a 4-ohm subwoofer. The Audio System plays deep bass orgies with frequencies close to DC cleanly and with vigor. At 1 Ohm, it's even more intense. Where smaller bass amplifiers slowly run out of breath, the X-2000.1 D warms up. SPL to the max and physically „crushing“ bass leave a lasting impression.

Conclusion

The X-2000.1 D scores with power. Its 2 kilowatts are more than sufficient for two full-grown subwoofers, but it can also be four for still decent bass. The clean build and the complete feature set are satisfying. And in the end, a moderate EUR 650 is a fair offer from the retailer.

Elmar Michels



Specifications

Channels	1
Power 4 ohms	709
Power 2 ohms	1330
Power 1 ohms	2067
Sensitivity max. mV	170
Sensitivity min. V	6,7
THD+N (<22 kHz) 5 W	0,010
THD+N (<22 kHz) Half Power	0,085
Signal-to-noise ratio dB(A)	83
Damping factor 20 Hz	248
Damping factor 40 Hz	248
Damping factor 60 Hz	248
Damping factor 80 Hz	248
Damping factor 100 Hz	235
Damping factor 120 Hz	235

Features

Low pass	30 – 150 Hz
High pass	–
Band pass	10 – 250k Hz
Bass boost	0 – 6 dB/45 Hz
Subsonic filter	10 – 50 Hz
Phase shift	0 – 180°
High-level inputs	•
Automatic switch-on (Autosense)	•, DC
RCA output	–
Start/stop capable	– (8,9 V)
Dimensions (L x W x H in mm)	480 x 185 x 50
Others	remote control

Audio System X2000.1 D

Price	650 Euro
Contact	Audio System, Germany
Internet	www.audio-system.de

Rating

▶ Sound	20 %	★★★★★
Bass foundation	5 %	★★★★★
Bass pressure	5 %	★★★★★
Accuracy	5 %	★★★★★
Dynamics	5 %	★★★★★
▶ Lab	55 %	★★★★★
Power	40 %	★★★★★
Damping factor	5 %	★★★★★
Signal-to-noise ratio	5 %	★★★★★
Noise	5 %	★★★★★
▶ Practice	25 %	★★★★★
Features	15 %	★★★★★
Build quality electronics	5 %	★★★★★
Build quality mechanics	5 %	★★★★★

Absolute Top Class



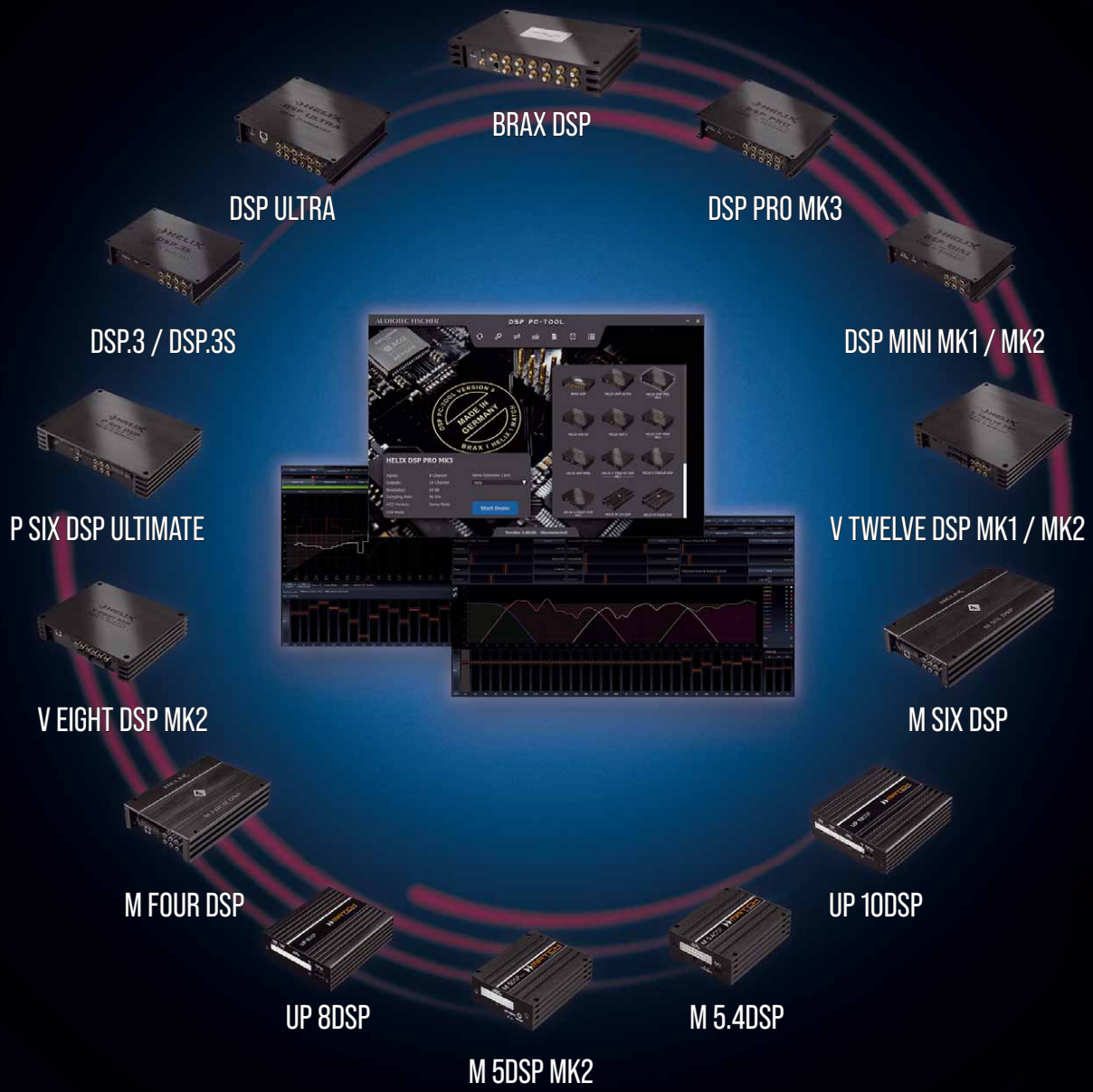
CAR & HiFi

INTERNATIONAL

Germany 3/22

Price/performance: excellent

"Powerful bass amplifier even for demanding subwoofers."



ONE TOOL TO RULE THEM ALL

www.audiotec-fischer.com/dsp-pc-tool/

AUDIOTECH FISCHER

DSP PC-TOOL 5

- FEATURING TUNE EQ -



„...The DSP PC-Tool 5 works on all of Audiotec Fischer’s current standalone DSP units and DSP amplifiers, including from brands Helix, Brax and Match, to drive analysis, measurement and processing functions. Ease of use is also high on the agenda – the software’s TuneEQ feature adjusts the equaliser to the desired reference curves automatically, there’s automatic time alignment delivered by built-in signals and analysis, and Audiotec Fischer’s interface is superbly intuitive. And the best part? The software is free...“

- Expert Imaging and Sound Association



**GZ ULTRA T-30 + K-165 –
new top line from Ground Zero**

High-End Loud- speakers

- ▶ Virtually out of nowhere, Ground Zero presents a new top line located even above the Reference series. We were allowed to test the very first loudspeakers.

GROUND ZERO



ULTRA – this is the name of Ground Zero's best components from now on. Whoever thought that the previous Reference components would not be able to be topped will be proven wrong. Not only an amplifier but also the matching speakers are about to be launched. At least partially and still as a pre-series. Therefore, the woofer GZ ULTRA K-165 and the tweeter GZ ULTRA T-30 are not yet finished visually. The finishing of the front panel, grilles, and frame will be modified again in series production. We have the final samples for series production approval in the editorial office. A whole speaker series will join our 6.5" woofer and tweeter. A midrange driver, probably 85 millimeters, and a 10" subwoofer are already in development. Component systems will not be available because

loudspeakers of this class are actively driven. The GZ ULTRA speakers are entirely new developments and have nothing to do with any previous Ground Zero speakers. Everything has been developed from scratch, with enormous development effort and complex tooling. The tweeter and woofer come in noble wooden packaging, including measurement protocol. The pairs have been selected before assigning the serial number so that the two drivers in the box fit together perfectly. Of course, this has its price. Each pair costs 2,000 Euros, so we're looking at a 4,000-Euro set.

Midbass driver

In return, however, Ground Zero also offers really noble ingredients: High-grade machined parts wherever you look, and already in our

pre-series chassis finest build quality. The frame of the bass-midrange driver is not a single casting but assembled from CNC-milled individual parts – this is only possible in small quantities, where a lot of manual work is feasible. Of course, solid aluminum is used for the four basket struts and the three rings that make up the bass-midrange basket. The beautiful spokes are trimmed for minimal air turbulence and partially enclose the motor - at the latest now, a cast part would be no longer an option. The connection terminals are integrated into two spokes opposite each other to ensure as symmetrical a load as possible from the tinsel leads when the cone assembly moves. The whole thing has an extremely open structure; viewed from the side, you can see through the speaker everywhere and virtually watch it at work. Wonderfully visible are the flat spider made of the best material and the perforated voice coil former, which uses fiberglass instead of aluminum because alu-



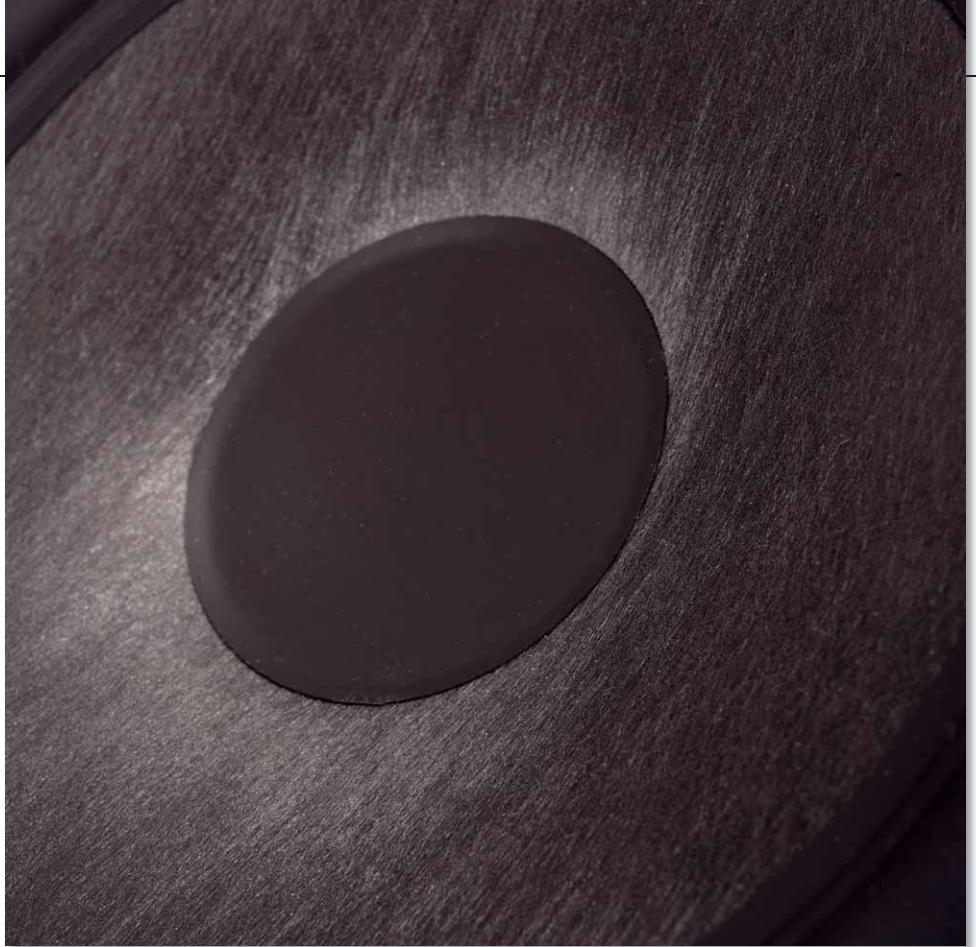
The midbass driver looks simple but has it all on the technical side

The brand-new ULTRA cone comes as a sandwich with carbon fibers

minum can develop harmful eddy currents but the electrically non-conductive fiberglass former does not. The voice coil is conservatively wound from round copper wire with an impedance of 4 ohms, and even the diameter of „only“ 32 millimeters doesn't knock your socks off. This was developed by someone who had exactly the intended use in mind, namely 100 % sound quality. The motor was, of course, also turned, milled, polished and machined. In its center is a high-quality, 8-millimeter thick neodymium ring, which supplies the magnetic field in the air gap. A perfectly rounded pole vent, along with the ring of holes in the back plate, ensures perfect ventilation of the driver, leaving no cavity without ventilation. But perhaps the most exciting thing is yet to come: the cone, encased in a very thin rubber surround, again to minimize mechanical losses. This cone is unlike anything we've seen before. Fibrous and charcoal/slate colored, the fibers seem to have a rough preferred direction. On the outside, at the back edge, a „flanging“ stabilizes the cone structure – very nice. We are dealing with a sandwich consisting of a damping layer in the middle and an outer layer each for stabilization. The outer layers are carbon fiber fleece bonded with resin, making it waterproof and airtight. A highly stable construction that at the same time provides the best damping and is also lightweight.

Tweeter

The GZ ULTRA T-30 is big and heavy. The flange measures 76 millimeters on the outside – you could have also accommodated a midran-



ge speaker there. The same applies to the mounting depth of 50 millimeters. So it's clearly not for inconspicuous installation in the original mirror triangle, but whoever treats themselves to this tweeter certainly has other things in mind. The ULTRA tweeter was allowed to be as large as necessary because it was uncompromisingly designed for sound. In the center of the front panel, which is shaped as a waveguide according to acoustic criteria, is a large fabric dome with a wide surround driven by a 30-millimeter voice coil. Naturally, the enclosure houses a large rear chamber to lower the resonant frequency, optimizing the tweeter for low-frequency reproduction. An immense amount of development work goes into this coupled chamber because with a tweeter, it's not just a matter of providing the right volume, as with a subwoofer enclosure, and that's it. The reason is that with the tweeter, the wavelengths (and the „common“ multiples the-

reof) are dangerously in the order of magnitude of the enclosure. At 1 kHz, the wavelength of 34 centimeters is still much too large for the cabinet (as it is for a subwoofer). But at 10 kHz, with 3.4 centimeters, we come into the range of standing waves. Therefore, the interior of the coupled chamber is designed with shape and damping to avoid them as much as possible. Ventilation is done by a ring of holes instead of a central hole, which is the first step. Furthermore, there is a cone-like structure at the bottom of the housing, the exact shape of which is precisely optimized as a function of pressure maxima and minima because standing waves are nothing other than pressure maxima and minima.

Accessories

Some words briefly about the installation accessories, namely the rings and grilles. Ground Zero introduces the matching grille series with the ULTRA speakers, called NRG (Non-

Resonant Grill). The sturdy metal grilles with hexagonal apertures show a molded shape in the center that fits snugly over the large dome for the tweeter. In the case of the cone drivers, it looks naturally matching so that the system can be installed harmoniously. Of course, the CNC-turned and polished retaining rings also make for a stable installation, helping the sound. Unlike with our photo samples, there are logos still on the grilles. The tweeter comes with a mounting ring and grille, while you pay another 300 EUR for the mid-bass driver accessories, which come with a laser-engraved logo, burnished screws, and a special O-ring for vibration-free mounting of the grille.



Here you can perfectly see the extremely airy design with a slim neodymium drive and a perforated voice coil former

midbass driver's frame is not a cast piece but assembled from individual parts



Measurements and Sound

Are the wonderfully designed high-end speakers still as excellent when faced with the incorruptible measuring system? Yes, they are. Looking at the electrical measurements already shows where the journey is headed. With the 165-K, the mechanical losses are also very low in terms of measurement. The moving mass of 13 grams doesn't set any records at first, but actually, only relatively inexpensive speakers undercut this value because they have thinner, less stable cones and small voice coils. In the exclusive and high-end range, 13 grams is very little because these speakers have to perform at a much higher level than „lightweight“ constructions. The woofer's soft suspension and low resonance frequency are remarkable, making the driver run very broadband, albeit

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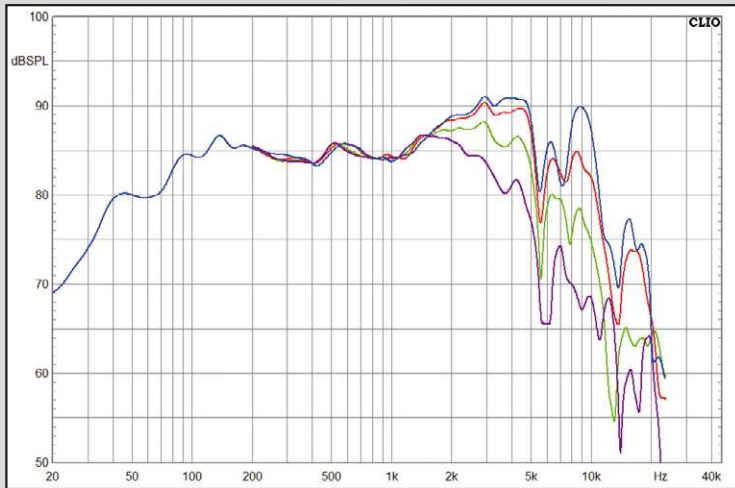


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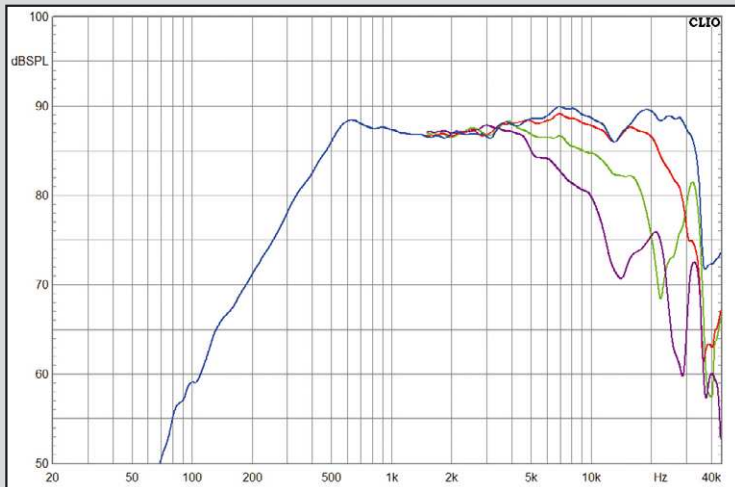
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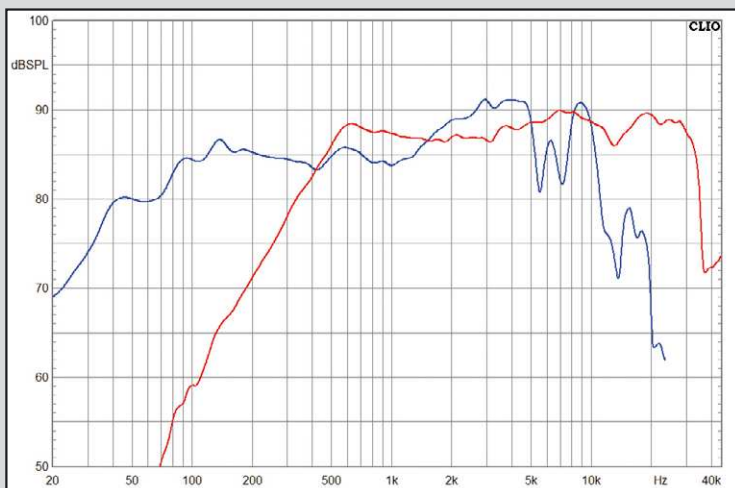
CAR&HIFI Laboratory



The GZ ULTRA K-165 runs up to 5 kHz without errors. Above that, a resonance becomes noticeable, but it is harmless



The tweeter GZ ULTRA T-30 runs up to a sensational 30 kHz on axis. However, the large cone also causes a significant amplitude drop under angle



The K-165 plays up to 5 kHz, and the T-30 plays from 1.5 kHz, giving a generous overlap of a little less than 2 octaves

with low efficiency. Clearly, no one will operate these speakers without an amplifier. The tweeter's large coupled chamber also ensures a low resonant frequency of only 500 Hz. The tweeter demonstrates its class in front of the microphone: it runs straight through from 600 Hz to 30 kHz, with only a minimal dip at 13 kHz, where the dome tip might briefly oscillate in opposite phase. The upper cutoff frequency is sensational for a 30-millimeter dome - we are delighted. The amplitude response of the 165-K is also excellent. It runs flawlessly up to 5 kHz, and the slight upward slope even helps with crossing over. Unfortunately, everything above 5 kHz is garbage - but very well sorted. This can be seen by looking at the decay, where cone resonances often result in eternal excursions with stiff cones, and no one wants to hear that - the 165-K dies away super-fast at its peak at 9 kHz. Here the excellent damping of the sandwich diaphragm has a highly positive effect. The midbass driver makes very few distortions. A small peak at 900 Hz doesn't harm the frequency response, and it's also exclusively the H2 that's pleasant to the ear. On the other hand, the unpleasant distortion components stick to the zero line. There's little to say about the tweeter. Close to perfection, the distortion only increases moderately below a very low 1.5 kHz - mind you, we're talking about 0.5% with a decent SPL and without a crossover - a killer component!

The grille design mimics the tweeter's dome shape



K-165 and T-30 are the first two drivers of the ULTRA series. A midrange driver and subwoofer will follow



In the listening check, the GZ ULTRA prove their class already after the first few beats. The sound is a coherent whole, everything fits together wonderfully, and it simply sounds like music. Everything is there, from the swinging of a triangle to the growling electric bass. The listener is immersed and only wakes up again when the music stops. Beautiful details can be heard in vocals, percussion comes out of thin air, crisp and dynamic, and even when the rockers unpack the guitars, these speakers make you happy. The bass is deep and clean but not at a maximum reference level. In our listening test, low-midrange speakers must run unfiltered toward the bottom. The GZ ULTRA 165-K is not necessarily designed for that. After we relieved it with a steep high pass, it plays exceptionally crisp and still anything but lean. In its natural environment, it can rely on low bass support in the form of a subwoofer, and that's what it's made for. With the two ULTRA components, we have an extremely high-class team in front of us without any doubt: One of the best tweeters ever meets a wonderfully musical bass-midrange driver.

Conclusion

With the GZ ULTRA, Ground Zero has created great speakers. Unfortunately reserved for an exclusive target group, they are among the best feasible in a car.

Elmar Michels

Specifications

Basket diameter	165 mm
Mounting diameter	146 mm
Mounting depth	66 mm
Magnet diameter	65 mm
Dome diameter tweeter	32 mm
Housing diameter tweeter	60 mm
Max. XO freq wf	5 kHz
Min. XO freq tw	1,5 kHz
XO for test	2,5 kHz
EQ for test	wf: (8 kHz/-6 dB/Q2,2)
Grilles	-
Misc.	Optional rings and grilles
Nominal impedance	4 Ohm
DC resistance Rdc	3,40 Ohm
Voice coil inductance Le	0,13 mH
Voice coil diameter	32 mm
Cone area Sd	125 cm ²
Resonance frequency fs	47,0 Hz
Mechanical Q Qms	6,08
Electrical Q Qes	0,53
Total Q Qts	0,49
Equivalent volume Vas	18,80 l
Moving mass Mms	13,0 g
Rms	0,64 kg/s
Cms	0,87 mm/N
B*1	4,98 Tm
SPL 2v, 1m	85 dB
Amplifier power recommendation	30 - 120 W

Ground Zero GZ Ultra K-165/GZ Ultra T-30

Price	3990 Euro
Contact	Ground Zero, Germany
Internet	www.ground-zero-audio.com

Rating

▶ Sound	55 %	★★★★★
Bass foundation	11 %	★★★★★
Neutrality	11 %	★★★★★
Sound stage	11 %	★★★★★
Spatiality	11 %	★★★★★
Dynamics	11 %	★★★★★
▶ Lab	30 %	★★★★★
Frequency response	10 %	★★★★★
Max. SPL	10 %	★★★★★
Distortion	10 %	★★★★★
▶ Practice	15 %	★★★★★

Absolute Top Class



CAR & HiFi

INTERNATIONAL

Germany 3/22

Price/performance: very good

"Noble Loudspeakers
of World Class Standard"

ZR65CS – ZR series speakers from Phoenix Gold

Top-class 6.5" components

- Phoenix Gold has been providing us with top-notch amplifiers and subwoofers lately, only holding back on speakers. This is about to change because, with the ZR65CS, Phoenix Gold enters the upper class right away.



The woofer has a huge magnet, immediately suggesting power



Sure, there are not only amplifiers and subwoofers from Phoenix Gold. They also have speakers that have been situated exclusively in the affordable market segment in the recent past. But now Phoenix Gold

also wants to play at the top of the loudspeaker segment and introduces the ZR65CS. The abbreviation ZR already indicates that this is an ambitious system, as ZR is ranked relatively high within the company's

hierarchy. The ZR series includes three newly developed amplifiers, all of which are pretty powerful, and the ZMAX subwoofers we have already tested.

Now, the ZR65CS adds a two-way component system that also turns out quite powerful. The appearance already leaves no doubt about that. The ZR65CS is entirely black, with only a few copper-colored spots on the crossover. These are due to the coils, which are wound of thick 1.4-millimeter copper wire. Additionally, they do without an iron core, which could show signs of saturation at high power levels, leading to distortion. The circuit is straightforward, with second-order high-pass and low-pass consisting of one coil and one capacitor each.

However, the showpiece of the ZR65CS is the woofer, which stands out with its colossal ferrite magnet - here, no one needs to fear that Phoenix Gold has skimmed on the motor. The magnet ring measures a full 110 millimeters in diameter. Such a giant magnet is rarely seen on a 6.5" driver. The voice coil is also larger than usual, with a diameter of 32 millimeters, which is good for power handling. The cone material used is aluminum, which is, of course, anodized black for aesthetic reasons. The cone has a unique feature: it is actually

cone-shaped. It is not flared towards the edge like the bell of a trumpet but shows a straight cone profile (AWI shape) when viewed from the side, giving maximum stability but being somewhat more susceptible to resonances than the usual curved NAWI shape. The dust cap and the surround, both made of soft rubber, have a somewhat moderating effect on these cone resonances. The ZR65CS's tweeter is inconspicuous. We are dealing with a one-inch fabric dome - by far the most popular design for high-quality car audio systems.



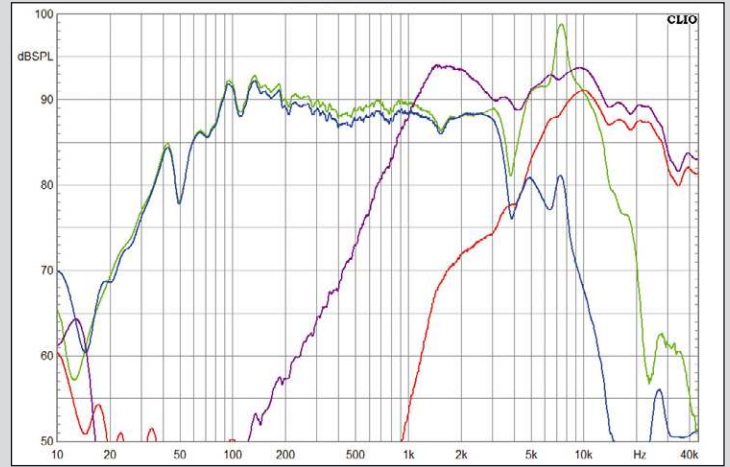
The crossover shines with two thick air core coils for low distortion



CAR&HIFI Laboratory



The woofer and tweeter run smoothly both on-axis and under an angle



The woofer shows cone resonances at 7.5 kHz, which are well-filtered by the crossover. The tweeter could also be used at lower frequencies



94 / 5.000

The woofer is equipped with a powder coated steel frame and a large 1.25" voice coil

Measurements and sound

Our measurement microphone certifies that both the woofer and the tweeter behave very well. The woofer runs smoothly up to 3 kHz. Its cone resonances are noticeable at 7.5 kHz, but the crossover attenuates them effectively. The tweeter pleases with quite broadband performance, running up to a respectable 27 kHz. The system satisfies us with very low THD values in the distortion measurements up to very high volume levels, for which it receives top ratings. Sound-wise, this is reflected in a clear, precise, and uncluttered performance that is also maintained at high volumes. Drums are especially fun because the ZR65CS offers a wonderfully dynamic reproduction. Hard-hitting drums and percussion come across as very crisp. The bass range does not soften impulses in the least, either. The tweeter contributes lovely details without annoying sharpness - that's how it should be. Male and female voices are presented honestly; nothing is glossed over or reproduced with a loss of detail.

Conclusion

With the ZR65CS, Phoenix Gold has created a speaker system that appeals to sound enthusiasts and provides plenty of fun and SPL. A striking combination.

Elmar Michels



The tweeter is designed as a 1" fabric dome featuring a wave guide under the grille

Specifications	
Basket diameter	165 mm
Installation diameter	146 mm
Installation dept	76 mm
Magnet diameter	116 mm
Tweeter diaphragm	25 mm
Tweeter cabinet	50 mm
slope woofer/tweeter	12 / 12 dB
Tweeter protection	-
Tweeter level adjustment	0, +3 dB
Grille	•
Other	-
Nominal impedance	3 Ohm
DC resistance Rdc	2,34 Ohm
Voice coil inductance Le	0,15 mH
Voice coil diameter	32 mm
Cone area Sd	129 cm ²
Resonance frequency fs	56 Hz
Mechanical Q Qms	4,52
Electrical Q Qes	0,68
Total Q Qts	0,59
Equivalent volume Vas	10,1 l
Moving mass Mms	18,4 g
Rms	1,44 kg/s
Cms	0,43 mm/N
B*I	4,72 Tm
SPL 2v, 1m	86 dB
Amplifier power recommendation	30 – 120 W

Phoenix Gold ZR65CS

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

Rating

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

Top Class



CAR & HiFi

INTERNATIONAL

Germany 3/22

Price/performance: very good

„High-output speakers, also for sound enthusiasts.“

Seta-Audio SCT - Sound tuning of factory loudspeakers

Sound Magic



- ▶ With SCT, Seta-Audio presents a new method for sound enhancement in any vehicle that works completely non-destructively without any intervention in the car. Sounds interesting.





Golf VII door speaker in 6.5" format, original on the left, with SCT coating on the right

It is safe to assume that many car drivers are unsatisfied with the sound of the original factory HiFi system. Often, the sound does not even deserve the designation HiFi. Although good sound can be easily achieved by installing additional components, many car owners are reluctant to do so. The first suspicion for the cause of the poor sound falls on the speakers. Cheap loudspeakers, such as those found as standard in the factory equipment of vehicles, generally do not do what is expected of them. Now, of course, you can install aftermarket components that remedy the situation with better quality. However, Seta-Audio's approach is different: Seta-Audio has identified the cones of the factory speakers as the culprit and promises to improve quality by tuning them. The advantages are obvious: apart from removing and reinstalling the speakers, no assembly work is necessary. Not a single cable is cut, and

the dashboard and interior remain in place. Thus, the sound tuning is 100% compatible with leasing, and nothing speaks against this measure – even in new vehicles.

The speaker tuning is done with a unique cone coating. Seta-Audio has patented the SCT (Solid Cone Technology) as a „method for stiffening the cone of a transducer.“ So, SCT is a tangible stiffening measure and not some form of voodoo with a magic potion that you're supposed to apply to everything from the speaker to the cable and then suddenly reap high-end sound. But let's take a closer look at the matter because SCT cannot be described with cone stiffening alone.

First, let's analyze why a mass-produced car speaker doesn't sound particularly good. Now, it's not that the car industry intentionally installs the worst possible speakers.

On the contrary, some are even very well thought out and not bad at all. The reason for the mediocre sound can be found in the pressure to save money due to competitive pressure. When a manufacturer haggles over a tenth of a cent for every switch, you can imagine that a lot can be saved on a loudspeaker. Factory speakers, therefore, usually have a relatively small magnet with a correspondingly weak motor.

Consequently, the cone assembly is a lightweight construction, and ultra-thin paper cones are used. These are correspondingly unstable and tend to behave unpleasantly, called partial oscillation. The cone does not perform the often-cited piston-like movement but bends in largely uncontrolled deformation oscillations. This causes distortions that audibly „muddy“ the sound in the entire frequency range, resulting in unsatisfactory reproduction, especially in the bass range. This is where SCT



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- Storage of settings without power supply
- Can be operated remotely via optional infrared card remote control, "Blaupunkt RC-10" remote control and steering wheel remote control (SWC)

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comes into play to stop this hustle and bustle and teach the cone exemplary vibration behavior.

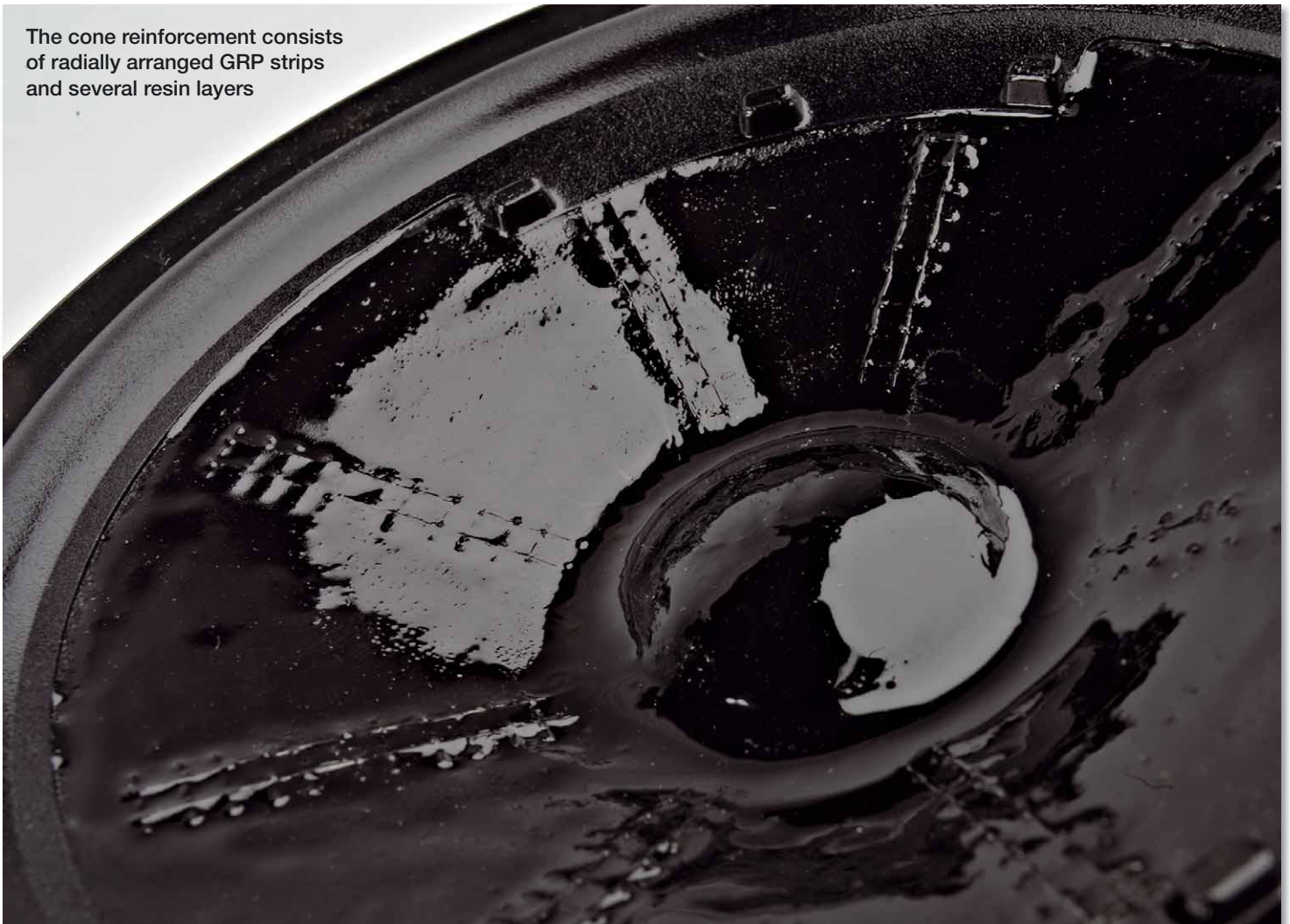
SCT is a cone coating process that, unlike many other measures, does not aim to attenuate any frequency peaks due to cone resonances but instead provides targeted stiffening. On his initiative, Florat Seta, owner of Seta-Audio, developed the process. Years of research on natural objects and extensive measurements preceded the market launch. The fact that partial oscillations are a thorn in Florat Seta's side is shown by his home sector developments. He prefers to build his own designs into his loudspeakers, which work with very special cones. In his solid

dome cones, a unique solid cone of foam sits in the skinny paper cone, resulting in a highly stable and guaranteed partial oscillation-free cone.

With SCT, Seta uses a sophisticated, multi-layer process based on various synthetic resins. Like laminating with GRP, a hardener component is added to the resin. The SCT process is divided into four work steps, which must be precisely coordinated. The first step applies a polyester resin with a special hardener. Depending on the type of loudspeaker, several GRP elements are laminated into this, with their shape and position matched to the loudspeaker. In the third step, a layer of epoxy resin

follows, also with exactly matching hardener, before finally being covered with spray paint that bonds with the epoxy. The result is a significantly stiffer cone. However, it does not become as hard as glass but retains a certain elasticity, which it needs in the midrange. Uncontrolled breakup into partial oscillations is thus significantly reduced, and the cone now has sufficient stiffness for clean bass reproduction. The additional weight of the coating reduces the resonance frequency, which is desirable in terms of a more profound bass response. Unfortunately, some efficiency is lost as a result. However, this loss of sound pressure is offset

The cone reinforcement consists of radially arranged GRP strips and several resin layers



by the loudspeaker consuming less energy for the partial oscillations after the treatment, producing more effective sound in percentage terms and less distortion.

Soundcheck

It gets interesting when you listen to the SCT effect in the car. For this, we listened to an original VW Passat (2005 - 2010) against the same model with speakers coated by Seta-Audio. Both vehicles have 16cm two-way systems in the doors, driven directly by the factory navigation system. Amplifiers are not involved, nor are other measures like damping, tuned crossovers, etc. The Passat already belongs to the better cars ex-works; in the original, it doesn't sound that bad. You just shouldn't listen closely – the bass is there, but of the rather muddy variety; it distorts pretty early when the volume increases.

Things become exciting when you switch to Seta Audio. From the first note, you feel like you are listening to a completely different system. Suddenly bass sounds come with contour and reach deeper into the frequency basement, and bass drums hit much more precisely. Over the entire frequency range, the Seta Passat sounds much more transparent and accentuated; voice reproduction is much more concise. Even spatiality improves due to a better midrange section with correct phasing. Of course, the Passat is far away from stage imaging with perfectly installed tweeters or even sound processors. Still, compared to the original, there is a significantly better three-dimensionality - and even with entirely unmodified tweeters. We continue with higher SPL levels, and here the Seta Passat creates an increased volume impression, at least subjectively. The more

transparent sound and the lack of distortions seem louder. The original Passat almost gave the impression of broken speakers during a test piece with double bass, while the same piece emerged clearly and distinctly in the Seta Passat.

Conclusion

In the listening test, SCT from Seta-Audio is convincing. A clear sound improvement can hardly be achieved more simply and with less intervention in the vehicle. Prices start at EUR 240 for a standard VW Golf. Many vehicle examples can be found on the Facebook page of Seta-Audio. If you don't want to do the work yourself and send your speakers to Seta-Audio, you can have them installed at any car hi-fi dealer. Who knows, maybe there's a bit of soft tuning with high-quality tweeter capacitors, and an inconspicuous subwoofer solution is also possible almost without installation effort. Wouldn't that be something?

Elmar Michels



The back of the paper cone also receives a stiffening coating

Seta-Audio SCT

Price	320 Euro
Contact	Seta-Audio, Germany
Internet	www.seta-audio.de

Specifications

- SCT – Solid Cone Technology**
- four-stage cone coating
 - cone reinforcement and reduction of partial oscillation
 - for all vehicles and all types of (cone) speakers
 - no manipulation of vehicle electronics or mechanics, only removal and re-installation of the original loudspeakers
 - no modification to the vehicle, suitable for leasing
 - cost depends on the number and size of the speakers

CAR & HiFi
INTERNATIONAL Germany 3/22

"Elegant sound improvement without modifications to the vehicle"



ESX VXP84 + VXP104 –
powerful subwoofer drivers
with a low mounting depth

Flat subwoofers with power

► We received two highly interesting subwoofers from ESX, which already signal at first glance that they are something special. We present the VXP84 and the VXP104.



The proportions show the huge motors of the VXP woofers





For a flat profile with maximum room for excursion, the cone bulges outward in the center

Subwoofers today are small and inconspicuous. Therefore, it is not surprising that ESX first launches VXP models with moderate diameters of 8 and 10 inches. The model name VXP or Vision Pro already signals the affiliation to the top series in the subwoofer program of ESX. And so our VXP84 and VXP104 are compact and relatively flat, but anything but lightweights. With mounting depths of less than 9 and 11 centimeters (because the motor is hidden in the frame), the VXPs also belong to the category of flat subwoofers. This makes them

suitable for space-saving boxes that can easily find space in the trunk floor. The remarkable thing about the VXP woofers is that they are serious about bass pressure - very serious. We're not looking at typical flat woofers where saving space is the very first priority, but performance woofers that can also save space, in that order. What also needs to be clear: The fun won't come cheap. If you want to enjoy the VXP bass po-

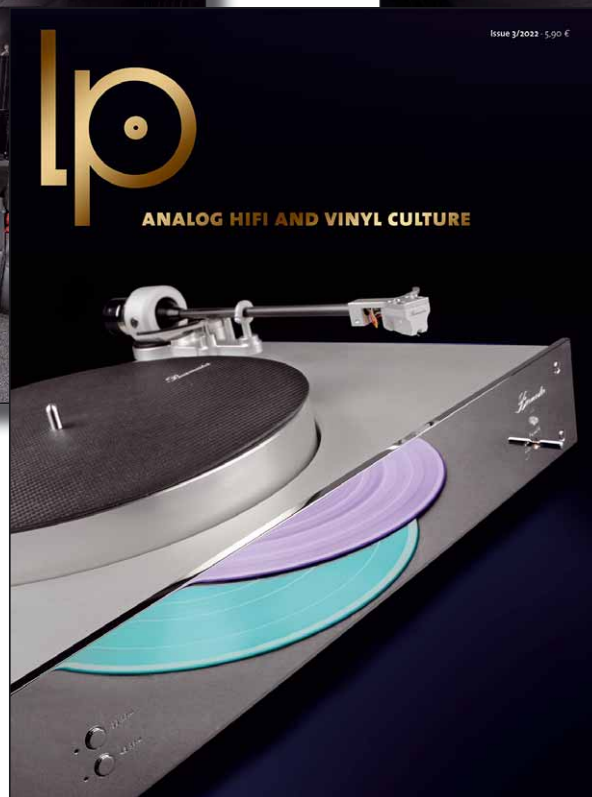
wer, you're looking at EUR 350 and up. So they are not for beginners or people who want „a bit more bass“ for the trip to the supermarket.

For those still reading, these are first-class subwoofers for the money. In keeping with SPL, the rubber surrounds are relatively high than wide to allow enormous excursions with little loss of cone area. The cones are thick fiberglass fabric, so strong that



There are flatter woofers than the VXP due to the enormous motors

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one has to speak of the proverbial board. The material also allows for arbitrary shapes so that the cones are not cone-shaped but resemble volcanic cones. In this way, they also keep the mounting depth low. The connection to the aluminum voice coil former is made by special aluminum transition pieces that offer large bonding surfaces and make the whole thing highly stable. ESX has not skimped on the voice coils: the smaller, 8"-woofer VXP84 is already equipped with a two-inch coil, and the VXP104 has a two-and-a-half-inch coil. Mighty die-cast baskets, which provide enough space for the fat double magnet systems, hold the woofers together. Accordingly, the VXP with 4.8 and 7.3 kilos do not belong to the lightweights.

ESX VXP84

Price	350 Euro
Contact	Audio Design, Germany
Internet	www.audiodesign.de

Rating

▶ Sound	50 %	★★★★★
Bass	12,5 %	★★★★★
Pressure	12,5 %	★★★★★
Purity	12,5 %	★★★★★
Dynamics	12,5 %	★★★★★
▶ Lab	30 %	★★★★★
Frequency response	10 %	★★★★★
Efficiency	10 %	★★★★★
Maximum level	10 %	★★★★★
▶ Processing	20 %	★★★★★

Top Class



CAR & HiFi

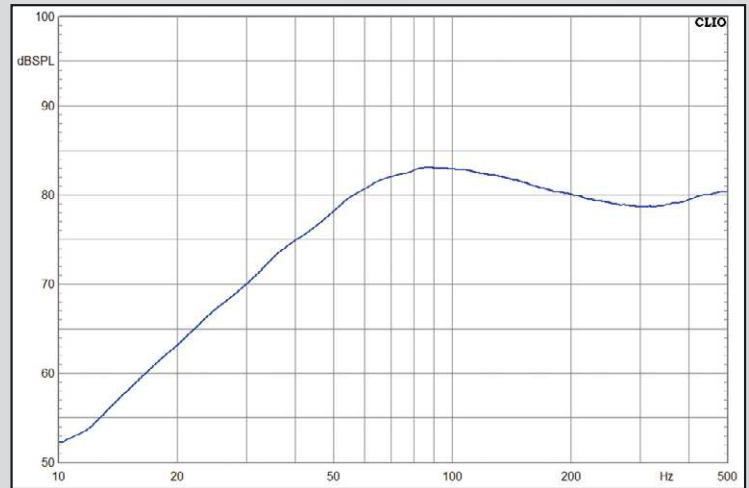
INTERNATIONAL

Germany 3/22

Price/performance: very good

„Full bass power in a small space.“

CAR & HiFi Laboratory



The VXP84 shows the flat decay towards low frequencies typical for closed subwoofers. You hear much deeper bass than the diagram suggests

Measurements and sound

Our measurements, however, do not turn out to be heavy or excessively fat. The VXP show that they are not designed to be extreme but instead find themselves in the middle. The suspensions are tight but not as stiff

as a board, and the moving masses are also moderate. This results in resonance frequencies that are neither excessively low nor too high. In addition, the relatively high Qs, in combination with still compact volumes, promise plenty of bass from small speakers. And so, the VXP woofers offer to be installed in closed boxes. Closed boxes are always smaller than reflex constructions, and the VXP do not necessarily need the reflex support – they produce more than enough bass even without it. Only efficiency naturally suffers with this space-saving use. Characteristic SPLs of 83 and 85 dB at one watt is not exhilarating, but in the car hi-fi world, they are not frightening either – you have enough power.

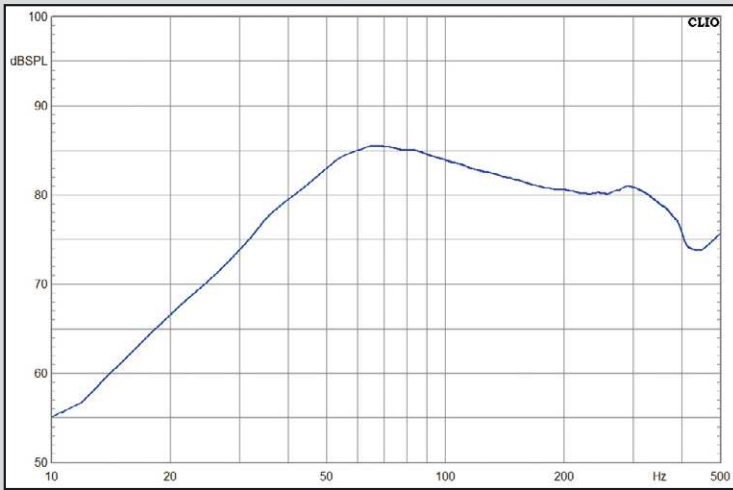
Sound-wise, a lot happens when the VXP are connected to the power amp. Already the VXP84 delivers a perfect mix of juicy low end and precision. Even the lowest registers are clearly audible, but they are not pushed on the listener's ears so that everything else sinks into a bassy

Specifications

Basket diameter	21,0 cm
Mounting diameter	19,0 cm
Mounting depth	8,7 cm
Magnet diameter	14,2 cm
Weight	4,8 cm

Nominal impedance	4 Ohm
DC resistance Rdc	3,76 Ohm
Voice coil inductance Le	1,52 mH
Voice coil diameter	50 mm
Diaphragm area	227 cm ²
Resonant frequency fs	39 Hz
Mechanical quality Qms	6,38
Electrical quality Qes	0,59
Total quality Qts	0,54
Equivalent volume Vas	16,0 l
Moving mass Mms	75 g
Rms	2,88 kg/s
Cms	0,22 mm/N
B x l	10,83 Tm
Sound pressure 1 W, 1 m	83 dB

Recommended power	250 – 400 W
Test enclosure	g 13 l
Port dimensions (d x l)	–



The amplitude response of the VXP104 is 2 dB higher than the VXP84, and the maximum is at lower frequencies



The surrounds are narrow to maximize the cone area, but the high profile still allows for large excursions

mush. Instead, even deep synth basses can be followed in detail, and the sound comes across as super tight and well-trained. Timpani hits and bass drums sound similar, not overly fat, but snappy to the point. The VXP104 does neither better nor worse. It serves up a whole lot more volume in the low bass, and it can also play a bit louder. But it sounds a tad less transparent, especially in direct comparison. However, compared to any bass reflex speaker, the VXP104 sounds more precise, and in fast runs, it outperforms even good twelve-inchers. This should please many listeners because it once again represents the golden middle. The bottom line is that the VXP104 is superior to its little brother because it produces more volume and more bass. If you like it drier and slimmer, you should rather go for the VXP84 in its nice small box.

Conclusion

With the VXP woofers, ESX puts something very refined on the shelves of specialist dealers: premium power

flat subwoofers that have never been seen before. For an admittedly not small amount of money, bass lovers get first-class woofers with first-class performance.

Elmar Michels

Specifications

Basket diameter	26,6 cm
Mounting diameter	23,8 cm
Mounting depth	10,8 cm
Magnet diameter	17,0 cm
Weight	7,3 cm
Nominal impedance	4 Ohm
DC resistance R _{dc}	3,72 Ohm
Voice coil inductance L _e	1,64 mH
Voice coil diameter	64 mm
Diaphragm area	377 cm ²
Resonant frequency f _s	32 Hz
Mechanical quality Q _{ms}	5,86
Electrical quality Q _{es}	0,72
Total quality Q _{ts}	0,64
Equivalent volume V _{as}	39,7 l
Moving mass M _{ms}	122 g
R _{ms}	4,22 kg/s
C _{ms}	0,20 mm/N
B x l	11,30 Tm
Sound pressure 1 W, 1 m	85 dB
Recommended power	250 – 600 W
Test enclosure	g 21 l
Port dimensions (d x l)	-

ESX VXP104

Price	450 Euro
Contact	Audio Design, Germany
Internet	www.audiodesign.de

Rating

▶ Sound	50 %	★★★★★
Bass	12,5 %	★★★★★
Pressure	12,5 %	★★★★★
Purity	12,5 %	★★★★★
Dynamics	12,5 %	★★★★★
▶ Lab	30 %	★★★★☆
Frequency response	10 %	★★★★★
Efficiency	10 %	★★★☆☆
Maximum level	10 %	★★★★★
▶ Processing	20 %	★★★★★

Top Class



CAR & HiFi

INTERNATIONAL

Germany 3/22

Price/performance: very good

„Full bass power in a small space.“

The equipment classes

In **CAR&HIFI INTERNATIONAL**, all products are classified into one of five performance classes:

Ratings only comparable within their class: ★ (worst) ... ★★★★★ (best)

- **Absolute Top Class** – Uncompromising products with outstanding build and sound quality
- **Top Class** – Products for higher demands with excellent performance, sound, and processing quality
- **Upper Class** – Products for quality-conscious connoisseurs who value good value for money
- **Middle Class** – Solid products that meet average requirements in all respects
- **Entry Level** – Qualitatively convincing products with an excellent price-performance ratio

The rating

Devices are tested and rated according to strict criteria and can reach up to five “stars”. Ratings are only comparable within a class and device type. To score four stars in the top class, the device must meet more demanding requirements than for a 4-star rating in the upper class. The model names, prices (RRP), and equipment specifications for the devices always refer to the German market at testing. For some devices, prices and features may differ in the individual countries.

The star rating provides comprehensive and concise orientation when searching for devices for your in-car entertainment. However, depending on your situation and application, the device with the best star rating is not automatically the best fit for you. For example, an amplifier may score very well overall but may be difficult to connect to your car radio. So additional effort has to be considered for integration or a different model might be the better choice. Therefore, you should additionally consult the detailed information provided in the text of the test reports.

The test equipment of the **CAR&HIFI INTERNATIONAL** editorial team

For our tests, **CAR&HIFI INTERNATIONAL** uses – among others – the following special measuring instruments and reference devices for the comparison of image and sound quality:

- Audio Precision
- CLIO 12
- Kenwood CS-6030
- Microtech Gefell

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- Frequency range: 50 – 20,000 Hz
- Sensitivity: 88 dB (1W/1m)
- Filter design: 12/12 dB slope (LP/HP)
- Crossover point): 4500 Hz
- Adjustable tweeter level: 0db and -3dB



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