

HI-FI+ GUIDE TO HEADPHONES, EARPHONES & RELATED ELECTRONICS

Sponsored by HIFIMAN AND CRYSTAL CABLE





With Our Complements



Our new HE560 and HE400i have won rave reviews and awards from the critics and been hailed as the best planar phones under \$2000.

But a world-class headphone is only as good as the amplifier driving it.

Meet the HIFIMAN EF100, a hybrid design guaranteed to deliver the absolute best from great headphones. That is the ultimate complement.

HI-FI+ GUIDE TO HEADPHONES, EARPHONES & RELATED ELECTRONICS

(Sponsored by HiFIMAN and CRYSTAL CABLE)

FROM THE EDITOR

WHAT'S NEXT? – COOL NEW HEADPHONES, EARPHONES & RELATED ELECTRONICS

(sponsored by Oppo Digital)

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FIVE MASTER DESIGNERS DISCUSS EARPHONE/CIEM TECHNOLOGY

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(sponsored by NuPrime and Celsus Sound)

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ENCYCLOPAEDIA HEADPHONICA

Headphone Terminology Explained



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WELCOME to the first-ever *Hi-Fi+ Guide to Headphones, Earphones & Related Electronics*. This guide represents the first in a series of what we hope will be informative, product-themed, digital buyer's guides published on a quarterly basis.

Why start with a Headphone Guide? The answer is that headphones and earphones have become, for a new generation of music lovers, the high-performance music delivery vehicles of choice. What is more, proponents of traditional loudspeaker-based high-end audio systems have discovered that the performance of headphone and earphone-based systems has increased so dramatically of late that headphones (or earphones) now make perfect adjuncts to conventional audio systems.

We have tried to craft this guide so that it will be welcoming and informative for headphone/earphone newcomers, yet pithy and substantial enough for veteran 'headphonistas'.

Some highlights of the Guide include:

- **What's Next?**
— A survey previewing cool new headphone, earphone, and electronics from 43—count 'em—manufacturers.
- **Designer Interviews – Part 1:**
Interviews with five master headphone designers.
- **Designer Interviews – Part 2:**
Interviews with five master earphone and custom-fit in-ear monitor designers.
- **Hi-Fi+ Editors' Choice recommendations for the following:**
 - o Full-size headphones,
 - o Earphones and custom-fit in-ear monitors,
 - o Desktop headphone amps & amp/DACs, plus
 - o Portable headphone amps & amp/DACs.
- **Hi-Fi+ Review Index:**
An in-depth, live-linked index to all recent Hi-Fi+ headphone-related equipment reviews & blogs.
- **Encyclopaedia Headphonica:**
Headphone terminology explained.

Are you new to high-performance headphones and earphones? No worries: This Guide will bring you up to speed in not time at all!

Or, are you an old hand at all things headphone-related? We trust this Guide will prove stimulating and thought-provoking for you, while pointing the way toward products you'll want to go hear and explore.

As always, *Hi-Fi+* is all about helping you derive deeper satisfaction from the music you love, while having great fun with the equipment used to reproduce the recorded arts. We wish you happy listening.

Chris Martens
Publisher, *Hi-Fi+*

WHAT'S NEXT?

Sponsored by Oppo



COOL NEW HEADPHONES, EARPHONES & RELATED
ELECTRONICS COMPONENTS FROM FORTY-THREE MANUFACTURERS

Alpha Design Labs by Furutech ADL H128 headphones

The dynamic, closed-back ADL H128 headphones are balanced in a completely audiophile way – rich tonal colours and textures with intimate and close harmonic interplay, a sense of space, and quiet backgrounds. Alpha Triform Contour Earcups™ designed for a superior seal over your ears help improve bass response vis-à-vis other designs, while also reducing internal standing waves and reflections for reduced distortion.

ADL's H128 incorporate new 40mm drivers designed and developed by engineers at Furutech, with high-quality PEEK trembler film and sound tuned with input from a team of renowned Japanese audio commentators. Both internal wiring and the headphone cord use Furutech Alpha-OCC cables, terminated with Furutech rhodium plated connectors, including the Furutech 3.5mm to 6.3mm adaptor plug. Available now (£295).

www.adl-av.com/products/headphones



AKG N90 Q TruNote technology headphones

AKG's N90 Q are the world's first headphones with personalized sound – designed in conjunction with legendary GRAMMY® winner Quincy Jones. AKG's (Harman) expertise in signal processing, psychoacoustics, and headphone ergonomics, has resulted in a true industry first.

The N90 Q, featuring TruNote technology, automatically and precisely reproduce sound optimized to match the user's inner ear anatomy. TruNote technology is composed of a new, proprietary software solution for auto-calibration and frequency response measurements, which uses two microphones in each ear cup in order to measure the frequency response of the headphone wearer and generates an accurate correction filter unique to the user. The N90 Q will be available in the summer of 2015. (£1,100).

www.akg.com



Astell&Kern AKT5p headphones

Astell&Kern's AKT5p On-Ear Headphones are the first Astell&Kern branded headphones in its accessory line. Through a partnership with Beyerdynamic, the AKT5p is based on the popular T5p closed back audiophile portable 'Tesla technology' headphone. The AKT5p are branded with the Astell&Kern logo and specially tuned to match perfectly with A&K's line of portable audio players.

The AKT5p include a 2.5mm four-pole terminal cable for fully balanced output when used with the AK100 II, AK120 II, and AK240 portable players, and a 2.5mm to 3.5mm conversion cable for use with other devices. Each pair of AKT5p headphones are hand-made in Germany to Beyerdynamic's exacting specifications. The AKT5p is currently available for \$1,400.

www.AstellnKern.com



Audeze EL-8 open- and closed-back planar magnetic headphones

Audeze is as passionate about music as you are. The firm's new EL-8 headphones are a statement of exclusive elegance inside and out. The EL-8 design features the world's most advanced planar magnetic technology including Fazor™ elements, Fluxor™ magnetics, and Uniforce™ diaphragms.

The EL-8 are flexible, portable, lightweight, and loaded with new technology for extreme performance. They work beautifully with most portable players and phones. With industrial design by BMW DesignWorksUSA and available in open and closed-back models, they're built with superb craftsmanship, wood veneer accents, and enormous attention to detail. Audeze claim the sound quality is unmatched at this or any other price category! Price: \$699.

www.audeze.com



AURALiC's TAURUS MK II balanced, Class A headphone amplifier

Named after the constellation Taurus, visible in the northern hemisphere's winter sky, the TAURUS MKII Balanced, Class A Headphone Amp was designed with a unique four-way output that lets users easily configure it into standard or balanced modes by pressing a button. Both modes are compatible with the 6.35mm jack used by all dynamic headphones, and enable headphones with four-pin balanced connections to benefit from fully balanced operation with enhanced performance.

AURALiC packed the TAURUS MKII's compact chassis with several patented technologies. Example: AURALiC's patented ORFEO Class-A output module, inspired by the Neve 8078 analogue console, enables sufficient capability to deliver 1,000 to 4,500mW, for maximum performance from any headphone. \$1,899.

www.auralic.com



Aurender FLOW portable headphone amplifier/DAC

With a substantial in-house software team, Aurender is uniquely positioned to develop a product like FLOW. The FLOW was under design for the past two years to provide laptop users with the ideal DAC+Amp to drive their high quality headphones. And, it has also become a favourite of custom IEM users, as it's so quiet.

FLOW's 32bit/384kHz, DSD64/128 DAC can render the most demanding of high-resolution audio content. Its sleek, undulating satin aluminium case has an LCD multiple-status display, sited inside a velocity-sensitive volume control dial for added convenience. The FLOW even accommodates a user-installable 1TB mSATA drive. Available now: \$1,295 complete with leather case.

www.aurender.com



Ayre Acoustics, Inc. Codex headphone amplifier/DAC/preamp

Hand built in Boulder, Colorado, the multifaceted Codex headphone amplifier/DAC/preamp is the first product in Ayre's new Anthology series, which utilises 20 years of the company's keystone technologies in a more affordable package. Said to deliver the complete emotional impact of your music as the artist intended, the Codex is designed to be the perfect foundation for any system.

Equally adept as a headphone amp, digital preamp, or stand alone USB/Toslink DAC, the fully-balanced, zero-feedback Codex includes two digital inputs, balanced and single-ended headphone outputs on the front, as well as balanced and single-ended variable outputs on the back. The estimated price for the Codex in the UK is £1,395.

www.ayre.com



Cardas Audio A8 Ear Speakers universal-fit earphones

The upcoming Cardas A8 Ear Speakers feature a golden-spiral shaped body machined from billet brass, and coated in Rubberized ABS. The flexible, lightweight cable has separately jacketed conductors for each channel, wrapped in a spiral around a centre textile core – ensuring that they are never stressed when the cable is pulled or tugged on. A quick cable change converts the A8 from single-ended to balanced-mode operation.

The headline development is the super-broad-band dynamic driver: the conventional pole piece has been replaced by a contoured field permanent magnet. The motor is linear to nearly DC, as is phase response. The diaphragm is multi gauge laminated PENN, with the piston area closely matched to the human eardrum.

www.cardas.com



oppo

HA-1

Headphone Amplifier



“ HA-1 is a well thought out and thoroughly engineered product at a competitive price ”

“ Its headphone amplifier stage is up there with the finest ”

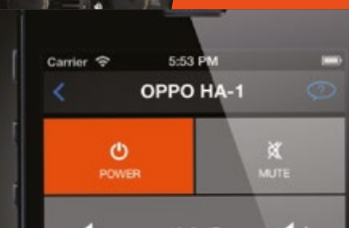
Class A balanced power amplifier section
Toroidal power transformer
Fully balanced design



Asynchronous USB DAC supports PCM and DSD

ESS 9018 Sabre³² Reference DAC

IR remote control included
Doubles as a digital audio dock for mobile devices
Bluetooth control & streaming



oppodigital.co.uk

Cavalli Audio Liquid Crimson hybrid valve/solid-state headphone amplifier

Cavalli's Liquid Crimson is a hybrid headphone amplifier and successor to the firm's popular Liquid Fire amp. The Crimson uses a unique embedded hybrid topology, which provides a blending of valve and solid-state sounds. It is powerful enough to handle any planar magnetic headphone with finesse with almost 6W per channel of overhead.

The Liquid Crimson has two selectable RCA inputs with a loop out and three headphone outputs: four-pin XLR, TRS, and low output TRS. It has two gain settings. The Crimson is Cavalli Audio's newest product in its recognized category of the world's best headphone amplifiers. Liquid Crimson is available now. The price is \$2,850.

www.cavalliaudio.com



Celsus Sound Companion One portable headphone amplifier/USB audio and wireless DAC

Celsus Sound is the brainchild of Jason Lim, a NuForce co-founder and former CEO. The Celsus Companion One (\$595) is a USB DAC and headphone amp suitable for desktop, portable, and wireless use. With four types of USB cable, it supports USB Audio (384kHz PCM, DSD128) for Windows, Mac, Android, and iOS devices. The Companion One's 24-bit/192kHz Wi-Fi audio receiver supports DLNA and Airplay.

The powerful, low noise (SNR 115dB) headphone amp is capable of driving high-end headphones and sensitive IEMs. Celsus also offers its companion Gramo One, which is a reference-grade, open-back, ear bud designed for long listening without the fatiguing weight of over-ear headphones or the irritating pressure of in-ear earphones.

www.celsus-sound.com



CEntrance HiFi-Skÿn iPhone battery case and headphone amp/DAC

CEntrance miniaturized its award-winning audio technology to fit inside a phone case, creating an amazing, on-the-go headphone experience with your phone. HiFi-Skÿn is an amplifier, DAC, and a battery case for the iPhone. It supports hi-resolution streaming up to 24bit/192kHz as well as DSD, and delivers amazing sonic fidelity. The powerful built-in headphone amplifier supports a wide variety of headphones, providing extra clarity, additional power, and extended frequency response.

HiFi-Skÿn is made from tough, impact resistant plastic, comes in three colors to match existing iPhones and is available for iPhone 5 and 5S, iPhone 6 and 6 Plus, and iPod Touch 5th generation. Expected to ship this summer, with prices starting at \$399.

www.centrance.com



Chord Electronics Hugo II desktop headphone amp/DAC/preamp

Chord Electronics, the world leading digital audio and amplification specialist, has just launched the Hugo TT, a desktop version of its phenomenally successful genre-defining Hugo DAC/headphone amp. The new FPGA (field-programmable gate array) based device offers wider connectivity including two galvanically isolated USB-B inputs, XLR outputs, two ¼-inch headphone outputs, Bluetooth, plus improved performance and features.

Hugo TT (£2,995) gains a larger chassis, remote control, an alphanumeric LED display with input/sample rate data, and supercapacitors for an improved output.

Hugo TT also supports up to 32-bit/384kHz audio via coax and USB, and 24-bit/192kHz over optical, plus DSD64 on all inputs and DSD128 via coax or USB (all via DoP). Chord has hinted it will extend the Hugo family further in 2015, too.

www.chordelectronics.co.uk



Crystal Cable portable audio cable solutions

Headphone and portable applications place unique demands on cable design and construction. Extreme mechanical challenges for stability create a field where cable performance has become a critical limiting factor.

The superb conductivity, shielding and high-tech insulation materials used in the new Crystal Cable Portable products are perfect for low-level and low-power signal applications typical in portable audio systems. They make the most of every little bit of signal, while dedicated designs combine inherent flexibility with skin-friendly outer sheathing to set new standards for unobtrusive comfort.

The range includes headphone and IEM cables, digital and analogue interconnects, and balanced and single-ended connections.

www.crystalcable.com



ENIGMAcoustics Dharma hybrid-electrostatic headphones

ENIGMAcoustics, best known for its Soprano electrostatic super tweeters and Mythology M1 hybrid-electrostatic loudspeaker system, recently unveiled the revolutionary Dharma hybrid-electrostatic high-end headphones.

Dharma features a unique 50mm paper cone dynamic driver coupled with ENIGMAcoustics' proprietary SBESL™ (self-biased electrostatic loudspeaker) driver technology, which integrate seamlessly via a premium first-order crossover. Dharma's headband frame is an ergonomic and stylish design crafted in high-grade aluminum alloy. Chris Martens commented on the Dharma's, "amazingly wide soundstages with very precise placement of vocalists and instrumentalists within those stages." Dharma presents listeners with an entirely new perspective on what high-performance headphones can and should be. Dharma is expected this summer, priced at £1,200.

www.ENIGMAcoustics.com



ESS Laboratories ESS-RLM-713 hybrid dynamic/AMT on-ear headphone

The \$299 ESS-RLM-713 features a dynamic mid-bass driver and a Heil-type AMT upper midrange/tweeter driver. The ergonomic design uses well-cushioned ear pads and lightweight headband materials to ensure the headphones softly wrap around listeners' ears while resting lightly upon their heads.

The ESS-RLM-713 uses large ebony ear cups whose big chambers help the headphone produce wider soundstages filled with subtle music details, creating the sensation of listening in a real, natural sound environment. Enhanced lows supply extras bass and smooth as warm mid-range frequencies inspire your imagination, while clear and crisp highs reinforce a cheerful, lively listening experience.

Finally, the ESS-RLA-713 employs passive noise cancellation technologies to minimise ambient sounds to get the highest fidelity with the least disturbance from outside.

www.essspeakersusa.com



Final Audio Design Sonorous X headphones

In the past, Final Audio Design's range of full-size headphones have collectively been called "Pandora Hope" models, but in the future Final's headphone range will carry the Sonorous name. Coming at the beginning of summer this year will be the first and finest Sonorous model: the Sonorous X.

The main parts of this model are comprised of aluminum and cut stainless steel, starting with the machined aluminium dynamic 50mm driver unit. Final thinks you'll be surprised by the well-defined, vivid sound spreading out before you, each and every sound distinct, something that can only be achieved with a highly rigid metal housing. This prestige model represents the summit of the SONOROUS series—a model with which there are no halfway measures. Price is to be confirmed.

www.final-audio-design.com/en/



HiFiMAN HE-1000 planar magnetic headphones

The upcoming HiFiMAN HE1000 is a no-holds-barred, state-of-the-art planar magnetic headphone that has been years in the making. This radical new model from HiFiMAN shares almost nothing with the company's current or prior models.

The HE-1000's all-new driver is the world's first Nanometer diaphragm that is so thin when viewed from the side it cannot be seen with the naked eye. The high transmittance and non-symmetrical magnetic circuit is also new and is claimed to offer perfect sound reproduction. HiFiMAN's flagship is also said to achieve new levels of comfort with a specially designed headband frame and support strap, asymmetrical ear cups, and beveled hybrid ear pads.

No price yet, but final development and testing of HE1000 is underway with a late spring/early summer delivery expected.

www.hifiman.com



iFi Audio headphone-friendly Retro-series audio system

iFi Audio's Retro-series audio system is a radical departure for a brand best known for its sleek, modern-looking DACs and headphone amps. The system comprises:

- Stereo 50: all-in-one valve amplifier with BT, DAC and Phono stage 25W+25W pure valve amplifier with aptX Bluetooth connectivity, an 'Intelligent SPDIF®' Coaxial/Optical Input, an MC/MM phono stage. and features a Burr-Brown True Native chipset that supports DSD512/ 2xDXD/PCM768kHz Bluetooth aptX/
- Ultra-Powerful Headphone amplifier: 8V/7000mW or 2V/250mW
- LS3.5 – classic design, latest technologies for 21st century reboot
- Proprietary iFi 25mm silk tweeter and 100mm paper cone driver
- Time-Aligned, Multi-chamber Voigt design
- 100% Bamboo cabinet for virtually nil colouration

The retail price of the Retro system is €2,149 (incl VAT).

ifi-audio.com/products/retro/



JH Audio Layla custom-fit in-ear monitors and universal-fit earphones

Of JH Audio's new flagship Layla model, designer Jerry Harvey says, "The Layla is the first earpiece I've designed to be a reference/mastering IEM. Most IEMs I design have a live/rock 'n' roll tuning with a little more emphasis on the lows and low mids: accurate but warm. The Layla's bass response when turned down is perfectly flat and when fully turned up has +13db of boost at 60Hz."

Harvey adds, "The Layla also has the most sophisticated crossover network ever put into a IEM... This crossover circuit combined with the Freqphase waveguide and new proprietary quad drivers delivers audio quality that will truly put you at the mix position in the recording studio." \$2,595. Available now.

(Universal-fit Layla models are sold exclusively through Astell&Kern.)

www.jhaudio.com



JSA (by Vertex AQ) passive headphone conditioner

JSA is a new spin-off brand from the established UK accessories company Vertex AQ, specialising in components aimed at headphone and computer audio enthusiasts. The first JSA product, the Passive Headphone Conditioner, employs the company's techniques for reducing microphony and RFI (Radio Frequency Interference) between the headphone amplifier and the headphones themselves. Available at two performance levels, the unit is simply plugged inline between amp and headphones (matching jack leads also available), bringing significant improvements in dynamics, tonality, and separation for a much more musically engaging sound.

- Several models of Passive Headphone Conditioners and jack leads are available:
- Type One, £210 (silver)
- Type Two £330/£350 (silver/gunmetal)
- Matching jack leads: Standard from £40. Super from £160

www.vertexaq.com

Available online through:

www.ammonite-acoustics.co.uk



Klipsch Reference On-Ear headphones

Klipsch Reference On-Ear headphones combine comfort and sound quality in a compact package that hides hinges and sliding mechanisms for a minimal, clean look. The 40mm drivers deliver clear vocals, crisp highs, and true, accurate bass.

The headphones' soft and deep ear cushions significantly improve comfort and separate music from outside noise. The ear cups provide articulation in every direction, ensuring that pressure is applied evenly across the entire ear, allowing for hours of unbeatable comfort.

Reference On-Ear headphones feature an advanced, iDevice-compatible, three-button remote/mic module, plus flat, tangle-resistant cables for hassle-free storage and transport.

The Reference On-Ear headphones are available in a black or white finish and come complete with a carrying case and one-year warranty: \$199.

www.klipsch.com

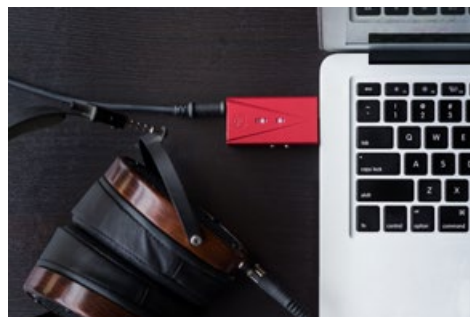


LH Labs Geek Out 1000 portable dongle-type USB headphone amplifier/DAC

LH Labs' Geek Out 1000 is claimed to be the most powerful portable USB DAC on the planet. Period. Despite its unobtrusive size, Geek Out is said to produce massive sound. Designed for professional level and consumer grade headphones alike, the Geek Out 1000 offers one full watt of pure Class A power capable of powering anything on the market.

The dual 1/8" analogue outputs let you connect multiple sets of headphones or speakers, so you can easily switch between devices or listen with a friend. Said to be a breeze to use, the Geek Out provides audiophile quality at minimal cost and maximum convenience. Geek Out 1000 is available now for \$299.

marketplace.lhlab.com



MIT Cable Vero headphone cable system

The revolutionary Vero headphone cable system is MIT Cable's entry in the personal audio interfacing. MIT recognized that even the highest performing headphones had trouble keeping up with the performance of modern high-end loudspeaker designs. This exposed the need for MIT's unique Multipole™ cable technology, as relied upon by scores of recording professionals worldwide, including the legendary Lucasfilms Skywalker Sound.

Vero (meaning "true" in Italian) cables are said to enable personal high-resolution playback systems to approach the performance of the finest speaker-based systems. Vero creates expansive three-dimensional sound stages with silent black backgrounds and freedom from perceived walls (other than wall reflections in the recordings themselves). In short, users will experience the music within realistic and immersive spaces. Vero is, Truth in Music.

www.mitcables.com



MOON by Simaudio Nêo 430HA balanced headphone amplifier with optional DAC

This fully balanced, pure analogue amplifier includes an output stage with discrete transconductance circuit topology, selectable gain, an oversized power supply, and a defeatable analogue crossfeed circuit. Moon's custom M-eVOL2 volume circuit offers 530 steps with 0.1dB channel matching. Output connections include a four-pin XLR and a pair of three-pin XLR's, as well as a TRS jack. The Nêo 430HA is claimed to effortlessly drive any headphone to its full potential thanks to an output of 8W at 50 ohms.

Finally, an optional DAC with four inputs supports decoding for DSD (quad) and PCM (32-bit/384kHz) digital audio file. The result is a reference-grade headphone amplifier. Available now. (\$3,500, amplifier only; \$4,300, amplifier with built-in DAC).

www.simaudio.com





Co-branding establishes a whole new benchmark!

Crystal Cable is pleased and proud to announce a new, co-branding initiative with Astell & Kern, manufacturers of what are widely recognized as the best available portable music players. The tough life of portable devices demands special solutions, while the increasing availability of high-res files demands special performance.

Crystal Cable Portable products provide both. Employing a specially developed silver-gold alloy, high-tech, skin-friendly insulation and soft-touch hardware, Crystal Cable Portable products feel as good as they sound.

Available as a wide range of dedicated interconnects or after-market headphone cables, until you use Crystal Cable Portable products....



You don't know just how good portable music can sound.

Enjoy Portable Music with
Highend Audio Quality



Crystal Cable Portable is available exclusively through Astell & Kern.
For more information visit: www.astellinkern.com www.crystalcable.com

MrSpeakers ETHER planar magnetic headphones

MrSpeakers introduces ETHER, the company's first open-backed planar magnetic headphone. ETHER is 100% designed in-house and is manufactured in San Diego. The company claims ETHER delivers great sound, superb comfort, and a timeless style.

MrSpeakers' proprietary single-ended driver with V-Planar processing is said to create a detailed and smooth presentation, immersed in an expansive soundstage. At 371 grams (13.1oz), ETHER is the lightest full-size planar magnetic headphone on the market, despite being almost entirely metal. The design features an ultra-light Nitinol 'memory-wire' headband and a new lambs-leather ear pad for extreme comfort.

MrSpeakers concluded, "We really enjoyed designing ETHER, and we hope you'll have as much fun listening to it as we do!" Available now (\$1,499).

www.mrspeakers.com



Noble Audio Prestige custom-fit in-ear monitors

Noble Audio, a world-leading high-performance in-ear monitor specialist, has launched a new flagship CIEM called Prestige, which unlike most CIEMs, is crafted from solid materials. A true reference-grade product, at its heart lies the *Hi-Fi+* recommended (*Hi-Fi+* 119) 10-driver Kaiser 10, the class-leading CIEM from Noble.

Prestige, priced from £1,650, takes Noble's 10 balanced armature driver configuration to the next level – offering consumers the chance to personalise their CIEM for a truly individual look, selecting from luxurious solid materials, including carbon glass, honeycomb and exotic woods.

Prestige offers the proven performance standards of the Kaiser 10 in a luxurious, bespoke package. The technology is likely to develop further in 2015, which could see a ground-breaking move away from wires!

www.nobleaudio.com



Nordost Heimdall 2 headphone cables

Personal audio has revolutionised the world of hi-fi. However, even when working with headphones, sub-standard cabling inhibits sound quality. Nordost's Heimdall 2 Headphone Cable uses Litz construction along with revolutionary and proprietary techniques, such as mechanically-tuned lengths and Micro Mono-Filament technology. These sophisticated procedures allow for much wider bandwidth than found in basic stock cables and are said to result in an amazingly realistic reproduction of sound.

Available at Nordost dealers worldwide, the Heimdall 2 Headphone Cable could be the perfect solution for personal audio enthusiasts looking to maximize the results of their gear. Thanks to an extensive list of available termination options and adaptors, this cable is compatible with all major players in the personal audio market.

www.nordost.com



NuPrime Audio uDSD portable USB-powered headphone amplifier/DSD DAC

Since acquiring the high-end product line from NuForce in December 2013, NuPrime Audio aims to achieve yet greater heights of excellence and value in high-performance audio. The NuPrime uDSD is a computer USB-powered portable DAC capable of PCM384 and native DSD256 decoding.

The uDSD's headphone output (140mW × 2 @ 32 ohm) is said to be capable of driving most high-end headphones. It has RCA (2V rms) and Coaxial outputs to connect to other devices. This is suggested to be an ideal personal high-res audio companion or a native DSD decoder for existing high-end home stereo systems. \$179.

www.nuprimeaudio.com



oBravo HAMT-1 hybrid dynamic/AMT-driver headphones

Fashioned from aluminium, wood, and hand-stitched leather, these headphones sport a unique coaxial two-way driver configuration. An AMT (Air Motion Transformer) tweeter and a dynamic bass driver combine to radiate sound from the same point, delivering a rich, detailed, and immersive listening experience.

When *Hi-Fi+* Editor, Alan Sircom, reviewed the HAMT-1 in issue 120, he wrote: "Best of all is the sound, which is at once deep and powerful, big and bold, and subtle and refined. It's like strapping a little pair of Wilson Audio loudspeakers to your ears." HAMT-1, £1499.

Also watch for oBravo's new HRIB-1 headphone, which swaps the AMT driver element for a planar magnetic tweeter. In a world of 'me too' headphones, oBravo's creations are unique.

www.obravoaudio.com

UK Distributor: www.absolutesounds.com



OPPO PM-3 closed-back planar magnetic headphones

The OPPO PM-3 combines true audiophile performance, elegant styling, noise isolation, and portability into a pair of sleek lightweight Planar Magnetic headphones. Tipping the scale at just under 300g, the PM-3 is the world's lightest closed-back planar magnetic headphone design.

The sound signature is said to be very natural and balanced, with plenty of emotion and impact, while its elegant styling and exquisite workmanship make the headphones a pleasure to wear. Ideal for use either at home or whilst mobile, the PM-3 is exceptionally comfortable to listen for hours on end. The closed-back design provides noise isolation from the outside world. The PM-3 is available now, for £349.

www.oppodigital.co.uk or
www.oppodigital.com



Peachtree Audio Shift portable headphone amplifier/DAC/battery charger

The Peachtree Shift is a DAC, high-performance headphone amplifier and battery charger all-in-one. It is finished in beautiful leather and aluminum and is little larger than a deck of playing cards. The Shift is said to elevate your headphone listening experience to a whole new level whether enjoying music at home or on-the-go. Product highlights include:

- Apple lightning connection with charge option (iPhone5/iTouch5 or newer)
- Android/PC USB input
- 32-bit/384kHz input compatibility for PCM, DSD (2.6 & 5.2MHz) and DXD audio
- 4100 mAh battery pack with up to 8 hours playback
- Output boost for high-impedance headphones
- Custom leather carrying case, Lightning, Android and PC cables included
- Variable/Fixed output switch

The \$399 Shift will be available from May

www.peachtreeaudio.com



PSB Speakers M4U 4 hybrid dynamic/balanced armature universal-fit earphone

The PSB M4U 4 In-Ear Monitor is a unique, two-way, hybrid design that features a moving-coil low-frequency driver and a balanced armature high-frequency driver controlled by a precision crossover network based on surface mount devices on a miniature PCB.

Musical textures are said to be finely wrought, bringing great insight into the music and clearly delineating individual instruments and their unique voices. The precision BA driver used in the M4U4 is individually calibrated to meet the exacting response tolerances of this In-Ear-Monitor. A waveguide is used to link the sound tube of the BA driver to the woofer, creating time-aligned driver integration.

The PSB M4U 4 are available in Black Diamond or Arctic White finishes, and are priced at \$299.

www.psb speakers.com



Quad PA-One headphone amplifier/DAC

Quad celebrates its 79th year of audio innovation with the launch of the PA-One: a beautifully built headphone amp utilising Quad's world-renowned expertise in valve-based audio to deliver a uniquely sumptuous sonic experience for headphone listeners.

Ideal for use with any digital or analogue source, the PA-One sports both balanced and RCA analogue inputs, plus USB, coaxial, and optical digital inputs. The integrated DAC is compatible with digital files up to 24-bit/192kHz, while the selected complement of vacuum tubes will make the most of whichever headphones the user chooses to connect. The PA-One is said to be the perfect amplifier for serious headphone listeners who crave a sound that is rich, fluid, and supremely musical. £1,199.95

www.quad-hifi.co.uk



Questyle Audio CMA800R current-mode headphone amplifier

Questyle's CMA800R's patented Current Mode Amplification technology redefines the state of the art by being the first headphone amplifier supporting Dual Mono Full Balance configuration and offering the airiness and musicality of a tube amp while maintaining the speed and accuracy of transistors. While in full balance mode, distortion levels drop to less than 0.00026% making the CMA800R a force to be reckoned with in terms of design and performance. Benefits include Current Mode Amplification, allowing the musicality, accuracy, authority, and reliability associated with the finest audio electronics.

Said to be perfect for both the studio and home, the CMA800R includes balanced XLR and RCA inputs/outputs to let you hear music as never before. CMA800R is available now for \$1,999.

<http://en.questyleaudio.com/>



RHA Audio T10i high fidelity, noise-isolating universal-fit earphone

The T10i is the flagship in-ear headphone from the British audio company RHA. Launched in November 2014, this in-ear headphone has received widespread critical acclaim for its ergonomic design, stainless steel construction, and accurate sound reproduction. The £149.95 T10i brings together pioneering technologies, materials, and manufacturing processes.

In addition to the injection moulded, stainless steel driver housings, the T10i also features a unique tuning filter system. This allows users to adjust the sound signature through a choice of reference, bass, and treble filters. Comfort levels are augmented by patent-pending mouldable over-ear hooks, ensuring effective noise isolation and an unobstructed, true-to-life listening experience. The T10i is available now.

www.rha.co.uk



Schiit Magni2 Uber desktop headphone amplifier/preamp

The Schiit Magni 2 delivers 1.8W of power into 16 ohms, and is ready for virtually any headphone. Switchable gain provides the fine control and low noise floor necessary for sensitive headphones, earphones, and CIEMs, as well as the power you need for hard-to-drive headphones.

Magni 2 uses newly refined, fully discrete circuitry, with a new fully DC-coupled gain stage that offers constant feedback across the entire audio band. There are no capacitors in the signal path and the amp's power supply is three times larger than its predecessor's. Preamp outputs are included. The versatile Magni2 Uber is a 'do-all' headphone amplifier/preamp at a hard-to-beat price. (£125 / \$149) A companion Modi 2 Uber DAC is available at the same price.

www.schiit.com

UK Distributor: www.electromod.co.uk



Sennheiser MOMENTUM Wireless headphones

Uncompromised performance, pure minimalist style, and the finest, luxurious materials: Sennheiser redefined the world of headphones with its successful MOMENTUM range and recently, the audio specialist took the vision further with the launch of the next generation of MOMENTUM and MOMENTUM On-Ear. For the first time the range now includes wireless versions with Active Noise Cancellation for the ultimate way to experience superior audio with effortless style. While the hybrid active NoiseGuard™ attenuates ambient noise, the high-definition aptX® codec carves out every aural nuance in even finer detail. Thus, the trademark MOMENTUM sound becomes still more brilliant.

Furthermore, the VoiceMax microphone, as an integral part of the MOMENTUM Wireless headphones, enables you to conduct crystal-clear conversations without the need of an external microphone. (\$499.95)

en-us.sennheiser.com



Trilogy 931 headphone amplifier

Headphone drivers are closely coupled to the ear and ruthlessly revealing, requiring a different approach to loudspeakers. Designer Nic Poulson painstakingly developed a discrete single-ended Class A design with an oversized linear power supply, giving excellent small signal resolution and good drive capability. Quality branded components are used throughout including a high mass, low resonance CNC heatsink, hand assembled in Trilogy's UK workshops. The standard finish is soft silver with optional lustrous paint finishes for those wishing to add an individual touch.

The 931 looks to carry all the traits that make its bigger brother (the 933) such an involving musical performer. Said to be detailed, spacious, communicative, and a joy to own, the 931 is indisputably pure Trilogy. Available now, £895.

www.trilogyaudio.com

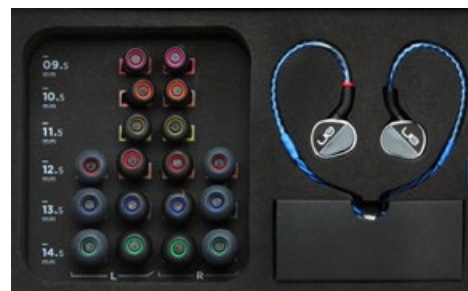


Ultimate Ears UE-900s noise-isolating universal-fit earphones

Whether you are a professional musician looking for reliable back-up sound, or a passionate audiophile in need of an audio upgrade, the Ultimate Ears 900s Noise-Isolating Earphones offer the most powerful sound on the market. Only surpassed by UE's Custom In-Ear Monitors, the UE 900s' four-armature design and three-way crossover universal-fit supports every low-end, midrange and high note.

The UE-900s are said to offer clean, well-rounded, textured sound, a wide soundstage with soul-satisfying bass, heavenly highs, and a crisp, piano-like timbre. Designed with comfort in mind, the earphones perfectly fit to your head with flexible ear loops, and you can customize the feel with detachable braided cables and nine pairs of state-of-the-art ear cushions. (\$399.99)

pro.ultimateears.com



Ultrasonex Edition 5 headphones

Hand-made by skilled craftsmen in the German Alps and equipped with Ultrasonex's next generation S-Logic EX® natural surround sound technology; there really is nothing that compares to the Edition 5. By incorporating a decentralised driver and internal waveguide these unique headphones are able to deliver a stunning sound image unveiling the tiniest details in your favourite music. Constructed from the finest materials available including precious metals and Ethiopian sheepskin leather, it's said that the Edition 5 makes ownership a real experience for all the senses.

They are available now in two forms; the exclusive Edition 5 limited (RRP £2,999) which is restricted to only 555 serial numbered pieces world-wide and the exquisite Edition 5 unlimited (RRP £1,499).

www.ultrasone-shop.com/uk/25-edition-5



V-MODA Crossfade M-100 headphone

V-MODA tapped the collective intellect of artists, editors, and audiophiles to design, develop, and vote on the Crossfade M-100 before going to mass production. The M-100 has earned over 15 Editors' Choice awards by evoking the experience of being at a live performance with crystal clear treble, lifelike vocals and bass that allows you to feel and hear the precise vibrations of your music.

Patent-pending 50mm Dual-Diaphragm Drivers sport inner and outer rings separating the bass from bleeding into the mids and highs resulting in a vibrant and crisp sound stage. V-MODA's Crossfade M-100 continues to be the headphone of choice for true audiophiles and many of the world's top DJs. The M-100 is available at V-MODA.com for \$310.

www.v-moda.com



Westone Laboratories W60 universal-fit earphones & ES60 custom-fit in-ear monitors

The ES60 (custom-fit) and W60 (universal-fit) IEM's feature a premier six-driver system with three-way crossover, said to yield the finest audio reproduction today from any earphone. Each model features dual drivers for high frequencies, mid-range, and bass, claimed to produce powerful sound with unrivalled sonic purity. Both are engineered to accurately reproduce mastered music the way the artist and producer intended.

The W60 is the most advanced universal-fit earphone available and comes with three faceplates, two cable options, and patented StarTip™ and TrueFit™ tips for personal customization. The ES60 is the ultimate CIEM with Dual Bore™ technology for transparent transition between frequencies, and Flex Canal™ for maximum comfort and acoustic seal providing incredible noise isolation. The ES60 (\$1299) and W60 (\$999) are available now.

www.westoneaudio.com



oppo

NEW

PM-3

Closed-back
Planar Magnetic
Headphones



NEW

HA-2

Portable
Headphone
Amplifier
& USB DAC



PM-3 available in
black or white



- Introducing the newest additions to our award-winning Planar Magnetic Headphone and Headphone Amplifier range.
- Optimized for portability, PM-3 is our first closed-back design for privacy and noise isolation. It features high sensitivity, light weight and comfortable fit.
- HA-2 is a compact headphone amplifier and USB DAC featuring ESS Sabre³² Reference ES 9018-K2M DAC chip and support for 384 khz/32-bit PCM and DSD up to 11.2Mhz.

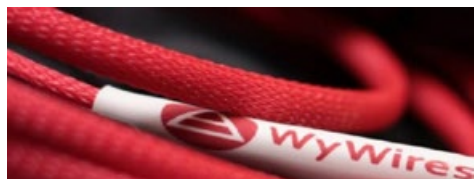
oppodigital.co.uk

WyWires Red Series headphone cables and adaptors

Launched in March 2014, WyWires Red Series cables represent a positive investment for owners of Audeze, MrSpeakers, HiFiMAN, and Sennheiser headphones. Importantly, WyWires can customize Red Series cables to fit each user's needs—building cables to virtually any length and with the user's choice of connectors. Adaptors, sold separately, help users switch between different sources and further enhance the options for personal audio listeners.

By avoiding excessive mass and unnecessary materials, Red Series cables are engineered to provide optimum weight, flex, and texture for comfortable, tangle-free use. Red Series cables offer WyWire's hallmark natural and revealing sound, giving headphone users a significant sonic upgrade without adversely affecting established ergonomics. Prices start at \$299/5-foot cable, custom lengths and connectors priced accordingly.

www.wywires.com/headphone-cables



hi-fi+

IS AVAILABLE FOR iPAD AND iPHONE

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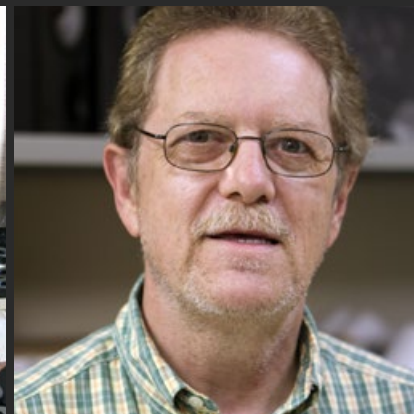
For more details visit our website, click the link below or search for 'Hi-Fi+' on the App Store.



www.hifiplus.com

↖ click here to get the app

MASTER DESIGNERS: HEADPHONES



HI-FI+ INTERVIEWS FIVE INFLUENTIAL HEADPHONE DESIGNERS
ON THE ART AND SCIENCE OF THEIR CRAFT

Mitsuru Hosoo, Final Audio Design

Hi-Fi+: How did you become interested in headphone (and earphone) design in the first place? What attracted you to this product category?

MH: When I was a child, I thought the Pioneer SEL40 we had at home was beautiful. So, Final's headphone designs are influenced by this. I learned the joy of listening to really loud music with headphones. I remember being really surprised at there being a lot of sounds – such as the back chorus – that I couldn't hear through speakers.

As you work to create new top-tier headphone products, what are the top design objectives you try to bear in mind?

I believe that what is most important is whether or not your emotions are stirred when you listen to music. I always see to it that my technical knowledge and experiences don't hinder my responses.

What technologies and product configurations best enable you to meet your design objectives?

The precise form of the diaphragm. The coil and the diaphragm are joined together with great precision. At our company, we believe that controlling such essential basic techniques is important. It's not possible to achieve your objectives just by sourcing and assembling cheap driver units on the market.

Do you favour particular types of drive units for use in your designs and, if so, why?

We don't favor any particular type of driver. At present, we're using BA (Balanced Armature) types and dynamic types, but we think that adopting the fruits of technological innovations of recent years is sure to bring about good results, and we're currently investigating new types of driver units.

How would you describe the ideal voicing 'target curve' for a headphone?

Frequency response is the most important measurement, and we place emphasis on this. On the other hand, we think that placing emphasis only on sound quality frequency measurements is problematic. I hesitate to discuss frequency response here.

What do you consider your top one or two product design achievements thus far?

What makes those products special from your point of view?

First, I would mention our Sonorous X headphone. This is a new product we're planning on releasing at the beginning of summer this year. The distinctive features of this product are its light, strong titanium diaphragm, its strong magnet, and its front baffle and driver unit cut from aluminium in an integrated machining process. Unnecessary vibrations are reduced with the housing, which has been machined from a mass of aluminium, and through powering



the light, strong diaphragm with a strong magnet. At the development stage of this model, we realized that combining the points above, which were right in theory, made for good results. The key points in creating a better quality product were the decisions to produce the important parts in-house, and to have the office and the production line for high-class items in the same place.

Second, I would mention our Piano Forte-series earphones. Piano Forte 8, 9, and 10 don't use ear pads or ear tips. Not sealing the ear canal with an earpiece enables a natural acoustic feel to be achieved. We are currently researching extending bass tone audio bandwidth while maintaining this acoustic feel.

When you listen for personal enjoyment, what types of music do you enjoy?

I listen to all kinds of music, from classical to jazz, rock and electronica. But, I particularly like listening to live recordings at a volume you would hear live music.

What do you think the high-performance headphone marketplace will be like five years from now?

I think perhaps it will be divided into wireless headphones and high-quality sound headphones. I believe that convenient wireless headphones with better sound than those at present will become common, but high-quality sound headphones will remain as items of particular interest for those with a fondness for such items. +



Final Audio Design's famous Piano Forte X earphones do not use or need traditional ear tips

Final Audio Design's upcoming flagship SONOROUS X headphone



Dr Fang Bian, HiFiMAN

Hi-Fi+: How did you become interested in headphone (and earphone) design in the first place? What attracted you to this product category?

FB: I first became a headphone fan back in the 1990s, when I was a middle school student. Even with average playback equipment, I was fascinated that I could hear things through headphones that I could not hear on a home stereo or in a car.

When I first started HiFiMAN, I wasn't involved in headphone design and engineering. My role was more in marketing and sales and generally running the company. However, as we developed our headphone technology, we noticed that the materials and methods of processing materials became the key in creating a new generation headphones. With my extensive background in nanotechnology, I was the only one with experience in R&D and science (the other members of my team were either engineers or experienced audio DIYers). So, beginning in 2011, I started to play an important role in our headphone design projects.

As you work to create new top-tier headphone products, what are the top design objectives you try to bear in mind?

First and foremost, I look for something with the critical balance of a neutral sound signature and musicality. In other words, I want to create an all-around solution for all kinds of music, rather than a headphone with so much coloration that it can only work well in certain types of music. I want a sound signature with broad appeal.

Another important point is that we have to make a headphone that is listenable for a long time and not cause fatigue for the listener. To achieve that, the headphone's sound signature has to be slightly soft and warm yet not too much.

Another consideration for full-size headphones and fatigue is the ergonomics of the headband and ear pads. How do they apply pressure to the head? Is it even? Too much pressure and it quickly becomes uncomfortable. Too little and it feels loose plus you lose bass.

Of course, total weight is a big factor too, especially for planar headphones, which have been notoriously heavy. In our newer designs, like the HE560 and HE400i, we have reduced the weight by 30%, which is a lot. We also employ all new headband and ear pad designs that apply pressure very evenly for greater comfort.



What technologies and product configurations best enable you to meet your design objectives?

Nanotechnology is a brand new area for audiophile products and of course; that is my area of expertise. The super light weight of our nano thickness diaphragm delivers incredibly fast response with exceptional detail.

For our upcoming HE1000 headphones, the nano diaphragm is so thin that when you look at it from the side, it is invisible to the naked eye. We made a video of me dropping a sheet of this diaphragm material. We showed this repeatedly at CES and I think it is on our Facebook page. The point is that this nano material is so light, it takes more than twenty seconds for it to hit the ground. It is really quite amazing.

Do you favour particular types of drive units for use in your designs and, if so, why?

Planar drivers are an important approach to such requirements. Both electrostatic and planar headphones provide more opportunity for applying nano technology into headphones. Dynamic headphones cannot because their moving-coil and cone operating principals force designers to keep the mass and thickness of diaphragm up in the micrometer level. HiFiMAN makes both dynamic and planar drivers, but our best performing models are planar.

How would you describe the ideal voicing 'target curve' for a headphone?

I prefer a neutral or natural sound signature. However, this doesn't necessarily mean a linear curve because when we talk about music reproduction, we have to keep a strong connection with music as played in a live concert. I like the sound signature in a good seat position and in a good concert hall, such as row 12 in the middle of Carnegie Hall. With such a sound signature, we have to consider that the effect of the sound curve from the environment and size of the room will not be linear.

What do you consider your top one or two product design achievements thus far? What makes those products special from your point of view?

HiFiMAN has had a number of significant products in our relatively short existence so it is hard for me to pick just one or two.

In planar headphones, the HE-6 was a headphone that put HiFiMAN on the map, so to speak. Compared to our newest designs, it is nowhere near as comfortable and it takes a lot of power. But with the right amplifier, HE-6 was and still is a great-sounding headphone.

HiFiMAN's coming flagship HE-1000 planar magnetic headphone features a true, nanomaterial diaphragm



The other product that I am very proud of is the HM901 high-res portable player. It was a very ambitious product and we learned a lot along the way, but HiFiMAN as much as anyone helped create the market for this category.

Coming up this year, we have two new products we showed at CES that created a lot of excitement. The HE1000 planar headphone and EF1000 hybrid amplifier. Some feel that HE1000 may be among the best sounding headphones available and we are working hard to make it even better. I am never satisfied with what we have and am always working to improve.



When you listen for personal enjoyment, what types of music do you enjoy?

I have an open mind and wide selection when it comes to music. Classic, opera, rock & roll, and jazz vocal are all my cup of tea.

What do you think the high-performance headphone marketplace will be like five years from now?

We believe that planar headphones will still be the hot point and I don't say that simply because that is what we happen to be good at. Current planar technology is very strong and continues to gain in popularity. With more research and design, planar technology will continue to improve in every way and will get cheaper as well. We will also see planar technology applied in more compact headphones including on-ear models.

So we will see planar headphones at lower price points and we will also see higher performance versions that will rival electrostatics. +

HiFiMAN's ambitious HM-901 portable high-resolution digital audio player/DAC supports various user-installable amplifier modules and—via an outboard dock—can be used as a plug-n-go DAC in full-size systems



The HiFiMAN HE-6 is the headphone that put the firm on the high-end headphone map

EXPERIENCE MUSIC THE WAY IT'S INTENDED.

*"Each product that I have designed is very special to me—particularly when the end product has exceeded the original design goals. The signature Westone sound is warm and detailed, yet spacious without overtly aggressive highs... for top-tier custom and universal-fit products, **the quality of the sound is the most important consideration.** Without that first priority met, no other consideration is relevant."*



Karl Cartwright
WESTONE MASTER DESIGNER



The world's most accurate and comfortable earphones. Designed by Master Designer Karl Cartwright.



ES series



W series

The most advanced universal earphones in the industry with superior fit and unmatched sound quality.

Westone has more than 55 years of experience building custom fit products for the ear. As one of the longest running employees at Westone, Karl Cartwright created the balanced armature driver for use in custom and universal earphones. Karl and his brother Kris designed the current ergonomic shape of the W Series which provides class leading comfort and noise reduction that makes Westone the industry's finest earphones.

Westone[®]
THE IN-EAR EXPERTS[®]
westoneaudio.com

Dan Clark, MrSpeakers

Hi-Fi+: How did you become interested in headphone (and earphone) design in the first place? What attracted you to this product category?

DC: About five years ago, I was sharing a home office with my wife. At the time I used a high-end open-back headphone. I was advised that if I wanted to stay married I needed a headphone that wouldn't allow her to hear it when I played the Talking Heads.

I started looking at closed back headphones, and I wasn't terribly enamoured of what I heard. Fortunately, I came across a Head-Fi thread on 'orthodynamic' headphones, which led to my discovery of the Fostex T50RP mod thread. I decided to try my hand at modifications and it was "love at first mod."

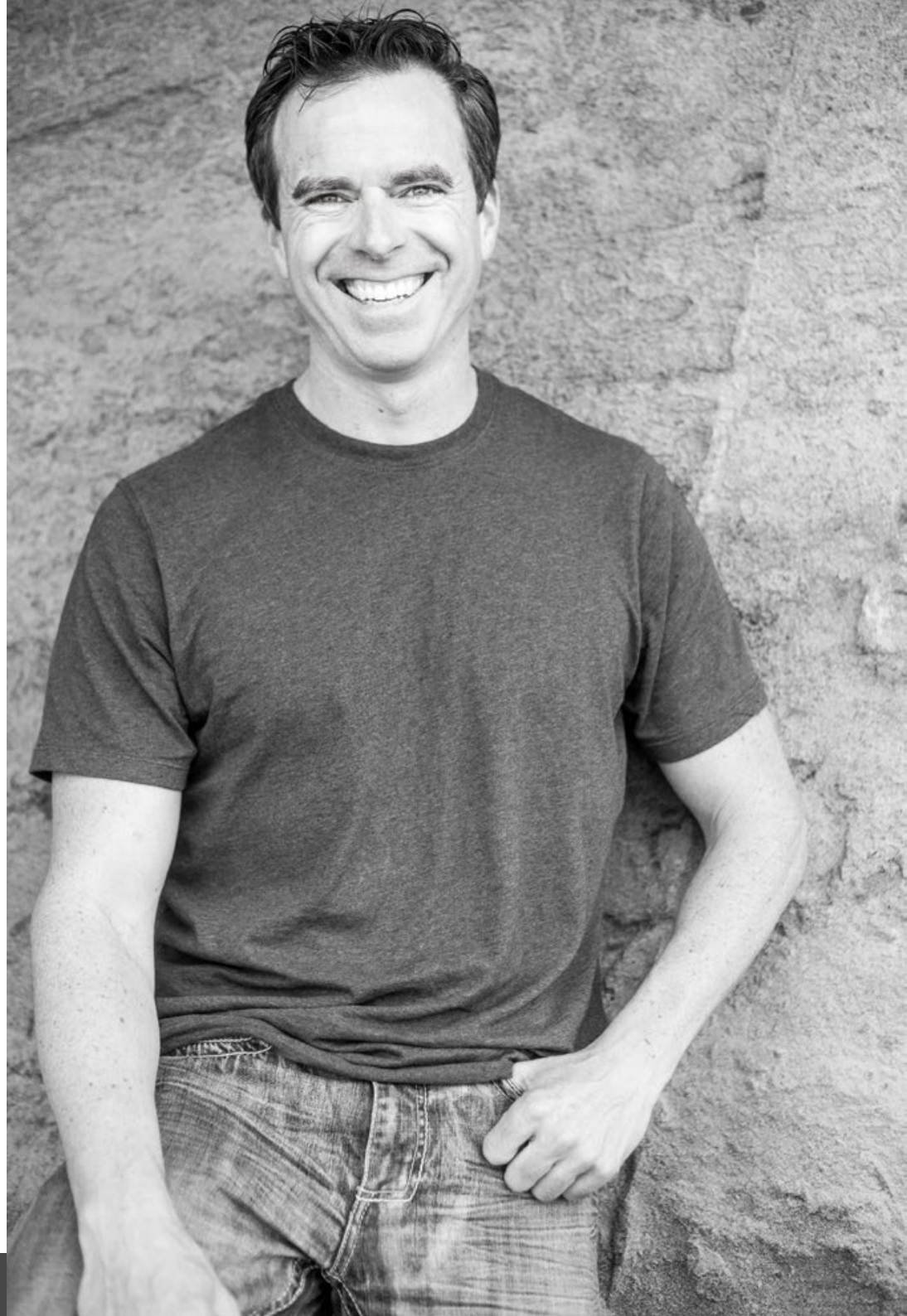
As you work to create new top-tier headphone products, what are the top design objectives you try to bear in mind?

Our first priority is to deliver excellent sound quality for the price. Whether we're working on entry-level or high-end products, we try to deliver exceptional sound quality at each price point. This becomes more difficult as price increases, but it's still our main goal.

Our next priority is comfort. If a headphone clamps too hard or weighs too much it detracts from the listening enjoyment. I have headphones on six or more hours a day, and if a design is uncomfortable for long listening, it goes back to the drawing board.

When we introduced our 3D printed Alpha line of headphones, we added the criteria of a pleasing finish. Modifying Fostex headphones imposed design limits since the headphone's basic design is out of our control. Nonetheless we worked really, really hard to get a striking finish on the 3D-Printed cups we designed for our Alpha line. The result is a beautiful show car quality finish. In fact the finish is so gorgeous that they're currently on display in a 3D printing exhibit at the Museum of Science and Industry (MOSI) in Tampa, Florida.

The finish-work carried over to ETHER, but since we've designed the whole headphone we could work on integrating form and function so ETHER would look and feel great. This can be seen in every facet of the design from our ultra-light yet comfortable Nitinol memory-metal headband to our custom ultra-soft sheepskin earpads.



What technologies and product configurations best enable you to meet your design objectives?

MrSpeakers got its start producing closed-back headphones. Closed headphones are very hard to make, at least if you don't want it to sound like you have cups on your ears. To get the best sound we had to learn a lot about how to control time-domain performance to eliminate ringing, vibration, and other effects that cups exacerbate.

Our first major technical innovation was the use of 3D printers to create our Alpha Dog and Alpha Prime headphones, which have a 'double wall with internal matrix' design that provide exceptional isolation while minimizing cup vibration and weight.

Our next innovation was 'V-Planar' technology, which is derived from the old idea of knurling (creasing) the driver to reduce panel oscillations and nonlinearities. V-Planar is a much more aggressive version of this that increases driver compliance and reduces distortion. The result is extended frequency response and greater clarity, without the edginess that some 'fast' drivers can exhibit.

Do you favour particular types of drive units for use in your designs and, if so, why?

Planar drivers are what we know and love. I just prefer their sound to dynamics, which to my ear tend to be more 'hi-fi' than natural sounding.

How would you describe the ideal voicing 'target curve' for a headphone?

This is the million-dollar question, but I don't think there's such a thing as an ideal curve.

For starters, many factors influence a target curve. For example, a target curve might sound different as a function of listening level, or whether a phone is closed, open or IEM.

If you listen at lower levels (below 80dB) your ear typically won't perceive as much bass or treble as it does midrange, so a 'V-curve' headphone may sound more linear than a 'flat' headphone. But as volume increases, a 'flat' headphone will sound more linear while the phone with a V-Curve will have too much bass and treble.

Frequency response and volume are only one of many factors to consider, including; time domain performance, interactions with the head and ear, distortion, phase, and more. In my opinion, getting too wrapped up in defining a 'unicorn' frequency curve may detract from paying attention to whether or not a headphone actually sounds musical.

MrSpeakers' Alpha Dog is a very highly modified Fostex TR50P headphone that helped put the firm on the high-end headphone map



What do you consider your top one or two product design achievements thus far?

What makes those products special from your point of view?

The first is easy: 3D printing our cups. This really pushed our sound quality to the next level by reducing the effect of the cups on the overall sound. I'm also really pleased with how we were able to make these parts look. Getting 3D printed parts to look beautiful and high-end was about an order of magnitude harder than we expected.

The second was our V-Planar work. Alpha Prime showed some of what the technology could do, but it's more apparent with ETHER, which is a very natural and detailed sounding headphone.

Lastly was the introduction of a Nitinol memory metal headband to reduce weight and increase the comfort of our headphones. It's pretty cool stuff, very flexible, and very hard to deform so it makes getting a great, comfortable fit really easy.

When you listen for personal enjoyment, what types of music do you enjoy?

My musical tastes are all over the map, but right now I mostly listen to jazz, electronica/EDM, and classical.

I've never been a big fan of most pop music, and with so much of today's music being run through dynamic range compression (not to be confused with data compression, which is it's own problem) I find it's just not pleasant or engaging.

I can't say enough for the smaller labels that really put passion into making recordings. There's real magic when you can clearly hear the texture and energy a musician puts into each note because that's often where so much of the emotion is conveyed. When a recording's dynamics are compressed, the emotion is compressed along with it.

Labels like Chesky, M•A, Reference Recording, Proprius, Water Lilly and many other labels really do some amazing work producing beautiful recordings of excellent music.

What do you think the high-performance headphone marketplace will be like five years from now?

I have no idea. In many ways, we're in the golden age of headphones. There are a number of companies doing really great work, and a lot of companies trying to enter the space, so either we'll see a consolidation, or an increase in diversity and choices. +

The new flagship ETHER is the first headphone manufactured in its entirety by MrSpeakers



Igor Levitsky, Oppo Digital

Hi-Fi+: How did you become interested in headphone design in the first place? What attracted you to this product category?

IL: Thank you for the opportunity to share my thoughts with your readers. This is very exciting. Well, I started R&D in planar magnetic technology in 1986 as a young engineer in the loudspeaker and headphone design department of a large audio and acoustics design company back in the USSR (in a city that is now in Ukraine). Our team made a breakthrough in developing an interesting concept for high efficiency planar magnetic headphones that went into limited production in the early 90s and sold in Eastern Europe. Over the years I have been working with a few partners that were interested in this technology, but it never worked out in the end for various reasons of a business nature.

Around 2006-2007, the market started to change with personal and computer audio gaining popularity and general audio market share. I felt the opportunity. I am an engineer and there is nothing more satisfying for me than overcoming challenges and creating new, exciting, and unique products that people would want to buy and enjoy. I must say that headphone design is very different and on some level more challenging than loudspeaker design. I was looking for an opportunity to get the technology and the know-how out into the market. The moment has arrived when I met with folks



from Oppo Digital (Oppo-rtunity). Oppo's attitude, culture, and strategic goals were all hitting the right places for me and we started working overtime to get things rolling.

As you work to create new top-tier headphone products, what are the top design objectives you try to bear in mind?

Without a doubt, for a top-level headphone, sound quality is the most important. If we talk about a real life headphone, not just a lab device for short term comparative sessions, then the second top objective for me is to make sure it is enjoyable to use in real life conditions for prolonged periods of time. This is mostly related to comfort (weight, construction), ergonomics, and, to some extent, to industrial design, feel, and appearance. You know, I am convinced that a listener needs to feel good, excited, and positive when handling and wearing headphones. It is all related. I don't think one can completely psychologically dissociate all the above factors from sound quality.

Some hard-core enthusiasts would say that they don't care about all those 'secondary' factors, but reality shows that this is not true for most people. Manufacturers that ignore these 'other' factors are forced eventually to solve comfort and other design problems no matter what.

Other factors, I would say, are truly secondary in the case of top of the line models. Surprisingly, even price seems not to be that important nowadays if a headphone can sound truly exceptional.

What technologies and product configurations best enable you to meet your design objectives?

It all depends on the objectives. The set of solutions and tricks is different every time. Each headphone has its own.... how to say, 'personality'. The design process is fascinating. It is not quite 'linear' as for some other audio products. Oppo's PM-1 headphone had one set of design objectives and the PM-3 had a different set. The PM-3 turned out to be a more difficult project since a truly portable headphone design imposes many additional limitations and requirements on top of the main goal – sound quality.

In terms of general approach, I am convinced that planar magnetic technology is the best overall solution for the majority of customers who demand high quality and high-resolution sound. It possesses many inherent advantages over traditional dynamic driver technology.

For most 'stay at home' applications, an over the ear, open back design is the best. With PM-3 I had to go with a smaller size 55 mm driver, along with many other mechanical solutions aimed at weight reduction and increased comfort on the go. It is also an over the ear design with a closed ear cup configuration to reduce external noise for use outdoors or in office environments.

Oppo's PM-3 is the firm's newest headphone design and its first closed-back model



Do you favour particular types of drive units for use in your designs and, if so, why?

With very rare exceptions, only thin film based transducers can offer exceptional sound quality and resolution. Planar magnetic drivers inherently have much lower distortion than traditional drivers. They uniquely combine the best qualities of thin film transducers (shared to some extent with electrostats) and yet can be truly portable or at least transportable. They do not require a special desktop bias power supply and amplifier as electrostatic headphones do.

In many ways, electrostats are almost ideal for use in a very quiet room. For me, besides some issues with bass reproduction, several of the best models of electrostats are truly exceptional. However, when one starts looking at their practical limitations, then it becomes clear that planar magnetic headphones offer more benefits while being able to rival electrostats in many aspects on sound.

If I take a very practical position, I would say that planar magnetic headphones offer a much better return on investment if we consider price divided by the number or hours of listening. However, even though we can compare technologies on an engineering level, there is quite a bit in headphones that lies beyond objective parameters and engineering principles. Therefore ultimately, I accept them both as exceptional technologies on their own that do have their own sound signature and do certain things better than the other one.

How would you describe the ideal voicing 'target curve' for a headphone?

Well, headphone sound has quite a large subjective component due to many varying factors, technologies, human anatomy, personal preferences, listening environments, and equipment. That is why headphones are so much fun. Everyone has a legitimate right to say, "This headphone sounds the best". However, they have to add - "for me". I came to the conclusion that for headphones, frequency response is similar to a two dimensional parameter that cannot fully describe a vastly multidimensional system. It is a good first approximation, but yet it fails to reliably predict the actual perceived sound over a wide range of listeners.

So in a way headphone tuning is a painstaking balancing act. I design headphones to have neutral, balanced sound, without artificial 'wow' effects, but also considering the particular application. In the recently launched Oppo PM-3, bass levels are elevated by about 5-6 dB from measured flat response to overcome the masking effect of noise when the listener is on the move or outdoors. A closed-back headphone has higher acoustic output impedance and is also more prone to bass loss due to realistically imperfect fit. Therefore that controlled amount of

Oppo's PM-3 is also available in white or classic black, as shown



measured bass boost was critical in making PM-3 sound right with realistic dynamic impact. Given a wide range of potential customers, program material, and the ways PM-3 will be used, I also carefully balanced the response to avoid excessive HF energy in the 3-to-5 kHz range that can easily lead to annoying sibilants and hardness on average pop music. Each headphone has its own 'tuning story'.

What do you consider your top one or two product design achievements thus far? What makes those products special from your point of view?

For many years I have worked on drivers and speaker system design with planar magnetic (ribbon) technology for consumer and professional markets. I found that headphone design has very unique challenges that push my creative engineering mind, expanding my understanding of some key aspects of sound reproduction, and of the fascinating world of audio in general.

With that in mind, I would say Oppo's PM-3 was a very special product for me that I am very happy about and proud of.

Traditionally, planar magnetic headphones, while having superior sound quality, suffered from low sensitivity and excessive weight. This is not typically a huge problem as long as it is used in a quiet room with a dedicated desktop headphone amp. We wanted PM-3 to be truly portable and affordable for a wide range of customers that would appreciate higher resolution quality sound.

This was a very tough call. How were we to retain superior sound quality at a much lower cost while also providing high sensitivity combined with small weight? I hope you realise that all those factors are contradictory, especially for planar magnetic headphones. It has never been done before. PM-3 is the first planar magnetic headphone that is truly portable and can be used with a smartphone. Working together with Oppo's engineering team for the past 12 months or so and solving those issues have been one the very special moments in my almost 30-year career. It has been an extremely satisfying project.

When you listen for personal enjoyment, what types of music do you enjoy?

Ha... great question! We should not forget what this is all about, right?

I must confess it's hard for me to avoid listening without thinking of technical aspects. It's like an audio designer curse. With headphones it is even harder since measurements do not tell me the whole story. I have to listen to many headphone samples and go through many tracks for prolonged periods of time, including night sessions when external noise is low and hearing is quite acute. It's hard to stop being in testing mode even though I try to avoid my test tracks when listening for pleasure.

I listen to almost all genres. I am open to new music, whatever resonates with me. A wide spectrum of jazz, instrumental, female vocals, and sometimes classic rock is typically my preference. I can't say I listen to classical very often; it is rather a conscious effort to put it on. But when I do, I can easily be engaged in it. It could be quite an emotional work... hard to do this every day. I love to listen to female performers, with no particular choice for genre: Eva Cassidy, Patricia Barber, Etta James, Lila Downs, and many more. Also lately I listen to Donald Fagen; his fusion music and the way he sings and plays is quite unique. David Gilmore as well. I recently discovered Keith Jarrett's Köln Concert. His way of playing piano resonates with me. Not sure if it has to do with the fact that it is largely an improvisation. Quite interesting.

What do you think the high-performance headphone marketplace will be like five years from now?

It will keep developing and will keep growing but will become more competitive. I think customers will be more demanding and discriminating. This is a good thing. I like the way this market grows. It is very stimulating and may push some traditional brands for innovation beyond their comfort zone. Brand name is not as important here as the actual performance. This is rare for consumer products and I welcome that. There is definitely room for a few more new names and new technologies. I also think that it would be more difficult for certain companies to ask for prices that are beyond reasonable since there will always be healthy competition. I also hope that this market will continue to grow its customer base so to speak with more people being interested in high quality headphones and at the same time the high-performance 'club' will hopefully lower its entry ticket price. +



With Our Complements



Our new HE560 and HE400i have won rave reviews and awards from the critics and been hailed as the best planar phones under \$2000.

But a world-class headphone is only as good as the amplifier driving it.

Meet the HIFIMAN EF100, a hybrid design guaranteed to deliver the absolute best from great headphones. That is the ultimate complement.

Paul Barton, PSB Speakers

How did you become interested in headphone design in the first place? What attracted you to this product category?

PB: I have used headphones for music listening as far back as the Koss Pro 4A and the Sennheiser HD 414 with the blue foam ear pads from back in the 1970's. But, my real interest came when I met Dr. Edgar Shaw in the mid 1970's at Canada's National Research Council (NRC) and, since then, where much of the research and product development for PSB Speakers has taken place. At that time Dr. Shaw was doing research for the medical field of hearing aids. While developing loudspeakers over the years at NRC, I was always interested in this research on human hearing and now I think this interest has paid off.

Today people listen to more music than ever before thanks to mobile and portable devices and with these devices there has been an increase in the use of headphones and ear buds, and the ability to easily store your music with high resolution. The weak link for the personal hi-fi listener is now becoming the headphones. For PSB this seemed like a natural product category to pursue.

As you work to create new top-tier headphone products, what are the top design objectives you try to bear in mind?

The design objectives for PSB headphones are the same as for our speakers with one addition. Natural sound reproduction, the best possible value, pleasing aesthetics, and reliability are the staples for PSB product development. With the new product category of personal hi-fi added to the mix, like headphones, we must add one more criteria to the list and that is comfort. Also, while listening to music with headphones, where the music has been recorded with the intention to reproduce the music on speakers in a room, I believe there must be some compensation to the music to make sure playback sounds properly balanced on headphones. It's important to remember that most of the music that people listen to on headphones was not recorded binaurally with headphone playback in mind; instead, most music was recorded to be played back on speakers in a normal room.



What technologies and product configurations best enable you to meet your design objectives?

With regard to personal music listening, the newest technology is something we call 'Room Feel'. Room Feel is a name we give to the target frequency response for the headphone; so that the effects of a typical room on the sound, of speakers in that room, are compensated for.

The M4U 2 was the first headphone that we developed so we wanted to pull out all the stops to make as grand an entrance into the new headphone market as we could. The M4U 2 (M4U = Music 4 You) is configured as a full featured portable folding headset with Active Noise Cancelling (ANC). You can use it in Passive Mode (no amplification) for listening with a high-end DAC/headphone amplifier (or if your batteries go dead... ha ha ha). Or you can turn on the internal headphone amplifier for a boost in power from passive mode and an increase of the input impedance, which will extend battery life of your mobile device. Or you can turn on the combination of internal amplifier and ANC to activate the four noise cancelling microphones. Another feature is the monitor function which allows you to hear what is going on outside when you push and hold the monitor button on the PSB cord. I have not found another headphone on the market that is as fully featured and accessorized.

Do you favour particular types of drive units for use in your designs and, if so, why?

I have done most of the development of headphones with dynamic drivers, much the same as for loudspeakers with one exception being the use of balanced armature drivers that are used in a new in-ear monitor that is about to be released in the next few months called the M4U 4. This model is a two-way design with a passive crossover network inside its tiny chassis along with a high frequency balanced armature and an 8mm dynamic low frequency driver.

I am most familiar with dynamic drivers and it is the most cost effective way to execute an acoustic source generator. Balanced armature drivers, which were mostly developed for the hearing aid industry, are ideal high frequency transducers because of their size and low moving mass.

I would love to investigate planar and electrostatic drivers in the future to see if they have any real performance advantages that justify the cost increases.

I would like to mention that today's driver platforms for headphones are primarily based on rare earth Neodymium magnet structures, which was not the case back in the mid 70's. Therefore, today's designs with neo magnets are inherently more efficient and powerful.

PSB's first-ever headphone, the M4U 2, became an immediate success



How would you describe the ideal voicing 'target curve' for a headphone?

As I mentioned before, we can characterize the 'target curve' for PSB headphones as something we call 'Room Feel', which I derived from research that took place at the NRC in the late 1980's and early 1990's. This research was about trying to develop an adaptive speaker ("a smart speaker") that would compensate for and include the effects of the environment that the speakers are in (in other words, the room). This research centred very much on subjective testing with paid listeners in double blind tests to determine listener preferences when a speaker is equalized in the listening room. If the speakers were equalized to be flat in the room then listeners always complained that there was not enough bass or the sound of the system was too thin or bright sounding. After much experimenting there was a target response that was widely agreed upon by listeners. This is the 'target curve' that is used on all PSB and NAD headphone products. By the way, all NAD headphones are designed with the same team and design criteria as the PSB headphones. (NAD and PSB Speakers are sibling brands within the Lenbrook Group. —Ed.)

What do you consider your top one or two product design achievements thus far? What makes those products special from your point of view?

I would have to say 'Room Feel' and the comfort that has been achieved on the M4U 2 is the major points on the over ear headphone. On the M4U 4 it's the integration

of the two driver types (dynamic and balanced armature) to achieve the 'Room Feel' target response in an in-ear monitor. What makes these special is the ability with 'Room Feel' to appeal to the largest possible listening audience. This has been borne out by what seems to be a fairly universal sonic appeal to PSB and NAD headphones.

When you listen for personal enjoyment, what types of music do you enjoy?

As a classically trained violinist, my background is in classical music, but also with my 44 years as a speaker designer I love all kinds of music, as long as the music is well performed and recorded. I don't know about you, but music has always done something for me, in terms of how good I feel, that nothing else does. Music is magic to me.

What do you think the high-end headphone marketplace will look five years from now?

The biggest hurdle that needs to be overcome for the future of headphones is the ability to get the sound from inside your head to being outside your head, when you listen to recordings that were recorded to be played back on loudspeakers in a room. I mentioned this earlier regarding the frequency response as it pertains to 'Room Feel', but what I am talking about here is real, three-dimensional sound when you listen to headphones. I have some ideas on how to do this but it will take some future work. Some people are doing this but it is not inexpensive or practical for portable use. I would like all our headphones to be able to do this in the future. +



The M4U4 will be PSB's first earphone—one offering a hybrid combination of dynamic and balanced armature-type drivers"

MASTER DESIGNERS: EARPHONES & CIEMs



HI-FI+ INTERVIEWS FIVE INFLUENTIAL EARPHONE/CIEM DESIGNERS
ON THE ART AND SCIENCE OF THEIR CRAFT

George Cardas, Cardas Audio

Hi-Fi+: How did you become interested in earphone design in the first place? What attracted you to this product category?

GC: I was requested to make a cable for an IEM manufacturer. I was shocked at the sound quality of the customer's IEMs and my subsequent survey of products in the field confirmed a serious need for improvement.

As you work to create new top-tier earphone products, what are the top design objectives you try to bear in mind?

I am mainly concerned about musical feel and sincerity. I feel that the sound should be correct from the bottom up.

What technologies and product configurations best enable you to meet your design objectives?

I am working to perfect the coil-driven dynamic driver as applied to in ear monitors. I have found the solution to the basic problems in small drive motors in the selection of metals and charging techniques used in the formation of their magnets and pole pieces.

What is your assessment of the comparative merits of universal-fit vs. custom-fit in-ear designs?

This is personal to the individual and their needs. With respect to universal-fit IEMs the removable ear tips are the obvious differentiators. No one tip solves every problem, but the variety of new tips available provides a desirable solution for 98% of the end user needs. Custom-moulded earpieces are applicable to certain specialized uses, but the hassle prevents most non-professional musicians from pursuing the option.

We have experimented in house with both types and have come to the conclusion that, in general use, a universal-fit earphone with a properly selected removable ear tip is preferred.

Do you favour particular types of drive units for use in your designs and, if so, why?

Yes, I prefer coil-driven dynamic drivers; they provide the best pathway to an efficient broadband phase-true transducer. High efficiency and true dynamics are essential to all portable, personal audio products.



How would you describe the ideal voicing 'target curve' for an earphone?

A difficult answer – in the end no existing measurement system can differentiate between the 'amplitude of the sound' and the 'quality of the sound'. This is particularly true at low frequencies where resonance is commonly overlaid into the sound to compensate for lack of the driver's ability to perform.

I find that pandering to amplitude graphs is total missing of the point. Adding resonance to make graphs look good is a basic violation of the principals of musicality.

With loudspeakers, I find that amplitude graphs out of the design room are largely irrelevant at the frequency extremes and vaguely relevant in the mid band. One must to have a general sense of the givens in the medium measured, a handle on distortion realities, and a knowledge of the measurement system to make any judgment based only on an amplitude curve, and even then there are vagaries in an object's relationship to the measuring system itself, particularly when artificial ears are used...

The sound of music is measured by its authenticity not its amplitude.

What do you consider your top one or two earphone product design achievements thus far? What makes those products special from your point of view?

My current and future designs incorporate a very unique all magnet motor core wherein the pole piece has been replaced by a contoured magnetic structure. This invention linearizes the motor at frequency extremes eliminating a major source of low frequency distortion. The elimination of inductive stored energy and flux modulation distortion is a major step forward in small drivers. The resultant phase coherency is also a boon to speech localization and the conveyance of musical sincerity.

When you listen for personal enjoyment, what types of music do you enjoy?

I like music with sincerity and feeling regardless of genre.

What do you think the high-performance earphone marketplace will be like five years from now?

Beyond imagination: in the end, it may well be ubiquitous. +

Above: Cardas A8 Ear Speakers

Right: Cardas EM5813 Ear Speakers



Jerry Harvey, JH Audio

Hi-Fi+: How did you become interested in earphone and CIEM design in the first place? What attracted you to this product category?

JH: When I started designing IEMs in 1995 the category was brand new and only existed in the professional touring world. Wireless IEM systems had just been invented and the earpieces or IEMs were an afterthought—typically just a set of moving-coil/diaphragm speakers housed in a set of custom-moulded shells. At the time, the available IEMs had horrible frequency response and no headroom before distortion.

I was a touring sound engineer with major rock bands. I toured with Van Halen, Kiss, Morrissey, The Cult, Linkin Park, and many others. My gig was the monitor engineer (the sound engineer for the aristocrats on stage so they can hear themselves). In 1995, while starting a tour with Van Halen, we put Alex Van Halen on a set of CIEMs. He wasn't pleased with the audio quality and asked me to find better ones.

As you work to create new top-tier earphone/CIEM products, what are the top design objectives you try to bear in mind?

Since 1995, when I designed the world's first multi-driver CIEM, my design goal has been to make a perfect sounding CIEM. What I learn from every new design builds on what I learned from the design before. I always try to perfect a new model by correcting or overcoming the deficiencies in the previous design.

What technologies and product configurations best enable you to meet your design objectives?

Dual and quad balanced armature drivers work the best for my desired results these days. Quads are actually the better drivers as they open up more options for crossover design. We were just granted a patent on the dual high driver earphone, which applies to the quad high driver earphone also. One of the most important breakthroughs I developed recently is the Freqphase waveguide. All balanced armature drivers have a different impulse time. It wasn't as bad with the old school single balanced armature drivers, but it is impossible to build a phase coherent IEM without making sure sounds from the drivers all arrive within .01ms of each other. We just received the patent for Freqphase also.



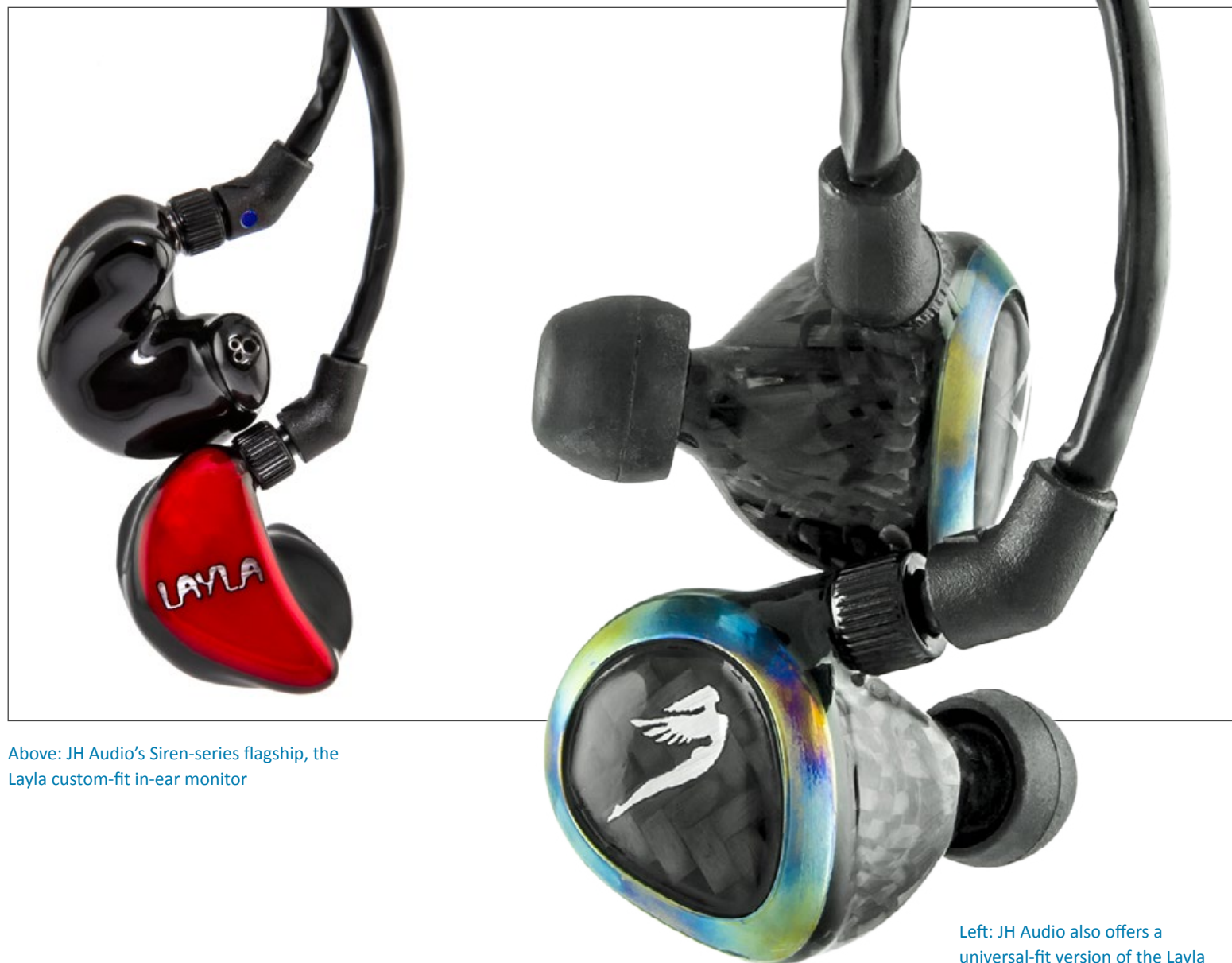
What is your assessment of the comparative merits of universal-fit vs. custom-fit in-ear designs?

It depends on whose universal-fit pieces we are talking about. If the universal-fit IEM is designed with multiple drivers, especially dual or quad drivers, and the main concern is a small size earpiece, it is impossible to have a phase correct IEM. If the CIEM or universal-fit earphone is not time and phase correct, it impacts the soundstage, frequency response and overall user enjoyment.

The JH Audio universals all have the Freqphase waveguide so they are phase correct like our custom models they derive from. So with my IEMS the only difference between custom and universal-fit model would be the consistency of the bass response due to the fit. Universals sometimes can lose a little bass response if they don't have a proper seal. This is not an issue with a good fitting custom.

Do you favour particular types of drive units for use in your designs and, if so, why?

Once again (I favour) quad balanced armature drivers as they give me more options for crossover design, and the quads allow me to get the top-end extension that is lacking in most IEMs.



Above: JH Audio's Siren-series flagship, the Layla custom-fit in-ear monitor

Left: JH Audio also offers a universal-fit version of the Layla

How would you describe the ideal voicing 'target curve' for an earphone or CIEM?

The ideal curve would be transparent and perfectly accurate on an FFT (Fast Fourier Transform) analysis from 10Hz to 20kHz, with variable-level bass output. No one can agree on the proper amount of bass response but everyone wants the earpiece to reproduce exactly what the audio source is without a hyped curve. I finally achieved this with the Layla—a mastering quality IEM with bass adjustable from board flat to +13db at 60Hz.

What do you consider your top one or two earphone/CIEM product design achievements thus far? What makes those products special from your point of view?

Speaking more of enabling technologies I've developed, I'd say I'm proud of my dual drivers, quad drivers, and the Freqphase waveguide.

When you listen for personal enjoyment, what types of music do you enjoy?

Old school classic rock, Motown, hard rock, and some country.

What do you think the high-performance earphone/CIEM marketplace will be like five years from now?

To keep innovating, all geared toward high resolution listening. And I'm positive we will be leading the industry in innovation and development. +



JH Audio's Siren-series Angie universal-fit earphone, shown in Astell&Kern livery

John Moulton, Noble Audio

Hi-Fi+: How did you become interested in earphone and CIEM design in the first place? What attracted you to this product category?

JM: I was always a hi-fi addict. From home audio, to car audio, to portable audio, I owned the best gear I could afford. The attraction to designing CIEMs was really a natural progression and fusion of decades of life exposure to hearing aids and hi-fi audio gear.

My father was heavily involved with the hearing impaired, so I was exposed to hearing aids while growing up. As a practicing audiologist, I was also around hearing aids everyday. Eventually I had a job at the largest hearing aid manufacturer in Thailand. At the time I had a fairly expensive IEM that I could not use as it didn't fit well. One day while at the office, I decided to build a custom-fit acrylic shell and mount the parts from the IEM into the shell.

From that point on I was hooked, I became obsessed with CIEMs, and I spent every moment I could learning about CIEMs and of course spent countless hours in the lab mastering CIEM shell building techniques.

At that time, the CIEMs available on the market were priced at around \$1,000 and looked like a cloudy wad of bubble gum. Due to my lab experience, I knew what was available to build CIEMs and I really felt that I could offer something that looked as good as it sounded, and sounded as good as it looked. I think Noble has a good record of doing that.

As you work to create new top-tier earphone/CIEM products, what are the top design objectives you try to bear in mind?

When creating a new top-tier CIEM, my objective is the same as that of many artists; I want to produce something capable of stirring emotions. However, it is important to note that we all have our own tastes and preferences, so two top-tier CIEMs may not necessarily be designed with the same people in mind. Take the Noble 8C and Kaiser 10 for example, both of these are top-tier products in their own right, but they are different in significant ways. Ultimately, a top-tier CIEM should evoke some greater feeling in the listener, but who that listener is really depends on where I am as far as my own musical tastes, a concept I will expand on later.



What technologies and product configurations best enable you to meet your design objectives?

The most important piece of equipment that we use at Noble is our ears. I will design something by ear and if I like it, I will send it to Brannan. If he likes it as well and we agree it has commercial potential, we will then share it with select friends and family of Noble for additional feedback.

Admittedly, the design process does not only consist of us sitting around listening to stuff. We use technical tools such as frequency sweeps to make sure that a new design has sound fundamentals. However, these technologies are really used to augment the larger design process of simply listening.

What is your assessment of the comparative merits of universal-fit vs. custom-fit in-ear designs?

This is a question that we receive a lot from people just getting started in the hobby. The main benefit of universal products in my eye is the immediacy and how readily available they are. There are a lot of excellent universal products out there today, all of which can be had in very little time. From a more personal perspective, another benefit is that you can share a universal product with friends and family. A lot of folks think that personal audio lacks the socialization aspect of home audio, but that doesn't have to be the case. Last and perhaps the most important factor is that the resale value of a universal piece is much higher than that of a custom. Here at Noble, we have tried to

level the playing field for our customers in this regard through the custom Ownership Transfer Service, but a discrepancy still very much exists.

There's nothing quite like a bespoke suit or pair of shoes and custom earphones are no different. Not only does the product fit you perfectly and has the potential to last a long time, but you also have the opportunity to dictate what the finished piece looks like as well. In addition to supreme sound quality, we come to work everyday with the mind-set that we are going to create the most visually stunning CIEMs out there.

Do you favour particular types of drive units for use in your designs and, if so, why?

At this time, Noble exclusively uses balanced armature drivers. This isn't a reflection of dynamic drivers themselves, I just have not spent enough time with dynamic drivers to know what they are and are not capable of. It is definitely possible that after further research we may offer a dynamic product or line of products in the future.

Above: Noble Audio Prestige custom-fit in-ear monitor

Right: Noble Audio Kaiser 10 custom-fit in-ear monitor, named after Noble's Kaiser Soze



How would you describe the ideal voicing 'target curve' for an earphone or CIEM?

JM: Following from the second question, my ideal voicing or target curve for a CIEM is determined by the various periods of my life, my age, and what music I was listening to at the time. For instance, there was a period where all I was listening to was country music. If I were to design a piece with that period in mind, it would be dictated by country and the various nuances that characterize the genre. It is important to note that my most recent designs do not necessarily reflect the latest periods of my life and that the entire process is completely independent of price. That being said, the Kaiser 10 is in fact most closely associated with where I am now and what I like at this moment. Since I am currently listening to a variety of music, the focus for the Kaiser 10 was creating a balanced, cohesive, piece that was still musical and engaging. More specifically, I wanted something with a low end that blended in perfectly until called for by the music at which point people would ask themselves, "Where in the world did that come from?"

What do you consider your top one or two earphone/CIEM product design achievements thus far? What makes those products special from your point of view?

I think having the top rated in-ear and custom in-ear product on Head-Fi, the largest personal audio website in the world, is a pretty significant achievement. Another proud achievement is the Prestige concept where we craft CIEMs entirely out of solid art mediums such as exotic woods, carbon glass, and aluminium honeycomb.

When you listen for personal enjoyment, what types of music do you enjoy?

I listen to pretty much everything with the exception of Jazz and Metal.

What do you think the high-performance earphone/CIEM marketplace will be like five years from now?

Over the years the IEM/CIEM industry has seen many companies come and go. Some come in with a bang, but most eventually fizzle out. These companies are usually side ventures belonging to small hearing aid companies attempting to dabble in an area that, from a hearing aid manufacturer's perspective, is an easy fit.

In these situations, the core products offered by these companies are not CIEMs, and wearing two hats can often times be difficult. While hearing aids do share some similarities in the build process, CIEMs are far more difficult to build than hearing aids. I expect the future will be more of the same, with more folks trying to break-in to the market as something they are doing on the side with a direct sales approach or as an original equipment manufacturer (OEM) for what is essentially a marketing team.

In five years, the market will probably be more congested and crowded than it is today. However, as with all markets, some will succeed and some will fade away. As with any new venture, the potential to fail is rather high. That is the nature of business; it is a struggle of attrition. Those who are obsessed and don't mind working seven days a week, 16 hours a day, and suffer from what some might classify as obsessive-compulsive disorder, have better odds of succeeding. But even then, there is no guarantee. +

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Vincent Liu, Logitech/Ultimate Ears

Hi-Fi+: How did you become interested in earphone and CIEM design in the first place? What attracted you to this product category?

VL: I have been an audiophile for many years, my system required a lot of space in my home and also the luxury of time to sit down and enjoy. While a good CIEM still can't replace my home system, it does get pretty close, and the small size allows me to listen to music with more spontaneity.

As you work to create new top-tier earphone/CIEM products, what are the top design objectives you try to bear in mind?

We always try to envision the intended user of the device. Who is he or she? What does he or she do – play an instrument? Is he or she a vocalist or an engineer? A CIEM is a tool, a means to an end, which is to listen to work better, or to listen for enjoyment.

What technologies and product configurations best enable you to meet your design objectives?

Our design team employs a variety of tools, from modelling software to measurement tools, but we focus on science and engineering first, and then test our prototypes with industry professionals in between iterations to check our work. Our team members bring their individual expertise in acoustic engineering, electrical engineering, mechanical engineering, and material science together to produce the final product.

What is your assessment of the comparative merits of universal-fit vs. custom-fit in-ear designs?

Universal-fit product has the ease of use and allows more people to experience the benefit of in-ear-monitors; however, universal fits are a step below the fit and comfort – and even sound – that CIEMs can provide.

Do you favour particular types of drive units for use in your designs and, if so, why?

We are not attached to any particular types of drive units, although we use drive units that are designed and built to our specs. Depending on the product's design goals, we may start with a combination of drive units with characteristics familiar to us while exploring new components.

How would you describe the ideal voicing 'target curve' for an earphone or CIEM?

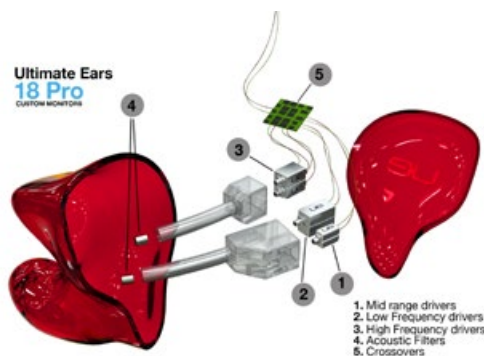
Since everyone has different anatomy, listen at different loudness, and has different subjective preference and different use of CIEMs, there isn't an ideal target curve that works for everyone. Ultimately everyone should be able to design his/her own curve and have us build it, and our UE Personal Reference Monitor is a step in that direction.

UE
ultimate ears



What do you consider your top one or two earphone/CIEM product design achievements thus far? What makes those products special from your point of view?

We have two products: our award-winning UE 18 Custom In Ear Monitors and our UE Personal Reference Monitors. The UE 18 is special because it has our patented triple-bore design with a unique concentric bore, which requires special high-precision tooling to execute the design goal. The UE Personal Reference Monitor is also special because it enables the customer to tell us what he/she wants (in terms of an ideal voicing curve), making it a true, fully custom IEM.



The exploded view of UE's UE 18 Pro shows there is more going on inside modern CIEMs than you might imagine

When you listen for personal enjoyment, what types of music do you enjoy?

I listen to a variety of music; so does everyone on our product team. Lately I have been listening to Barbra Streisand's Partners, Sam Smith's In The Lonely Hour, Mark Ronson's Uptown Special, and Serena Ryder's Harmony. Coldplay, One Republic, Adele, Daft Punk, and U2 are also on my playlist.

We also have musicians on the team, which helps allow us to listen to live sound, which is more of a reality check than listening to recorded audio.

What do you think the high-performance earphone/CIEM marketplace will be like five years from now?

The marketplace will be more competitive, consumers will be more informed and knowledgeable, which means we really need to advance the engineering and science behind our product to stay competitive. +

Above: Ultimate Ears' flagship Personal Reference Monitors not only offer a customised fit, but also bespoke, user-customised voicing curves

Right: Ultimate Ears' UE 18 Pro is considered a top model for performing musicians"



Karl Cartwright, Westone

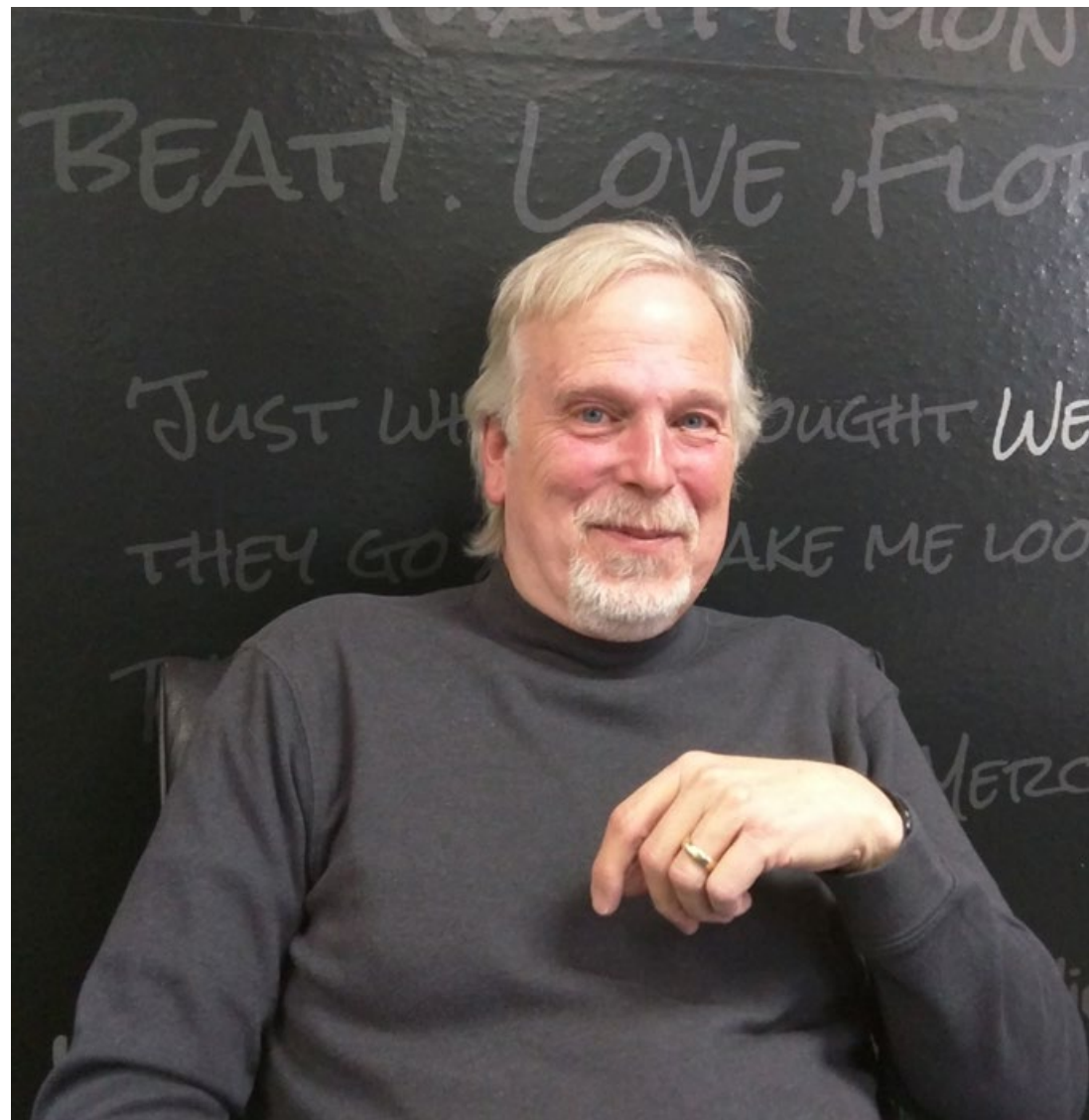
Hi-Fi+: How did you become interested in earphone and CIEM design in the first place? What attracted you to this product category?

KC: I love music! Whether listening to it or playing it, music has always been very important to me. I have many childhood memories of my Dad playing Herb Alpert and the Tijuana Brass albums, or putting together reel-to-reel tapes of choral and orchestral music for the Christmas Holidays. From the beginning, I tried to get the best stereo equipment my meagre check book could afford, which meant I was playing music in bands and creating sound-on-sound recordings with old reel to reel tape recorders. When the Sony Walkman revolution hit in the mid-1980's, the way that people listened to music dramatically changed, and as a result, made the entire experience much more personal. People started listening to music where they could never have enjoyed music before like when jogging, biking, and walking on the beach, etc. This was great except for one major hitch (besides having to carry all those cassette tapes); the earpieces just would not stay in the ear.

By this time, Westone was a well-established company in the hearing healthcare industry that provided custom ear-molds for hearing instruments, communications, and hearing protection devices. It wasn't long before

people were asking us for a solution to the portable-music problem and started making custom earpieces that would accept the Walkman style ear buds. Soon after developing the 'ear bud custom', I was approached by a local factory that was having communication difficulties on the production line. Although they were using Westone's custom earpiece with an ear bud, the lack of attenuation made it very difficult for the team to clearly hear their line supervisors. To solve the problem, we discovered the earpiece had to offer more hearing protection than an earbud based system could provide. The solution was an earpiece that acted as hearing protection first and allowed for communication as well. By using a balanced armature driver from the hearing aid world, and engineering it within a fully occluding earpiece, we were able to combine the two things this factory needed most: a clear audio signal and hearing protection.

Shortly after that, 1990 or '91, Bill Chrysler, who was working with Def Leppard and Rush as they were preparing for their world tours, approached me. They each had a unique problem that they were trying to solve before the tour started. With Def Leppard the volume on stage had grown to such a level that it was becoming extremely difficult for lead singer Joe Elliot to hear the vocal monitors over the guitar amplifiers on



stage. With Rush, the issue revolved around the milliseconds of delay caused by all the various signal sources on stage like floor monitors, drums, guitar amps, and side-fills. Using the same principals as we learned in the factory, we were able to sufficiently reduce the level of ambient sound in the ear to a level that the earpiece became the primary listening source. For Joe Elliot, his voice could be turned up enough in his ears that it could compete safely with the volume of the guitar amplifiers simply because the stage volume in his ears was reduced by 25 to 30 dB! For Rush, the monitor signal provided a clear and precise listening experience as opposed to a smear from all the different signal sources on stage.

A few years later a stage-monitoring gear company, called Leabody Systems, approached me to work with them to help solve some problems Van Halen was having as they were preparing for their 1995 world tour. Leabody introduced me to the monitor engineer for the tour, Jerry Harvey. The problem was that Alex Van Halen was using earbud style monitors and was consistently blowing them up as he cranked up the volume to compete with the stage monitors. After describing the solutions that I had developed for Def Leppard and Rush, we decided to give it a try. We built Alex some earpieces that used balanced armature drivers and featured removable faceplates so that if a driver did fail, it could be replaced in the field.

It was from this early first collaboration that Ultimate Ears by Westone was born! Originally we offered both moving coil and balanced armature driver earpieces. However, once we had introduced the UE5 Dual Driver earpiece, the balanced armature driver had proven itself as the ideal source to use within the demanding on-stage environment. A few years later we worked with Shure to create the first fully occluding universal fit in-ear monitor that was primarily planned to be used in the launch of the PSM 600 wireless monitor system. As you know, much has changed over the ensuing years – some of them firsts for Westone some for other companies. Through all of this change, one thing has remained the same: a fully occluding earpiece with balanced armature drivers is the first choice for most people in a critical listening environment.

As you work to create new top-tier earphone/CIEM products, what are the top design objectives you try to bear in mind?

For top-tier custom and universal-fit products, the quality of the sound is the most important consideration. Without that first priority met, no other consideration is relevant.

Above: Karl Cartwright plays bass in the Westone house band that sometimes performs at trade shows, where the 'PA' system, naturally, features Westone earphones

Right: Westone's flagship ES60 custom-fit in-ear monitor



What technologies and product configurations best enable you to meet your design objectives?

If you look back at the history of Westone, before we created the first universal-fit in-ear monitors for Shure, before there was Ultimate Ears by Westone we were pioneering the use of balanced armature drivers and fully occluding earpieces in critical listening environments. To that end, the balanced armature driver is one of the first tools we would turn to when creating new designs. That said, I am a huge believer in using the 'right tool for the job' and use the best technology that is available, whether balanced armature or moving coil, to solve the problems of a particular design objective.

What is your assessment of the comparative merits of universal-fit vs. custom-fit in-ear designs?

I am a big fan of both and believe each has its place in a discussion about high-end audio. Westone is one of the few companies that make both types of in-ear designs and I'm proud of what we have accomplished. The CIEM is a natural extension of the legacy and heritage that Westone developed from the beginning. We have been making custom-fit products for the human ear since 1959 and have developed an intimate understanding of the human ear. That being said, for some people the purchase of a custom-fit earpiece is not a consideration, which should not preclude them from a high-quality audio experience. The purchase of a CIEM is a very interesting exercise in faith; you read the

reviews, you see what the opinion leaders have to say about the different products but unlike a headphone or a speakers system you can't 'try before you buy'. With universal-fit earphones, the consumer can demo the products to find the one that sounds the best for their needs. Because our standards are high for all Westone products, our understanding of the human ear is also applied to the design and fit of our universal-fit line. No compromises are allowed for reproducing the Westone sound signature or fit just because it is universal.

Do you favour particular types of drive units for use in your designs and, if so, why?

First the application needs to help drive the decision as to which type of driver technology will be used for a particular design. Is the design going to be used in high noise or low noise environments, and what is the end user expectation for the product? Is it for critical listening, lifestyle, or a convenience product? In addition, there are many physical factors that need to be taken into consideration when designing an earpiece such as insertion loss, canal resonance, internal electrical and acoustic design parameters, to name a few. However, the overall motivation for me is that the earpiece never sounds harsh or overly aggressive in any one frequency band. The design should be very detailed yet should have a homogenous character with all the frequency bands supporting each other.

I have been fortunate enough to design listening products that are used in space, combat aircraft, by soldiers in the field, musicians on stage, and audiophiles using both balanced armature drivers and moving coil speakers. The requirements of a F22 Raptor pilot are very extreme with a unique set of design challenges that need to be overcome. While an audiophile will never have to count on his earpiece surviving a 5g combat manoeuvre, the quality of the sound is as important to him as for the pilot. The varying sizes of balanced armature drivers can offer many advantages from a design flexibility and packaging standpoint. This gives me many unique opportunities to acoustically and electronically control the output.

How would you describe the ideal voicing 'target curve' for an earphone or CIEM?

The signature Westone sound is warm and detailed, yet spacious without overtly aggressive highs (as this can become fatiguing over a period of time). Having grown up in the end of what I call the 'Tube Era' where we were spinning records and listening to tape, this is the kind of warmth that I call home.

What do you consider your top one or two earphone/CIEM product design achievements thus far? What makes those products special from your point of view?

One of the most important realizations was that by treating the earpiece first as a fully occluding product, and understanding the dependence on an acoustic seal in the ear,

we could finally realize the full potential of the balanced armature drivers. Without first understanding this concept, a lot of future work would not have been possible either by Westone or other manufactures.

Each product that I have designed is very special to me particularly when the end product has exceeded the original design goals. Whether it is the communications earpiece used in SpaceShipOne or a universal-fit W60, each product inspires me and allows me to learn a lesson that can be applied to the next design challenge.

When you listen for personal enjoyment, what types of music do you enjoy?

Now this is a tough question! I really love all music so it might be easier to say what I don't listen to! I will often move through Classical, Jazz, Progressive Rock, Rock, Blues, World, and Funk whether they are old or new recordings. The power of a well-recorded classical piece, the intimacy of jazz, and the textures of progressive music always appeal to me. When I listen, I want to hear the authentic sound of the artist. Whether it's someone kicking the bass pedals on a Hammond in an organ trio, the warm saturated fuzz of Mel Schacher's bass tone on Grand Funk's Live Album, the bite and spank from a Fender Telecaster, or the saw-tooth wave from an old Mini-Moog, this is what gets me fired up. As a musician, these sounds are something I have become familiar with first hand and this is what I want our earpieces to reproduce.

What do you think the high-performance earphone/CIEM marketplace will be like five years from now?

I believe digital ear scanning will be a big part of getting a custom earpiece made in the future. Instead of using impression material and injecting it into the ear canal, a digital picture will be sent to us where the earpiece will be manipulated in virtual space for the optimal fit and comfort. This will greatly increase the availability of custom fit products as digital scanning technology improves and becomes more accessible to the public. Westone has been on the forefront of this technology and has manufactured earpieces from digital scans of ear impressions for over 10 years.

Also, as wireless technology gets smaller and smaller, earpieces will be asked to perform many functions beyond just listening to music. The interesting compromise for the consumer may be how much battery life is required, the transmission protocol, the number of functions a consumer wants, etc. versus the sound quality of the earpiece. I see two distinct consumer segments that will start to converge over time. One group will be interested in taking their music with them as a convenience or backdrop to their daily lives. The other listens to music as an immersive experience and desires the best reproduction available. We have come a long way in the design of IEM's, but there is still some distance to be travelled. It will certainly be interesting to see where the road leads us next. +



Westone's ES60 is equally at home on stage or in the studio



Abyss®

AbyssHeadphones.com

"..AB-1266 listeners can "read" the placement of musicians and instruments within the soundstage almost as if they had a floorplan of the recording venue detailed with the utmost precision."

Chris Martens- HiFi+ Magazine

"What does the AB-1266 sound like? With good recordings you feel like you're in the room with the band; no other headphone can come close to producing that level of realism."

Steve Guttenberg- CNET / Chesky Records



JPS® Labs

.com

The differences made by the JPS Alumina products were by far the most drastic changes I've ever heard when going from one interconnect, speaker cable, or AC cord to another. Put a little more bluntly, I've never heard wire do this before."

Art Dudley- Stereophile Magazine

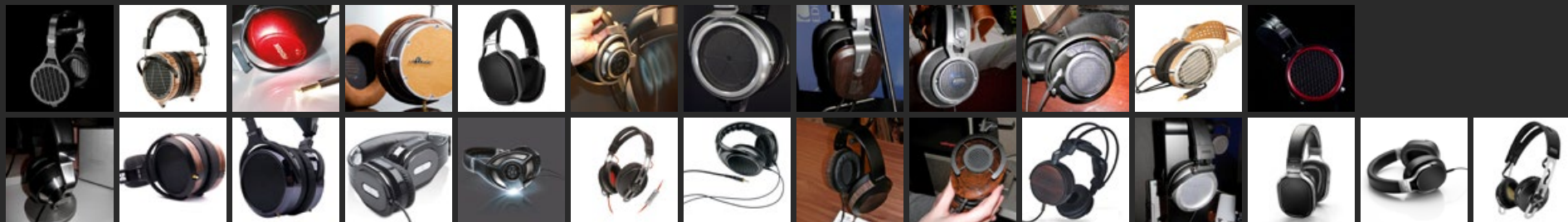
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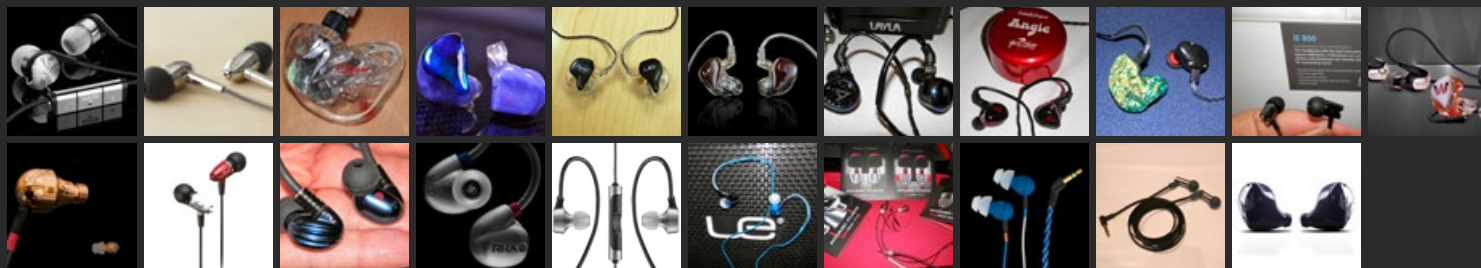


EDITORS' CHOICE

HEADPHONES



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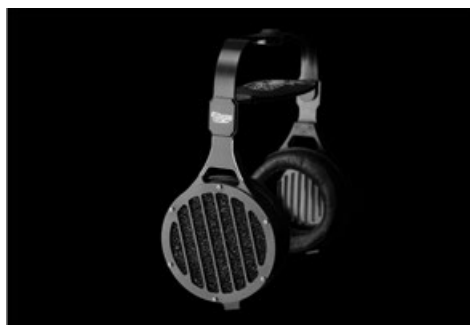


NUPRIME

HI-FI+ RECOMMENDED UPPER END HEADPHONES (\$1,000 AND UP)

Abyss AB-1266 planar magnetic headphones

Abyss' handcrafted AB-1266 headphone offers exceptional sonic performance. Its strengths include high levels of transparency and resolution, neutral tonal balance tempered with a judicious (not overblown) touch of bass lift, extraordinarily revealing yet smooth midrange frequencies, and terrific dynamic expressiveness and power. The AB-1266's iconoclastic frame design and adjustable ear pad system are points of controversy; some find the Abyss quite comfortable, while others consider it too unorthodox to embrace. The Abyss is expensive and requires powerful, top-quality amplification, but if the fit works for you and you can afford the price of entry, expect a rare, exotic sonic treat.



Audeze LCD-3 planar magnetic headphones

The flagship LCD-3 is not Audeze's newest headphone, but it arguably does more things right than any other Audeze model – especially in terms of resolving subtle musical details and nuances. The LCD-3 is easy to listen to owing to clear but gentle-sounding highs, a wide-open midrange, and hearty, beautifully defined bass. Build quality is high, as evidenced by the LCD-3's exotic hardwood ear cups. The LCD-3 is not particularly light, but it is easy to adjust and comfortable to wear, although some might find clamping pressures a bit high. The moderately sensitive LCD-3 requires refined but not excessively powerful amplification.



Fostex TH-900 dynamic headphones

Until the TH-900, Fostex was best known for its pro and semi-pro recorders, but this high-quality closed-backed dynamic headphone surprised everyone with its high performance, comfort, and refined styling. With a 1.5Tesla, 50mm dynamic driver, the TH-900 has class-leading bass response, and outstanding treble performance. However, it is engineered not to sound like a studio monitor, and has a deliberately laid-back midrange, and the sumptuous red "Urushi" lacquered ear cups are less sealed than most engineers would like. But this all combines to make a headphone that is as easy to listen to as it is to wear for long sessions.



oBravo HAMT-1 hybrid dynamic/AMT headphones

At first glance, the oBravo HAMT-1 might look like any other headphone, but in addition to a conventional dynamic driver, it also features a Heil Air Motion Transformer-type driver, the kind used as high-end tweeters for top loudspeaker brands like Adam Audio, Burmester, ELAC, and GoldenEar Technology. The elegant wood, metal, and velour headphone (supplied in its own flight case) sounds more like a high-end loudspeaker than many headphone systems, conveying a sense of dynamism and musical intent to the performances being reproduced. The HAMT-1's bass can also be adjusted through a series of user-replaceable silicone bungs, but before making adjustments, make sure you first give the headphones plenty of run-in time (they will need this to sound their best).



HI-FI+ RECOMMENDED UPPER END HEADPHONES (\$1,000 AND UP)

Oppo PM-1 planar magnetic headphones

Oppo's top-of-the-range PM-1 headphone offers several distinctive design touches, including a diaphragm featuring conductive traces on both its front and rear surfaces – a detail that makes the PM-1 markedly more sensitive and easier to drive than its planar magnetic competitors. The PM-1's sound is highly dependent upon which of several available ear pads are installed. With standard pads, the PM-1 sounds rich and relaxing, but somewhat darker and less open sounding than some might prefer. However, with Oppo's Rev 2 ear pads installed the sound becomes much more neutrally balanced, transparent, and revealing. The PM-1 offers superb ergonomics, fit, and finish.



Sennheiser HD-800 dynamic headphones

Six years after its launch, the open-backed dynamic Sennheiser HD-800 is still one of the best detail retrievers available, although extremely careful choice of upstream equipment is required to prevent all that detail tipping over into brightness. Large, lightweight drive units inside the extremely comfortable ear cups give the HD-800 class-leading dynamics and volume headroom. Unlike most headphone and loudspeaker systems, that volume headroom is so significant that your amplifier (and your ears) may give up long before the HD-800 begins to struggle. The king of dynamics from Sennheiser shows little sign of being dethroned, and the HD-800 remains a true reference point.



Stax SR-009 electrostatic headphones

Stax has been the choice of headphones of discerning music lovers for many years, and for good reason; the Japanese maker of electrostatic headphones has stuck to its guns, producing a range of energizer-powered models, right up to this, the SR-009 flagship. The Stax sound is one of great fidelity to the source, and in the SR-009 that fidelity takes on 'absolute' levels. It's like walking into the studio, or the concert hall, without any of the overhang, colouration, or bloating heard in other system. The SR-009 demands a good a purpose-built electrostatic headphone amplifier, but you won't hear a better sound from audio!



Ultrasonne Limited Edition 5 dynamic headphones

Unlike other high-end headphones, which place high demands on the upstream amplification, Ultrasonne designs its headphones to be efficient enough to be powered by a smartphone or tablet. The Edition 5 is the company's latest and greatest exponent of its S-Logic EX technology, which is designed to minimize lateralization effects, making the sound appear as if coming from studio monitors in front of the listener. Just 555 pairs of Ultrasonne Edition 5 Limited have been made and most are already sold, but there's an Unlimited version that eschews the 'Bog Oak' wood and Ethiopian sheep leather, without a performance sacrifice.



HI-FI+ MODELS 2 WATCH: UPPER END HEADPHONES (\$1,000 AND UP)

AKG K812 dynamic headphone

What's the draw? Although the open-back K812 is available only through AKG's pro audio sales channels (not its consumer audio channels), it is arguably the most audiophile-worthy of all current production AKG headphones. In fact, it just might be the best dynamic driver-equipped AKG model produced to date: Balanced, open, and transparent in a way that AKG's earlier K7xx series models could not match.



ENIGMAcoustics Dharma hybrid dynamic/electrostatic headphone

What's the draw? ENIGMAcoustics' ingenious Dharma headphone combines dynamic bass/midrange driver power and dynamic expressiveness with the exquisite transparency of an electrostatic high-frequency driver. Better still, its self-energising electrostatic driver does not need a dedicated electrostatic amp; it can be powered directly from conventional headphone amplifiers. A preliminary listen suggests that the Dharma can produce soundstages of remarkable 3D realism.



HiFiMAN HE-1000

What's the draw? HiFiMAN has made many great planar magnetic headphones in the past, but with the HE-1000 it is pulling out all the stops in order to push performance limits as never before. The HE-1000 features a new frame design, new ear cup design, and an all-new planar dynamic driver whose diaphragm—for the first time ever—is based on ultra low mass nanomaterial. An initial listen led us to think the HE-1000 may well be one of the most (if not the most) accurate, well balanced, fast, and extraordinarily transparent headphones on the planet.



MrSpeakers ETHER

What's the draw? Up to this point, the San Diego-based firm MrSpeakers has earned a sterling reputation for the sound quality offered by its Mad Dog/Alpha Dog-series planar magnetic headphones, which have all been extensively modified/re-worked Fostex TR50p headphones (although you might never guess this on the basis of the sonic results MrSpeaker has achieved). With the ETHER, however, we have the first headphone manufactured in its entirety by MrSpeakers and the first open-back, cost-no-object design the firm has ever produced. Initial listening impressions suggest that is an open, expressive, and beautifully balanced headphone with very low colouration. It is also remarkably light and comfortable to wear.



HI-FI+ RECOMMENDED MID-PRICED AND AFFORDABLE HEADPHONES (UNDER \$1,000)

Final Audio Design Pandora Hope VI hybrid dynamic/balanced armature headphones

The Final Audio Design Pandora Hope VI (soon to be a part of the Final's 'Sonorous' product line) uses a hybrid combination of dynamic and balanced armature-type drivers, perhaps reflecting a company that started life in traditional high-end audio engineering but is now fully committed to the headphone and IEM world. The closed-back 'modern retro' design takes time to run in, but is sensitive enough not to need powerful amplification, vivid enough to draw the listener into the music, neutral enough to help them enjoy the experience, and expressive enough to keep them there. A unique, but entertaining, headphone experience.



HiFiMAN HE-560 planar magnetic headphones

The design brief for the HE-560 posed some stiff challenges because the new model was expected not only to improve on the build quality, ergonomics, sensitivity, and overall sound quality of HiFiMAN's well-loved HE-500 headphones, but also—insofar as possible—to outperform the firm's flagship HE-6. The impressive part is that the HE-560 actually manages to pull this off! The result is a remarkably well-rounded, do-all, high-end headphone that offers accurate and extended frequency response, very good resolution, and excellent transient speed. Though some might find the HE-560 almost too neutral for its own good, accuracy is in this case its own reward. One tip: Do plan on using a fairly powerful headphone amp for optimal results with this beauty.



HiFiMAN HE-400i planar magnetic headphones

Intended as a substantially cost-reduced little sibling to HiFiMAN's HE-560, the HE-400i actually turned out to be something more. As compared to its illustrious big brother, the HE-400i is significantly easier to drive (it's 3dB more sensitive), differently but no less attractively finished (it's ear cups are trimmed in metallic smoke grey rather than wood), considerably more affordable (the HE-400i sells for roughly \$400 less than the HE-560), and it offers voicing and overall sound quality that come astonishingly close to the HE-560. In side-by-side comparisons, the HE-560 is the better headphone, but not by as big a margin as one might think. Overall, the two models seem more similar than not, which makes the HE-400i a bargain, pure and simple.



PSB M4U 2 active/passive noise-cancelling dynamic headphones

One of the first loudspeaker brands to turn its hand to headphones, PSB has also remained one of the best examples of how to leverage the skills of the loudspeaker maker in the age of the headphone. PSB is very much a science-led brand, and that is clear in the execution of the M4U 2. In fact, the M4U 2 response curve matches the in-room response of the company's loudspeakers (including some 'room gain'). The M4U 2 is one of very few active noise-cancelling headphones whose noise cancellation circuits can be switched on or off, thus allowing the built-in active amplifiers to work their musical magic with maximum sonic purity.



HI-FI+ RECOMMENDED MID-PRICED AND AFFORDABLE HEADPHONES (UNDER \$1,000)

Sennheiser HD-700 dynamic headphones

Not simply the HD-800 for those who can't afford an HD-800, there are many who prefer the tonal balance and effortless listening of the Sennheiser HD-700 over its bigger, older brother. Although there are strong family similarities between the two models, the driver unit is voiced to strike a balance between the warmer presentation of the company's classic HD-650 and the lean, clean, detail machine that is the HD-800. The HD-700 is easier to drive, too, making it the ultimate choice for the listener who wants a lot of detail, but not so much as to make the music hard to take!



Sennheiser Momentum dynamic headphones

The Sennheiser Momentum product range continues to grow as it spawns on-ear, in-ear, over-ear, and two wireless models, though the current sweet spot is the original over-ear model. Whether in its original guise (stocks still available at discount) or in the latest and subtly-reworked Momentum 2 version, the closed-back dynamic headphone is designed to be an efficient partner for smartphones, and the Momentum has become the first choice for discerning music-loving commuters. The biggest change between Momentum and Momentum 2 is the folding headband, allowing the later models to be packed into a small case after your journey. The ear-pads are slightly larger, too!



Shure SRH1440 dynamic headphones

It's been said that every good product line deserves a good 'sleeper' model. You know the type: quiet, self-effacing, and modest to a fault on the outside, yet chockfull of latent performance potential on the inside and just itching to 'kick out the jams' to show the world what it can really do. In Shure's headphone range, that magical model would be the affordably priced, open-back SRH1440. This dynamic driver-equipped headphone offers neutral tonal balance, a substantial measure of detail, plus the elusive qualities of expressiveness, subtlety, and finesse aplenty. Imaging and retrieval of low-level spatial cues in the music is exceptionally good. Better still, the SRH1440 is easy to drive (even for iPods and the like) and extremely comfortable.



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HI-FI+ MODELS 2 WATCH: MID-PRICED AND AFFORDABLE HEADPHONES (UNDER \$1,000)

Audeze EL-8 open- and closed-back planar magnetic headphone

What's the draw? Audeze's new EL-8 open-back and closed-back headphones are chock-full of advanced planar magnetic driver technologies. The EL-8's are said to include the firm's proprietary Fluxor magnet array system, which focuses the magnetic flux field on the diaphragm-side of the array, Uniforce conductor system, which widens or narrows conductive traces on the diaphragm to minimise the effect of possible flux field 'hot spot', and the Fazor waveguide system, which helps to smooth wave launches from the diaphragm. The result promises to be an exceptionally sophisticated pair of headphones at an unexpectedly accessible price.



AudioQuest Nighthawk dynamic headphone

What's the draw? AudioQuest's Skylar Gray-designed Nighthawk fairly bristles with new technologies and fresh design thinking. Examples would include the Nighthawk's injection moulded 'liquid wood' ear cups, elastic ear cup mounting system, distinctive 3D-printed ear cup vents, and above all its 50mm bio-cellulose driver diaphragms, which are said to offer the stiffness of titanium with the damping of paper cones. In short, the Nighthawk aims to compete with headphones selling in the \$1,000–\$1,200 range, while selling for roughly half that price.



ESS ESS-RLM-713 hybrid dynamic/AMT-type headphone

What's the draw? ESS is the company that first introduced Dr. Oskar Heil's radical Air Motion Transformer (AMT) type driver many decades ago. Now, ESS has crafted an impressive, hybrid dynamic/AMT driver-equipped headphone that offers substantial performance potential at a sub-\$300 price. The most recent version as shown at CES 2015 took significant strides relative to ESS' circa-2014 prototype, offering greatly improved integration of drivers plus a far more well-balanced sound that should appeal to a broad spectrum of listeners.



Fostex TH-500RP planar magnetic headphone

What's the draw? Keenly aware that a number of manufacturers have built a veritable cottage industry around the concept of selling highly modified, 'hot-rodded' versions of Fostex' popular T50rp headphones, Fostex decided to launch substantially updated and dramatically performance-enhanced model of its own, called the TH-500RP. Based on a brief listen at the UK's National Audio Show at Whittlebury Hall, we think the TH-500RP will likely become a major player at its £529 price point.



HI-FI+ MODELS 2 WATCH: MID-PRICED AND AFFORDABLE HEADPHONES (UNDER \$1,000)

Oppo PM-2 planar magnetic headphone

What's the draw? Oppo's PM-2 planar magnetic headphone is more like the firm's flagship PM-1 headphone than not, yet it shaves about a third off the price of its bigger brother. Indeed, in most critical, structural respects, the PM-1 and PM-2 are nearly identical, save the fact that the PM-2 offers a less finely polished and refined exterior (though it is still quite handsome in its own right), a less elaborate set of accessories, and a somewhat less sophisticated and accomplished set of signal cables. Happily, though, Oppo will sell you a set of the PM-1's cable at a moderate price, making the higher spec cables a popular PM-2 upgrade. If there's one thing better than a fine headphone (namely the PM-1) selling for \$1,099, it's getting competitive sound quality from a sibling model (the PM-2) that sells for just \$699.



Oppo PM-3 planar magnetic headphone

What's the draw? Elsewhere in this Guide, readers will find an interview with Oppo designer Igor Levitsky in which he discusses the extensive design effort that went into the PM-3. In essence, Oppo's aim was to build a planar magnetic headphone that was well and truly easy to drive (something not easily done with planar magnetic technology), highly responsive, and voiced to make the very most of on-the-go listening.



Sennheiser Momentum 2.0 Wireless wireless dynamic headphone

What's the draw? Bluetooth wireless headphones are currently all the rage among commuters. Unfortunately, however, many of those commuters trade sound quality for convenience in the process. The \$500/£380 Sennheiser Momentum 2.0 Wireless promises to be the exception. With the build, comfort, and performance of the popular wired closed-backed Momentum designs, outstanding battery life, 'NoiseGuard' active noise cancellation, and a neat fold-away design, city-dwellers may find something wireless to smile about on their way to work. You can even use them wired, for in-air listening.



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hi-fi+

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**HERE AT NOBLE, WE CRAFT SOME OF THE
FINEST UNIVERSAL AND CUSTOM IN-EAR
MONITORS AVAILABLE TODAY.**



HI-FI+ RECOMMENDED PREMIUM EARPHONES & CIEMS (\$900 AND UP)

AKG K3003 universal-fit earphones

There can't be much more 'premium' than the AKG K3003. Sold in the more salubrious department stores worldwide, these three-armature earphones are more than just fancy design. Although they do look good: they sit further out of the ear than usual, but deliver an excellent sound all the same. They include three different voicing filters, with 'reference' fitted as standard, and 'high boost' and 'bass boost' colour-coded filters in the elegant case. Because of the unique design, only AKG's own ear sleeves will fit the K3003. The design is available as K3003 and K3003i, with an in-line microphone for smartphones.



Final Audio Design FI-BA-SS universal-fit earphones

With their stainless steel bullet-shaped finish, the FI-BA-SS earphones from Final Audio Design have classic appeal and look surprisingly elegant. The custom made, full-range single balanced armature design uses Final Audio's Balancing Air Movement technology, which exit as tiny pepper-pot ports at the back of the headphone. This is designed to give the unit the bass depth of a two-armature design, with the elegance of a single armature. More importantly though, we felt its sound combined effortless clarity with top-to-bottom coherence and integration. Final Audio's FI-BA-SS is, quite simply, one of the most sophisticated-sounding earphones available today, regardless of cost.



JH Audio Roxanne custom-fit in-ear monitors

The Roxanne was the first in JH Audio's flagship Siren-series of CIEMs (each named after women whose names figure prominently in the titles of classic rock songs) and as such it pulled out all the technological stops. The Roxanne employs JH Audio's soundrive technology: namely, three ganged sets of proprietary quadruple balanced armature drivers per earpiece. The three-way driver array provides quad low, quad mid, and quad high drivers, with each group of drivers feeding one of three bores (that is, sound outlet tubes) tuned with JH Audio's proprietary Freqphase time/phase alignment waveguide system. Finally, Roxanne incorporates a distinctive, entirely passive, bass output control signal cable that allows users to set relative bass levels to suit their personal tastes.



Noble Audio Kaiser 10 custom-fit in-ear monitors

Noble Audio's John Moulton and Kaiser Soze worked up the design of the Kaiser 10 (or K10) over a period of years, intending it to be one of the world's finest CIEMs, and they have succeeded brilliantly. The K10 is a four-way, 10-balanced armature design whose driver arrays comprise two bass drivers, two mid drivers, two mid/high drivers, two high-frequency drivers, and two super high frequency drivers. The K10s deliberately do not provide ruler-flat frequency response, but instead offer a finely judged response curve with slightly elevated bass, neutral mids and upper mids, and subtly subdued highs. Pitch definition, detail, transient speed, and dynamics are all excellent, together yielding an uncanny quality of sonic coherency that becomes addictive over time.



HI-FI+ RECOMMENDED PREMIUM EARPHONES & CIEMS (\$900 AND UP)

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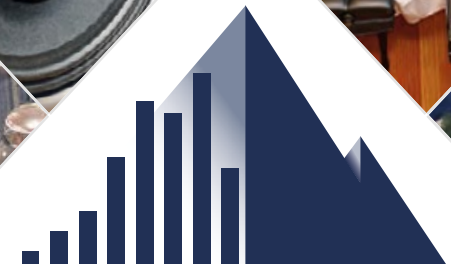
Ultimate Ears In-Ear Reference Monitor (IERM) custom-fit in-ear monitors

At the time of its inception, Ultimate Ears' In-Ear Reference Monitor (IERM) was the first CIEM ever to receive explicit endorsement from a major recording studio for use as in-ear control-room or mixing monitor. Denoting this fact, IERMs ship with one earpiece marked with the "UE" logo and the other bearing the "Capitol Studios" symbol. The IERM is a three-way, 3-balanced armature design that offers a clear and revealing sound with uncommonly smooth, neutrally balanced frequency response. Although low-level detail retrieval may be surpassed to a small degree by the latest generation of über-costly multi-driver designs, the gap (if any) is a narrow one while the IERM remains very well priced as upper tier CIEMs go.



Ultimate Ears Personal Reference Monitors (PRM) custom-fit in-ear monitors

Ultimate Ears' Personal Reference Monitor (PRM) is the first and only CIEM to give owners the freedom to voice their monitors as they wish—including the ability to dial-in separate response curves for their left and right ears. To this end, select Ultimate Ears centres worldwide offer "Personal Reference Tuning Stations", where prospective buyers can listen through special sets of universal-fit PRMs while adjusting inter-related bass, midrange, and treble curves as they wish for both earpieces. Once the customer finds his or her ideal response curve(s), technicians record their personalised settings and build the customer's PRMs accordingly. Thus, the three-way, 5-balanced armature PRM ultimately winds up sounding however users need or want it to sound, which is the whole point.



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HI-FI+ MODELS 2 WATCH: PREMIUM EARPHONES & CIEMS (\$900 AND UP)

JH Audio Layla universal-fit earphones & CIEM

What's the draw? JH Audio founder Jerry Harvey says his new flagship Layla is "the first earpiece I've designed to be a reference/mastering IEM," adding that, "the Layla's bass response when turned down is perfectly flat and when fully turned up has +13db of boost at 60Hz." The Layla is very expensive, but holds the potential to be one of the most accurate and neutrally voiced CIEMs that JH Audio (or anyone else) has yet produced. Layla is a three-way, 12-driver design that uses new 4th-order crossovers. Layla is offered as a CIEM (from JH Audio) or as a universal-fit model (exclusively through Astell & Kern).



JH Audio Angie universal-fit earphones & CIEM

What's the draw? JH Audio's Angie is explicitly designed to be "the little sister" to the firm's flagship Layla model, with somewhat simplified technology, but otherwise following the Layla's "reference/monitoring IEM" design brief. Thus, the Angie is a three-way, 8-driver model that uses, as does the Layla, 4th-order crossovers. Better still for somewhat budget-constrained high-enders, the Angie sells for about half the price of the Layla. Angie is offered as a CIEM (from JH Audio) or as a universal-fit model (exclusively through Astell & Kern).



Noble Audio Kaiser 10 universal-fit earphones

What's the draw? In our "Recommend Premium Earphones & CIEMs" section you can read about all the qualities that make Noble's Kaiser 10 CIEM so special, but now Noble has changed the game by its decision to offer a universal-fit version of the Kaiser 10. Even though the universal-fit model has, as a matter of practical necessity, a much smaller earpiece enclosure than the K10 CIEM (see our photo of the two side by side), the universal-fit K10 uses the same exotic, four-way, 10-driver array as found in the CIEM—a marvel of miniaturisation. If the universal-fit model can preserve the CIEM's sumptuous and addictive sound, it will be special indeed.



Sennheiser IE800 universal-fit earphones

What's the draw? Frankly, we've been itching to get our hands on these top-drawer earphones since they launched. Part of the no-quarter range that includes the HD-700 and HD-800, the IE-800 features a 7mm extra-wide-band linear-phase dynamic transducer instead of a balanced armature design, with a unique dampened two chamber absorber. This is said to create a uniquely low-distortion, high SPL system. It also sports unique oval-shaped adaptors, said to be uniquely comfortable.



HI-FI+ MODELS 2 WATCH: PREMIUM EARPHONES & CIEMS (\$900 AND UP)

Westone W60 universal-fit earphones & ES60 CIEM

What's the draw? Westone's 60-series universal-fit (W60) and CIEM (ES60) models together represent everything the firm has learned about building top-tier in-ear transducers through many years of experience in the field. Both models use three-way, 6-balanced armature driver designs that feature passive, multistage crossover networks. Based on initial listening impressions with the W60, we expect great things from both models, though with the either units—as with most top-tier in-ear models—we urge you to use high-quality amplification in order to hear the Westones at their best. (True, you could drive either model straight from a smartphone or tablet in a pinch, but to do so would be like listening to great loudspeakers with a wet towel wrapped over your ears.).



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HI-FI+ RECOMMENDED MID-PRICED & AFFORDABLE EARPHONES & CIEMS (UNDER \$900)

Cardas EM5813 Ear Speakers universal-fit earphones

Cardas Audio is best known as a maker of fine copper audio cables of all descriptions. Its first earphone – the EM5813 Ear Speaker – is a solid brass design featuring a single 11.45mm dynamic transducer, the engineering of which made to replicate the cochlea and tympanic membrane of the human ear itself. Although great care must be taken in choosing the correct tips for your ear, the end result is an exceptionally engaging and seductive sounding earphone, capable of rendering the harmonic structure of instruments and the reverberant space around those instruments (or 'fixed in post' reverb tails) with consummate ease.



Final Audio Design Adagio III universal-fit earphones

The little brother of the incredible FI-BA-SS may trade stainless steel for ABS in its enclosure, but the balanced armature, rear-ported Balancing Air Movement design of the Final Audio Design Adagio III gets surprisingly close in performance terms, despite being exactly half the weight and roughly 1/15th the price. Like the FI-BA-SS, this is an earphone of grace, subtlety, and sophistication. Also like their bigger brothers, the Adagio III deliver prodigious bass for a single-driver earphone. Careful partnering of these earphones with portable amplifiers is required in taming their exuberant qualities, but the Adagio III will win you over thanks to its extraordinary resolution.



NuForce Primo 8 universal-fit earphones

Though best known for its high-end amplifiers and digital source components, NuForce (now owned by the famous projector manufacturer Optoma) took a step in a bold direction with its ambitious Primo 8 universal-fit earphones. Specifically, the Primo 8, which is a three-way, quad-balanced armature design (with dual bass, single midrange, and single high-frequency drivers) aims, says NuForce, to "replicate the sound quality of reference-class, multi-driver, high-end speakers in your ears." Accordingly, NuForce has equipped the Primo 8 with a proprietary linear-phase crossover network that gives the earphone perfectly phase-coherent response from the top to the bottom of its operating range. Happily, NuForce's performance claims have merit, as the Primo 8's defining sonic characteristics are neutral tonal balance, focus, and coherency.



RHA Audio T10i universal-fit earphones

Following in the footsteps of RHA's very successful MA750i earphones, the firm's T10i's represent a significant and still quite affordable step forward toward even higher end sound quality. As RHA's reigning flagship model, the T10i offers several important technical advances, including earpieces made of injection-moulded stainless steel (a costly and demanding construction technique), new purpose-built dynamic drivers, and a set of colour-coded, metal, screw-in type voicing filters to fine-tune the T10i's voicing for a "Reference" (neutrally balanced), "Treble" (slightly treble-enhanced), or "Bass" (subtly bass enhanced) presentation. The upshot is one of the most balanced sounding and versatile affordable earphones we have yet heard—one whose impressive construction quality (and extensive accessories set) belies its modest price.



HI-FI+ RECOMMENDED MID-PRICED & AFFORDABLE EARPHONES & CIEMS (UNDER \$900)

RHA Audio MA750i universal-fit earphones

The Scottish firm RHA Audio offers its MA750i earphones as keenly priced sonic overachievers of the first rank. In fact, if you have any tendency toward pre-judging products by their price tags, you might overlook the MA750i as not costing enough to sound as good as it actually does. Build quality is remarkably good, with the MA750i's offering machined stainless steel earpieces and cable fittings and high quality dynamic drivers. Moreover, the RHAs come with an extensive and useful set of accessories. But the best part is the sound, whose defining characteristic is a broad, smooth midrange band that is articulate, smooth, and expansive, coupled with bass that is taut and nicely defined (but never overblown) with good depth.



Ultimate Ears UE-900 universal-fit earphones

The UE-900 is at the crossroads between universal-fit earphones and custom in-ear monitors. It offers much of the performance of CIEMs but without the need for custom molds and fitting. It features detachable signal cables, a range of ear-tips and two signal cables (one with an in-line microphone). They are best used with external headphone amplifiers. Although no universal-fit can have the same level of noise isolation offered by CIEMs, they do achieve the goal of matching the sound quality of top-notch custom-fit monitors at around half the price of a comparable CIEM, and that is worthy of significant praise.



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HI-FI+ MODELS 2 WATCH: MID-PRICED & AFFORDABLE EARPHONES & CIEMS (UNDER \$900)

Atomic Floyd Super Darts Titanium universal-fit earphones

What's the draw? Atomic Floyd is a new UK-based earphone maker on a mission. Its range of sophisticated and good sounding earphones have already been picked up by Apple Stores and the company is clearly going places. Proof of this comes in the guise of its top Super Darts Titanium universal-fit earphone. Everything from the packaging, to the fit, to the extremely full sound bode well for the company, and the reasonable price makes sense, too.



Cardas A8 Ear Speaker universal-fit earphones

What's the draw? The second Ear Speaker from the Cardas cable brand, the forthcoming A8 eschews a solid brass housing in favour of a blue rubberized ABS body, but still features a single ultra-linear dual magnet driver, this time 10.85mm instead of 11.45mm. Given the quality of the first EM5813 Ear Speaker, we expect great things from this soon-to-be-seen model.



Final Audio Design Heaven II universal-fit earphones

What's the draw? Available in either black or blue and grey with contrasting stainless steel housings, the Heaven II uses Final's own single balanced armature drivers (one per earpiece), plus the firm's signature Balanced Air Movement technology, which is said to design to help improve bass detail and depth. They also feature a built-in (non-adjustable) filter grommet designed to improve overall tonal balance, plus flat cables that help reduce conduction noise.



Noble Audio 4 & 4C/4S universal-fit earphones & CIEM

What's the draw? The Noble Audio 4 is neither the most complicated nor most costly design Noble Audio offers—not by a long shot, but it just might offer the flattest response curve and most linear, neutral sound of any model the firm offers. The Noble 4 uses four balanced armature-type drivers per earpiece and is offered in either universal-fit or CIEM format (as the 4C, for custom). Incidentally, the CIEM version gives users the choice having earpieces moulded either of acrylic materials or cold-cure, soft-gel silicone materials (as the 4S, for silicone). In fairness, the silicone version crosses the line up into our Premium-priced bracket, though it's still nice to have the choice.



NuPrime IDA-8

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MSRP \$179

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HI-FI+ RECOMMENDED HEADPHONE DESKTOP AMPS & AMP/DACS

AURALiC TAURUS MkII balanced headphone amp/preamp

The TAURUS MkII is the finest headphone amplifier offered by AURALiC, a company led by Xuanqian Wang, a true 'renaissance man' who has trained as an electrical engineer, recording engineer, and as a classical pianist. The TAURUS MkII provides balanced and single-ended inputs, preamp outputs, and headphone outputs. Internally, the TAURUS MkII sports a host of noise reduction features and power supply refinements, and it leverages the firm's signature Class A ORFEO modules whose sound, says Wang, is patterned after that of analogue circuitry from classic Neve recording consoles. The result is a powerful, highly revealing, yet unfailingly musical headphone amplifier that is reasonably priced in light of the exceptional sound and build quality on offer.



Burson Audio Soloist headphone amp/preamp & Conductor headphone amp/DAC/preamp

The Australian audio expert Burson has taken the headphone world by storm, first with its Soloist headphone amp/preamp and then the Conductor headphone amp/DAC/preamp. The two are essentially similar in build, sound, and performance, the Conductor simply bringing a DAC and a larger case to the party. But unlike most brands with a fixed idea of componentry, the Conductor offers a range of DAC options, and we went with the popular ESS Sabre DAC. Whatever you choose, you get a performance that is transparent, if slightly warm, with oodles of deep bass. And they make great conventional line-level hi-fi preamps, too!



Cavalli Audio Liquid Gold balanced headphone amp

Pardon our pun, but many critical listeners consider Cavalli's Liquid Gold amplifier to be the 'gold standard' against which all other top-tier headphone amplifiers must be compared. Here's why. People who joke about amplifiers with bandwidth from 'DC to green light' were probably picturing something like the Liquid Gold, whose bandwidth extends from 3Hz – 650kHz. Moreover, the Liquid Gold offers seemingly limitless transparency and resolution, superb control, dead quiet backgrounds, and perhaps the most accurate and neutral voicing of any high-end component in recent memory. If you want to explore the innermost depths of your favourite recordings, this is your go-to headphone amplifier. Yes, it's expensive, but worth every penny.



Cavalli Audio Liquid Glass hybrid valve/solid-state headphone amp

The third of Dr. Alex Cavalli's ever-expanding range of headphone amplifiers, the Liquid Glass affords the headphone user the perfect opportunity for a spot of 'tube rolling'. Alongside its ultra-transparent solid-state unity buffer stage, the amplifier allows a significant range of double-triode paired valve substitutions in its gain stages, supporting either eight- or nine-pin tube configurations, while providing user-adjustable heater and plate voltages allowing for hundreds of options. Understandably all this flexibility makes the sound of the amp very difficult to pin down. It always sounds good, but with the right valve/headphone combination it can sound remarkable. It's a valve-tweaker's dream amp!



HI-FI+ RECOMMENDED DESKTOP HEADPHONE AMPS & AMP/DACS

iFi Micro iCAN headphone amp

iFi Audio has been reliably showing the audio world that good things don't have to come in big, heavy boxes. The Micro iCAN is part of iFi's first range of components (the new Nano-series models are even smaller and cheaper) and it runs off wall-wart instead of battery power. But the joy of the iCAN is it can drive surprisingly difficult headphones well (while its 3D sound and XBass systems helping to boost the performance of less-than-stellar models), bestowing the sound with a sense of warmth, smoothness, and midrange subtlety, all without undermining fidelity. The Micro iCAN would be good value at four-times the price!



Moon by Simaudio Neo 430HAD balanced headphone amp/DAC/preamp

Moon by Simaudio's Neo 430HA is a world-class headphone amplifier—a description we don't take lightly. As such, the 430HA demonstrates that Simaudio has invested the time and effort necessary to understand (and then address) the needs, wishes, and performance expectations of discerning headphone enthusiasts. In many respects the amp is cut from similar sonic cloth to Cavalli's also excellent Liquid Gold amplifier, meaning that it sounds clear, pure, transparent, and very muscular. Simaudio has even applied certain design elements from its über-expensive Evolution-series components in the 430HA, with benefits you can readily hear. For a modest upcharge, Simaudio can also fit this amp with a built-in, high-res PCM/DSD-capable DAC module, which turns the amp into the 430HAD.



Oppo Digital HA-1 headphone amplifier/DAC/preamp

Much like Oppo's high-performance universal disk players the firm's HA-1 headphone is all about flexibility, a forward-looking mix of features, and high performance for the money. Specifically, the HA-1 combines a powerful, balanced-output, Class A, solid-state headphone amplifier; a high-res DAC with 32/384 PCM and DSD 256 support; and a highly capable stereo preamplifier with balanced and single-ended analogue inputs and outputs, a broad set of digital inputs, and aptX/Bluetooth support. Sonically, the HA-1 offers an unexpectedly sophisticated and self-assured sound, with power, nuance, and control comparable to those of far more costly components. Better still, the HA-1 offers qualities of treble delicacy and 'sweetness' no previous Oppo component has so gracefully achieved.



Trilogy 933 headphone amp

London-based Trilogy Audio Systems is best known for its hybrid preamps and power amplifiers. This, its top headphone amp, sees the company go with a solid-state design instead. This two-box design (with external choke regulated PSU) is curious in that it must be used with a remote control, but that doesn't stop it from being one of the best headphone amplifiers available today, with a sound quality of rare refinement and excellent dynamics. It's extremely reactive to the music playing, in the style of true high-end audio at its best. Unless you want balanced operation, the 933 is the amp to beat.



HI-FI+ RECOMMENDED DESKTOP HEADPHONE AMPS & AMP/DACS

ELECTROSTATIC HEADPHONE AMPLIFIERS

As many *Hi-Fi+* readers know, electrostatic headphones typically require purpose-built electrostatic headphone amplifiers.

Unlike conventional desktop amplifiers, electrostatic headphone amplifiers are designed to provide the high bias voltages that electrostatic headphones require in order to operate and the also are designed to 'swing' the very high signal voltages that electrostatic headphones require.

Below are three of the best of the breed we've encountered thus far.

Cavalli Liquid Lightning electrostatic headphone amplifier

The Cavalli Liquid Lightning is a powerful, wide-bandwidth, ultra-transparent, solid-state electrostatic headphone amplifier designed to probe the performance limits of top-tier electrostatic headphones such as the Stax SR-009. Now updated to become the Liquid Lightning 2T, the amp adds new circuit boards and a revised chassis layout for lower noise, plus a new processor-controlled, photo resistor volume control. Moreover, the LL2T can be built in either a solid-state or—at extra cost—valve-powered configuration. There is nothing quite like listening to Stax SR-009s through the Liquid Lightning; the sensation is that of having one's heart, ears, and mind 'hard-wired' directly to the mixing engineer's recording console, which means you'll get closer than ever to the music you love.



Stax SRM-007tII 'Kimik' electrostatic headphone 'energiser'

For reasons lost to posterity, the Japanese firm Stax traditionally called its electrostatic headphone amplifiers 'energisers'. But no matter the terminology, Stax's balanced, valve-powered SRM-007tII 'Kimik' Energiser is the firm's amplifier of choice for use with its flagship SR-009 electrostatic headphone. The 'Kimik' part of the name refers to a handful of subtle but beneficial 'tweaks' that the UK distributor Symmetry applies in the form of cryo treatment, gold plated pins, and EAT Tube Dampers for the valves. The tweaks are worthwhile, as the 'Kimik' upgrades add to the energiser's already agile and harmonically vibrant sound certain qualities of heightened transparency and intense focus. Interestingly, the SRM-007 tII 'Kimik' sells for about half the price of many high-end electrostatic amplifiers.



HeadAmp Blue Hawaii SE electrostatic headphone amplifier

The Blue Hawaii SE is a hand-built, hybrid valve/solid-state electrostatic headphone amplifier crafted by HeadAmp president Justin Wilson. Headphone amplification guru Kevin Gilmore created the original circuit design for the BHSE though the design has since been refined and tweaked by Wilson. The upshot is a beautifully crafted, gorgeous sounding electrostatic headphone amp that has enjoyed uncommon popularity given its relative rarity and lofty price. (Wilson builds BHSEs in small batches of units that are almost invariably sold out before the amps are completed). Sonically, the BHSE marries resolution with a superb sense of warmth, life, and integrity in the music, showing how the musical fabric forms a cohesive whole rather than deconstructing music into its constituent pieces and parts.



HI-FI+ MODELS 2 WATCH: DESKTOP HEADPHONE AMPS & AMP/DACS

Cavalli Audio Liquid Crimson hybrid valve/solid-state headphone amplifier

What's the Draw? The Liquid Crimson represents a fresh take on the design concepts behind the firm's first-ever product: the critically acclaimed Liquid Fire headphone amp. Like the original Liquid Fire, the Liquid Crimson is a hybrid valve/solid-state amp whose front-end is based on a single 6922 valve. The amp provide hot-switchable high/low gain setting and operate in Pure Class A up to 2.25Wpc @ 50 Ohms; maximum output is about 6Wpc @ 50 Ohms. Although not fully balanced as some Cavalli design are, the Crimson does provide two single-ended and one 4-pin XLR headphone outputs. Best of all, the very attractive Crimson is the least expensive of all full-size Cavalli desktop models.



Chord Electronics Hugo TT headphone amplifier/DAC/preamp

What's the Draw? Chord now offers a bigger, more capable desktop version of its Hugo portable amp/DAC called the Hugo TT (for table top). What's changed? First, Hugo TT doubles the battery life of the original Hugo and a power supply reinforced with a 10,000,000µF bank of 'supercapacitors' for enhanced energy storage. Next, Hugo TT's FPGA DAC receives Chord's latest WTA filter algorithm. Finally, Hugo TT sports improved inputs and outputs, providing two USB B-type input jacks, plus a 32/384-capable BNC coax digital input, both single-ended and balanced analogue outputs, and three headphone jacks (two 6.35mm, one 3.5mm), plus a remote control. Hugo TT is said to be about 4dB quieter than the Hugo, for greater dynamic range and even better low-level detail.



Schiit Audio Ragnarok integrated amplifier/headphone amplifier

What's the Draw? The Schiit Audio Ragnarok is the Swiss Army Knife of headphone amplifiers. Capable of driving single-ended and balanced headphones, as well as loudspeakers with a 100W per channel stereo amplifier. Although Schiit's earliest days had it using tubes for the best performance, the Ragnarok features its circotron-style 'Crossfet' solid-state output stage. Ragnarok sports both balanced and single-ended line inputs, and is the perfect amplifier to match Schiit's own Yggdrasil bitperfect DAC.



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HI-FI+ RECOMMENDED PORTABLE HEADPHONE AMPS & AMP/DACS

AMI Musik DDH-1 portable headphone amp/DAC

A young Japanese brand, AMI (short for Audio Music Interface) Musik makes just two electronics products, and one, the 24-bit, 192kHz DDH-1 is a little bit special. It combines analogue preamp, digital-to-analogue, and even digital-to-digital and analogue-to-digital conversion, making it an ideal adjunct to a computer desktop system. Despite a superb build, a precise, clean, and spacious sound, and a high-spec parts list (it even features two TCXO clocks, rather than simple and cheaper crystal oscillators, for low jitter across both multiples of sample rates), this remains on the value-for-money side of all things audio!



AudioQuest Dragonfly V1.2 USB dongle-type headphone amp/DAC

AudioQuest's Dragonfly USB stick headphone amp and DAC always fought beyond its weight, but as the v1.2 model appeared, with markedly better performance for less money, it became a true giant-killer. Whether it's the colour-coded illuminated dragonfly (which changes colour on resolution), the surprisingly powerful, yet easy to drive headphone amp, or the fact it can do all this (and 24-bit/96kHz resolution) for less than the price of a good dinner for two, it's the real deal, with excellent dynamics and a detailed sound for the money. Unless you must use 24/192 native or DSD, this is hard to beat.



Aurender FLOW portable headphone amp/DAC/player

Aurender's FLOW portable headphone amp/DAC/player is versatile and refined. FLOW incorporates a 32/384 PCM and DSD 64/128-capable DAC with extensive and useful digital playback filter settings. Next, FLOW provides a quiet, powerful, 570mW headphone amplifier whose output capabilities closely match those of Chord's Hugo. Finally, FLOW incorporates an internal bay for an optional mSATA driver, so that with a little help from a music playback software-equipped PC or Mac, FLOW can act as its own music server—literally playing music files from itself back through itself. Sonically, the FLOW offers powerful and articulate bass, clear yet very smooth mids and highs, and a deliciously three-dimensional quality that proves seductive over time. Fit, finish, and industrial design are sublime.



CEntrance HiFi-M8 portable balanced headphone amp/DAC

The name should be read as 'hi-fi mate', and the HiFi-M8 is just that; it's CEntrance's portable pal for the audiophile on the move who is not prepared to put up with so-so sound. With its asynchronous USB 24/192 DAC, low-jitter clock, powerful Class A amplifier, and plenty of battery life, it offers refinement and a sound quality so well balanced, we found it hard to describe without almost damning it with faint praise. Nevertheless, it's a muscular, clean, and versatile sounding performer, and the fact that it can drive almost any headphone from a battery-powered device is deserving of high praise.



HI-FI+ RECOMMENDED PORTABLE HEADPHONE AMPS & AMP/DACS

Chord Electronics Hugo portable headphone amp/DAC/preamp

Chord's Hugo sounds less like a portable and more like a top-class, full-size, desktop DAC and headphone amplifier/preamp, which is most impressive. The Hugo's DAC section is based in part on a low power-draw Xilinx FPGA device that allows 26k tap-length digital filters (the theory being that the greater the tap-lengths available, the better the sound). Moreover, the Hugo's DAC and amp sections are extremely quiet and offer admirable dynamic range. Finally, because its DAC section draws so little power, Hugo's battery reserves can be devoted to powering headphones, even those considered difficult to drive. Those seeking a highly sophisticated headphone amp/DAC to address their listening needs at home and on the go will be well served by this one.



iFi Micro iCAN portable headphone amp

iFi Audio has been reliably showing the audio world that good things don't have to come in big, heavy boxes. The Micro iCAN is part of iFi's first range (Nano products are even smaller and cheaper), and runs off USB instead of battery power, but the joy of the iCAN is it can drive surprisingly difficult headphones well, while its 3D sound and XBass systems help boost the performance of less-than-stellar models. This bestows the sound with a sense of warmth, smoothness, and midrange subtlety, all the while never undermining fidelity. The iCAN would be good value at four-times the price!



iFi Nano iDSD portable headphone amp/DAC

One of the great 'how do they do that for the money?' products, the iFi Nano iDSD represents one of the cheapest possible ways to convert DSD (DoP, via USB), it can be powered from the USB cable or run from its internal batteries, has an adjustable filter setting and comes with a perfectly serviceable headphone amp. How it sounds largely depends on how much you tax its headphone amplifier; with high efficiency designs, it's warm, full-bodied, and sophisticated, with excellent midrange and well-detailed highs. With more demanding headphones, we'd recommend beefing it up with the Nano iCAN headphone amp!



iFi Nano iCAN portable headphone amp

The perfect partner to the Nano iDSD, the Nano iCAN is perfectly named: it's small, and it CAN drive headphones; even surprisingly difficult headphones like the Audeze LCD-3. As a headphone amplifier in its own right, it's cheap, cheerful, and deceptively powerful (and with a 70 hour battery life, stays powerful for longer), but with the Nano iDSD in tow, it creates a true high-end headphone DAC/amplifier combination at a ridiculously keen price. The two Nano products have a similar, and entirely mutually beneficial, tonal balance; the iCAN just brings some muscle to the party, when it is called for.



HI-FI+ RECOMMENDED PORTABLE HEADPHONE AMPS & AMP/DACS

LH Labs Geek Out 1000 USB dongle-type headphone amp/DAC

Not all USB dongle-type amp/DACs are created equal, but one of the first and finest of the breed is LH Labs' tiny but mighty Geek Out 1000. The Geek Out 1000 can decode audio files from MP3 to 384kHz/DSD 128 and it provides pure class A analogue output circuitry capable of delivering an impressive 1000mW (more than many desktop amps!). Then, the Geek Out 1000 provides two switch-selectable digital filters (Time Coherence Mode and Frequency Response Mode), two output jacks (optimised for 0.47 and 47 Ohms, respectively), plus a 64-bit digital attenuator whose output settings are controlled via the user's chosen music playback software. The result is an ultra-capable mini-amp/DAC that easily fits in a pocket or handbag.



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MUSIC + MAGIC

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THD+N: 0.001 % at 0 dB, 10k Ohm load
Frequency Response: 20Hz–22kHz (+0, - 0.5dB)
Output voltage (0dB): High Gain 3 V rms; Low Gain 1.5 V rms
S/N ratio: > 115 dB (at 2 V rms)
Crosstalk: < -110 dB
Dynamic range: > 115 dB
Output power: 160 mW @ 32 Ohm, 28 mW @ 300 Ohm

Outputs:

- Digital: Toslink S/PDIF
- Analog: 3.5mm
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- Gain Control: 2 levels, for earphone impedance of 16 to 300 Ohm

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Gramo One

Reference-grade Open-back In-ear Headphone

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Transducer principle: Dynamic Open
Size of driver: 16 mm
Impedance: 32 Ohms
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MSRP \$249



Contact: sales@heapaudio.com
www.celsus-sound.com

HI-FI+ MODELS 2 WATCH: PORTABLE HEADPHONE AMPS & AMP/DACS



Celsus Sound Companion One portable headphone amp/USB – Wi-Fi DAC/streamer

What's the Draw? Celsus Sound's Companion One offers deceptively simple good looks (patterned after the style of the iPhone 6) that cleverly conceal the sophistication within. Specifically, the Companion One provides an ESS device-driven 32/384 PCM and DSD128-capable DAC, a quiet and moderately powerful headphone amplifier, a very large but compact Li-ion battery, plus something more. To wit, the Companion One can support USB audio playback from Windows, Mac OS, iOS, and Android devices, while also—get this—providing Wi-Fi digital audio streaming from those same four environments. No other portable offers connectivity options like these.



CEntrance Mini-M8 portable balanced headphone amp/DAC

What's the Draw? CEntrance's popular HiFi-M8 portable balanced headphone amp/DAC is a wonderful thing, with just one problem; owing to its physical thickness, it's not exactly portable in the 2015 sense of the word! The Mini-M8 thins down the profile, yet is claimed to retain the HiFi-M8's excellent battery life and 24/192 performance. It's said to be not quite as powerful as the HiFi-M8, but unless you are using 'difficult' headphones on the road, the Mini-M8 is more than powerful enough!



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ENCYCLOPAEDIA HEADPHONICA

HEADPHONE TERMINOLOGY EXPLAINED, Chris Martens



As you might expect, the world of high-performance headphones and earphones has gradually adopted specialised terminology all its own. This article is provided in an attempt to make it easier for newcomers and veterans alike to navigate that world.

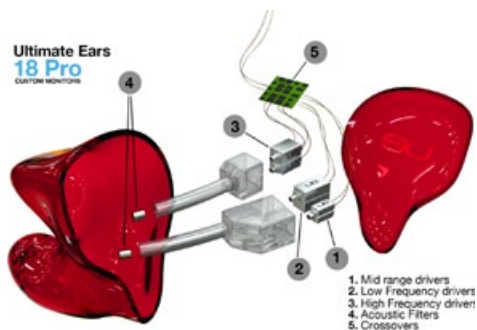
Some of the terms described here are in common use throughout the industry, while others are more specific to *Hi-Fi+*. Our publication does try to use terminology consistently, especially within our on-going series of headphone/earphone-related product reviews, so that this glossary will—we hope—help you get more out of past, present, and future *Hi-Fi+* content.

- Balanced Armature Driver
- Balanced Headphone Amplifiers
- Bore
- CIEM
- Circumaural Headphones
- Clamping Force
- Closed-Back Headphones
- Diaphragm
- Dynamic Driver (Moving-Coil Driver)
- Ear Buds
- Ear Cup
- Earphone
- Earpiece
- Ear Pads
- Ear Tips
- Electrostatic Drivers
- Headband/Headband Frame

- Headphone
- Headphone Connector Plugs
- Hybrid Headphone & Earphone Designs
- Noise-Cancelling Headphones & Earphones
- Noise-Isolating Headphones & Earphones
- On-Ear Headphones
- Open-Back Headphones
- Planar Magnetic Drivers
- Ribbon Drivers
- Signal Cables
- Supra-aural Headphones

Balanced Armature Driver

A type of miniature drive unit frequently applied in earphone and CIEM designs, but also—much less frequently—used in full-size headphone designs. Balanced armature drivers feature extremely small can-like enclosures containing very small armatures wound with wire coils and suspended with in a magnetic field. As audio signals are applied, the changes in the magnetic field across the coil cause the armature to rock back and forth, pivoting on its balance point or fulcrum. As one end of the armature is driven upward, the other end goes downward (much like a child's 'seesaw' or 'teeter-totter' in motion). In order to produce sound, one end of the armature drives an actuator connected to an extremely small diaphragm, which flexes inward and outward as the armature moves up and down. Output from the diaphragm typically is routed to the listener's ears via a sound outlet tube commonly called a 'bore'.



This exploded view of Ultimate Ears' UE18 Pro CIEM shows just how tiny balanced armature drivers really are.

Balanced Headphone Amplifiers

In the world of headphones and earphones—as in traditional audio—there are two distinct topologies of amplifiers available: single-ended amplifiers and balanced amplifiers. By convention, in a single-ended amplifier the '−' output terminal is tied to electrical ground, while the '+' terminal carries the active signal. In single-ended headphone amplifier applications specifically, outputs are typically delivered through a three-conductor jack sized to fit either a 6.35mm phone jack-type plug or a 3.5mm mini-jack-type plug. In either case, one of the conductors in the jack/plug serves as the '−' or ground connection, while the other two conductors serve, respectively, as the '+' connections for the left and right audio channels.

In balanced (some would call them 'differential') amplifiers, internal circuitry is differently arranged so that in essence the amplifier has two equal but opposite halves; one handling the positive-going side of the audio signal and the other handling the negative-going side of the signal. Both the '+' and '−' halves of the amplifier are referenced to electrical ground. As a result, the outputs of each amplifier channel will have three (rather than just two) connections for audio signals: a '+' connection, a '−' connection, and a dedicated 'GND' or ground connection. In balanced headphone amplifiers, outputs are typically handled by two 3-pin XLR connectors (one for the left channel and the other for the right), where the 3-pins correspond to '+', '−', and 'GND'.



Note the multiple types of balanced output connectors on the front panel of Cavalli Audio's fully balanced Liquid Gold headphone amplifier.

Bore

Many CIEM and some earphone manufacturers use the term 'bore' to describe the sound outlet tubes associated with balanced armature-type drivers. Sometimes the outputs of multiple drivers might be routed through a single bore tube. Thus, one might read CIEM descriptions that state something like this: "Ours is a four-driver, triple-bore in-ear monitor design."

CIEM

CIEM is an increasingly popular acronym that stands for 'Custom-fit In-Ear Monitor'. The key idea is that CIEMs, unlike universal-fit earphones, have custom-moulded earpieces that are crafted to provide a precise custom-fit that exactly matches the contours of the individual wearer's ear canals and outer ears (or pinnae).

In order to have a set of CIEMs made, prospective owners must first obtain, either through a qualified audiologist or through the CIEM manufacturer, a set of ear-mould impressions, or else have the interior surfaces of their ears digitally scanned. Either way, the ear-mould impression or digital scans are used to create moulds from which the CIEM's custom earpieces are made.



CIEMs like the Noble Audio Kaiser 10 offer beautifully finished, user-specific, custom-moulded earpieces.

Circumaural Headphones

Full-size headphones generally come in two forms: on-ear designs and around-the-ear designs. The word 'Circumaural' is the correct, formal term for 'around-the-ear' designs, where the ear pads surround the wearer's outer ears, but do not rest directly upon them.

Clamping Force

The term 'Clamping Force' describes the amount of pressure that a given headphone design exerts in squeezing or pressing the left and right ear cups of headphones against the sides of the wearer's head. There is no industry standard for such forces and listener's tastes can and do vary on the matter. The key concept is to have sufficient force for the headphone to stay in place during listening (too little clamping force might make the headphone prone to slipping out of position or even falling off), but force low enough to allow comfortable long-term listening sessions.

Closed-Back Headphones

Generally speaking, full-size headphone designs follow one of two possible configuration formats: open-back or closed-back designs. In closed-back designs, as the terminology suggest, the back sides of the ear cups are completely sealed or 'closed'—making each ear cup much like the enclosure of an acoustic suspension-type loudspeaker, but in miniature. For obvious reasons, closed-back headphones do better job of blocking out external noise than open-back headphones do. However, there is much debate on which design format—open-back or closed-back—makes for superior driver performance and all-around sound quality.



Closed-back headphones like this Audeze EI-8 have ear cups completely sealed on the back side.

Diaphragm

Regardless of type, headphone and earphone/CIEM drivers invariably have some sort of diaphragm, which is the moving element that actually produces the sounds we hear.

Some headphone/earphone diaphragms are much like miniature versions of the circular woofers, tweeters, etc. that most of us have seen in conventional dynamic driver-equipped loudspeakers; these tiny diaphragms operate like tiny pistons moving inward and outward to produce sound waves.

Other headphone/earphone diaphragms are thin, planar membranes whose entire surface area vibrates to produce sound, much as in full-size electrostatic or planar magnetic-type loudspeakers.

Finally, some headphone drivers used folded membranes whose pleated surfaces move somewhat like the bellows of an accordion to produce sound, much like loudspeakers fitted with ribbon-type or Heil air motion transformer (AMT) types of drivers.

Dynamic Driver (Moving-Coil Driver)

Dynamic drivers (also sometimes called 'moving-coil' or 'pistonic drivers') are by far the most popular types of drivers for use in loudspeakers, headphones, and earphones (although many CIEMs use balanced armature-type drivers). The core elements of dynamic drivers consist of diaphragms (the cone or dome that actually moves to produce sound), voice coils (ring-shaped coils of wire wound on small, cylindrical 'voice coil formers') that are attached to the diaphragm, and magnets (which are usually cylindrical in shape with ring-shaped grooves called 'voice coil gaps' on top).

As a musical signal is routed through the voice coil, which is positioned within the voice coil gap of the magnet, the electromagnetic interaction between the voice coil and the magnetic field causes the voice coil/diaphragm to move forward and backward, thus producing sound.



Dynamic headphone drivers like this one from Beyerdynamics' T1 Tesla headphone are built much like miniaturised dynamic drivers for loudspeakers.

Ear Buds

The term ‘ear bud’ is the slang expression for the sort of loose fitting transducers worn in the outer ear, as typically supplied with smartphones, personal digital music players, etc.

Some people use the terms ‘ear bud’ and ‘earphone’ interchangeably, but we at *Hi-Fi+* see those terms as having distinctly different meanings. For us, the defining characteristics of ear buds are, first, that they are worn in the outer ear and not within the ear canal, and second, that ear buds almost always fit loosely and do not provide any sort of airtight seal with the ear canal. Note, please, that ear buds typically are voiced so that they sound normally balanced without requiring an airtight seal.



Ear buds such as this Urbanears Medis are meant to rest lightly in the wearer’s outer ear—not inserted into the ear canal.

Ear Cup

In full-size headphones, ear cups are the physical housings or ‘enclosures’ to which the headphones’ drivers are attached, and to which the headphones’ ear pads are attached. Typically, signal wire connections to the headphone are also made through the ear cups. There are many different schools of thought on ear cup construction so that you will find ear cups made of wood, moulded thermoplastics, composites, and metal.



Ear cups can be made of various materials such as these exotic wood ear cups from Fischer Audio

Earphone

Hi-Fi+ (and many manufacturers and enthusiasts) consider the term ‘earphone’ to be a contraction of the longer though more descriptive term, ‘universal-fit in-ear headphone’. For us, the defining characteristics of earphones involve the fact that, regardless of the earpiece configuration used, earphones are meant to be worn within the ear canal, with the assumption that a flexible set of ear tips (offered in various sizes) will be used to ensure a comfortable yet airtight seal between the earphone and the ear canal. The voicing of earphones presumes and indeed requires this airtight seal for proper tonal balance to be achieved.

Some people use the terms ‘earphone’ and ‘in-ear monitor’, plus the acronym ‘IEM’, interchangeably, but at *Hi-Fi+* we again feel these terms have distinct and different meanings.

As above, we define ear buds as typically loose-fitting devices worn in the outer ear, while ‘earphones’ are worn within the ear canal and require the aforementioned airtight seal within the ear canal in order to work properly, in the process achieving significant levels of noise isolation.

‘In-ear monitors’ and ‘IEMs’ are, strictly speaking, in-ear transducers worn for monitoring applications, but the practical reality is that majority of listeners doing actual monitoring work tend to choose CIEMs (Custom-fit In-Ear Monitors) for the job, owing to their superior noise isolation and more sophisticated sound quality.

In our opinion, most earphone makers who call their products ‘IEMs’ are overreaching, probably in the hope that the ‘IEM’ label will confer upon their earphones some of the perceived ‘hipness’ and sophistication of true CIEMs.



By design, earphones are compact and use sound outlet tubes fitted with flexible ear tips designed to create a comfortable yet airtight seal within the wearer’s ear canals.

Earpiece

The term ‘earpiece’ refers to the physical housing or enclosure within which ear bud, earphone, or CIEM driver(s) and crossover networks (if any) are mounted and from which the sound outlet tube(s), if any, extend.

For obvious reasons, earpieces must be large enough to accommodate the intended driver or driver arrays, yet small enough and smooth enough to fit comfortably within the wearer’s outer ears. The physical shape of the earpiece must also allow for with very wide variations in ear shapes and sizes, while at the same being easy for the wearer to grasp, to insert, or to remove.

As with headphone ear cups, there are many schools of thought on earpiece construction, so that shoppers may encounter earpieces made of wood, moulded thermoplastics, composites, metal, acrylic materials, or even cold-cure soft-gel silicone.



Manufacturers go to great lengths to balance the demands of fit and functionality in high-performance earpiece designs.

Ear Pads

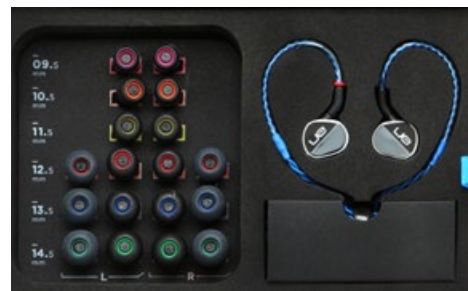
All types of full-size headphones feature ear pads that provide a comfortable, soft, and flexible interface between the headphones’ ear cup/driver assemblies and the wearer’s head.

Ear pads typically are shaped either as circular, oval, or ‘racetrack’-like rings, open at the centre to allow the sound to pass through; pads may be covered in fabric, leather, faux leather, or any combination of those materials.

Ear Tips

Almost all contemporary universal-fit earphones come with several sizes of flexible ear tips designed to provide a comfortable but airtight seal between the earphone’s sound outlet tubes and the wearer’s ear canals (even a seemingly minor air leak can upset if not ruin the tonal balance of the earphone). The sole exception would be certain ear tip designs that provide built-in vents (e.g., some of the tips used for the Cardas Ear Speakers) though vented ear tip designs are comparatively rare.

Ear tips come in a variety of configurations with popular variations including single-, double-, and triple-flange designs, and round or ‘bell-shaped’ designs that might include special features designed to enhance noise isolation. Ear tips are typically made of soft, silicone rubber, but some manufacturers have experimented with multi-layer ear tips, in some cases with noise isolation gel sandwiched between the inner and outer layers. Another popular variation involves ear tips constructed of compressible foam materials—a concept patented by the firm Comply Foam (which is a spin-off of 3M Corporation).



Modern universal-fit earphones, such as this Ultimate Ears UE-900s, sometimes ship with extremely elaborate sets of ear tips.

Electrostatic Drivers

Electrostatic drivers feature diaphragms made of thin membranes typically constructed of polyester-like materials (e.g., polyethylene terephthalate or PET) to which an electrically conductive coating has been applied. These membranes carry a high voltage (typically greater than 500V) but very low-current charge and are suspended between two metal (or metallised), mesh-like electrode grids called stators.

In operation, high voltage (but again, typically low-current) audio signals are applied to the stators. By design, the stator pairs are configured so that at any time when musical signals are present, the stators will carry opposite charges (one carrying a negative ‘–’ charge and the other a positive ‘+’ charge, and then vice-versa, as the audio signal flows back and forth). As the charge on the stators varies in response to musical signals, the diaphragm is simultaneously attracted to one stator and repelled from the other, so that the diaphragm moves back and forth within the air gap between the stators, producing sound.



The stator (or electrode) grid of the classic Stax SR-009 electrostatic headphone driver.



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Headband/Headband Frame

In a general sense headbands are the frames used on all full-size headphones that reach up and over the top of the wearer's head, while holding the left and right ear cups in proper position for optimal sound and user comfort. Frames can be made of various materials including metal, moulded thermoplastics, composites, or other materials.

One key aspect of any headband design will be an adjustment mechanism of some kind that will allow the frame to expand or contract as needed in order to accommodate the varying sizes of users' heads. Two other key elements of any good headband frame will be the ear cup yokes and the headband pad or strap.

Ear cup yokes are the frame elements to which the headphones ear cup/driver assemblies attach. Some yoke designs that are minimal while others are quite elaborate. Some minimalist yoke designs hold the ear cups in fixed, or very nearly fixed, positions, trusting in the springiness of the headband frame to sufficient flex for a decent fit. Other yoke designs allow ear cups to swivel (in horizontal and/or vertical axes) to obtain a better overall fit. Trade-offs can be involved either way. As a general rule, minimalist yoke designs tend to be more rugged—say, for headphones that might be worn while participating in action sports, while swivelling designs offer greater flexibility for purposes of fit, but are somewhat more complicated to build and more prone to breakage should the headphone inadvertently be dropped.



The frame and yoke design of the Oppo PM-1 headphone allows ear cups to swivel in both horizontal and vertical axes.

Headband pads or straps are the 'suspension system' for the headphone, enabling the headphone's weight to be spread across the top of the wearer's head. One school of thought calls for padding the headphone frame itself to provide a soft, comfortable point of contact with the wearer's head. A second school of thought, however, calls for a broad, flexible strap to be suspended, sometimes via elastic or rubber suspension rings, from the frame of the headphone (so that the weight of the headphone is borne, in part, by the suspension bands or rings).



HiFiMAN's new HE-560 headphone uses a suspension strap system, as show, to help support the headphone's weight for greater user comfort.

Headphone

The term 'Headphone' refers' to full-size headphones (as opposed to earphones or CIEMs) that are worn on the head, with ear cups that either fit around or alternatively rest upon the listener's ears.

We at *Hi-Fi+* draw a distinction between headphones, which by definition are worn on and rest upon the user's head, versus earphones or CIEMs, which are worn in the user's ears but do not rest upon the top of the head.

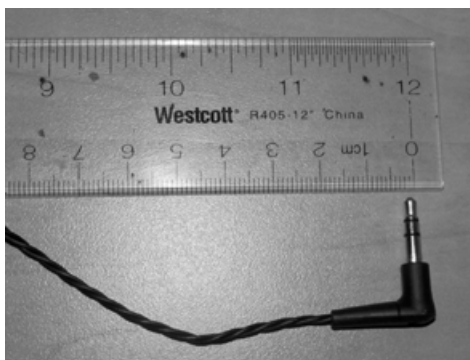
Headphone Connector Plugs

There are a handful of physical connector types commonly used for connections between headphones and headphone amplifiers (or tablets, smartphones, etc.). One useful distinction, however, can be drawn between connectors designed for use with single-ended amplifiers vs. connectors designed for use with balanced amplifiers.

Single-ended Connector Plugs: Single-ended connector plugs have three conductors—a ground "GND" conductor (shared by both the left and right channels), plus two '+/-' signal conductors (one each for the left and right channels).

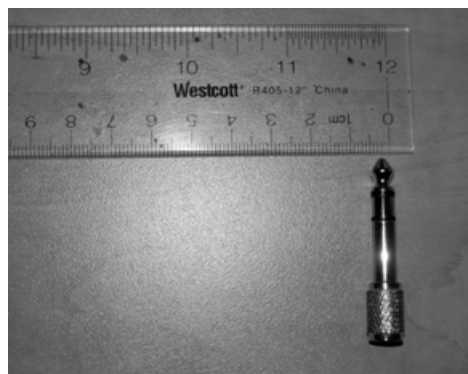
3.5mm, three-conductor, mini-jack plug: By far the most common connector for earphones/CIEMs (but also for some headphones), the small, three-conductor 3.5mm mini-jack plug is the type of connector used to plug headphones into

iPods, digital music players, iPads and other tablets, and iPhones and other smartphones. Quite recently, some manufacturers have begun using pairs of 3.5mm sockets to support balanced stereo output connections



3.5mm plugs, as on this Westone signal cable, are probably the most common in all of personal audio.

6.35mm phone/headphone plug: Think of this as a considerably larger scale version of the 3.5mm plug. The 6.35mm plug is typically used to connect full-size headphones to full-size desktop (but also some portable) headphone amplifiers. Like the 3.5mm plug, the 6.35mm plug provides three conductors (sometimes called the Tip, Ring, and Sleeve) and supports connections to single-ended amplifiers.



6.35mm plugs, like this 'garden variety' adapter plug, are essentially bigger, sturdier version of 3.5mm plugs.

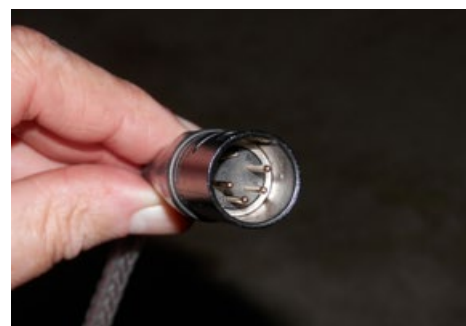
Balanced Connector Plugs: Balanced connector plugs will typically provide four, or in some cases two sets of three, conductors—with separate '+' and '-' conductors for each channel, plus a separate ground 'GND' conductors in some configurations.

Three-Pin XLR connector plug: Three-pin XLR connector plugs are designed specifically for balanced signal connections and in headphone contexts are always used in pairs (one for each channel in a stereo pair of balanced mode connections). The three pins provide '+', '-', and 'GND' connections for one channel; hence, the need for two plugs to provide stereo (two-channel) connections.



Traditional three-pin XLR plugs, as on this Abyss AB-1266 headphone's right-channel signal cable, are among the most common balanced audio connectors in use today.

Four-Pin XLR connector plugs: Externally identical to three-pin XLR connector plug, internally four-pin XLRs provide separate '+' and '-' signals for both the left and right channels.



Robust four-pin XLR plugs, as on this ALO Audio cable, allow balanced audio connections from a single, sturdy, locking plug."

RSA connector plugs: RSA connector plugs, named in honour of Ray Samuels Audio, are sometimes found on small, portable, balanced output headphone amplifiers. RSA connector plugs essentially function like miniaturised 4-pin XLR connectors. Interestingly "RSA connectors" were developed by the firm Kobiconn Connector for use in certain types of camera connections, but Ray Samuels was the first to use Kobiconn Connector as a balanced audio connector in compact, portable amplifiers.



Tiny four-pin RSA/Kobiconn plugs support balanced audio connections for devices where space is at a premium.

3.5mm, four-conductor, mini-jack plugs: A handful of manufacturers have offered amplifier and headphone cables that provide balanced output connections through comparatively uncommon, four-conductor (or 'four ring') 3.5mm mini-jack plugs (where the conductors are labelled Tip, Ring, Ring, and Sleeve).

2.5mm, four-conductor, connector plugs: Yet another means of providing balanced output connections is via a comparatively new-to-the-market four-conductor (or 'four ring') 2.5mm plug. This plug is the chosen balanced-output connector for use with the popular Astell & Kern AK240 portable digital music player/headphone amp.

Hybrid Headphone & Earphone Designs

Headphone and earphone makers, as well as the team at *Hi-Fi+*, use the descriptor 'hybrid' to indicate that the product in question uses a mixed (or 'hybrid') combination of technologies. One good example would be the recently released oBravo HAMT-1 headphone, which employs the hybrid combination of the dynamic-type mid/bass driver and a Heil air motion transformer-type mid/high-frequency driver. Another good example would be the PSB M4U 4 universal-fit earphone, which employs the hybrid combination of a dynamic mid/bass driver and a balanced armature-type mid/high-frequency driver.



Final Audio Design's Pandora Hope VI headphone looks conventional enough, but it features a hybrid dynamic/balanced armature-type driver array.

Noise-Cancelling Headphones & Earphones

The term 'noise-cancelling' as applied to headphones or earphones means exactly what it says: namely, that the headphones/earphones provide active circuitry that detects external noise and then applies (to the best extent possible) an equal and opposite signal designed to cancel out the noise. For this reason, some designers (and marketers) prefer the term 'active noise-cancelling'.



PSB's M4U 2 is one of the very few active noise-cancelling headphones that manages to offer serious, audiophile-grade sound quality.

Noise-Isolating Headphones & Earphones

Recognising that active noise cancelling headphone and earphones can potentially create scenarios where the intended sonic 'cure' (active noise-cancellation) turns out to be worse than the sonic disease (noise), some designers have instead chosen to work on designs that use purely passive means of isolation or blocking out external noise. Generally, these passive designs are called 'noise isolating' (as opposed to 'noise-cancelling') headphones or earphones.

On-Ear Headphones

Unlike circumaural (around-the-ear) headphones, on-ear headphones feature comparatively small ear cups with ear pads designed to rest upon, rather than to surround, the wearer's ears.



On-ear headphones like the Klipsch Reference On-Ear have smaller ear cups and ear pads than equivalent circumaural headphones.

Open-Back Headphones

Open-back headphones feature ear cups that, by design, are open both on their front (that is, ear-facing) sides and on their back sides (so that there is virtually nothing—apart from protective grilles—but open air behind the rear sides of the headphone drivers. In many respects open-back headphones are analogous to dipolar loudspeakers in that they have rigid perimeter frames, or in this case ear cup housings, with no sealed enclosures behind the drive units at all.

For self-evident reasons open-back headphones offer little if any isolation from external noise. However, there is much debate on whether open-back or closed-back designs offer superior overall driver performance and sound quality.

Planar Magnetic Drivers

The loudspeaker manufacturer Magnepan first pioneered planar magnetic drivers and holds (or once held) many of the core patents on the technology. Therefore, today's modern planar magnetic headphones could, in a sense, be regarded as 'Magnepans writ small'. In planar magnetic drivers, the diaphragm consists of a very thin but strong membranes on whose surfaces are found conductive circuit traces typically arrayed in very precisely dimensioned serpentine patterns, with the conductive traces are spread over the entire radiating surface of the diaphragm. Many manufacturers use some form of Mylar-like material for their diaphragms, but at least one manufacturer (HiFiMAN) is using a radically thin, low mass 'nano-material' diaphragm.

Then, placed in close proximity to the diaphragm there is a precisely aligned grid or array of powerful magnets with deliberate open air spaces between the magnets to allow sound waves to pass through. Some designers favour the concept of having magnet arrays positioned on both the front and rear sides of the driver diaphragm, while others favour having an array on one side only—usually the side facing away from the listener's ears. Either way, as musical signals are applied to the conductive traces on the diaphragm, the diaphragm is attracted to and/or repelled from the magnet array(s), thus producing sound.



The planar magnetic drivers used in the Abyss AB-1266 are considered to be among the most revealing in any headphone produced today.

Ribbon Drivers

Ribbon drivers could be considered a specialised-case version of planar magnetic drivers, but with one critically important difference. In a ribbon driver, the entire diaphragm is made of conductive, thin-film, metal material, so that in a very real sense the diaphragm is—to borrow dynamic driver terminology—its own voice coil. In most case the ribbon driver diaphragm will be corrugated or 'pleated' and then suspended in the presence of very strong magnetic field. As musical signals are passed through the ribbon diaphragm/conductor, the diaphragm interacts with the surrounding magnetic field, moving fore and aft to produce sound.

Signal Cables

As is true in full-size, loudspeaker-based audio systems, headphone/earphone-based systems can be and typically are very sensitive to the quality of the signal-bearing cables in use. If you have any doubts as to whether cable substitutions can influence sound quality, let us assure you cables can impact sound in quite audible and obvious ways (and no, you don't need to be a 'golden ear' to hear their effects).

We haven't the space to go into cable technologies at this time, but suffice it to say that it is worth seeking out headphones and earphones that either ship with very high quality signal cables in the first place, or for which high-quality, third-party, aftermarket cables are available. Over time, you may discover—as we have—that judicious cable changes can help unlock hidden layers of performance in your favourite transducers.

Some pundits say wire substitution can't possibly make an audible difference, but bluntly they're wrong. You can easily prove this point by visiting a good headphone shop, trying some cable substitutions, listening carefully, and then drawing your own conclusions.

Finally, we cannot overstate the importance of choosing headphones/earphones that have removable, user-replaceable signal cables. Setting aside questions of sound quality, it is important to recognise that most headphone/earphone failures in the field are attributable to cable failures. The point is that it is simpler and cheaper to replace a set of signal cables than to have to go shopping for entirely new headphones or earphones.



Specialised headphone/earphone signal cables, such as these from Crystal Cable, can have a big impact on overall sound quality.

Supra-aural Headphones

Although you might rarely if ever hear this phrase in common usage, the term 'supra-aural headphones' is the formally correct way to say, 'on-ear headphones'.

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