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# Warwick Acoustics Aperio

It's a brave company that launches a £20,000 headphone as only its second product – and an electrostatic too. Yet more remarkable: that company isn't Chinese but British!  
 Review: **Keith Howard** Lab: **Keith Howard & Paul Miller**

**E**lectrostatic headphones are like royalty: rarefied enough to assume an aura that rivets mass attention. In the case of Warwick Acoustics' Aperio, it's not just its operating principle that catches the eye and sparks interest but its price too: at £20,000 this isn't the most expensive headphone/amplifier combination ever seen but it's up there with the very few daring to dangle a price tag greater than that of a family car.

Warwick Acoustics, it must be said, makes considerable effort to justify the cost of the Aperio beyond promises of transcendent sound quality. Not only is it supplied with a versatile DAC/amplifier (no small energiser box here), it also comes with special USB and Ethernet cables (2m and 3.1m in length respectively) and a massive, wheeled Peli case for storage and transportation. The whole thing weighs over 20kg when loaded and is never going to pass as a listening room presentation case – but the Four Horsemen of the Apocalypse would quail at it.

## IMPACT DRIVERS

Looking at the Aperio can induce a sense of déjà vu. Isn't this the Sonoma Acoustics Model One (M1) [*HFN* Feb '18]? No, it isn't – but the visual similarity is no surprise given that the Model One uses drivers built in Warwick Acoustics' Nuneaton factory. (Final assembly of the Model One takes place in Asia whereas the Aperio is assembled here in the UK.)

What distinguishes the two most importantly is that the drivers used in the Model One are single-sided, whereas those in the Aperio are symmetrical, push-pull designs. Expressed in loudspeaker terms (assuming that your memory stretches back to the 1950s), the Model One is a Janszen tweeter to the Aperio's Quad ELS.

The result should be lower distortion, and Warwick Acoustics also claims

a doubling of diaphragm excursion capability. However, it's worth noting immediately that the Aperio does not support very high peak output levels. Via its amplifier's digital inputs it is specified as achieving a maximum output of 104dB SPL rms, equivalent to 107dB peak for a sine input, with a minimum of 106dB SPL available via the unit's analogue input.

Let's look more closely at the electronic unit, which at 413x68x315mm (whd) is about the size of a slim integrated amplifier. On the fascia, left to right, are a chunky on-off toggle switch (up is on), rotary input selector with LED indication of the active input, a small colour display which shows volume level setting (0dB maximum) and details of the input (eg, sampling rate and bit depth). Centrally a large rotary control adjusts volume, and to the far right – beyond the latching left/right

headphone output sockets – is a second toggle switch that directs output either to the headphones or the line output.

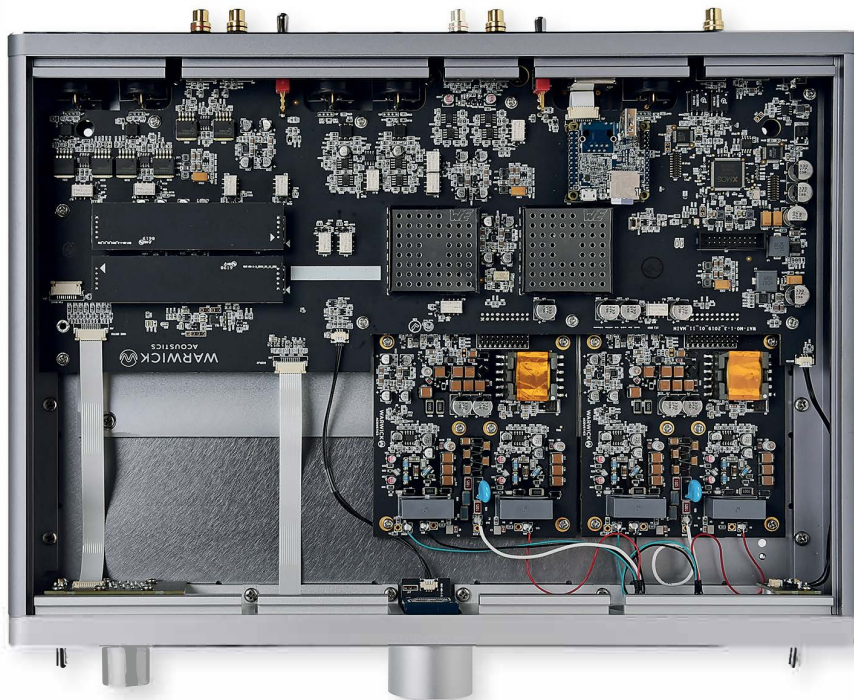
## CODE OF PRACTICE

On the back panel, left to right when facing it [see p47], are a socket for DC input from the external PSU, followed by four digital audio inputs: USB-B, coaxial S/PDIF, AES/EBU (on XLR) and a network (Ethernet) input via an RJ45 socket. Next come the analogue inputs, both unbalanced

'Warwick has stayed true to the principles of high fidelity'

(RCA) and balanced (XLR) with toggle switches to control input sensitivity. Last, to the right, are the analogue outputs, unbalanced and balanced like the inputs.

Central to the design philosophy of the electronics is that no transcoding takes place within [see PM's lab boxout, p43]. Neither DSD nor analogue inputs



**RIGHT:** Dual-mono Class A headphone amp/energisers [lower right] are driven by two ESS ES9038 DACs [under screens, centre], an AKM sample rate converter and XMOS USB solution





are converted to PCM. So PCM inputs are equalised by DSP, while DSD and analogue signals are equalised using equivalent analogue circuits. Warwick Acoustics says that the digital and analogue EQ curves match each other extremely closely, and I was able to confirm that as part of my testing for the lab report [see p47].

The DAC/energiser runs quite warm, so the ventilation holes at the front of the top panel are not a merely aesthetic touch. Four ultra-quiet internal fans operate if device temperatures rise too high but were never triggered during my time with the Aperio and won't be, Warwick Acoustics says, 'in 90% of usage cases'. The headset isn't featherweight at 406g but is still lighter than the heaviest planar magnetics.

Deep, elliptical earpads just large enough to accommodate my pinnae, a wide scalp pad on the headband and moderate head clamping force (6.7N for 150mm head width) ensure that it's comfortable to wear. But I found that the earpads, particularly the right one, were prone to squeak in response to jaw movements.

### BORN FREE

My listening took in analogue, S/PDIF and USB inputs, the first derived from a Chord Electronics Qutest DAC [HFN Nov '18] while S/PDIF came from a TC Electronic Impact Twin FireWire audio interface and second-generation Mac

**ABOVE:** The Aperio's interlocking aluminium chassis is very substantial and includes four ultra-quiet cooling fans. The TFT display shows volume, input and data type while the L/R capsules are driven via 4-pin connectors

mini. As for USB signals, these were derived from my desktop PC with the Aperio's ASIO driver installed. The first thing to say about the Aperio's sound is that it has a largely neutral tonal balance, blissfully free (for me) from the low frequency emphasis and consequent thickening of textures that has become fashionable in recent years. The corollary of this, of course, is that if that's

the type of tonal balance you crave, you may find the Aperio's sound to be a little chilly.

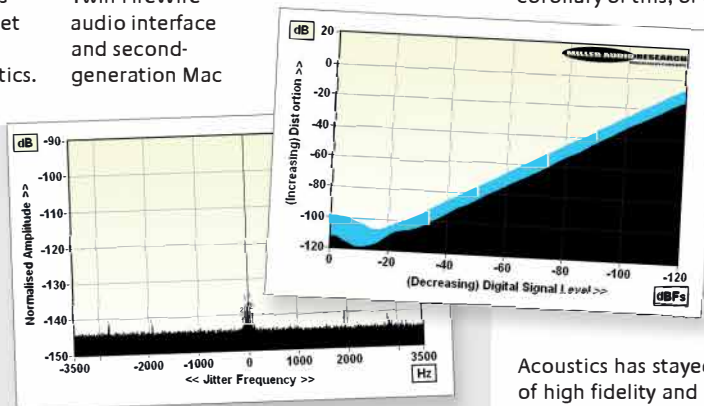
Whatever headphone you buy, though, this is an inescapable issue and you need to decide where you stand on it. Me, I'm relieved that Warwick

Acoustics has stayed true to the principles of high fidelity and resisted the temptation to sacrifice accuracy for added warmth and 'easy listening'. But note what I say in the lab report [p47] about the Aperio's sensitivity to earpad sealing. If the seal is compromised by thick spectacles or hair the Aperio will lose bass, and then its sound will lack natural warmth and weight.

If I go on to say that the Aperio reminds me in many ways of electrostatic loudspeakers, that may seem an obvious statement to make – and if you love electrostatic loudspeakers, the Aperio will assuredly delight you. This characteristic electrostatic quality is not easy to describe but if you're familiar with it, you can rest assured that the Aperio has it. ☺

## APERIO DAC

While Keith was testing the Aperio headphones, its partnering Aperio DAC/preamp was put through its paces in my lab. Testing the proprietary headphone output with its 1.8kV DC bias voltage was impractical, but the ESS9038-based DAC/preamp remains accessible via the USB and S/PDIF digital inputs and balanced XLR analogue line outputs. In practice this turns out to be a textbook implementation of ESS's latest Sabre DAC and one that clearly benefits from the brand's proprietary jitter suppression technology to the tune of <math>10\text{psec}</math> at any incoming sample rate [see inset Graph, above]. The maximum line output is 2.66V from a fabulously low <math><200\text{mohm}</math> source impedance, delivering a wide 112dB A-wtd S/N ratio and THD that falls as low as 0.00008% over the top 20dB of its dynamic range through bass and midrange [black infill, top inset Graph]. Distortion is almost inevitably higher at 20kHz but its minimum of 0.0004% over the same 20dB is impressive [blue infill, top inset Graph]. A steep linear phase digital filter is selected, offering a 99dB stopband rejection, and a response flat to  $\pm 0.02\text{dB}$  with CD/48kHz sources, a steep cut-off of  $-0.7\text{dB}$  between 43-45kHz (96kHz media) and  $-8.6\text{dB}$  between 70-90kHz (192kHz media). The only oddity: this line output is phase-inverting but is corrected in the Class A driver amp to the Aperio 'phones, where the output is phase positive. PM



## HEADPHONE

**RIGHT:** The Aperio headset succeeds in feeling substantial without being too heavy, but the earpads are prone to squeak

I've opined many times before that the S/PDIF input of most outboard DACs typically sounds better than the USB input, where fitted, and I had the same reaction with the Aperio. While audio-over-USB can seem more controlled, the S/PDIF input often provides what I find to be a more vibrant and engaging sound – as was the case here.

So I elected to use the S/PDIF input for most of my listening. Owners, I suggest, should decide this issue for themselves and not assume that the different digital inputs are equivalent. The analogue input certainly sounded good too, if not quite so incisive on the same source material when converted externally.

### GONE NATIVE

As an aside, I didn't get great results playing DSD files natively through the Aperio but am reluctant to draw any conclusions from this. As I've reported in these pages on previous occasions, when I've compared DSD via my Teac UD-503 DAC [*HFN* Apr '16], J River Media Center has never elicited as good a result as

Teac's own software player (which with the UD-503 provides the best DSD replay I've yet heard). So it may well be the case that a different software player will elicit superior DSD results from the Aperio than those that I was able to achieve.

### HONEY HIGHS

With this initial experimentation done, one of the first pieces of music I played just for the joy of it was Norah Jones's fine live performance of Randy Newman's 'I Think It's Going To Rain Today' from the *Higher Ground Hurricane Relief Benefit Concert* set, recorded in New York in 2005 [EMI/Blue Note 0946 3 45238 2 0]. And a joyous experience it was as this track – just that honeyed voice and piano accompaniment – proved to be right up the Aperio's street. Jones's vocal was crystal clear, without straying into hardness as sometimes it can, and there was a good live feel to the performance. Why the audience claps politely at the end of the song rather than baying their appreciation always mystifies me.

Mostly the Aperio proved to have ample available gain but one track – 'Bourée' from David Munrow's *Instruments Of The Middle Ages And Renaissance* ↪

## MARTIN ROBERTS

'I'm a design engineer by background who cut my teeth for a decade in the aerospace and defence industry,' explains Warwick Acoustics' MD Martin Roberts, 'before getting involved in the world of hi-fi back in 1999.' That in itself is not so unusual a route into the audio industry, but the path thereafter demonstrates a real sense of determination.

'It was always our intention to develop an award-winning product [the Sonoma Model One] to prove our patented core technology and put Warwick Acoustics on the map. Then we planned to follow that up with a flagship headphone product that raised the bar of acoustical performance to a new level.'

Warwick's team was tested *en route*, 'Our balanced-drive BD-HPEL driver was an intensive engineering project that took us the best part of two years. There were three main challenges: electrically insulating both sides of the membrane, providing electrical connections to three layers in a very compact space, and ensuring the system was balanced, both within the amplifier and the transducer.'

'There are other applications for our technology outside of high-end headphones. We are also active in the automotive sector developing the first electrostatic audio system designed specifically for in-car use. There are other possibilities but headphones and automotive are our strategic focus right now.'

Maintaining focus is important in any business, especially a start-up, like Warwick, with big ambitions.



**ABOVE:** Distinctive wave pattern grilles provide a clear view of the new BD-HPEL push-pull drive unit and ensure that the Aperio behaves like a true open-back headphone with minimal obstruction





# HEADPHONE SYSTEM

# LAB REPORT

## WARWICK ACOUSTICS APERIO



**ABOVE:** Powered via an outboard DC supply, the Aperio DAC/preamp includes USB, S/PDIF, AES3 and wired network ins alongside singled-ended (RCA) and balanced (XLR) analogue inputs (inc. high/low gain modes) and variable RCA/XLR analogue outs

[Erato Veritas 0946 3 85811 2 3] required perilously close to 0dB on the volume control to achieve sufficient output level. This caused me to dig out Hans Werner Henze's 'Prison Song' [Percussion XX, ARTS 47558-6; 96kHz/24-bit rip], which has the widest dynamic range of any recording in my collection – a crest factor (peak to RMS ratio) of about 35dB on both channels.

### COMING CLEAN

I thought that perhaps the Aperio would struggle to provide sufficient gain/output level here but my fears were unfounded. In fact it replayed the track at as high a level as I'd ever wanted with a few decibels to spare.

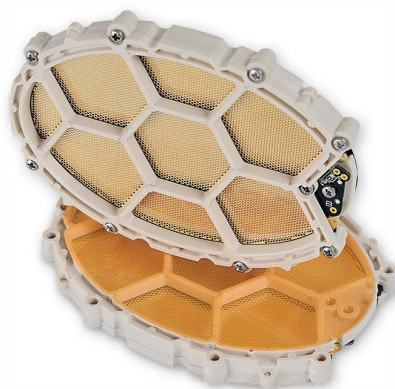
The same was true of Jim Keltner's *Drum Improvisation* [Sheffield Lab Drum & Track Disc; 44.1kHz/16-bit rip], although this track has been subject to limiting to control its dynamic range and the clipping symbol appeared fitfully in the Aperio's display.

The essential cleanliness and clarity of the Aperio's sound was also to the fore in Frank Sinatra's 'It Was A Very Good Year' from *Sinatra At The Sands* [Reprise 8122 73777-9;

96kHz/24-bit rip] – but this track also exposed the one respect in which I found the Aperio's sound less than revelatory. There is, on occasion, a matter-of-factness about its delivery that means your heart doesn't always follow your head in admiration of it.

Having said that, the difficult audience applause on this track was negotiated without problem, Sinatra's voice – never finer than here – was stable centre-stage, and the contributions of the marvellous Count Basie orchestra were minutely detailed. Perhaps I've heard more character, a greater sense of 'being there' from this classic recording than the Aperio provided, but never have I heard it painted with a truer palette of colours.

Furthermore, Diana Krall's 'The Girl In The Other Room' [a 96kHz/24-bit rip from the DualDisc of the same name; Verve B0003758-82] then swiftly reminded me again of the Aperio's considerable strengths. Viz: its utter clarity, its resistance to sibilant harshness – which this track co-written with Elvis Costello can easily induce – and its overriding sense of a place for everything and everything in its place. ☺



**ABOVE:** The BD-HPEL transducers – a multilayer film diaphragm clamped between two gold-plated OFHC stators – are pair-matched to within  $\pm 0.5$ dB

### HI-FI NEWS VERDICT

That a young British start-up should create the Aperio as only its second product is enough to puff out every patriotic chest. But the headphone that is all things to all men doesn't exist, even if it does cost £20,000. The Aperio offers a tonally neutral, open and clean – some might say clinically clean – sound. But if you are fortunate enough to be able to afford it, it will deliver rare insights into your music.

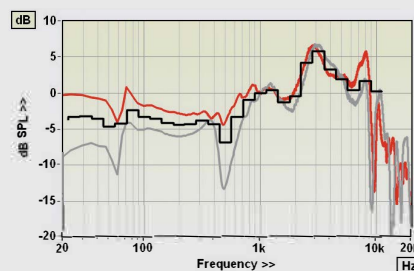
Sound Quality: 88%



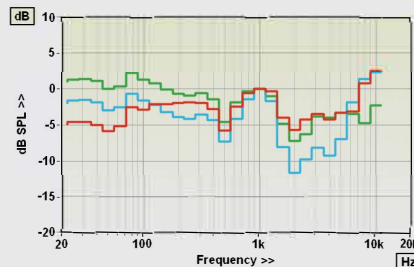
The two capsules of the Aperio behaved somewhat differently on our artificial ear, as the two overlaid uncorrected responses show [see Graph 1]. In particular, the left capsule had a lower output below 1kHz and a distinct notch at around 500Hz. Both capsules evince a dip at about 60Hz and a nearby peak at 70Hz, suggesting a common structural resonance there – which was confirmed by the acoustic crosstalk test (result not shown) which showed a large crosstalk peak at 72Hz, almost certainly caused by a poorly damped headband resonance.

Warwick Acoustics has its own response target function but from the third-octave corrected responses this appears to be pretty close to the classic diffuse-field (DF) target [green trace, Graph 2]. The averaged response of the two capsules is pretty flat with DF correction applied, albeit with some shelving down above 1kHz. The Harman-corrected response [red trace] is pretty flat too, without the lower midrange and bass prominence, but bear in mind we are using Harman's earliest (2013) correction. Later iterations of the Harman target response from 2015 and 2017 have significantly boosted bass output, so applying their inverses would indicate that the Aperio is *lacking* bass output. This despite its fine bass extension, which is in marked contrast to the Stax Lambda Signature [HFN Nov '13], which had a response peak at 80Hz and rolled off rapidly below that.

Both the corrected and uncorrected responses were obtained with good earpad sealing, but the Aperio is sensitive to this so if the seal is compromised, either by thick spectacle frames or hair, bass output can drop by up to 20dB at 20Hz. So the Aperio's perceived tonal balance may change if you wear chunky specs and/or have a thick barnet! You might suppose from the small ripples in the uncorrected frequency responses that the measurements were corrupted by noise but this feature – seen also in planar magnetic designs – is caused by closely packed diaphragm resonances. Cumulative spectral decay waterfalls for both capsules show that the Aperio – just like the Sonoma Model One – has a series of high-Q diaphragm resonances reaching up to around 6kHz. KH



**ABOVE:** Unequalised responses (L/R, grey/red; ave. 3rd-octave, black) show differences below 1kHz but are otherwise reasonably flat [see responses, below]



**ABOVE:** Third-octave freq. resp. (red = Harman corrected; cyan = FF corrected; green = DF corrected)

### HI-FI NEWS SPECIFICATIONS

Capsule matching (40Hz-10kHz)	$\pm 11.0$ dB
LF extension (-6dB ref. 200Hz)	<20Hz
Distortion 100Hz/1kHz (for 90dB SPL)	0.1% / 0.2%
Weight (headset only)	406g