

# hi-fi news

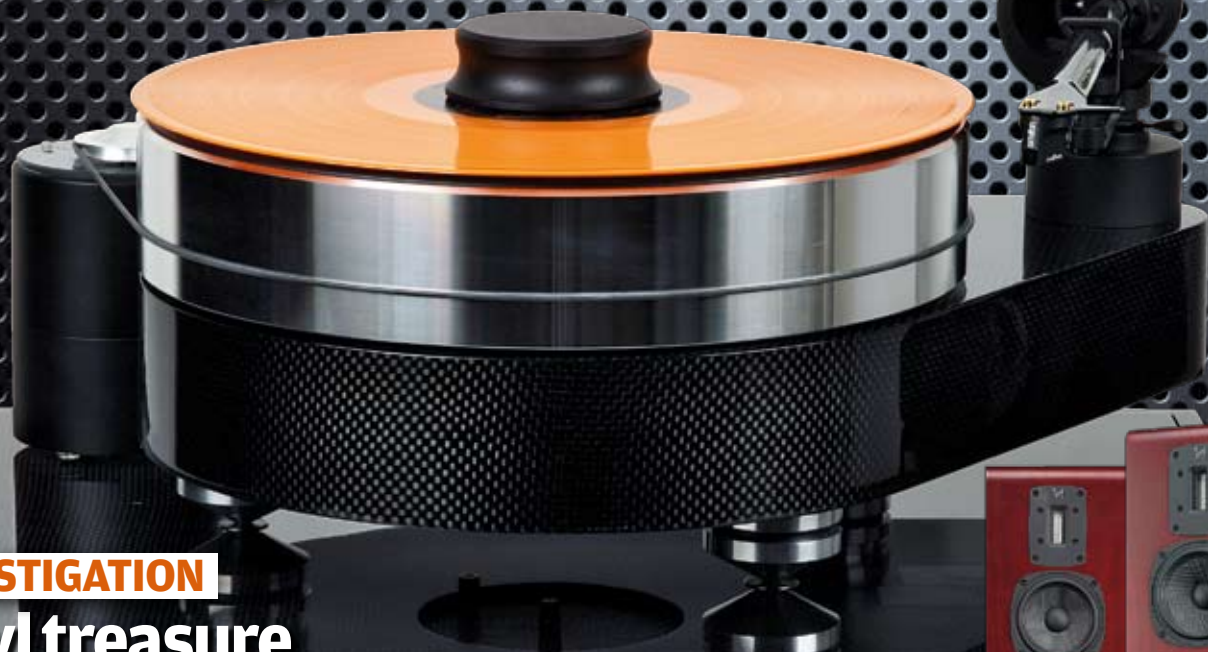
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## Chord Mojo

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# Chord Mojo

Tiny, solidly made, extremely capable and still built in Britain – is the smallest DAC/headphone amp from Chord Electronics the company's most ambitious move to date?  
Review: **James Parker** Lab: **Paul Miller**

If not quite betting the farm on its new Mojo pocket-sized DAC/headphone amplifier, it's clear Kent-based Chord Electronics is taking quite a flyer – its new product is both engineered and built the expensive way, and yet is a fraction of the price of the company's previous portable digital introduction, the Hugo, at just £399.

Asking £1400 for the Hugo and £2995 for the TT version, you might expect ways have been found to cut costs: a plastic case, perhaps; the adoption of off-the-shelf technology in place of the pricier models' in-house digital solution; or the outsourcing of production to China, for example, as so many other companies have done.

That, however, isn't the way Chord does things, or so the company founder John Franks explains it. In order to ensure the Mojo lives up to the acclaim heaped on previous Chord products, the new model had to be built like them, from the casework to the clever stuff under the lid to the UK manufacturing. In other words, it had to be a recognisable Chord product, just much smaller.

## CITING NUMBERS

Speaking at a lavish launch event for the Mojo, Franks outlined the thinking behind the product, and it soon became clear that, for the numbers to work, it needs to sell not only in substantial quantities, but in volumes so far unimaginable for a Chord product. The company has clearly invested heavily in getting the cost of the Mojo's build and components down to a level commensurate with a product that's designed to sell for less than a third of the price of the Hugo.

And Franks talks ambitious numbers for the Mojo, which is ostensibly aimed at the smartphone users of the world: citing analysis of the penetration of iPhones,

**RIGHT:** A version of Robert Watts' WTA filter and DAC technology runs on a powerful Xilinx Artix-7 FPGA while LEDs indicate volume level and incoming sample rate. The rechargeable battery occupies the lid (not shown here)

Galaxies and the like worldwide, he says that, were the new device to sell to just one in every 100,000 smartphone owners worldwide, that would bring sales of some 350,000 units a year. Not to be sniffed at...

So the Mojo may be small, but it's still cased in aluminium, the main housing being milled from a single piece of the material and adorned with a translucent version of the 'ball' controls which are found on other models in the range together with the colour-changing illumination to indicate volume, sample rate and so on.

Inside the case there's a large battery, just about occupying the whole of the plan dimensions of the enclosure, and underneath that the electronics, again based around Chord's use of a Field Programmable Gate Array (FPGA) running the number-crunching for filtering and digital-to-analogue conversion in the form

of Chord-written – or to be more accurate, Rob Watts-written – code.

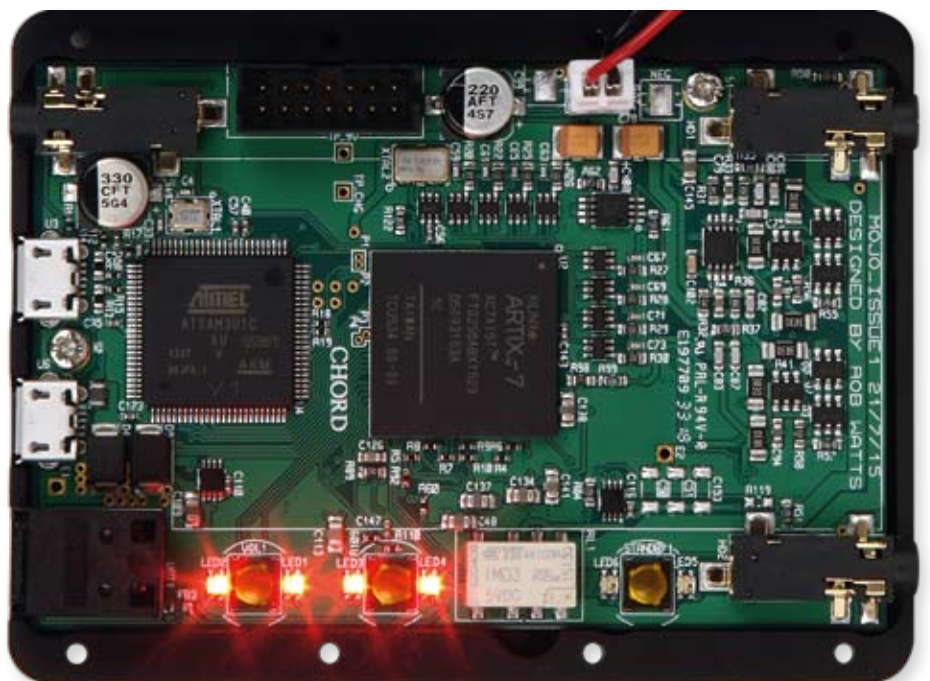
## INTUITIVE TO USE

Franks explains that the obvious way to do a product like this would be to use a bought-in DAC chipset, these days costing a few dollars when purchased in bulk. But engineers using such chips, he says, 'are really DAC users, not DAC designers', and the company has chosen to stick with its long-developed digital

platform even in this lower cost, highly portable device. The reason is simple: Chord wants the Mojo to sound as good as it can, even at this more affordable price – and that means retaining as much control as possible over the design.

So what is the Mojo? Well, a 'DAC/headphone amp' sums it up in basic terms, but there's more to it than that as this little box can handle 'mastering grade audio',

*'Its performance makes many more elaborate devices look overpriced'*







**LEFT:** The Mojo has Chord's usual 'milled from solid' aluminium casework for durability, while the single power button lights to indicate digital lock, and changes colour to show sample rate

thanks to sampling rate compatibility from 32kHz all the way up to 768kHz, as well as DSD up to DSD256/11.2MHz. It boasts entirely automatic file format detection and switching, indicated by changing of the colour of the single power 'ball' and runs from the aforementioned internal battery, which is designed to give ten hours' use from a four hour charge (either from a computer or using a standard USB phone/tablet charger).

Separate micro USB sockets for audio input and charging are fitted alongside optical and electrical S/PDIF digital inputs while two headphone outputs on 3.5mm sockets include digital volume control plus the option of setting a fixed level for use into a preamp or integrated amplifier.

And it is truly tiny: in the old days we would have said it was about the size of a fag packet, but suffice it here to mention dimensions of 82x60x22mm, and a weight of just over 180g. Think about the size of a boxed pack of cards, and about twice the weight, and you're just about there.

In use, the Mojo is entirely intuitive, basically because there's nothing much to learn. The power button does exactly what it suggests, while holding the two volume buttons while switching on will set

the outputs to fixed level, the buttons then lighting a bright blue. If you switch off and then back on again, the setting defaults to variable level, to avoid nasty surprises should you connect your headphones.

As already mentioned, the power button lights up to show the presence of a digital signal, and changes colour to show what 'flavour' the signal is, while the other two buttons increase or reduce the volume level, with an additional extra-fine cycle of adjustment at each end of their range. A brief press of the two volume buttons once the Mojo has powered up reduces the illumination brightness. Both brightness and variable level settings are remembered when turning off and on again.

To use the Mojo with an iOS device requires Apple's Lightning to USB female Camera Adapter Kit (the Chord only works with Lightning-equipped devices), to which the USB cable Chord supplies can be connected, although at the time of writing plans were well advanced for a range of Mojo add-ons to simplify this and some other connections [see boxout].

To play high-res music on an iOS device

connected to the Mojo will also need a third-party player: Chord suggests Onkyo's HF player, which I used to good effect during this review.

Using the Mojo with an Android device requires the use of an 'on the go' (OTG) cable to enable the smartphone or tablet to act as a USB host, and again the Onkyo app, or USB Audio Player Pro.

Chord supplies drivers for Windows PCs but none are needed for Mac OSX computers, though it should be noted that at the time of writing the Mojo, in common with a number of other devices of this kind, doesn't seem to be supported by the latest version of OSX, El Capitan. Beyond that, the only real operational foible is that the Chord can tend to run rather warm, both when charging and when playing hard: the company explains that this is entirely normal, due to the compact dimensions and high-power battery.

### ALL YOU COULD ASK

It's hard not to see the Mojo selling in unprecedented numbers if the word spreads out beyond the hi-fi community and into the wider world, as well as finding a lot more hi-fi enthusiast buyers for the British brand.

You see, it's good: very good indeed, and while the intention may have been to make a product offering almost all of the performance of the Hugo line in a more portable form, I think what Chord has actually

done is create something just as good, but with a £1000 discount!

I've been using the Mojo for some weeks now, both on the end of my iPhone and Mac computer, and straight into my main audio system both as a source component and as a digital preamplifier, and to be frank it does everything anyone could ☺



### MOJO WORKING

**The flexibility of the Mojo is set to expand with the impending availability of a number of add-ons, previewed at a recent launch event. These will come in the form of even smaller boxes designed to attach to the input end of the Mojo. Held in place by plugging into the existing ports, the first will be an iOS interface with a short lead terminated in a Lightning plug, giving a much neater connection than the current 'Camera Adapter plus USB cable' arrangement.**

**Chord is literally thinking outside the box with its future plans for these add-ons: on the way is a module able to accept SD card storage, allowing the Mojo to function as a standalone player, a Wi-Fi bolt-on to turn it into a network player, and a Bluetooth add-on for wireless connection to suitable devices. At the time of writing, pricing has not been announced for what is clearly an intriguing range of Mojo expansion modules.**

## HEADPHONE AMP/USB DAC



want of a device such as this, delivering levels of performance likely to make larger and more elaborate devices look overpriced.

### A THRILLING DEVICE

Having tried it with a range of headphones from high-end planar magnetics such as those in the Oppo range to in-ears including Focal's excellent Sphear and a pair of the remarkable Astell&Kern AK T8iE, I have no doubt about the ability of the Mojo to drive cleanly even demanding designs with both confidence and power.

Meanwhile the Chord claim that this is an extremely low-noise design is entirely borne out by the superb dynamics the Mojo delivers – not to mention the almost eerie silence between tracks – even when under the scrutiny of the 'direct injection' effect of really good in-ear 'phones.

Having used a number of DAC/amps of this kind, both portable and home-use, I'd go so far as to suggest that not only is the Mojo a remarkable example of the portable audio art, but also more than good enough to be considered very seriously as a DAC for use with a static hi-fi system.

Whether playing a selection of music via Tidal or Qobuz from the computer, or the likes of the excellent releases available via the NativeDSD website, this is a thrilling device to use, whether at home or out and about.

Play the set of string quartets by Joseph Wöfl played by the Pratum Integrum Orchestra Soloists [Caro Mitas CM0032006; DSD64], and the Chord delights with the tight, clear resolution of the instrumental lines and the manner in which the music is propelled forward with excellent rhythmic integrity.

Load up Yuja Wang's energetic reading of the Ravel Piano Concertos [96kHz/24-bit DG download; 479

**ABOVE:** One micro USB port is provided for audio in (up to 768kHz/32-bit), the other for charging, with a 3.5mm coax and Toslink optical in for S/PDIF. Two 3.5mm headphone sockets are fitted

4954] and the Mojo both delivers the intensity and expressiveness of the performance, but also recreates the space and ambience of the Zurich Tonhalle recording venue.

It'll do down and gritty, too, blasting out 'Bonzo's Montreux' from the 96kHz/24-bit version of Led Zep's *Coda* [Swan Song 8122795584] with both full-on attack and serious weight, even when levels are pushed up into the kind of area you probably shouldn't explore except briefly, and then purely in the interests of science.

This mix of fine detail and ambience – all the hi-fi stuff – and sheer connection with the music is what makes the Chord so involving and enjoyable. So is there a problem with the Mojo? Only one: it's so good it begins to make buying a Hugo look a bit of an extravagance.

But I have a feeling that won't trouble the company too much – this little device is going to sell by the truckload. ☺

### HI-FI NEWS VERDICT

The Mojo is nothing short of sensational value for money, challenging many more expensive DACs with its superb sound quality and ability to drive a wide range of headphones. You can even use it to drive a conventional hi-fi system. An even more impressive statement of Chord's capabilities than was the Hugo, it should prove a runaway success for the company, and an unmissable audiophile bargain.

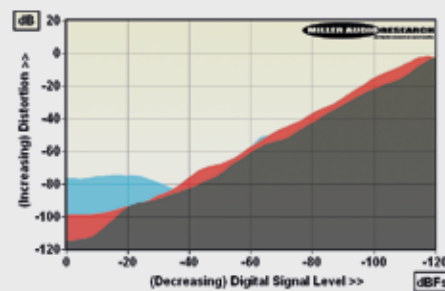
Sound Quality: 90%



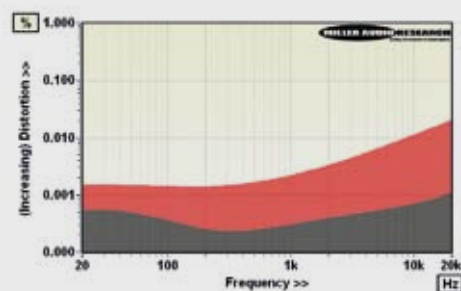
### CHORD MOJO

Presaged by the performance of its larger Hugo models, Chord's Mojo is the most impressive portable battery-powered USB DAC/headphone amp we've tested in *Hi-Fi News* so far. At full volume, and with a peak level (0dBfs) digital input, the Mojo's output is already clipped (+15.5dBV or 5.95V), but backing off reveals a 'clean' voltage output of +13.4dBV (4.66V or 36mW/600ohm) with a power output of 550mW/25ohm at 1% THD, 530mW at 0.5%, 520mW at 0.2% and 510mW at 0.005% [see Graph 1, below]. These figures are within a whisker of those offered by the larger and costlier Chord Hugo TT [*HFN* Dec '15] although, because its analogue output stage is necessarily built to a tighter budget, the Mojo's treble performance is slightly more influenced by headphone loading.

Unloaded, the Mojo's response reaches -0.1dB/20kHz, -3.2dB/45kHz and -10.8dB/90kHz with 48kHz, 96kHz and 192kHz media, respectively, but droops slightly to -0.5dB/20kHz, -4.4dB/45kHz and -12.1dB/90kHz at the same sample rates while delivering 10mW/25ohm. Fortunately the Mojo's low 0.75-2.0ohm output impedance promises little additional variation with undulating headphone loads. However, there's a similar, but mild, increase in HF distortion with loading, the Mojo's vanishingly low 0.0002-0.001% THD (20Hz-20kHz) increasing to 0.0014% through bass and midrange to 0.021% at 20kHz at 10mW/25ohm [see Graph 2, below]. But digital jitter is as low as we've seen from a portable USB DAC at just 50psec and the A-wtd S/N the widest at 104dB – stunning at the price. Readers may view a full QC Suite test report for Chord's Mojo USB DAC/headphone amp by navigating to [www.hifinews.co.uk](http://www.hifinews.co.uk) and clicking on the red 'download' button. PM



ABOVE: THD vs. digital signal level at 1kHz (black, unloaded; red, loaded into 25ohm where 0dBfs = 550mW, -10dBfs = 55mW and -27.4dBfs = 1mW) and 20kHz (blue, into 25ohm)



ABOVE: Distortion versus frequency from 20Hz-20kHz (black, 1V unloaded; red, 10mW into 25ohm load)

### HI-FI NEWS SPECIFICATIONS

Maximum output (re. 0dBfs into 47kohm)	4.66V
Max. power output (re. 0dBfs into 25ohm)	550mW
Output Impedance (20Hz-20kHz)	0.74-1.96ohm
A-wtd S/N ratio (re. 0dBfs)	103.8dB
Distortion (20Hz-20kHz, re. 10mW)	0.0014-0.021%
Freq. resp. (20Hz-20kHz/45kHz/90kHz)	-0.0 to -0.5/-4.4dB/-12.1dB
Digital jitter (loaded at 25ohm/unloaded)	50psec / 45psec
Power consumption (charging)	2W
Dimensions (WHD) / Weight	82x22x60mm / 180g