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PAGES
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BAT REX3 DAC
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custom digital tech
and luxurious tubes



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Primare R35
Flagship phono stage
is an analogue triumph

INVESTIGATION

Classical Cannons
We recommend the best recordings
for the classical music buff

SVS Prime Pinnacle
Floorstanders from the bass kings



Vertere DG-1
'Entry' deck gets into the groove

• **OPINION** 12 pages of letters & commentary • **VINYL RE-RELEASE** Gong's *Camembert Electrique* LP
• **FROM THE VAULT** Wadia 16 CD Player • **VINTAGE REVIEW** Back to the '70s with JVC's JA-S11 amp
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Balanced Audio Technologies REX 3 DAC

Launched to the audiophile world at CES in 1995, Balanced Audio Technologies may have lifted off like a rocket but has only had patchy distribution in Europe. Until now...
 Review: **Andrew Everard** Lab: **Paul Miller**

Balanced Audio Technologies – BAT for short – has been much discussed over its 25-year life to date, but until now has remained an object of distant interest for UK audio fans. Now, thanks to distribution by Yorkshire-based Karma AV, all that might be set to change, so perhaps now is the time to take a closer look at the brand.

Where better to start than the latest version of the company's DAC, the £19,995 REX 3? After all, the company has its roots in digital technology, co-founders Steve Bednarski and Victor Khomenko having met at Hewlett-Packard, and bonded over an interest in recorded sound. Legend has it that, growing up in what was then Leningrad, Khomenko built his first crystal radio set when he was just eight, and was sourcing parts from various places including the dump used by the Svetlana factory, best-known for its manufacture of valves.

TUBE POWERED

Not surprisingly, the company's debut products – the VK-5 linestage preamp and the VK-60 power amplifier, which launched at the 1995 CES (in an age when that show was still a major focus for hi-fi) – both used valves and, given the name of the new company, were of balanced circuit design. Joining forces with Geoff Poor, then sales director of Dunlavy speakers and later to join BAT, the pair demonstrated the new products driving that company's SC-V loudspeakers, which were also being introduced at the show that year.

That's the history: scroll forward a quarter of a century, and the Wilmington, Delaware, company now has an extensive offering covering six preamps, eight power

amps (both valve and solid-state), an integrated amplifier and two phono stages, each available in a range of specifications. And a DAC... the REX, now in '3' guise and reviewed here for the very first time. The REX 3 is part of the company's flagship valve-powered line alongside the REX II preamp and 'no-compromise' all-triode REX II power amp.

The latter employs two single-ended power amps per channel, summed at the output transformers to deliver 80W in stereo, according to the company, or 160W when it is bridged as a monoblock. You can even go further should you want, by daisy-chaining two mono'd REX II power amps per channel, to yield a claimed 320W.

Which, as they say, should certainly be adequate for most requirements.

UNIQUE SOLUTION

The REX 3 DAC shares the styling of the REX II preamp, which is striking with its thick, curved front plate (available in either silver or black), and also much of its tube technology. Editor PM covers off the proprietary DAC technology [see extended boxout, p47], but the 'executive summary' is that the REX 3 uses independent designer Andreas Koch's unique signal processing solution that, in this implementation, handles PCM inputs up to 384kHz/24-bit and DSD5 12, at least via its USB input.

'Its freshness and vitality has the illusion of total ease'



RIGHT: Our REX 3 DAC was fitted with BAT's 'Super Pak' PSU reservoir bank [centre] which feeds the 6C19 tube stage [right]. Two of these tubes are used in the PSU itself, the others in the transformer coupled output [top right]



As is usual, a driver is needed to connect the USB input to a PC: the fact that this is also provided by Koch's AKDesign company via the BAT website indicates that the USB interface is also designed by Koch. Mac users won't need a driver, but in this case DSD input is purely by DoP.

Other inputs are provided for AES/EBU (XLR) and S/PDIF (two optical and two coaxial), these selected using front-panel pushbuttons or the VK-R4 remote handset supplied. As far as controls go, that's almost it on the REX 3, apart from standby and mute buttons. It's also possible to dim the display from the handset and – slightly laboriously – rename the inputs.

Back to the internals of this DAC, and while the digital-to-analogue conversion is essentially an 'off the shelf' solution (if a very superior one), the BAT philosophy is clearly apparent in the design of both the

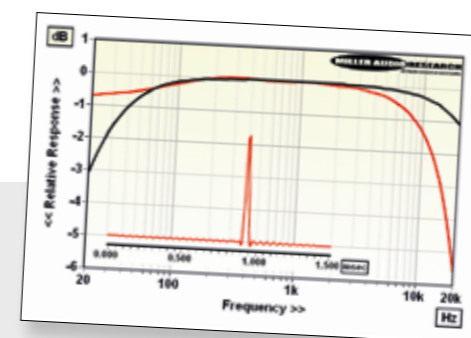
analogue output section – which only feeds balanced sockets, by the way – and the power supply provision. Like BAT's preamps, the REX 3 uses an all-valve output section (complete with a wrench in the box in the unlikely event you should need to pop the lid to do a spot of tube-reseating after transportation), using six 6C19s in total.

Two are employed as PSU current sources for the output stage, the latter using no overall negative feedback, buffers or followers in the signal path, and which BAT calls 'UniStage'. It also lacks any signal path capacitors, and has amorphous-core transformers for output coupling – a technique rare in 'consumer' audio, but

ABOVE: Big and imposing, yes, but the REX DAC 3's fascia is simple: input selectors at the centre, standby and mute buttons either side, and a function control to tinker with the display

widely used in pro-audio equipment. Amusingly, where this design is used in the REX II preamp, BAT refers to this transformer-coupled layout as T-REX.

The other element of the design is the use of the company's 'SuperPak' capacitor bank [see our internal picture, p46], now in its second generation, and previously available as an upgrade for the last REX DAC model, as indeed it still is for models such as the VK-P12SE phono amp. Fitted as standard to the REX 3 DAC here, it adds to the usual electrolytic power supply capacitors a bank of large oil capacitors, greatly increasing the energy on tap. It's all part of the design of this DAC's highly-specified output stage.



ACTING ON IMPULSE

Designed by one of the founders of the SACD format, and all-round ambassador for DSD, Andreas Koch, his AKDesign AKDAC-3 filter and converter solution lies at the heart of the REX 3.

Key to this DAC is its proprietary upsampling and adaptive digital filtering, the latter bearing a conceptual similarity to Denon's 'Advanced AL32 Processing' (ALPHA or Automatic Low-Pass filter Harmonic Adjustment). Koch's vision of the adaptive filter also has the transient integrity of the music signal at its core, choosing the optimal algorithm on a sample-by-sample basis. Ultimately the data is upsampled to 11.3MHz, and the wordlength truncated to a bitstream, before it is low-pass filtered to reveal the desired analogue (music) signal.

It is possible to expose the extremes of Koch's adaptive filter by comparing its performance with continuous and transient test signals. The former might indicate the REX 3 uses a fairly standard linear- or minimum-phase filter with its superb 104dB rejection of stopband (alias) distortions and steep roll-off beyond 22kHz with CD/48kHz inputs. At 20kHz the response drops by only -1.05dB [black trace, inset Graph]. The transient impulse [red] however reveals an interpolation filter with no pre- or post-ringing – a more 'natural' result – but with poorer stopband rejection and a heavily tailored HF response, -1dB/8.7kHz, -3dB/14.7kHz and -5.6dB/20kHz with some visible passband ripple. With constantly changing music signals, the digital filter algorithm will adapt and segue between these sets of mathematics. PM

RIGHT OFF THE BAT

Clearly, then, the REX 3 DAC is a long way from the fallacious stereotype of 'well, all DACs are not much more than a chip and a simple output stage, so why are they so expensive?'. There's a lot of engineering going on here – even if the remote looks like it's escaped from a 1980s TV – and fortunately no shortage of performance to set the REX 3 apart from its peers.

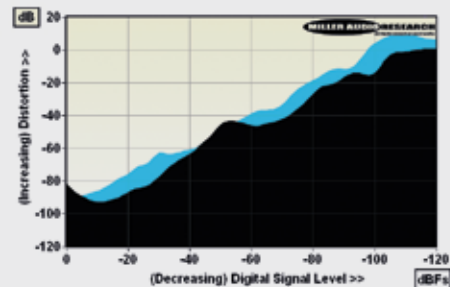
Fire it up and right from the off – well, right from the minute or so's wait while it soft starts and stabilises itself ready for action – you realise you're on to something special, even when doing something as simple as playing CD-quality music in through one of the coaxial digital inputs.

An album like Yazz Ahmed's *Polyhymnia* [Ropeadope RAD506CD] is immediately notable for the way the transients of Sophie Alloway's percussion opening 'Ruby Bridges' really zings out of the speakers, and then remains just as crisp, tight and focused however busy the track becomes, the slinking beat driving the music along. ↪

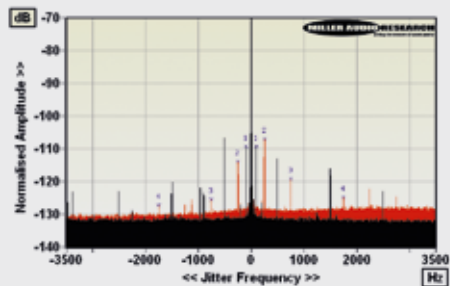
BAT REX 3 DAC

High-end outboard converters featuring bespoke DAC architectures – the dCS Vivaldi One [HFN Feb '18] and MSB Premier [HFN Aug '19] being good examples – will typically exhibit a distinct technical behaviour, all of which can inform how the product will *sound*. This is not entirely true of the REX 3 because, although the adaptive nature of the digital filter can be examined in the lab [see boxout, p47], other 'features' of Andreas Koch's AKDAC-3 DAC module are masked by BAT's 6C19 tube-based output stage. For example, while the DAC's low-level linearity is good to within $\pm 0.2\text{dB}$ over a 100dB dynamic range, the overall A-wtd S/N ratio is reduced to just 95dB because of a prominent 100Hz PSU noise component. PSU noise does influence the REX 3's jitter spectrum but the overall figures of 280psec (48kHz/24-bit data) and 155psec (96kHz data) are still very low [see Graph 2, below]. Furthermore, the sharpness of the main test signal suggests very low phase noise on the part of the AKDAC-3 design – always a good indicator of stereo focus.

The moderate 530ohm output impedance, decreasing to 315ohm/20Hz, is a function of the transformer-coupled balanced output, as is the loss in sub-100Hz bass which falls to $-0.7\text{dB}/50\text{Hz}$, $-2.9\text{dB}/20\text{Hz}$ and $-6\text{dB}/12\text{Hz}$. With non-transient signals the response reaches out to $-1.1\text{dB}/20\text{kHz}$, $-16.5\text{dB}/45\text{kHz}$ and $-23.7\text{dB}/90\text{kHz}$ [48kHz, 96kHz and 192kHz media]. In all likelihood, the tube output pushes up (2nd harmonic) distortion uniformly higher than might be incurred by the AKDAC-3, but the unusual *pattern* of distortion vs. digital level is indicative of the DAC's digital processing and final bitstream mapping. At its lower-than-typical 1.55V maximum output, the tube stage incurs some 0.003-0.006% THD. **PM**



ABOVE: Distortion vs. 48kHz/24-bit digital signal level over a 120dB dynamic range (1kHz, black; 20kHz, blue)



ABOVE: High resolution 24-bit jitter spectra via S/PDIF and USB inputs (48kHz sampling, red; 96kHz, black)



ABOVE: Six digital inputs are fitted including AES/EBU (XLR), S/PDIF (two on RCA and two optical) and USB-B for computer connection. Fixed analogue outputs are offered on balanced (XLR) connections only

And with more than 30 musicians involved in this album, things do tend to get a bit complex at times, yet the beauty of the REX 3 DAC's sound is that it gives every instrument, every line of the scoring, plenty of breathing space, allowing the listener that luxury of 'listening around' the performance, to focus on single performers or luxuriate in the sheer spread of sound.

It's an experience akin to that 'live performance' presentation so often sought, and a very long way from the technical fireworks with which so much audio equipment seeks to dazzle. Instead, when one reaches the album-closing homage to influential saxophonist Barbara Thompson, the lasting impression is of the rich variety of musical colours and textures on offer in the playing and recording, and not how good the hi-fi is sounding.

KING OF HEARTS

That sparkling sound, packed with freshness and vitality while maintaining the illusion of total ease, is the clever stuff here, as is clear with Compagnia di Punto's 'small band' recordings of Beethoven's first three Symphonies [Deutsche

Harmonia Mundi 19439706502-2; 48kHz/24-bit]. With just 11 musicians deployed instead of the usual massed forces, these arrangements are sprightly, crisp and intimate, and the REX 3

DAC again does that wonderful thing of taking the listener to the heart of the music while allowing each individual contribution to be examined if required.

That's not to say it can't turn on the thunder if really necessary. With the blazing 'Walk On Hot Coals' from Rory Gallagher's *Check Shirt Wizard* live set [Cadet Concept/Chess 0836846; 96kHz/24-bit], the sheer vitality of performances, recorded in 1977 on the Rolling Stones and Jethro Tull's *Maison Rouge* mobiles, is irresistible. Mixed from the original multitracks, the album allows the guitarist's performances new life, and the REX 3 DAC's winning combination of spark, speed and dynamic power makes the most of them, whether Gallagher is blues picking almost solo, or crashing it out with the band.

With all this ability, it's a given this remarkable DAC will do its thing with demo-quality jazz, too, and it passes the piano, bass and brushed drums test with total nonchalance. But don't even consider it if you limit your musical choices by what's likely to show off your system at its best. So well does the REX 3 perform across the board that you're going to be spending a lot on music. **Ⓛ**

HI-FI NEWS VERDICT

Despite what some would have you believe, all DACs don't sound the same, and they certainly don't all deliver in musical terms as well as the REX DAC 3. Simply, this unashamedly expensive converter gets you closer to the music without you even realising it's doing it. Just let it weave its magic, and you'll be too immersed in what's being played to give another thought to all the engineering making it possible.

Sound Quality: 89%



LEFT: BAT's VK-R6 remote provides access to input selection, mute and limited display and menu items

HI-FI NEWS SPECIFICATIONS

Maximum output level / Impedance	1.55Vrms / 315-565ohm
A-wtd S/N ratio (S/PDIF / USB)	95.1dB / 95.1dB
Distortion (1kHz, 0dBFS/-30dBFS)	0.0059% / 0.017%
Distortion & Noise (20kHz, 0dBFS/-30dBFS)	0.0025% / 0.095%
Freq. resp. (20Hz-20kHz/45kHz/90kHz)	-2.9 to -1.1dB/-16.5dB/-24dB
Digital jitter (48kHz / 96kHz)	280psec / 155psec
Resolution (re. -100dBFS / -110dBFS)	$\pm 0.2\text{dB}$ / $\pm 3.5\text{dB}$
Power consumption	128W (W standby)
Dimensions (WHD) / Weight	483x146x394mm / 14.5kg