JOHN ATKINSON

Lumin P1

STREAMING D/A PREAMPLIFIER

I start this review with a confession. I have consistently found that when I play CDs on a transport and feed the digital data via AES3 (AES/EBU) to a D/A processor, the music has more drive, particularly at low frequencies, than it does when I send the same 16/44.1 data to the same D/A processor via my network. However, these days I almost always stream my music rather than playing physical discs. Not only is it much more convenient; the wealth of metadata available with Roon 1.8 is addictive. I also have convenient access to much more music: my growing library of hi-rez files and hi-rez music streamed from Qobuz.

SPECIFICATIONS

Description P1 Roon Ready streaming D/A processor/preamplifier with optical and wired Ethernet ports (support for PCM up to 384kHz, 16–32 bits, with Full MQA Decoding and DSD up to DSD512); USB (USB Audio Class 2 compatible, PCM 44.1–384kHz, 16–32 bits, DoP128); AES3, TosLink Optical, RCA S/PDIF (all, PCM 44.1–192kHz, 16–24 bits, DoP); 3 HDMI (PCM 2.0 audio support, 4K video passthrough). Extensive upsampling options. Supported audio file formats: DSF (DSD), DIFF (DSD), DoP (DSD), PCM FLAC, Apple Lossless (ALAC), WAV, AIFF, MP3, AAC (in M4A container), MQA. Analog inputs: 1 pair balanced (XLR), 1 pair RCA (unbalanced). Digital outputs: USB (native DSD512 support, PCM 44.1–384kHz, 16–32 bits); S/PDIF (BNC, PCM 44.1–192kHz, 16–24 bits, DSD64 via DoP); HDMI (HDMI Passthrough and ARC support, PCM 2.0 audio support, 4K video passthrough, ARC support). Analog outputs: 1 pair balanced (XLR), 1 pair single-ended (RCA). Maximum output level: 6V RMS (balanced), 3V RMS (unbalanced). Analog input impedance: not specified. Analog output impedance: not specified. Supplied accessories: remote control, quick start guide; Lumin app available for iOS and Android devices; online manual available at luminmusic.com/manual/index.html.
L1: NTFS-formatted network-attached storage (NAS) device with 2TB or 5EB hard drive. Supplied accessories: 12V wall wart power supply, USB and Ethernet cables.
Dimensions P1: 13.8" (350mm) W × 4.2" (107mm) H × 15" (380mm) D. Weight: 26.4lb (12kg). L1: 3.9" (100mm) W × 2.2" (55mm) H × 8" (204mm) D. Weight: 2.2lb (1kg).
Finish Natural aluminum or black-anodized aluminum.
Serial numbers of units reviewed P1: 60182183-07-0001-1000014 & '1000056. Firmware: 14.4. L1: 601B1874-07-0004-1000578. "Designed in Hong Kong, Assembled in China" (both).
Price P1, $10,000; L1, $1400. Approximate number of US dealers: 49. Warranty: 2 years, international.
Manufacturer
Pixel Magic Systems Ltd., Unit 1316-1318, Building 19W, Hong Kong Science Park, Shatin, New Territories, Hong Kong. Tel: (852) 2655 6700. Web: luminmusic.com.
US distributor: Source Systems Ltd., San Clemente, CA 92672-6000. Tel: (949) 369-7729. Web: sourcesystemsltd.com.

I don't understand why there should be an audible difference between AES3 and network audio. The data are the same in both cases, and the reclocking of those data when fed to the processor's DAC chips should be identical. And if the reclocking *isn't* identical, the timing accuracy should favor the network connection, where the clock doesn't have to be extracted from the datastream, as it does with AES3. In any case, for the reasons stated above, I always keep my ears open when I try new streaming D/A processors, like the one under review here, the $10,000 Lumin P1 from Hong Kong–based Pixel Magic Systems.

The P1

The elegant-looking P1 offers a complete set of digital inputs—AES3, S/PDIF (coaxial and TosLink), plus USB and Ethernet (electrical and optical) with full MQA decoding—adding to that balanced and unbalanced analog inputs, one HDMI 2.0 input, and three ARC-enabled HDMI 2.0 outputs with 4K video passthrough. The P1 offers balanced and single-ended analog outputs and S/PDIF (BNC) and USB digital outputs. The P1's gently curved front panel displays the volume setting or metadata for streamed music being played, including bit depth and sample rate, though not the album cover. The Roon Ready P1 can be controlled with Roon or with Lumin's own app for iOS and Android devices. It comes with a slim, solid remote control.

The elegance continues inside the case. The linear power supply for the analog circuitry is based on a shielded toroidal transformer. The digital and analog input circuitry is housed on one printed circuit board; the dual-mono, solid state output circuitry (balanced and unbalanced) and the D/A converter chips—a pair of ES9028PROs capable of processing PCM data up to 384kHz and DSD data up to DSD512—are on a second board. The analog outputs are coupled to the outside world with a pair of premium-quality Lundahl transformers.

The USB input uses an XMOS controller, and the DAC chips are clocked with what Lumin refers to as "Femto Crystal Oscillators" with "precision FPGA distribution." The P1 has a volume control based on Leedh processing,[1] which was invented by Gilles Millot of Acoustical Beauty, a French high-end loudspeaker manufacturer. Leedh minimizes the number of additional bits introduced in mathematical operations to reduce or eliminate the truncation-related loss of information. The P1's Leedh volume control operates with 32-bit precision. Leedh processing is the P1's default setting; it can be disabled with the Lumin app[2] for with/without comparisons.

Installation

When I connected the P1 to my network, it was recognized by Roon as "Lumin X1." (The X1 is the P1's bigger brother.) The small image of the P1 on Roon's Audio Settings page confirmed that it was a legitimate Roon Ready device. I enabled the P1 as a Roon endpoint, setting the volume control to "Device control" and MQA decoding to "Decoder and renderer." Lumin recommends burning in the P1 for 400–500 hours; with outputs not connected, I streamed audio to it for five days. At the end of that time, I connected the P1's balanced outputs to my Parasound JC 1+ Halo monoblocks, reduced the volume control to a relatively low value, selected a file with Roon, and pressed "play."

Nothing.

I told Lumin and Source Systems, the company's US distributor, about the problem,[3] and a second sample was shipped *tout de suite*. I set up the new P1, made sure its firmware was the current version, and made the necessary connections. Success! I had sound via both digital and analog connections. I repeated the burn-in and started my critical listening.

The L1

Along with the second sample of the P1, Source Systems sent this diminutive, network-attached UPnP server, styled to match the P1 and powered by a 12V wall wart. The L1 is priced at $1400 for the 5TB version; a 2TB version is also available. The L1 is a network-attached storage device, but not a conventional one. To load it up, you must copy files from a computer via a USB 3.0 port. Once it's loaded up, the L1's network port can be connected to the user's router and the P1 can see it and access music files.

One wrinkle for this Mac user was that the L1's 5TB hard drive

1 See processing-leedh.com, especially the AES paper at processing-leedh.com/copie-de-presentation.

2 See luminmusic.com/support-leedh-processing.html.

3 After this first sample had been returned to Pixel, they discovered that the linear power supply had been wired for 220V operation instead of 115V.

MEASUREMENTS

I measured the Lumin P1 with my Audio Precision SYS2722 system.[1] Looking first at the digital inputs, the AES3 and coaxial and TosLink S/PDIF inputs accepted data sampled at all rates up to 192kHz. Apple's AudioMIDI utility revealed that the P1 accepted 16- and 32-bit integer data via USB sampled at all rates from 44.1kHz to 768kHz.[2] Apple's USB Prober app identified the Lumin as "LUMIN" from "PMS" (Pixel Magic Systems, presumably), and the USB port operated in the optimal isochronous asynchronous mode.

The Lumin's analog outputs with the Invert Phase control set to Off preserved absolute polarity (ie, were noninverting) via all of the P1's digital inputs. The maximum output with full-scale 1kHz data and the Gain set to High was 2.95V from the P1's single-ended analog outputs and 5.89V from the balanced outputs. Setting the Gain to Low gave maximum output levels of 987.4mV single-ended and 1.974V balanced. The balanced output impedance was a usefully low 37 ohms from 20Hz to 20kHz. The single-ended output impedance was an even lower 30.1 ohms, again at all audio frequencies.

Fig.1 shows the P1's impulse response with 44.1kHz data. It is a very short linear-phase reconstruction filter, with a small amount of ringing on both sides of the single full-scale sample. With 44.1kHz white-noise data, the filter rolled off slowly above the audioband (fig.2, magenta and red traces), not reaching full stop-band attenuation until 28kHz. Consequently, the aliased image at 25kHz of a full-scale tone

1 See stereophile.com/content/measurements-maps-precision.

2 This is the sample-rate acceptance window of the XMOS USB data receiver chip. The P1 itself appears to be limited to a maximum PCM rate of 384kHz.

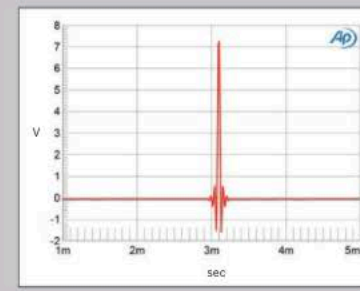

Fig.1 Lumin P1, impulse response (one sample at 0dBFS, 44.1kHz sampling, 4ms time window).

is NTFS-formatted "due to drive size and Windows recognition," and Macs don't recognize NTFS drives. Lumin says that the L1 was intended to be populated by simply dragging-and-dropping files from a PC—"it's not designed for anything else." To copy files from a Mac, the L1 can be reformatted as a FAT32 drive (for the 2TD version) or exFAT (for the 5TB), or third-party apps could be used to allow the drive to be recognized by a Mac. For simplicity's sake, I copied my music library onto the L1 using a USB connection from a Windows 10 PC that lives in the test lab.

Once the L1 has been populated and connected to the network, it scans the files to create the metadata it displays with the Lumin app. During scanning, its status LED blinks blue. 100 albums take approximately two minutes to scan.

The Lumin L1 is expensive for a NAS. However, when it is the only NAS on your network, it links automatically and seamlessly to the Lumin app: Fit-and-forget ease of use, which is especially welcome for those, like me, who have bad network karma.

Listening with Roon

I started my auditioning in "Roon Ready" mode, using Roon to

measurements, continued

at 19.1kHz (cyan, blue) is suppressed by only 27dB. The harmonics associated with the 19.1kHz tone are all very low in level.

Fig.3 shows the Lumin's frequency response with data sampled at 44.1, 96, and 192kHz. The responses are all flat to almost half the sample rate with then the beginning of the ultrasonic rolloff. Channel separation (not shown) was superb, at >125dB in both directions below 1kHz. It decreased to a still-excellent 113dB at the top of the audioband. The low-frequency noisefloor (fig.4) was free from any power supply–related spuriae. This graph was taken with TosLink data; the spectrum with network-sourced data was identical.

The red trace in fig.5 plots the error in the analog output level as a 24-bit, 1kHz digital tone drops from 0dBFS to –140dBFS. The amplitude error is negligible until the signal lies below –120dBFS, which implies high resolution. An increase in bit depth from 16 to 24 with dithered data representing a 1kHz tone at –90dBFS (fig.6) dropped the P1's noisefloor by almost 20dB, which implies a resolution of better than 19 bits. When I played undithered data representing a tone at exactly –90.31dBFS, the waveform was symmetrical, though the three DC voltage levels described by the data were overlaid with some high-frequency noise (fig.7). Repeating the measurement with

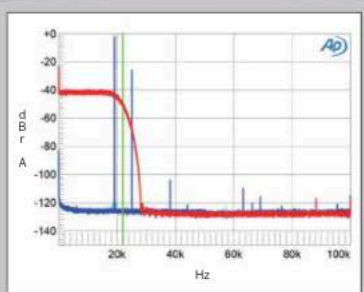

Fig.2 Lumin P1, wideband spectrum of white noise at –4dBFS (left channel red, right magenta) and 19.1kHz tone at 0dBFS (left blue, right cyan) into 100k ohms with data sampled at 44.1kHz (20dB/vertical div.).

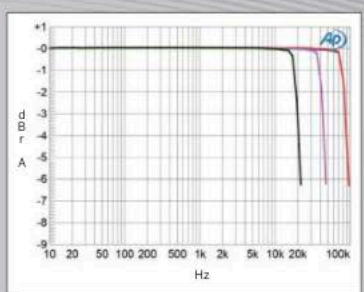

Fig.3 Lumin P1, frequency response at –12dBFS into 100k ohms with data sampled at: 44.1kHz (left channel green, right gray), 96kHz (left cyan, right magenta), and 192kHz (left blue, right red) (1dB/vertical div.).

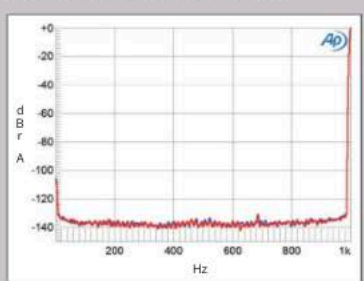

Fig.4 Lumin P1, balanced output, spectrum with noise and spuriae of dithered 1kHz tone at 0dBFS with 24-bit TosLink data (left channel blue, right red) (20dB/vertical div.)

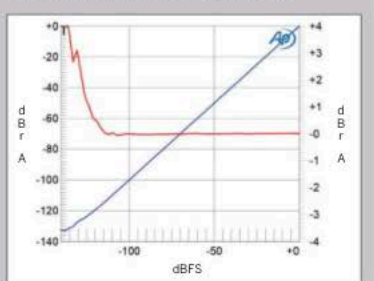

Fig.5 Lumin P1, left channel, 1kHz output level vs 24-bit data level in dBFS (blue, 20dB/vertical div.); linearity error (red, 1dB/small vertical div.).

stream audio data from the internal drive in my Nucleus+ server. In this mode, the P1 utilizes Roon's "RAAT" protocol, which stands for Roon Advanced Audio Transport. Still on a prolonged Rachmaninoff kick, I played Vladimir Ashkenazy performing the second Piano Concerto accompanied by Bernard Haitink conducting the Concertgebouw Orchestra (16/44.1 ALAC file ripped from CD, Decca 4757550).

The track's elapsed and total playing time appeared within the blue ring on the right of the P1's display, with the elapsed time also shown as the portion of the ring highlighted in bold. Clicking on the small orange button on the Roon screen shows that the P1's volume was being controlled with Leedh. Using the app, I disabled Leedh. Though the volume was the same, a thin gauze screen was now interposed between the music and me. I reactivated Leedh and used it for the rest of my time with the P1.

The orchestra in the Rachmaninoff recording had excellent dynamics and a wide, deep soundstage. Ashenazy's piano had well-defined weight in the left-hand register, even when I changed from the Bowers & Wilkins 804D loudspeakers I reviewed in the January 2022 issue to the GoldenEar BRX standmounts. But to make absolute judgments on the P1's performance, I needed to play something with which I was intimately familiar.

I cued up Antony Michaelson's 2003 performance of the Mozart Clarinet Concerto with the Michaelangelo Chamber Orchestra conducted by Robert Bailey (16/44.1 ALAC file ripped from CD, Musical Fidelity Records), which I produced. Engineer Tony Faulkner had done a superb job in the mix of presenting the image of Antony's clarinet in front of the orchestra in London's Henry

Wood Hall; the soloist's careful placement was readily audible with the P1 decoding the bits. The clarinet's lower, chalumeau register sounded appropriately warm, and the delicacy of Mozart's orchestral scoring was preserved, with excellent soundstage depth.

measurements, continued

undithered 24-bit data gave a well-formed sinewave (not shown), but some high-frequency noise was still present.

The P1 produced very low levels of harmonic distortion. With a full-scale 50Hz tone, the third harmonic was the highest in level in the balanced outputs at just –100dB (0.001%, fig.8). This spectrum was taken into the high 100k ohms load. When I reduced the load impedance to the punishing 600 ohms, the levels of the harmonic didn't change, a tribute to the quality of the Lundahl output transformers. With the unbalanced output driving 100k ohms, the third harmonic with the 50Hz tone rose to –90dB (0.003%), but this is still negligible. Repeating the spectral analysis with a 1kHz tone at 0dBFS, the third harmonic in the balanced output lay at just –119dB (0.0001%, fig.9). Intermodulation distortion with an equal mix of 19 and 20kHz tones, each lying at –6dBFS, was vanishingly low in level (fig.10), though the aliased images of the primary tones are present.

Fig.11 shows the spectrum of the P1's output when it was fed high-level, optical 16-bit J-Test data. The odd-order harmonics of the undithered low-frequency, LSB-level squarewave lie at the correct levels, indicated by the sloping green line. While some very low-level noisefloor modulation

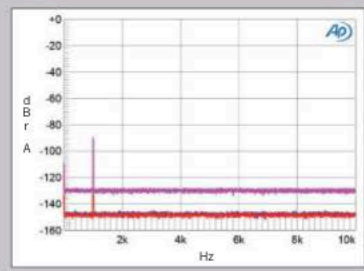

Fig.6 Lumin P1, spectrum with noise and spuriae of dithered 1kHz tone at –90dBFS with: 16-bit TosLink data (left channel cyan, right magenta), 24-bit TosLink data (left blue, right red) (20dB/vertical div.).

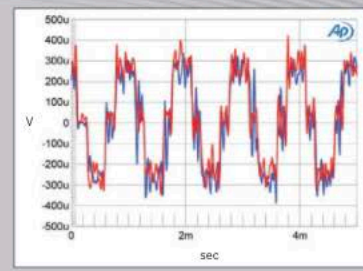

Fig.7 Lumin P1, waveform of undithered 1kHz sinewave at –90.31dBFS, 16-bit data (left channel blue, right red).

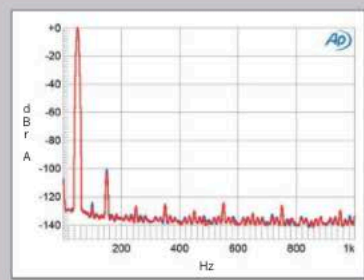

Fig.8 Lumin P1, balanced output, 24-bit TosLink data, spectrum of 50Hz sinewave, DC–1kHz, at 0dBFS into 100k ohms (left channel blue, right red; linear frequency scale).

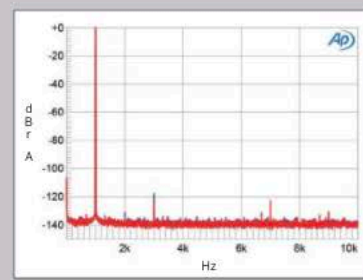

Fig.9 Lumin P1, balanced output, 24-bit TosLink data, spectrum of 1kHz sinewave, DC–10kHz, at 0dBFS into 100k ohms (left channel blue, right red; linear frequency scale).

Compared with the MBL N31 at the same volume using the MBL's slow-rolloff reconstruction filter, which is similar to the P1's filter, the P1's highs were slightly more forward-sounding.

What about DSD? I have been a fan of UK band Talk Talk since I was belatedly turned on to them by *Stereophile*'s erstwhile assistant editor Stephen Mejias. I have a version of the track "Happiness Is Easy" in my library, ripped from a SACD of the band's 1986 album *The Colour of Spring* (DSD64 file, EMI 591452). I selected the track in Roon and pressed Play. "DSD 2.822 MHz 1 Bit" appeared on the P1's display.

The drum intro sounded natural on the P1, with well-defined attacks. The reverb surrounding the piano and acoustic guitar interjections was well-resolved, and the children's choir was placed well behind Mark Hollis's plaintive vocal. The sparse double bass and electric bass lines sounded suitably forceful even on the diminutive KEF LS50s. The P1 does DSD well.

And MQA? Max Richter's post-minimalist reimagining of Vivaldi's *Four Seasons* caught my ear at a 2019 dealer event, and I subsequently found the MQA-encoded album, with violinist Daniel Hope and the Konzerthaus Kammerorchester Berlin conducted by André de Ridder, on Tidal (24/44.1 MQA, DG). With 24/44.1 MQA, the FLAC file doesn't unfold to a higher sample rate, but as decoded and rendered by the P1, the eerie-sounding strings that surrounded the bold solo violin in *Winter*'s first movement were set well back in the soundstage. The lower strings sounded rich. Turning off MQA decoding with the Lumin app brought the midrange forward and reduced soundstage depth. Score one for the P1 and MQA.

Listening with the Lumin app

When you use the Lumin app, the P1 manages the music.[4] The app's control screen allows a multiplicity of options: Switch on or off MQA decoding, Leedh processing, Lumin Streaming (which allows compatibility with Apple AirPlay), and Roon Ready operation. Preset the maximum volume and switch between Normal and Low volume ranges. Specify the desired output—analog, USB, or S/PDIF—and the polarity of each, direct or inverted. Select an input, remembering the last volume set. Specify whether to play CD data with or without deemphasis. And select what music to play: from whatever is connected to the analog inputs; from files stored on the L1 or other local servers; or from Spotify, Tidal, Qobuz, other streaming services, or internet radio stations.

With the app (v7.2.0) installed on my iPad mini 2 running iOS 12.5.5, I selected the balanced analog outputs, set the Leedh volume to "79" (out of 100), called up the music library on the L1 NAS, and chose *11 Tracks of Whack*, Walter Becker's 1994 solo album (16/44.1 ALAC ripped from CD, Giant 24579-2), which I had played with Roon after the Richter *Four Seasons*. My favorite track from *Whack* is "Book of Liars," which has a beautifully even-sounding bass line. To my surprise, the bass guitar had a better sense of drive than when I had played the file from the Nucleus's internal storage with Roon.

measurements, continued

is visible around some of the sidebands, this should not have audible consequences. This behavior was not present with 24-bit J-Test data (fig.12), though a pair of sidebands at ±120Hz is visible in this graph. The spectrum in fig.12 was taken with network data; the AES3 and S/PDIF inputs behaved identically, though these supply-related sidebands were a little higher in level with USB data.

Turning to the Lumin's analog inputs, the input impedance was low, at 1240 ohms balanced and 1260 ohms unbalanced, which might be a problem with source components having tubed output stages. The maximum gain for balanced inputs and outputs was –0.13dB, ie, an input of 1V resulted in an output of 983mV. For single-ended inputs, the maximum gain was –0.43dB at the unbalanced outputs but 5.56dB at the balanced outputs. Both sets of analog outputs preserved absolute polarity with both types of analog input signals. The analog inputs offered a wide frequency response, with the output down by 3dB at 61kHz (not shown). (This response was not affected by the sample rate of data present at the digital inputs.) The distortion via the analog inputs was slightly higher than via the digital inputs (fig.13) but was still very low in absolute terms.

Lumin's P1 did very well on the test bench.—**John Atkinson**

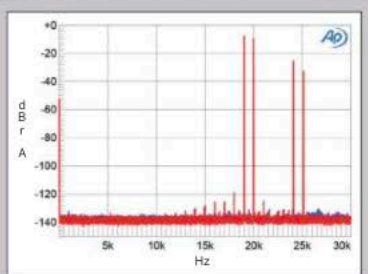

Fig.10 Lumin P1, balanced output, 24-bit TosLink data, HF intermodulation spectrum, DC–30kHz, 19+20kHz at 0dBFS into 100k ohms, 44.1kHz data (left channel blue, right red; linear frequency scale).

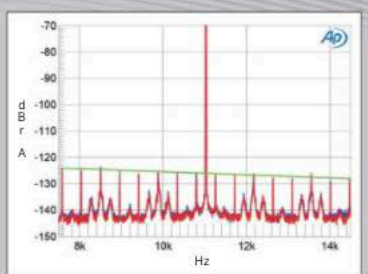

Fig.11 Lumin P1, high-resolution jitter spectrum of analog output signal, 11.025kHz at –6dBFS, sampled at 44.1kHz with LSB toggled at 229Hz: 16-bit TosLink data (left channel blue, right red). Center frequency of trace, 11.025kHz; frequency range, ±3.5kHz.

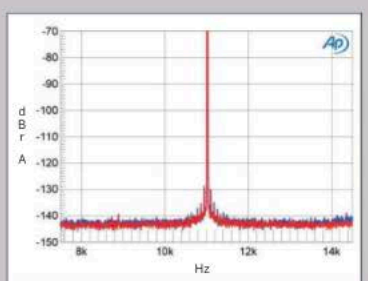

Fig.12 Lumin P1, high-resolution jitter spectrum of analog output signal, 11.025kHz at –6dBFS, sampled at 44.1kHz with LSB toggled at 229Hz: 24-bit Ethernet data (left channel blue, right red). Center frequency of trace, 11.025kHz; frequency range, ±3.5kHz.

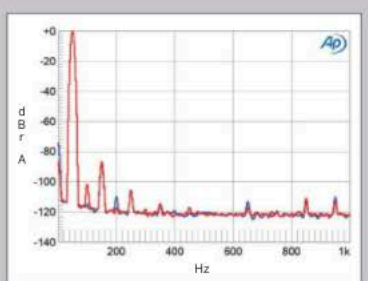

Fig.13 Lumin P1, analog input, spectrum of 50Hz sinewave, DC–1kHz, at 2V into 100k ohms (left channel blue, right red; linear frequency scale).

I wanted to compare what I had just heard from the L1 with the CD played on my Ayre C-5xe^{MP} and connected to the P1 via an AES3 link—but I couldn't find it in my compulsively alphabetized CD racks! I therefore selected a track I *did* have to hand on CD: "Friends to Burn" from Jimmy Webb's *Suspending Disbelief* (16/44.1 ALAC, ripped from CD, Elektra 61506). Recorded and mixed by the incomparable George Massenburg and released in 1993, before the advent of the Loudness War,[5] *Suspending Disbelief* is a rock album with dynamic light and shade.

This track's verses feature a relentless bass riff played by Leland Sklar. With the track sourced from the L1 and selected with the Lumin app, the bass line had a touch more of a certain chugging quality and the same improved sense of drive I heard with the Walter Becker track. With the same track on CD, with the Ayre's digital output fed to the Lumin's AES3 input, the chugging was very slightly better defined, and, if I had to swear to it on the first issue of *Stereophile*, there was a little more space around Russ Kunkel's drums. A close-run thing, but overall, playback via AES3 edged slightly ahead when it came to presenting the music's sense of timing.

Finally, I switched to the P1's balanced analog inputs fed from the Ayre's analog outputs. The presentation was a tad lighter, but the sound of Sklar's bass guitar had excellent definition. Used as an analog-in/analog-out line preamplifier, the P1 did an excellent job of preserving the sonic character of the Ayre player.

Conclusion

I very much enjoyed my time with Lumin's P1. Not only is it a superb-sounding D/A processor, but its transparent-sounding analog inputs and full video functionality are a welcome bonus. The Lumin app proved to be an excellent means of controlling the P1. And while I remain puzzled why the presentation with files sourced from the L1 UPnP server had more drive than with the same music played with Roon, I can recommend the L1 as a useful companion to the P1. ■

ASSOCIATED EQUIPMENT

Digital sources Roon Nucleus+ file server; Ayre Acoustics C-5xe^{MP} universal player; MBL N31 CD player/DAC; PS Audio DirectStream DAC.
Power amplifiers Parasound Halo JC 1+ monoblocks.
Loudspeakers Bowers & Wilkins 804D, GoldenEar BRX, KEF LS50.
Cables Digital: AudioQuest Vodka (Ethernet), AudioQuest Coffee (USB), DH Labs (1m, AES3). Interconnect: AudioQuest Wild Blue (balanced). Speaker: AudioQuest Robin Hood. AC: AudioQuest Dragon Source & High Current, manufacturers' own.
Accessories Target TT-5 equipment racks, Ayre Acoustics Myrtle Blocks; ASC Tube Traps, RPG Abffusor panels; AudioQuest Niagara 5000 Low-Z Power/Noise-Dissipation System (amplifiers) and AudioQuest Niagara 1000 Low-Z Power/Noise-Dissipation System (source components). AudioQuest Fog Lifters cable supports. AC power comes from two dedicated 20A circuits, each just 6' from breaker box.
Room 20' (left side), 25' (right side) × 16' × 8'.—**John Atkinson**

4 When you listen with the app, the P1 uses whichever protocols are necessary to do the job. The P1's default protocol is UPnP, with OpenHome, a UPnP extension.—**Jim Austin**

5 The Waves L1, the first digital brickwall limiter with look-ahead, was introduced in 1994.—**Jim Austin**