JOHN ATKINSON

Pass Labs HPA-1

HEADPHONE AMPLIFIER

When Pass Labs is mentioned, it's natural to think of its founder, iconic engineer Nelson Pass. But Nelson heads a team of engineers at the California company: Their XP-30 preamplifier, which I enthusiastically reviewed in April 2013,[1] was designed by Wayne Colburn; and the subject of this review, the HPA-1 headphone amplifier, is the first Pass Labs product designed by Jam Somasundram, former director of engineering for Cary Audio. Somasundram joined Pass Labs in July 2013; he spent a year working on the HPA-1, which was shown at the 2015 Consumer Electronics Show, in Las Vegas,[2] but not formally launched until the 2016 CES, at a hefty $3500.

The HPA-1 headphone amplifier is the first Pass Labs product designed by Jam Somasundram.

Technology

The HPA-1 has two pairs of single-ended inputs, one pair of single-ended outputs to allow it to be used as a preamp, and, at the center of its front panel, a single, locking Neutrik ¼" headphone jack. To the jack's right is the volume control, to its left three pushbuttons and their associated LEDs. These buttons select the chosen input and, using high-quality relays, switch between the rear-panel preamp-output jacks and the front-panel headphone jack.

The HPA-1 looks more like a small integrated amplifier than a headphone amp. At 11" by 4.5" by 12.9", it's larger than the Naim Nait 2, which Art Dudley wrote about in the May issue; and at 14 lbs, it's not much lighter than the Creek Evolution 100A integrated, which Herb Reichert reviewed in July 2015. In part, the weight comes from the beveled, ½"-thick faceplate, the case panels of aircraft-grade aluminum, and the solid-aluminum volume knob—but inside are a hefty, mu-metal–shielded toroidal transformer and multiple heatsinks. The power supply comprises a bridge rectifier, generous CRC passive filtering followed by discrete DC regulators, and then more passive RC filters. Overall, the HPA-1 boasts more than 40,000µF of supply capacitance.

The supply and audio circuitry are carried on a single multilayer circuit board that, other than a rectangular cutout at the right rear for the transformer, occupies the full width and depth of the HPA-1's interior. On the left, following the two pairs of Cardas input jacks (RCA), are, first, the left-channel audio circuits, then the right-channel circuits. According to Pass Labs, this circuitry is a simple two-stage CFA (current-feedback amplifier) topology using two pairs of

1 See www.stereophile.com/content/pass-laboratories-xp-30-line-preamplifier.
2 See http://tinyurl.com/m4w62me.

SPECIFICATIONS

Description Solid-state headphone amplifier/line preamplifier. Analog inputs: 2 unbalanced (RCA). Analog outputs: 1 pair unbalanced (RCA), 1 locking ¼" headphone jack. Maximum output power: 3500mW into 20 ohms, 200mW into 300 ohms. Frequency range: 10Hz–100kHz. Voltage gain: 8dB. Input impedance: 50k ohms. Output impedance: <2 ohms, headphones. Signal/noise and channel separation: not specified. THD+N: <0.005% at 1V output. Power consumption: 6W.
Dimensions 11" (280mm) W by 4.5" (115mm) H by 12.9" (330mm) D. Weight: 14 lbs (6.35kg).
Serial number of unit reviewed 31083.
Price $3500. Approximate number of dealers: 20.
Manufacturer Pass Laboratories Inc., 13395 New Airport Road, Suite G, Auburn, CA 95602. Tel: (530) 878-5350. Web: passlabs.com.

cascaded, ultra-low-noise Toshiba JFETs for the input stage, and a direct-coupled output stage comprising a complementary pair of Fairchild power MOSFETs biased into class-A, each mounted on its own heatsink. Between the left- and right-channel circuits is a single Burr-Brown OPA2804 dual op-amp chip, presumably to provide DC-servo action. The volume control is a top-line Alps potentiometer, and the board is replete with metal-film resistors and other premium parts.

Pass Labs says that the HPA-1 "easily drives headphones presenting loads from 15 to 600 ohms, particularly excelling with planar headphone designs." Overall, the amplifier appears superbly well made and finished.

Listening

Pass Labs recommends that the HPA-1 be left powered on at all times, and says that it sounds its best after having been powered up for an hour. I used several pairs of headphones with the HPA-1: my long-term references, Audeze's LCD-Xes, which I reviewed in March 2014;[3] the Master & Dynamic MH40s, which Art Dudley wrote about in February;[4] AudioQuest's NightHawks; and Audeze's LCD-4s, which I review elsewhere in this issue.

The output MOSFETs and regulators are each mounted on a hefty heatsink.

Authority—the word appears repeatedly in my listening notes, especially with good recordings of piano: The instrument's left-hand register was weighty but without boom. My love affair with Brahms's chamber music continues unabated; recently, I bought the complete set of his Piano Trios, performed by Christian Tetzlaff on violin, Tanja Tetzlaff on cello, and Lars Vogt on piano (DSD128 files, Ondine/HDtracks). The soundstage on this recording engineered by René LaFlamme has a tangible delicacy that the HPA-1 preserved, even if, through headphones, that soundstage exists only inside the listener's head. The instruments in the mysterious *Andante grazioso* of Trio 3 in c, Op.101, were stably positioned in a subtly present acoustic, each with a superbly natural tonal quality. Again, *authority* was the appropriate word to describe

3 See www.stereophile.com/content/audeze-lcd-x-headphones.
4 See www.stereophile.com/content/listening-158.

MEASUREMENTS

I measured the Pass Labs HPA-1's electrical performance with my Audio Precision SYS2722 system (see the January 2008 "As We See It," http://tinyurl.com/4ffpve4). I performed a full set of measurements from both the HPA-1's preamplifier and headphone outputs. The graphs all refer to the headphone output; I comment when the preamplifier output behaved differently.

Both sets of outputs preserved absolute polarity (*ie*, were non-inverting), and the maximum gain was the same from both, at 8.35dB, this very similar to the specified 8dB. The maximum output level at 1kHz was close to 10V. The input impedance measured a usefully high 46k ohms at 20Hz and 1kHz, dropping inconsequentially to 40k ohms at 20kHz. The output impedance from the headphone jack was a very low 1.35 ohms at all audio frequencies; it was higher from the preamplifier jacks but still low in absolute terms, ranging from 55 ohms in the low bass to 48 ohms at the top of the audioband.

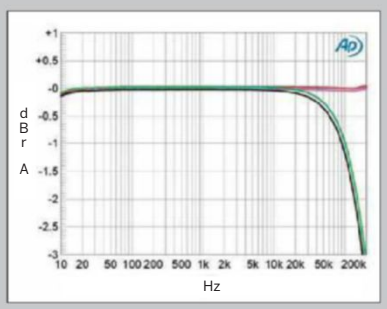

Fig.1 Pass Labs HPA-1, headphone output, frequency response with volume control set to its maximum (left channel blue, right red) and at 12:00 (left green, right gray) at 1V into 100k ohms (0.5dB/vertical div.).

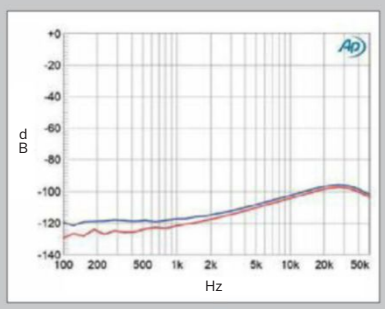

Fig.2 Pass Labs HPA-1, headphone output, channel separation ref. 7V into 100k ohms (R–L blue, L–R red) (20dB/vertical div.).

The frequency responses of the HPA-1's two channels matched very closely but varied with the volume-control setting. The blue and red traces in fig.1 were taken from the headphone output with the volume control set to its maximum—the response is flat to the 200kHz limit of the graph. The green and gray traces were taken with the volume control set to 12:00—the output is now down by 3dB at 190kHz, but the audioband response is still perfectly flat. The response from the preamplifier outputs was also flat within the audioband, but down by 1dB at 200kHz with the volume control

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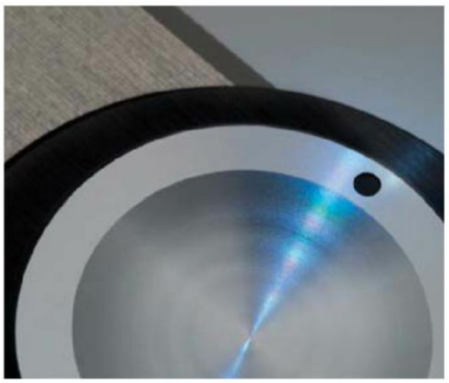

Left: RCA output jacks allow the HPA-1 to be used as a preamp. **Right:** that solid aluminum volume knob.

the character of Vogt's piano as reproduced by the HPA-1.

I have belatedly been ripping my Joni Mitchell HDCDs to 20-bit AIFF files with the dBpoweramp app running on a Windows 7 PC. (The Mac version can't unravel the HDCD encoding.) In "Coyote," from *Hejira* (Asylum 1087-2), with the HPA-1 driving the Master & Dynamic MH40s, Jaco Pastorius's fretless Fender bass underpinned the music to great effect. The combination of low-frequency clarity and, yes, authority proved addictive.

As I write these words, it is five years to the day that I played at Otto's Shrunken Head, in the East Village. The late Bob Reina had put together the gig to celebrate my first 25 years as *Stereophile*'s editor. Bob was playing Fender Rhodes piano, Liam Sillery trumpet, Mark Jones drums, Chris Jones double bass, and I was on fretless bass guitar. A band with two bass players constantly skirts disaster, especially when the music is improvised. The key is for both bass players to listen to each other and play in a complementary rather than a competitive fashion. Ideally, when one bassist is in the pocket low down, the other is playing up the neck, and vice versa—except that, much of the time that May night in 2011, Chris and I managed to occupy the same pitch space!

For example, I began the second set with a groove in B-flat minor[5] based on the riff featured in the verses of Traffic's "The Low Spark of High-Heeled Boys." When Chris came in, rather than soloing, he added bass harmonies to the second half of the riff. I'd recorded the gig at 24-bit/96kHz with a Zoom H4n portable recorder, using its coincident cardioid mikes. I had then added some first-order boost in the bass to compensate for the cardioids' inherently shelved-down low frequencies, which did insufficient justice to Mark's well-tuned kick drum. However, I forgot that, by doing do, I would add extra mud to those passages in which Chris and I were competing rather than collaborating. But through either set of Audeze 'phones driven by the HPA-1, Chris's double bass and my fretless electric bass were clearly differentiated in both space and tonality. Even through the AudioQuests, which can be a little bass heavy, there was no confusing the sounds of our instruments.

5 If that key causes a frown to furrow the brows of sharp-key–loving guitarists, note that we were playing jazz. With a trumpet player.

measurements, continued

set to its maximum, and down by 3dB at 190kHz with it set to 12:00. The response from neither output was affected by the load impedance.

Channel separation (fig.2) was superb, at close to 120dB in both directions at and below 1kHz, and still 95dB at the top of the audioband. The unweighted, wideband signal/noise ratio, measured at the headphone output jack with the inputs shorted to ground but with the volume control set to its maximum, was excellent, at 86.5dB ref. 1V. This improved to 98.5dB when the measurement bandwidth was restricted to the audioband, and to 102dB when A-weighted. The unweighted, wideband ratio was slightly greater from the preamplifier outputs, but otherwise similar to the ratios measured at the headphone jack.

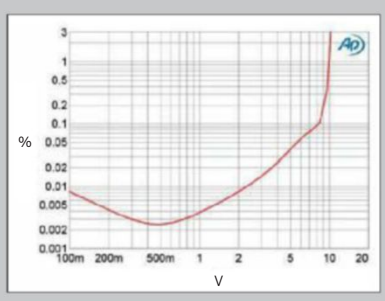

Fig.3 Pass Labs HPA-1, headphone output, THD+N (%) *vs* 1kHz output voltage into 30 ohms.

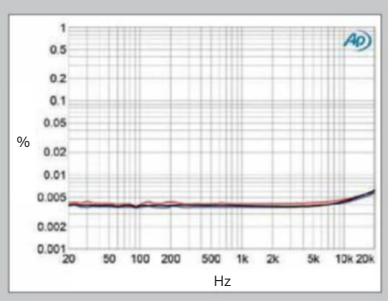

Fig.4 Pass Labs HPA-1, headphone output, THD+N (%) *vs* frequency at 1V into: 200 ohms (left channel blue, right red), 30 ohms (left gray).

Fig.3 plots how the percentage of THD+noise changes with output level into a low (30 ohm) load. The measurement is dominated by noise below 500mV, and although the actual distortion begins to emerge from the noise floor above that level, it remains below 0.01% up to 2V. The linear rise in THD+N with level above 2V suggests that only a moderate amount of loop negative feedback is used, and that actual waveform clipping occurs much higher in level. Into the low 30 ohm impedance, the HPA-1 clips (defined as

Against the Ayre Codex

Jon Iverson enthusiastically reviewed the Ayre Acoustics Codex ($1795) in our June issue, commenting that it "presented a simple, well-recorded, unaccompanied voice with ease, humanity, and that essential breath of life." In contrast to the Pass Labs HPA-1, the Codex combines USB and TosLink digital inputs with a high-quality D/A converter, and can drive balanced or unbalanced headphones. As the Codex has a set of single-ended preamplifier outputs, for comparisons with the Pass Labs amplifier I fed these outputs to the HPA-1 so that the same D/A converter was used for both amps. And as I'd be swapping headphones between amps, I used the Ayre's unbalanced headphone output. With the low-sensitivity Audeze LCD-4s, this meant that, to achieve a satisfactory playback level, the Ayre's volume control needed to be set to "97," very close to its maximum of "100." But every time I plugged the balanced headphones into the Ayre after listening to the Pass Labs, the Codex helpfully reset its volume to "66," which slowed my otherwise instantaneous comparisons.

My primary impression of the sound of the DSD Brahms Trio recording through the hot-running Ayre[6] was that the images of the instruments were slightly farther toward the front of my head than through the HPA-1. The Pass Labs had a little more high-frequency air, and kept Jaco's plucked harmonics in "Coyote" slightly more separated from the strummed guitars at far left and right. Jaco's distinctive bass lines had a little more upper-bass emphasis through the Codex, a little more midbass body through the HPA-1. Overall, the Pass Labs edged ahead on points.

But the Codex is optimized for balanced headphones; it could be argued that, with the Audeze 'phones running unbalanced, it was fighting with one hand—er, signal phase—tied behind its back. With the LCD-4s connected to the Ayre with balanced Cardas Clear cables,[7] the Ayre's overall sound remained a little more forward than the Pass Labs', but the Codex's low frequencies acquired greater apparent extension with the Joni Mitchell track, and greater weight in the piano's left-hand register in the Brahms recording. The two amplifiers were now much more closely matched, though I ultimately preferred the sound of the Ayre's DAC feeding the HPA-1 via unbalanced interconnects and the Pass Labs driving single-ended headphones.

ASSOCIATED EQUIPMENT

Digital Sources Antipodes DX Reference, Aurender N10 music servers; Apple 2.7GHz i7 Mac mini computer running OS10.9.4, iTunes 12, Pure Music 3.0, Audirvana Plus 1.5.10; PS Audio PerfectWave DirectStream, Logitech Transporter D/A processors.
Headphone Amplifier Ayre Acoustics Codex.
Headphones Audeze LCD-X & LCD-4, AudioQuest NightHawk, Master & Dynamic MH40.
Cables USB: AudioQuest Coffee. Interconnect (unbalanced): AudioQuest Fire. Headphone: Cardas Clear (balanced), manufacturers' own (unbalanced). AC: manufacturers' own.—**John Atkinson**

Summing Up

As balanced headphone operation is the audio fashion du jour, it might be felt that Pass Labs's sticking with single-ended operation could work against the HPA-1. But regardless of circuit topology and the active devices, it's the sound quality that matters, and on that count the HPA-1 scores big-time. Yes, it's an expensive headphone amplifier; but I venture to suggest that, in bass clarity and *authority* and in midrange transparency, the Pass Labs HPA-1 is without peer. ■

6 After a couple of hours of operation, the temperature of the Ayre's enclosure stabilized at 108°F (42.3°C).

7 Unfortunately, this disabled the Codex's single-ended outputs, making instantaneous A/B comparisons with the Pass Labs even more cumbersome and causing me to reflect, once again, that those who declare that A/B comparisons are "easy" have very little practical experience of such tests.

measurements, continued

when the THD+N reaches 1%) at 10V. The HPA-1 will have no problem driving even low-impedance headphones to unsociably high volumes. I measured how the THD+N percentage changed with frequency (fig.4) at a level, 1V, at which fig.3 had indicated that I would be looking at actual distortion. Even so, the level of distortion was very low, at around 0.004%, and the expected rise in THD at the top of the audioband was minimal.

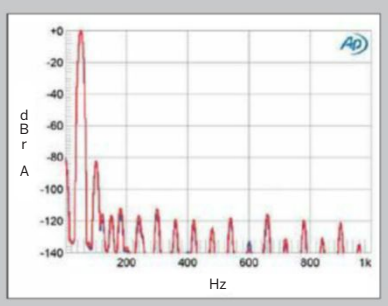

Fig.5 Pass Labs HPA-1, headphone output, spectrum of 50Hz sinewave, DC–1kHz, at 2V into 300 ohms (left channel blue, right red; linear frequency scale).

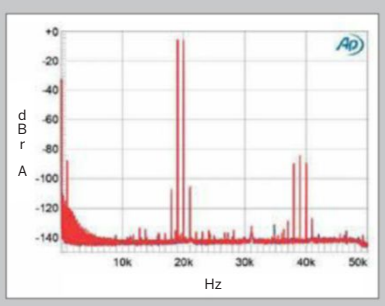

Fig.6 Pass Labs HPA-1, headphone output, HF intermodulation spectrum, DC–50kHz, 19+20kHz at 2V into 300 ohms (left channel blue, right red; linear frequency scale).

The main distortion component was the second harmonic (fig.5), which is subjectively innocuous even when much higher in level than the –83dB (0.007%) at which it lies in this graph. Though some third harmonic is also present, this lies close to –120dB (0.0001%), and will therefore be irrelevant to sound quality. Similarly, though AC supply components can be seen at 120, 180, 240Hz, etc., unmasked by the very low level of random noise, these are all way too low to be anywhere close to audibility. Intermodulation distortion (fig.6) is also extremely low, with the 1kHz difference component resulting from an equal mix of 19 and 20kHz tones lying at –89dB (0.003%).

Pass Labs' HPA-1 offers superb measured performance that reflects equally superb audio engineering.—**John Atkinson**