

[Review: HeadAmp Pico w/ DAC](#) *portable headphone USB DAC/amp*

www.headamp.com

retail price at press time:

without optional DAC: \$349

with DAC: \$499

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[Intro]

HeadAmp Audio Electronics' new \$499 Pico is aptly named as it's truly diminutively sized for a product of its type—never before has a USB DAC/amp for headphones been this *small*, as it's truly pocket-sized and can fit in the palm of the hand. It may be tiny, but does its sound belie its size? That's what I wanted to find out, and my findings follow below.

For this review I bought and listened to two Pico units, serial #11 (black) new from HeadAmp and #202 (silver) off the Head-Fi FS forums, over a period of 6 months off and on.

[Reviewer Biases]

I usually expect solid-state amps to sound solid-statey—linear, in other words, as far as frequency response goes. "Neutral" and "flat" are standard expectations of mine when it comes to solid-state. A "flat" amp is theoretically a "transparent" amp, an essential wire with gain, that simply passes the sound of the source to the transducers, so when I listen to the ideal solid-state amp, I expect to hear the sound of the source, not the sound of the source plus the amp.

For reference, all previous amps I've heard in quiet conditions are listed in my profile on Head-Fi.

[Associated Equipment]

Digital Sources:

- Arcam FMJ CD33 and Plinius CD-101 CDPs w/ Signal Cable Silver Resolution Reference power cord; iAudio X5 (DAP); Asus Z71V (laptop PC)

RCA-mini Interconnect:

- Signal Cable SilverMini

Headphones/IEMs:

- AKG K701 re-cabled w/ SAA Equinox

- Audio-Technica ATH-ES7 plus ATH-AD2000 & ATH-W5000 both re-cabled w/ APureSound V3
- Grado HP1000/HP2 re-cabled w/ APureSound V3
- Klipsch IMAGE X10
- Sennheiser HD650 re-cabled w/ SAA Equinox
- Ultimate Ears triple.fi 10 Pro

Comparison Portable Amplifiers and USB DAC/Amps:

- DIY PINT
- HeadAmp AE-2
- HeadRoom 2006 Total Bithead

[Evaluation CDs]

A Fine Frenzy - **One Cell In The Sea**

Alison Krauss & Union Station - **Lonely Runs Both Ways, New Favorite, So Long So Wrong**

Julie London - **The Very Best of Julie London**

Laika - **Good Looking Blues, Sounds of the Satellites**

Orbital - **Middle of Nowhere, The Altogether**

Porcupine Tree - **In Absentia, Deadwing**

Portishead - **Portishead**

Renee Fleming - **Thais**

Sarah Brightman - **The Andrew Lloyd Webber Collection**

The Crystal Method - **Community Service, Community Service II**

The Prodigy - **The Fat of the Land**

[About the Pico]

Released in December 2007, the Pico represents HeadAmp's clear product statement in the portable USB DAC/amp market. As designer Justin Wilson put it when asked about his design process, "My approach was to pick a top level DAC chip that I was familiar with, because it wouldn't have been possible to try all of them since they all need different circuits around them, so I went with the WM8740 because I liked what I heard from the Arcams [CD players]. From here the goal was to make sure the DAC performed to its highest level possible, and I did this by using the best upsampling chip (AD1896), separate voltage regulators for each digital chip, and a lot of testing and tweaking."

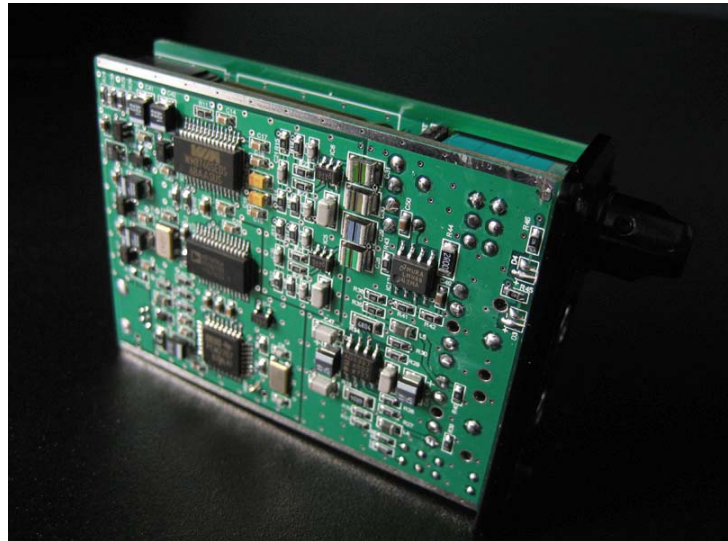
And as Justin says in his sponsored Member of the Trade forum thread on Head-Fi, "In making the Pico, I set out to make a very small amp that has the voltage and current capability needed to drive headphones of all impedances and sensitivities, and a very low noise floor important for sensitive in-ear-monitors. In designing the Pico I went through every op-amp that made sense for headphones and I'm convinced the Pico is the best it can be. I don't know of any amp this size that has the drive capability of the Pico. I also wanted to offer many features important for a great user experience and to keep the Pico on the cutting-edge."

On the subject of the ICs in the Pico, Justin wrote this in his sponsored MoT thread: "The PCM2707 from Texas Instruments is what takes in the USB data, and puts out the I2S format which is 3 separate clock and data signals that make up the digital audio. It then goes to the AD1896 sample rate converter from Analog Devices, which puts the data into a buffer and then upsamples it to 24/96 using the Pico's own low-jitter clock. The result of these 2 steps is a significant reduction in jitter, some expensive DACs even go as far as to call this method "jitter-free design" which will be important playing off a computer. The upsampling also means the digital noise which must be filtered out is at a frequency (96khz) further away than what is audible. The digital-analog conversion is done by one of Wolfson's best DACs, the WM8740

which has been my favorite of the few high-end DAC chips. This 24-bit DAC has a great smooth sound and is also very low noise, 117dB signal-noise ratio compared to 98dB for the DAC integrated into single USB chips. The op-amp used here is a unique MOSFET design which eliminates input crossover distortion, something that has been limiting op-amp performance. The sound of this op-amp is very deep and layered, my favorite so far from an op-amp. The headphone amp section of the Pico uses the AD8397 by Analog Devices, which is a very linear, high output current op-amp. The Pico's li-ion battery is actually two cells in 1 pack, giving it 8.4V or double the voltage of most li-ion batteries, so at least twice as much sound can be delivered to the headphones. This voltage and high current from the op-amp will allow even the most power hungry headphones to be properly driven."

Internal construction of the Pico consists of two PCBs, one for both DAC and amp sections, the other for charging & power. An internal 8.4V 2-cell Lithium-polymer battery pack (providing ~20 hours of runtime), along with a 16V capacitor that absorbs turn-on surge, are sandwiched between these two PCBs.

In terms of technical differences with HeadAmp's other portable amp, the AE-2, Justin said this when asked about the subject: "The Pico uses the same amp chips as the AE-2, because they are still the best available for making a small portable amp that meets the criteria of having enough power for all headphones,



low noise, and have a good enough battery life. But it is better implemented with a better circuit board layout, lower value resistors & volume control for lower noise, shorter signal paths, and a better gain switch setup. The circuit board on the Pico is 4 layers. The signal and power layers are separate on the inner layers. The outer layers are both ground planes which are stitched together with plated holes. The idea is this creates a shielded cage around the signal and power and isolates the amp from the world." In addition to this, the AE-2 uses 4 X7R ceramic caps whereas the Pico uses 4 C0G ceramic caps instead, that improve dynamic range.

Accessories included with the Pico include: 4 stick-on rubber feet, user manual, one USB cable with length of your choice (if ordered with the optional DAC), AC charger, and a small protective leather bag. The AC charger powers the amp when plugged in, as the DAC (if installed) receives its power from over USB (the amp section receives its power from the lithium-polymer battery). If the 4 rubber feet are installed, the Pico will not fit into the leather bag very well, so anyone who intends to use the bag should not install the feet. (As a counter-measure, the bag can be used in place of the feet for scratch-protection and friction as it fits snugly and its seams can be cut to expose the back panel.)

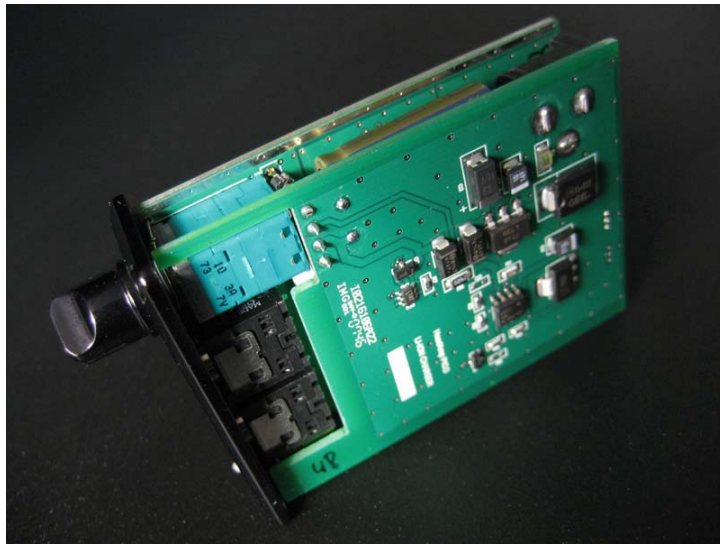
Currently available *standard* colors at the time of this review were black and silver, with *premium* colors available in blue, light blue, bronze, gold, gray, green, orange, and red. Premium colors add \$20 to the base price, and blue, light blue, gold, green, orange, red are available only on the DAC version. (The Pico is available without the DAC section for an amp-only version at \$349.)

Finally, HeadAmp's position on burn-in is an official "no comment," so as a reviewer I decided to completely disregard this controversial issue and started listening right away and gave no further thought to it.

[Form & Function]

The Pico's dimensions measure at just 2"x2.74"x0.86" (51x70x22mm), and at its weight of just 2 oz (~57 g), it's more than light enough for it to be tugged around on a desk by pulling an attached headphone cable or interconnect. The rubber feet, if installed, don't add much friction, which makes the Pico somewhat skittish, so caution is advised when using it on a surface with a limited area so it doesn't fall off.

The chassis is polished aluminum, which makes it highly susceptible to fingerprints and scratches, especially on black-color units, so caution is advised during general handling. To mitigate highly visible fingerprints & scratches, the Pico should be ordered in another color such as silver, gray, or bronze.



Operationally, the Pico is intuitive and simplistic. All of its important features are clearly labeled, and two red LEDs iconized with a computer-style "I/O" and lightning bolt indicate when it's on and charging, respectively. Turning on the Pico is achieved simply by turning the volume knob, as there's a hard click set into it for a power-on point, and the charging LED is only lit when the battery is actually being charged and turns off when the battery is full.

The two-way gain switch flips between multipliers of 2 (Low) and 6 (High) to accommodate a wide range of low- and high-impedance headphones. High gain is

certainly useful but wasn't essential during actual testing on the K701 or HD650, as there was more than enough turn on Low gain to deliver loud volume for both headphones. Low gain, on the other hand, wasn't quite as adept with the 32 Ohm UE triple.fi 10 Pro or 40 Ohm Audio-Technica AD2000. The triple.fi and AD2000 were more than a bit frustrating to control on Low gain, so anyone using either these or other similarly low-impedance, efficient headphones/IEMs will want to add a resistance adapter (the UE triple.fi 10 Pro comes with one).

[Listening Environments]

I listened to the Pico in three setups:

- (1) As an amp lined out from the iAudio X5 DAP.
- (2) As a DAC/amp connected to my Asus Z71V laptop computer, and compared to the HeadRoom 2006 Total Bithead.
- (3) As an amp lined out from the Arcam FMJ CD33 and Plinius CD-101 CD players.

The Pico did not noticeably improve much upon the X5's sound, at least for MP3, the only format that I tested.

In the laptop setup, files were in lossless FLAC, played back with Foobar2000 0.9.5.1, and output over ASIO4ALL V2. All software volume sliders were maxed out to avoid any software-based attenuation.

In the setups with the CD players, the Pico was directly compared against the HeadAmp AE-2 using the Signal Cable SilverMini RCA-mini interconnect.

All CD tracks referenced in the next section were directly A/B'd *twice* in both their Redbook CD and digital file formats for a comparison of the D/A conversion quality of the Pico's single Wolfson WM8740 DAC versus the Wolfson WM8740 dual-pair and TI PCM1704 single-pair DACs in the Arcam FMJ CD33 and Plinius CD-101, respectively. Using FLAC+ASIO on the laptop ensured a valid bit-perfect comparison of the DACs between the Pico and the two CDPs.

[Pico vs itself - DAC vs amp]

In this comparison, the Pico was compared in amp-only form off my two CDPs versus DAC/amp form off my laptop PC. (Caveat: not entirely a fair comparison between the three DAC sections though since the CDPs have their own analog output stages.)



To start with, the Arcam FMJ CD33's DAC section was sonically superior to the Pico DAC in nearly every way, even if the two did share a general similar tonality. (Incidentally, this Arcam CDP also uses the same Analog Devices AD1896 ASRC as the Pico and does full upsampling to 24/192 while the Pico does up to 24/96.) On AKUS' "Goodbye Is All We Have" from *Lonely Runs Both Ways*, there was simply greater concert-hall acoustics on the Arcam, with simply more air and space overall. Krauss' voice was also more finely detailed on the Arcam, with more legible lyrics and more texture. The Arcam also displayed a treble tilt that gave more emphasis on the guitar plucks and sliding. The Pico missed those details a bit but it did balance out the mid-range and mid-bass better, as the Arcam is a bit thin in that area. In most aspects, though, the Arcam clearly eclipsed the Pico, as it conveyed significantly more "breathing air" around the instruments with an excellent "reach out and grab it" kind of soundstage, it was able to sound crunchy and tactile, and it made Krauss' voice accurately delicate and fragile. And on A Fine Frenzy's "The Minnow and The Trout" from *One Cell In*

The Sea, the Arcam provided a better sense of vibration of the piano movements, along with more increased separation between the various layers, and a deeper tone on the lower piano notes.

The Plinius CD-101's DAC section also beat the Pico's DAC—well it had a different sonic signature, which was more easily noticed than the ways in which it was superior, but it too sonically crushed the Pico. Again on A Fine Frenzy's "The Minnow and The Trout," and also on Alison Krauss & Union Station's "The Lucky One" and "Take Me For Longing" from *New Favorite*, the Plinius DAC was bold with a confident attitude, almost brash, and very quick. And versus the Pico, layer separation was cleaner, the overall sound was crystal-clear (whereas the Pico was merely "clear"), there was more separation in the virtual air, and the sound was bold, rich, vibrant, and very dynamic. The Plinius just flowed better

with more musical ease, and threw greater snap and impact, along with a more powerful, authoritative, and more subterranean bass that showed up on The Prodigy's "Breathe" from *The Fat of the Land*. It was like a full awakening of energy and attitude, with an all-encompassing & surrounding soundstage and a visceral bass that gave at least 150% more force and impact. The Pico DAC sounded downright boring and half-alive in comparison.

[DAC Mode - Pico vs Bithead - Lossless Music]

In this comparison, the Pico was compared to HeadRoom's 2006 Total Bithead off my laptop PC using FLAC files. Not quite a fair comparison of course as the two use different DAC chips, op-amps, and differ in key technical aspects, but if the Pico offers high-quality sound, it must sound better than the Bithead, right? And if so, by how much?

The Bithead had decent clarity overall, but the Pico was even clearer, like a clean, scrubbed-out window, compared to the Bithead's fuzzy, blurry imaging and edges, somewhat like a window with streaks on it. The Bithead was also slow with a weak attack, lacking the ability to fully keep up with the music, while the Pico much more easily kept up with quick runs of notes and complex rhythms. On the other side of this aspect, the Bithead also demonstrated a short decay, routinely cutting the last breath of air off from notes. This wasn't a problem with the Pico, which drew things out longer and fuller and more naturally. The Pico also had considerably more bass oomph than the Bithead, which sounded bass-light in comparison. The most serious flaws, though, were mostly in the areas of soundstage, spatial dispersion, and layer separation, as the Bithead just couldn't manage its way through ambient space and complex mixes. It routinely stuffed up the soundstage for a direct, upfront feel that ultimately gave a suffocating, "get me out of here" vibe, and it also mashed in the instruments for more of a 2D-type presentation than a 3D one. And on complex mixes with lots of simultaneous layers, the Bithead also consistently converged them, losing individual focus on them. This made it very difficult to discretely pinpoint instrument positions with it by ear.

The Pico, on the other hand, displayed none of these flaws and came out on top with a very well-balanced sound, plenty of speed (though ultimately, not enough to catch every fast detail), and excellent separation between air and layers for a nicely separated, 3D presentation that actually delineated between near, out, further away, and far away. Overall, top-quality sound indeed, and tonally centered square in the mid-range—not too much bass, not too much treble. Soundstage too was very well-done, with a complete illusion of a dead-center z-axis (a quality I haven't heard often in portable devices) and no convergence of left and right—just clean separation of the channels for a realistic width span. Overall, a fantastic presentation that really made it sound absorbing—time and time again I found myself deeply listening to it and was rewarded by new details in the subtleties.

[DAC Mode - Pico vs Bithead - DVD]

A DVD movie test was briefly done to compare the Pico's effect on movie soundtracks versus the Bithead. The DVD used was *Black Hawk Down*, chapters 12 and 13, which comprise part of the film's intense street-level battle scenes. For those unfamiliar with this film, it's about the 1993 Battle of Mogadishu in Somalia where over 100 US Army Special Forces soldiers were sent in on a top-secret mission and had to fight their way out of the hostile city into a safe zone. The soundtrack is appropriately dominant with sound effects of military vehicles & weapons including various Foley sounds like explosions and impacts (e.g., bullets hitting stray surfaces, shattering glass, and falling empty bullet casings).

Here also the Pico clearly beat the Bithead. The Bithead, for all intents and purposes, did a fine job with the film's soundtrack, letting you hear everything going on without much confusion, but the Pico was

simply a noticeable step up. Explosions boomed nicely on it and there was significantly more tactile detail too—more of their earth/air-moving impact and aftershock, along with a better sense of different materials being impacted by gunfire. The gunfire too emerged from a blacker background and sounded a lot more sudden and intense than on the Bithead, with an actual sense of variation in the physical actuation. And as expected, the Pico also separated the musical score from the sound effects, placing it more towards the background so it wasn't as prominent.

[Amp Mode - Pico vs AE-2]

In this comparison, the Pico was extensively compared to HeadAmp's other portable amp, the AE-2, off my two CDPs. Ultimately, the only real conclusion I could come to was that the Pico and AE-2 are sufficiently different-sounding and will appeal to different ears and preferences. (Most of the technical reason for the sonic difference between the two may be attributed to the ceramic caps—C0G on the Pico, X7R on the AE-2.)



The Pico had the warmer mid-range, with sweeping, broad strokes that fleshed it out nicely and fully. Armed with a palette of rich, dramatic colors, the Pico consistently cast a dynamic, involving performance that went deep & expressive on vocals and bold, assertive, & confident on faster, more insistent music. The AE-2, on the other hand, carried itself more as a slicer and dicer of flash and speed with an edgier treble that allowed it to sound quicker, more metallic, more “electric,” and more sizzly. The Pico wasn't totally quick though—the fast guitar plucks on AKUS' "Little Liza Jones," the guitar strumming on AKUS' "Unionhouse

Branch," and the piano keys on Porcupine Tree's "Lazarus," respectively, were all cleanly separated and individually accentuated only on the AE-2—the Pico effectively glossed over these in comparison.

The Pico was noticeably more dynamic than the AE-2 and contrasted soft from loud with excellent control and responsiveness. The Pico was instantly intense on the operatic dialog exchange in *Thais* between Fleming (the female vocalist) and Hampson (the male vocalist) and rose & fell with the swells in their voices like a rolling wave. Porcupine Tree's "Blackest Eyes" and "Prodigal" were both great examples too, as the Pico rose to meet the swells in volume and power. It also easily handled drops to low volume just as well, with an excellent barely-there quality to the violin soloist in the famous "Meditation" from *Thais*. And on several Alison Krauss discs, low-volume passages had clear rolling contrast against the louder waves, with smooth transitions that easily translated very subtle volume variations.

In the area of bass, the AE-2 delivered more quantity with a solid thump and strong kick. The Pico did provide a hard fast impact, along with plenty of inner force (maybe about 20% more than the AE-2 in fact), and it was faster and punchier too, but the AE-2 was the winner otherwise. The AE-2's bass was more virtuous with a lower extension, more raw oozing power, more rumble, and more mass. It could be said that the AE-2's bass was loose in comparison to the Pico's more reserved, controlled bass, but this looseness worked some bass x-factor on the AE-2, which was more palpable with texture in the 50-80 Hz range specifically, allowing a greater feeling of thump and more definition on chamber resonance and

other physical movements. The AE-2 also carried more low-level strength, with a heavy, fat, & thick presence that showed up on various tracks from The Crystal Method. It had a terrific massive-sounding size that might be compared to a huge racquetball—big yet still bouncy quick. The Pico, on the other hand, was more like an actual-size racquetball—same speed, just less size/presence.

And in the area of overall soundstage and presentation, the Pico delivered a more compact, integrated sonic image, with near-perfect alignment and positioning of the instruments. There was also more soundstage height with it than the AE-2, and despite its more compact spatial retrieval, it portrayed more subtle z-axis gradation, with the layers on distinct depth planes. These separate depth planes that it seemed to set up allowed instruments to sound as if they were coming from discrete near, away, & far-away positions in the soundstage, which created a completely realistic, surrounding semi-circle. The AE-2, on the other hand, had a different style that gave a higher sense of open air and expansion, as it projected outwards and wider more. It also had a very diffuse and almost "crystallized" presentation—it separated parts of the musical event from each other, splitting them and inserting air between them, to impart a wider and deeper soundstage. Because of this splitting, elements also usually sounded more individual on it than as part of a group effort as on the Pico. In this way, the musical elements usually did sound as if they'd "crystallized" in place, with clearly outlined positional edges.



These different presentations between the two amps also gave different perceptions to the nebulous word "detail"—what does "detail" mean specifically? In the case of the AE-2, its speed and treble tilt allowed it to easily close snaps, simmer over metallic sheens, and scrub squeakier for that perception of detail. The Pico, on the other hand, displayed a clearly superior spatial retrieval that allowed it to more easily capture the full range of layers and depth planes within the mix for a true ability to hear everything going on and preventing individual layers from sounding buried or lost within the mix, for that perception of detail.

[vs HeadAmp's discrete home amps?]

I didn't own the Pico simultaneously with any of HeadAmp's discrete Gilmore Lite, GS-1, or GS-X amps, but I did own those three together for several months, along with the AE-2, which I compared to the Gilmore Lite. So while no direct comparisons were made, I was able to use the AE-2 as a reference point of sorts.

With that said, the Pico did not meet initial expectations as an addition to HeadAmp's line. Initially it sounded boringly neutral as opposed to the treble-tilted AE-2 and Gilmore Lite, and the lack of speed was also disappointing, as speed is an area in which the GL excels. The difference between the two was fairly obvious—the GL has an agile, lean character with an excellent transient response and a soundstage that leaves the air open in the back (the GS-1 goes even deeper). Coming after it, the Pico sounded merely

ok—no standout qualities but it certainly didn't sound bad. But to put it bluntly, I thought that the GL essentially crushed the Pico as an amp. Those who are looking for a reasonably-priced *high*-quality amp regardless of size or battery power should put the GL near the top of their list—of course it lacks the USB DAC, along with a gain switch, but its sound is a clear lead over the Pico's.

[Headphone Synergies]

With the exception of extremely inefficient headphones like the 400 Ohm AKG K340 (which distorted easily with the AE-2 when I owned the two together), the Pico should do a fine job of driving a wide range of dynamic headphones easily and sounding at least decent with everything, and indeed it certainly sounded good with the AKG K701; Audio-Technica AD2000, W5000, & ES7; Grado HP1000/HP2; Sennheiser HD650, and the Klipsch IMAGE X10 & UE triple.fi 10 Pro IEMs. A true jack-of-all-trades, it simply sounded good with all of them—but of course, not exceptional with each one. Notable detractors with my headphone collection included a loss in bass extension and quality that didn't work well with the AD2000 or W5000 (and not enough balance against these headphones' signatures). In fact, the AD2000 sounded downright boring with the Pico compared to the AE-2, which helped to add bass boom/buzz and crisp articulation. I would advise against using the AD2000 and Pico together for this reason—part of the AD2000's attraction is its low-level, fast, & snappy but firm bass but it barely registered with the Pico. As



for the W5000, it sounded ok but not particularly special, as the W5000 is a headphone that can transcend itself on a select few amps and the Pico was clearly not one of them. The UE triple.fi 10 Pro was a decent match but tended to have some treble grain that was recording-dependent. An amp with even less treble tilt and a warmer mid-range would probably be more advisable for the UE triple.fi 10 Pro.

The AKG K701 and Sennheiser HD650 were both driven acceptably, though I would advise that a portable amp should not be used with either in general cases as a primary amp solution. I would

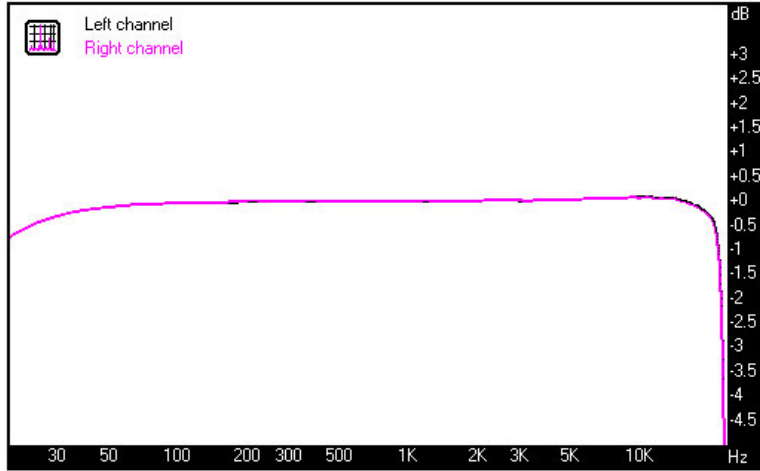
recommend the Pico for either of these headphones only if they're part of a collection that includes portable or smaller headphones—it is more than worth it to invest in a better-quality DAC and amp for either headphone if used alone or with other higher-end, revealing, full-size headphones. The Pico, to its credit, did do a very fine job driving these headphones with an acceptable level of detail, but significantly more detail can be heard on these headphones with higher-quality source components and amps.

[Conclusion]

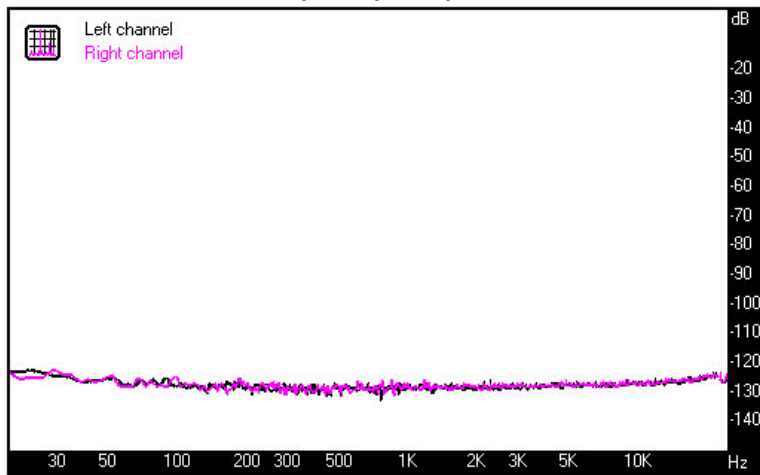
Though I came away from the HeadAmp Pico w/ DAC still preferring the AE-2, I came away with a new appreciation of it *and* a new understanding of subjective differences in audio, and there's a whole lot to like about it too. Simply put, it's an excellent-sounding DAC/amp solution with few faults and will almost certainly be the state-of-the-art accomplishment in portable USB DAC/amps for a long time to come.

[Measurements]

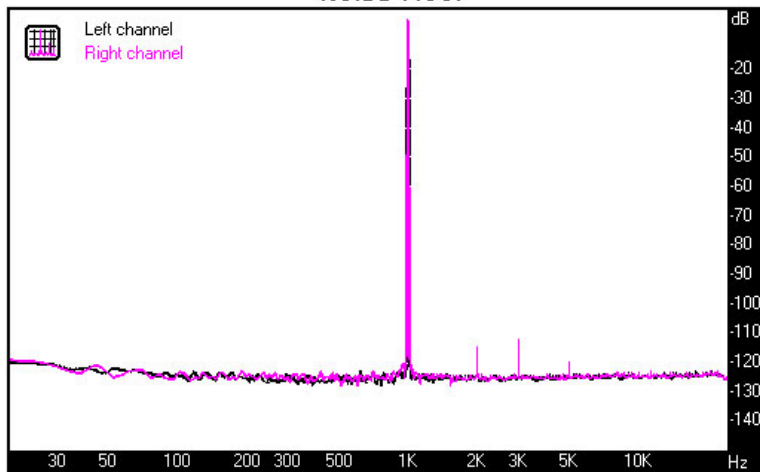
The following three pictures have been copied from Justin Wilson's post #473 in the Pico's Sponsored MoT thread on Head-Fi and should be considered copyrighted © 2008 by HeadAmp.



Frequency Response



Noise Floor



Harmonic Distortion