

Musical Fidelity AMS Primo

LINE PREAMPLIFIER

MICHAEL FREMER



Musical Fidelity AMS Primo preamplifier

DESCRIPTION Tubed, two-channel line preamplifier. Tube complement: 14 ECC81. Frequency response: 5Hz–50kHz, –0.5dB. Maximum output: 32V RMS. Output impedance: 600 ohms. Input impedance: 150k ohms, line inputs center-tapped. THD+noise, 20Hz–20kHz: <0.005% typical. Signal/noise: >105dB (no reference level quoted). Input sensitivity (full output): 8V. Overload margin: 30dB. Channel separation: 105dB.

DIMENSIONS 18.8" (483mm) W by 5.9" (150mm) H by 16" (410mm) D. Weight: 37 lbs (16.8kg).

FINISHES Silver, Black.

SERIAL NUMBER OF UNIT

REVIEWED PR0013 (MAR 2009).

PRICE \$10,999. Approximate number of dealers: 25. Warranty: 5 years parts & labor.

MANUFACTURER Musical Fidelity Ltd., 15-17 Fulton Road, Wembley, Middlesex HA9 0TF, England, UK.

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Musical Fidelity's Tri-Vista kWp, introduced in 2003, was an impressive, high-tech, "statement" audiophile preamplifier. Its outboard power supply weighed almost 56 lbs—more than most power amplifiers—and its hybrid circuitry included miniature military-grade vacuum tubes. As I said in my review of it in the January 2004 *Stereophile*, the kWp's chassis and innards were overbuilt, the measured performance impressive, and any sonic signature imposed on the signal was subtle and, essentially, inconsequential.

But while the kWp's fit and finish were jewel-like, its appearance was cartoonish. The front panel was dominated by two large knobs about as subtle in their susceptibility to alternate interpretation as the butter nipples topping the pancakes in IHOP's TV ads. The gargantuan remote control, apparently milled from a solid block of army tank, made every visitor to my listening room laugh. Most of us, when we buy pricey audio gear, aren't going for laughs. In fact, Musical Fidelity's Tri-Vista kWp preamp and kW monoblock amplifiers was the homeliest bunch of expensive audio components I've ever owned.

I loved how they sounded, especially together. That was good enough for me. But I never understood how someone with Musical Fidelity chief Antony Michaelson's finely honed aesthetic sensibilities could produce such ungraceful-looking kit, or why, with so many years in the business, his company had yet to develop a unified look for its premier products.

That all changed with the introduction of the Titan power amplifier, which I reviewed in June 2009. But while its attractive art-deco looks are unmistakable, they've so far had little effect on the design of other Musical Fidelity products. Rather, the company's sleek new AMS Primo preamplifier (\$10,999), launched at about the same time as the Titan, introduced a new, understatedly elegant look that's now found throughout MF's AMS and M6 series of components.

Built in the UK

The AMS Primo is a fully balanced, class-A preamplifier with 14 dual-triode tubes (ECC81/12AT7). It employs zero global feedback and weighs 37 lbs. An internal enclosure of mu-metal shields the signal-carrying circuits from the two onboard power supplies, one each for the signal path and the control functions. The power supply rectification is dual-mono and solid-state. Each channel has its own fully regulated high-voltage and heater circuits.

Why so many tubes? According to Antony Michaelson, because the Primo

is fully balanced in operation from input to output, it includes four mono amplifiers attenuated via a four-gang ALPS volume control. Low-current, small-signal tubes don't drive loads effectively, becoming variably nonlinear when presented with an ever-changing load such as a volume pot. When you change the volume, you change the tubes' operating conditions, hence their performance. Paralleling the tubes gives you twice the current capability in each stage, as well as lower the coupling impedance between them, both of which produce greater linearity, "average out" tube performance, and better deal with tube aging. Michaelson warns against tube rolling with the Primo: the linear performance of its zero-global-feedback design depends on carefully matched sets of tubes.

Peer through one of the two mesh-covered vents on the top plate and all you'll see will be the crowns of the tubes—seven per channel—isolated by a secondary enclosure that runs from just behind the large, central volume control all the way to the rear plate, on which are mounted the various

high-quality input and output jacks and other connectors. All circuit boards and associated wiring are hidden beneath the internal subchassis, making for an extremely neat and orderly look that complements the Primo's exterior.

The tidy and understated front panel is dominated by that big, motorized volume knob at the center. There are also two rows of small pushbuttons, each surmounted by a small blue LED. The five to the right of the volume knob select among the five inputs: CD, Tuner, Aux 1, Aux 2, and Tape. The three to the left are a single Power/Standby/Mute button, as well as ones for Gain and Tape Monitor. Gain is used to program the individual inputs to compensate for the 6dB difference in gain between the balanced and single-ended inputs. The panel's simplicity and ease of use are welcome, but the lack of an LED on the volume knob makes it difficult to ascertain the setting from a distance or in the dark.

Musical Fidelity's inclusion of a tape loop is an interesting choice in 2010. Few audiophiles today use tape re-

MEASUREMENTS

I used *Stereophile's* loan sample of the top-of-the-line Audio Precision SYS2722 system (see the January 2008 "As We See It" and www.ap.com) to examine the Musical Fidelity AMS Primo's measured behavior; for some tests, I also used my vintage Audio Precision System One Dual Domain.

For both balanced input to balanced output and unbalanced input to unbalanced output with the Primo's Gain switch operative, the maximum voltage gain was a sensible 12.5dB. (The Gain switch added exactly 6dB to the level of unbalanced sources, to match balanced ones.) The unity gain setting of the volume control was 1:00. The XLRs are wired with pin 2 hot, and all inputs and outputs preserved absolute polarity; *ie*, were non-inverting.

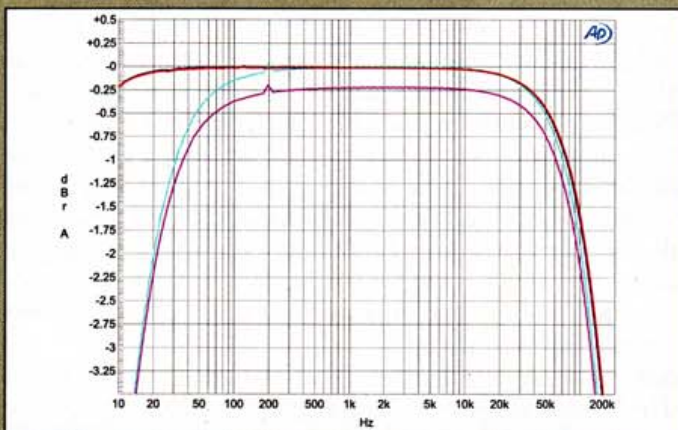


Fig.1 Musical Fidelity AMS Primo, volume control at maximum, frequency response at 1V into 100k ohms (left channel blue, right red) and 250mV into 600 ohms (left cyan, right magenta). (0.25dB/vertical div.)

The input impedance was very high, at 153k ohms at 1kHz unbalanced and 266k ohms at 1kHz balanced. These values were measured with the rear-panel switch set appropriately for each input, and remained the same down to 20Hz. They did drop slightly but inconsequentially at 20kHz, to 81k and 182k ohms, respectively. This Musical Fidelity preamp will hardly load the source components to which it is connected. The Primo's output impedance was low for an all-tube design, at 604 ohms balanced and 385 ohms unbalanced, at midrange and high frequencies. It did rise slightly in the low bass, to 766 ohms balanced and 435 ohms unbalanced, but this will not have any practical consequences.

Into the high 100k ohms laboratory load, the Primo offered a very wide bandwidth, the -3 dB point for balanced operation lying at 140kHz (fig.1, blue and red traces). Commendably for a tubed design, this bandwidth was not significantly affected by the volume-control setting, though it did decrease a little with the punishing 600 ohm load (fig.1, cyan and magenta traces). The low frequencies also started to roll off a little prematurely with this very low load impedance.

Crosstalk for fully balanced operation was buried beneath the noise floor (fig.2, blue and red traces), but channel separation rose with increasing frequency with unbalanced operation (fig.2, cyan and magenta). It was still a good 78dB at the top of the audioband, however. This graph suggests that the noise floor was higher in the left channel than in the right, and this was confirmed by the unweighted, wideband signal/noise ratio (with the input shorted but the volume control at its maximum): 91.3dB right but 87.1dB left, both figures ref. 1V output. I imagine that this difference

orders, and fewer still have decks that include separate record and playback heads, but those who do will welcome this loop. The Tape input, of course, can be used for any source, as can the other four inputs.

The rear panel is equally orderly. Each of the five inputs has both high-quality single-ended RCA and balanced XLR inputs, selectable via a slider switch. (The Tape Out jacks are single-ended only.) Trigger in and out jacks allow the Primo to be turned on via remote trigger, and to turn on other remote-triggered products, including MF's Titan and AMS power amps. The Primo is built in the UK.

Included is an equally sleek-looking, ergonomically pleasing remote control machined from a solid billet of aluminum—large, but not tank-like. While not backlit, the remote's 10 buttons are logically placed on its spacious surface, and I found their functions easy to memorize. In addition to repeating the front panel's Input, Gain, and Power controls, there are also Volume Up and Down and Mute buttons.

Setup and Use

With the exception of the Gain button, setting up the AMS Primo was straightforward. Just plug in your sources, select balanced or single-ended input for each, run single-ended or balanced cables out, plug in the power cord, turn on, and play. To set a single-ended input for additional gain, just select that input and push Gain. The Primo will then remember to raise the gain each time you select that particular single-ended input, even if you

sometimes confusing audiophile journey can't blame a manufacturer for doing likewise. Antony Michaelson began with tubes—1977's highly acclaimed Michaelson & Austin TVA-1 power amp is now a classic. Later he switched to solid-state exclusively for Musical Fidelity's premium products, and then to hybrid designs using military-grade, low-noise, high-tech, long-lived mini-tubes, hardwiring into his circuit such tubes as the metal-cased nuvistor triode and the glass-cased

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lose power. I drove the Titan in balanced mode and ran a combination of balanced and single-ended sources to feed the Primo, which performed without a glitch for the many months it was in and out of the system.

The eternal question

Anyone who's vacillated between tubes and transistors in his or her long and

5703WB. Tubes were also used in MF's X series. Musical Fidelity claims to have made and sold more electronic components employing small-signal tubes than anyone else in the past 30 years.

The Primo's published specs boast a very low THD+noise of 0.005% from 20Hz to 20kHz, a signal/noise ratio greater than 105dB, and a relatively wide-band frequency response of 5Hz–50kHz,

was due to a noisy tube in the left channel, but the noise in the left channel is still low in absolute terms. The A-weighted ratios were excellent, at 91.1dB left and 103dB right.

The lower trace in fig.3 plots the THD+noise percentage present in the Primo's balanced output against the level of a 1kHz signal. The preamplifier doesn't clip into 100k ohms (defined as 1% THD+N) until the output level reaches an enormous 34V—way above what the preamp will be required to deliver in real life. But note, from the shape of the lower trace in fig.3, that the distortion is buried beneath the noise below an output level of 3V. As the maximum output voltage the Primo will be required to deliver in a real-world system will be around 4V, this suggests a sensible gain architecture. However, into the, admittedly, unrealistically

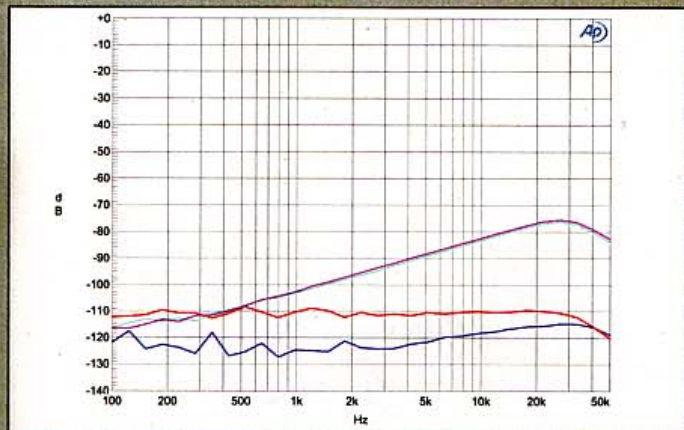


Fig.2 Musical Fidelity AMS Primo, channel separation, balanced input to balanced output (L-R blue, R-L red) and unbalanced input to unbalanced output (L-R cyan, R-L magenta).

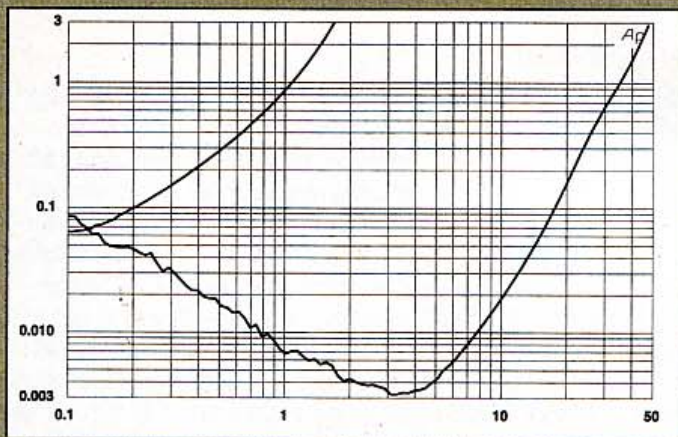


Fig.3 Musical Fidelity AMS Primo, THD+N (%) vs balanced output voltage at 1kHz into (from bottom to top): 100k, 600 ohms.

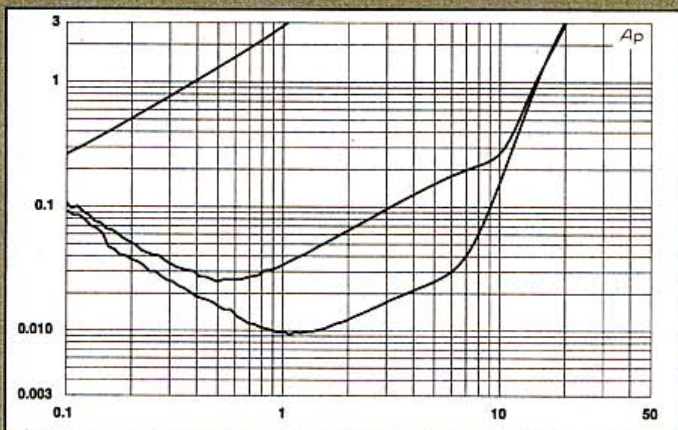


Fig.4 Musical Fidelity AMS Primo, THD+N (%) vs unbalanced output voltage at 1kHz into (from bottom to top): 100k, 10k, 600 ohms.

-0.5dB. The claimed maximum output voltage of 32V (!) and the 30dB overload margin are impressive. In fact, many of the Primo's specs read like those of a good solid-state design.

Between the Primo's high output and the volume control's taper, I never had to turn the knob above 11 o'clock—even when using a single-ended input *without* additional gain. Beyond that, it was too loud. But with no signal, turning the pot almost all the way up produced through my speakers nothing but the faintest suggestion of hiss. "Tube rush" was nonexistent.

Wow!

After breaking in and warming up the Primo with the Sooloos music server set to Swim (*ie*, Shuffle) mode, the first LP up was a test pressing of a vinyl reissue of Donald Johanos and the Dallas Symphony's justifiably famous recording of Rachmaninoff's *Symphonic Dances*, engineered by David B. Hancock in 1967. The entire series of Johanos/DSO recordings are audiophile spectaculars recorded with four custom ribbon microphones at 30ips in Southern Methodist Univer-

sity's McFarlin Auditorium. The original LP edition, on Vox Turnabout, was made from the master tapes, and David B. Hancock's initials are inscribed in the dead wax. Unfortunately, Vox, a budget label, pressed on poor-quality vinyl; quiet copies were hard to find. Still, if you see any in the \$1 bins or at your local Goodwill, don't pass them up!

The new reissue of *Symphonic Dances* (2 45rpm LPs, Vox/Turnabout/Analogue Productions) beats the original in every way. It's as warm and harmonically complex, but sounds more open and less boxy, and dynamically it's in a different league entirely. Through the AMS Primo the imaging and soundstaging were ultra-expansive, the harmonics richly and vividly drawn, the dynamics thunderous. Most significant, the bottom-end extension and control, particularly in the big timpani wallops, gave up nothing obvious to solid-state sound, nor did the Primo's top-end extension sound truncated. Mostly, the midrange plumped up, but by a subtle amount that never caused bloat, or produced ballooning images like those in a Macy's Thanksgiving Day Parade. At no time

did I think, *Yes, this is really pleasing, but I wish I had more weight and/or definition on bottom, or better top-end extension or transient attack*. The Primo was fast and extended on top, and well defined and pleasingly punchy on bottom, with enough weight to anchor the low-frequency end of every kind of music.

Going from the twice-as-expensive darTZeel NHB-18NS solid-state pre-amplifier's precise, some might say clinical, control and finely drawn images to the Primo's harmonically vivid, exuberantly drawn sound pictures was jarring and invigorating. The Primo elicited from me an immediate and enormous "Wow!" that I still felt even after weeks of listening. No solid-state device in my experience can produce the sense of effortless musical flow that all-tube designs—even poorly designed, tonally colored ones—deliver with ease.

Yet, clearly, the Primo's overall sound was altogether different from that of the darTZeel NHB-18NS: wetter, stickier, slappier (not sloppier), and altogether more generous. But unlike with some other tube preamps, with the Primo I never had a sense of darkness creating

measurements, continued

low 600-ohm load (fig.3, upper trace), the preamp clips at just over 1V output. Fig.4 shows similar behavior for unbalanced operation, but with the maximum output half that available from balanced operation. The Primo should be used with power amplifiers having a sensibly high input impedance. How high is "sensibly" high? The middle trace in fig.4, taken into 10k ohms, reveals that while the preamp doesn't clip prematurely, it is still starting to get a bit uncomfortable above levels of a few hundred millivolts. At least 20k ohms is recommended, therefore; as the Musical Fidelity Titan that MF used for his auditioning offers 10 times that value, he was hearing the Primo at its best—*ie*, with the lowest distortion and noise.

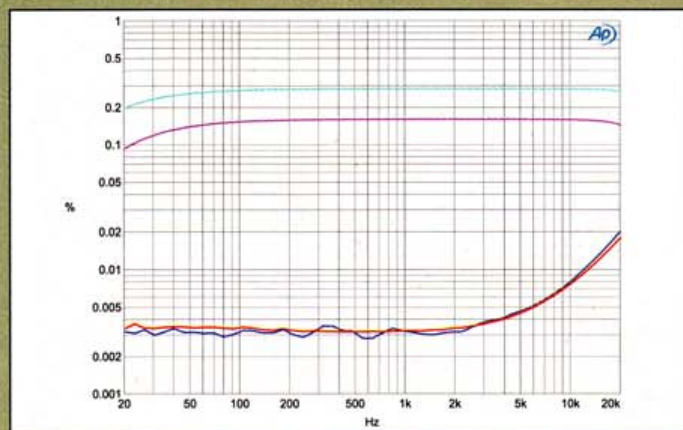


Fig.5 Musical Fidelity AMS Primo, balanced output, THD+N (%) vs frequency at 4V into 100k ohms (left channel blue, right red) and 500mV into 600 ohms (left cyan, right magenta).

The bottom pair of traces in fig.5 show that that distortion into 100k ohms is very low indeed, though it does start to rise in the top two octaves due to the circuit's usual lack of gain-bandwidth product in this region. The distortion is high into 600 ohms (fig.5, top pair of traces), as expected from fig.3, but uniform with frequency. This graph was taken with balanced operation; the THD+N percentage was typically 0.012% at 2V into 100k ohms.

The spectrum of a high-level balanced tone into 100k ohms is shown in fig.6. Again the left channel (blue trace) can be seen to be noisier at low frequencies than the right channel (red). However, while the right channel offers the second harmonic at -90dB (0.003%) and the

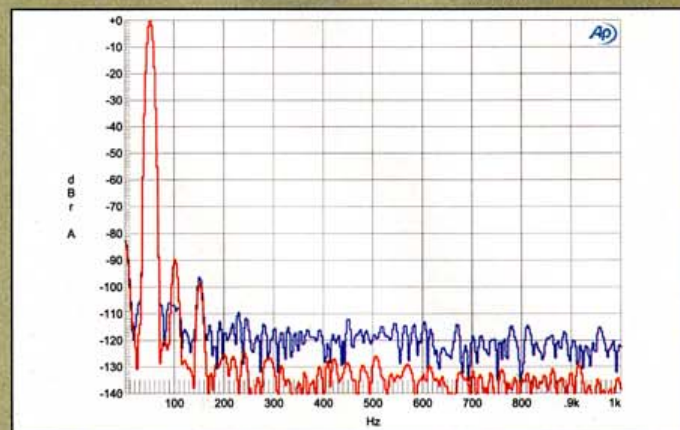


Fig.6 Musical Fidelity AMS Primo, balanced output, spectrum of 1kHz sinewave, DC-10kHz, at 4V into 100k ohms (left channel blue, right red; linear frequency scale).

a desire for more light, or a lessening of bottom-end resolve creating a desire for more intense wallop.

The overall sound was harmonically rich without turning overripe. Attacks were surprisingly lightning-fast and ultra-clean for an all-tube product. But sustain was where the magic lived: sounds just sailed generously on and on, their full harmonic envelope unfurled, slowly decaying into the sunset of background ambience before finally, cleanly disappearing altogether. Musical events effortlessly appeared, lingered, and dissolved, one after the other, meeting along the way no grain, glaze, or grit-induced resistance.

No syrup

I couldn't characterize the Primo's sound as "warm" or "tubey," nor were there any obvious lumps in its frequency response. The bass foundation—even amplified rock bass—was well extended and defined, muscular yet harmonically complete. The spatial presentation was wraparound large, with well-focused images of generous size on a very wide soundstage that extended beyond the outside edges of the speakers and seemed

to curl toward me in a gentle U-shape.

In a listening room as small as mine, the pictures painted were almost *too* big, but that's no criticism of the Primo. In a much bigger space, the same spatial presentation would be ideal. However, even larger than life, as it sounded in my room, the pictures were more than pleasing.

as it should, and that what I'm hearing is not the product of a warm, sloppy—in a word, distorted—tube midband. The Primo has tube flow, but not the colorations often found in tube front ends. If you didn't already know this about the Primo, it's doubtful you'd think you were listening to tubes.

THE PRIMO HAS TUBE FLOW, BUT NOT THE COLORATIONS OFTEN FOUND IN TUBE FRONT ENDS.

As I write, the Sooloos has Swum to a Pat Martino tribute to Wes Montgomery (CD, Blue Note 11226), and Martino's big, hollow-bodied electric guitar is taking up most of the space between the speakers. The guitar sounds warm and full—certainly much more so than it does through the darTZeel—yet with enough speed and definition to delineate the attack of the fingerpicked strings. The piano, occupying the same center space, is wrapped far tighter, cleaner and appropriately more percussive, producing in me a feeling of confidence that Martino's big, warm guitar is sounding

I could be enthralled by the Primo's graceful, nuanced reproduction of a well-recorded piano concerto, then switch to Bernie Grundman's stunningly mastered 180gm-vinyl reissue of Nirvana's *In Utero* (LP, DGC/ORG 033), and still feel as if I was getting it all—from Kurt Cobain's barbed-wire Fender Mustang guitar to the bottom-end drive of Krist Novoselic's thickly textured bass, to drummer Dave Grohl's warm, hard-pounding tom and edgier snare. On "Heart-Shaped Box," Cobain's voice has the appropriate sibilant edge and, behind it, the warm envelope of the recording

third harmonic at -100dB (0.001%), the left channel has only the third harmonic apparent, at -96dB (0.0015%). With the circuit's absence of loop negative feedback, these differences are, like the differences in noise performance, presumably related to the tubes used; the left channel's tubes are matched more closely than the right channel's, eliminating the residual even-order distortion. Reducing the load impedance to 600 ohms dramatically raises the level of the third harmonic in both channels, and of the second harmonic in the left channel (fig.7). However, the fact that the harmonics present in this worst-case condition are still only the subjectively innocuous second and third, with no high-order spurious visible, is a good sign.

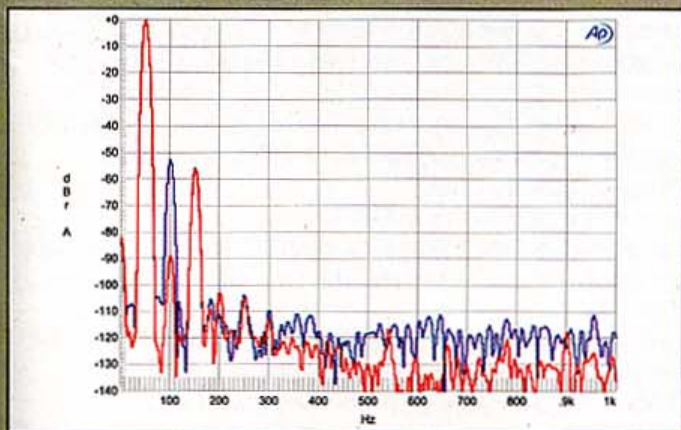


Fig.7 Musical Fidelity AMS Primo, balanced output, spectrum of 1kHz sine wave, DC–10kHz, at 500mV into 600 ohms (left channel blue, right red; linear frequency scale).

Finally, even with its decreasing linearity in the top octaves, the Primo offers low levels of intermodulation distortion with the torture test of equal levels of 19 and 20kHz tones (fig.8). The second-order difference product at 1kHz is higher in the left channel than the right, at -84dB (0.006%) compared with -100dB (0.001%), but this is still very low.

Provided it is used with a power amplifier having an input impedance of at least 20k ohms, the Musical Fidelity AMS Primo offers superb measured performance, with only the slight differences in left- and right-channel noise and linearity giving any indication that its circuit exclusively uses tubes. And in any case, those departures from perfection will not even be close to audibility under normal conditions. —John Atkinson

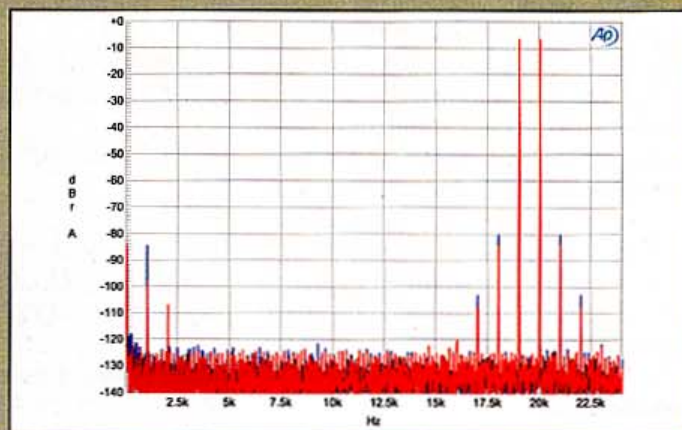


Fig.8 Musical Fidelity AMS Primo, balanced output, HF intermodulation spectrum, DC–24kHz, 19+20kHz at 4V peak into 100k ohms (linear frequency scale).

space so carefully captured by Steve Albini. While a solid-state front end might provide a bit more bottom-end drive and extension, no grunge rocker listening to *In Utero* through the Primo will feel the need for more of *anything* while luxuriating in the generous fullness of its solid, three-dimensional picture.

The Primo didn't pour syrup over everything, as some tube preamps do. If anything, its midrange was on the light, buoyant, effervescent side, and its sound could push too much midrange information to the front of the stage, which made me want to turn down the volume a bit (though that might have been a side effect of my small room). Or perhaps it would be a better match with a loudspeaker less generous in the midrange than the Wilson Audio MAXX 3s.

For instance, when I played—at what I consider an appropriate level—Liszt's Piano Concerto 1, with pianist Byron Janis accompanied by Kiril Kondrashin and the Moscow Philharmonic (CD, Mercury Living Presence 432 002-2), the images were too big and crowded the stage. In addition, the piano sounded a bit milky and tonally ill defined. Dropping the overall level clarified the picture, widened the stage, shrank the piano to the appropriate size, and restored the proper harmonic and percussive balance. It also moved me back about 20 rows, but that's where the Primo made this recording sound most appropriate.

Going back to the darTZeel NHB-18NS produced a mixed bag of wholly expected sonic sensations: a more precise if less exuberant picture with smaller, more precisely defined images of the individual source and greater three-dimensional space, particularly in terms of depth; tighter but not necessarily deeper bass; somewhat truncated, less fully fleshed out harmonic structures; shorter sustain; more precise and crystalline attack; greater transparency and blackness between notes; and a more clinical, somewhat drabber, yet more detailed sound overall, accompanied by diminished sense of musical flow. In short: two completely different, equally valid sounds, each with its own attractions and minor shortcomings.

Conclusions

To some audiophiles, a preamplifier should be a "straight wire with gain." To others it acts more like a mastering en-



RCA and XLR inputs are selectable via a slider switch.

gineer, putting the final subtle touches on the raw material it's fed. Some audiophiles in search of a mythical audio grail use an unbuffered passive volume pot to attenuate the level and leave it at that—never mind how, depending on attenuation level, *that* will affect the signal.

Most of us aim for a device that conveniently and flexibly routes and processes the signal while altering that signal as little as possible, even as we acknowledge that, inevitably, such a device will affect to *some* degree, however slight, the music's transparency, dynamics, and frequency response.

But the better a preamp is, the less it will impose its sonic will on any signal it's fed, particularly in terms of noise, frequency response, and linearity. I've never heard one that's 100% transparent, though some come closer than others—if that's what you want. If, on the other hand, you want to dramatically shift your system's sound in one direction or another, there are many other preamps that can do that.

Musical Fidelity's AMS Primo is among the most transparent tube preamplifiers I've heard in terms of transient

speed, frequency extension, subjectively flat response, low audible distortion, and low noise floor. And, unlike some tube gear, it was *not* about adding to the signal some dark, lush beauty or golden glow. It did, however, impart to signals from

solid-state sources a particularly pleasing and lively quality that produced great drive, musical flow, and an appropriately rich harmonic palette. For many listeners, all of those will be most welcome additions to their systems' sound—particularly if, as happened with me, the Primo calls no attention to itself by either committing obvious sonic sins or sinning by omission.

The biggest problem I had with the Primo was that when it drove Musical Fidelity's own Titan, I didn't feel the volume control was sensitive enough: once I'd got to about the 11 o'clock position of the volume knob, the level was louder than I wanted, while below that setting the level changed dramatically with each little nudge. All this sometimes made finding the ideal volume difficult. However, I'm sure that will prove system-dependent—especially if you're not using a 100Wpc amp such as the Titan!

At \$10,999, the Musical Fidelity AMS Primo is a beautifully built, visually sophisticated, technically competent, evidently reliable, fully balanced, high-performance tube component that was a pleasure to live with, look at, and use. It also produces superb, musically graceful sound—I recommend it. ■

ASSOCIATED EQUIPMENT

ANALOG SOURCES Continuum Audio Labs Caliburn turntable, Cobra tonearm, Castellon stand, Graham Engineering Phantom II tonearm; Montegiro Lusso turntable, SME 309 & DaVinci Nobile tonearms; Lyra Titan *i*, Transfiguration Orpheus, Ortofon A90, MySonic Eminence EX cartridges.

DIGITAL SOURCES Camelot Technology Round Table DVD player with digital input Anagram Technologies DAC, BPT-modified Alesis Masterlink hard-disk recorder, Sooloos music server.

PREAMPLIFICATION Manley Steelhead, Einstein Turntable's Choice, Boulder 1008, AMR PH77 phono preamplifiers; darTZeel NHB-18NS preamplifier.

POWER AMPLIFIER Musical Fidelity Titan.

LOUDSPEAKERS Wilson Audio Specialties MAXX 3.

CABLES Phono: Graham/Hovland MG2 Music Groove. Interconnect: ZenSati. Speaker: TARA Labs Omega Gold. AC: TARA Labs The One Cobalt, Shunyata Research King Cobra Helix CX.

ACCESSORIES Shunyata Research V-Ray II Reference, Audience Adept, TARA Labs Power Screen power conditioners; Oyaide AC wall box & receptacles; ASC Tube Traps, RPG BAD & Abffusor panels; Finite Elemente Pagode, HRS SXR stands; Symposium Rollerblocks; Audiodharma Cable Cooker; Furutech DeMag & deStat LP treatments; VPI HW-17F, Loricraft PRC4 Deluxe, Spin Clean record-cleaning machines.

—Michael Fremer