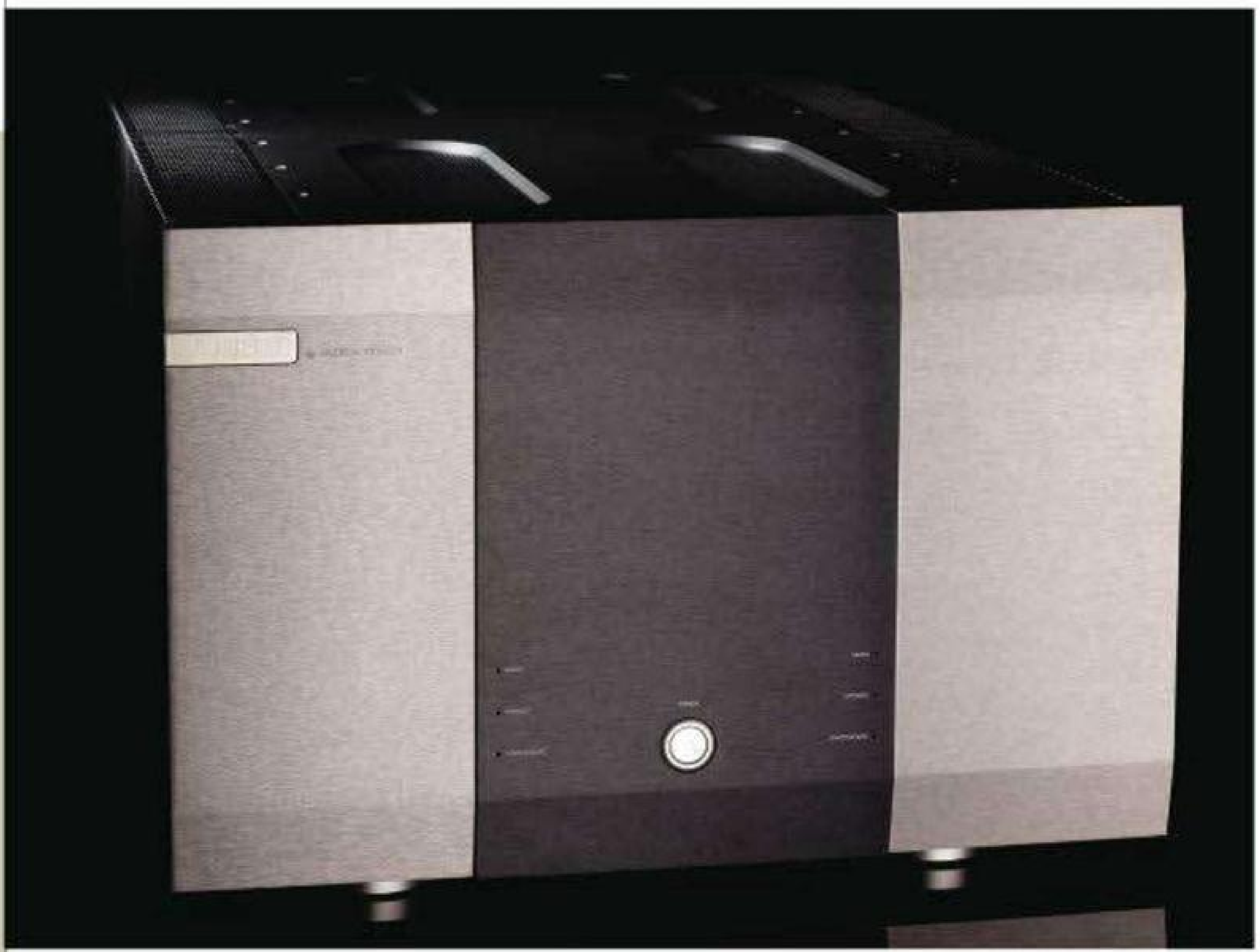
Musical Fidelity
AMS100
POWER AMPLIFIER

JOHN ATKINSON



DESCRIPTION Solid-state, bridged, two-channel power amplifier with class-A output stage and switchable balanced and unbalanced inputs. Rated output: 100Wpc into 8 ohms (20dBW), 200W into 4 ohms (20dBW). Peak output voltage: 80V p–p. Peak output current: 200A p–p. Frequency response: 10Hz–40kHz, +0/–0.4dB. Input sensitivity: 650mV for 100W into 8 ohms. Input impedance: 50k ohms, balanced and unbalanced. Damping factor: 200, equivalent to an output impedance of 0.04 ohm. THD+noise: <0.005% unweighted. Signal/noise: >110dB, A-weighted, ref. maximum power. Power consumption: 1200W maximum, 14W idle.
DIMENSIONS 19" (483mm) W by 12.75" (325mm) H by 34.67" (880mm) D (inc. terminals). Weight: 220 lbs (100kg) net, 334 lbs (152kg) shipping.
FINISH Black with dark gray front-panel highlights.
SERIAL NUMBER OF UNIT REVIEWED AMG0003.
PRICE $19,999. Approximate number of dealers: 15. Warranty: 5 years P&L.
MANUFACTURER Musical Fidelity Ltd., 15-17 Fulton Road, Wembley, Middlesex HA9 0TF, England, UK. Tel: (44) (0)181-900-2866. Fax: (44) (0)181-900-2983. Web: www.musicalfidelity.com. US distributor: Tempo Distribution LLC, PO Box 541443, Waltham, MA 02454-1443. Tel: (617) 314-9227. Fax: (617) 336-3486. Web: http://tempohighfidelity.com.

"That's just silly on so many counts, Antony."

I was talking last winter to Musical Fidelity's Antony Michaelson, who had been enthusing about his forthcoming stereo amplifier, the AMS100. It would be physically enormous—almost a yard deep—and commensurately heavy at 220 lbs. Despite its bulk, its maximum rated output would be just 100Wpc into 8 ohms. It would also be expensive, at $19,999. And to cock a snoot at environmentalists and their concerns, the AMS100's output stage would be biased into class-A up to its rated 8 ohm power, meaning that, even when not playing music, it will draw around 10 amps from a typical US wall supply of 120V. This also means that it will run very hot, making the amplifier impracticable for summer use in homes without central air-conditioning. Like mine.

Antony dismissed my concerns with a snort. "The AMS100 realizes the full true potential of class-A sound. The AMS100 has been designed for an elite band of audiophile purists who want the ultimate class-A amplifier ever made. We don't expect to sell many. Those lucky few who get their hands on one will be fulfilled."

For a while, I became one of those lucky few.

Class A class-A

The very first amplifier I ever reviewed, for the August 1983 issue of the British magazine *Hi-Fi News & Record Review*, was a class-A design: the Krell KSA-50. Small-signal amplification circuits are almost universally run in class-A, in which the transistors conduct current continuously. But this is impracticable for an output stage because of the sheer amount of bias current required, which must be half the peak current at maximum power. The KSA-50's output transistors, for example, continuously passed 1.8 amps at idle, which allowed a maximum power of just 50W into 8 ohms before the upper and lower output transistors turned off at, respectively, the signal's maximum negative and positive voltage excursions in each cycle of the signal.

When the transistors are alternately turned on and off in every cycle, this is called class-B operation; if there were no standing bias current, there would be severe distortion every time one transistor turned off and the other turned on. This is called crossover distortion, and results from the fact that a finite gate or base voltage (the "cut-in" voltage) must be present before the transistor will begin to conduct current. Crossover distortion consists of high-order harmonics and is very audible. It also differs from nearly every natural phenomenon in that, instead of being monotonic—*ie*, proportional to level—crossover distortion is independent of level. As the signal decreases, the distortion increases as a percentage of that signal. Designers cope with this by arranging for just enough bias current to be present at all times to keep the transistor operating in the linear portion of its transfer function, which is called class-A/B operation. This significantly reduces crossover distortion, but the circuit still depends on loop negative feedback to eliminate it altogether.

There are advantages to class-A output-stage operation. As both transistors are conducting current throughout the entire signal cycle, there's no crossover distortion, which means less need for negative feedback. Both the current gain and the cut-in voltage of a transistor are dependent, in a nonlinear manner, on the transistor's junction temperature; if that fluctuates, then the current amplification of the transistor will be modulated by the change in temperature. With class-A operation, the transistors are handling the same average current at all power levels. Those transistors are therefore in thermal equilibrium and are not being operated anywhere near the cut-in voltage. With class-A operation, the power supply is under constant stress, whether or not the signal is present. As long as the maximum signal-voltage swing remains below the troughs of the rectifier ripple, the power supply is effectively regulated.

By contrast, with class-B operation, the demand on the power supply is signal-related. If the power supply is regulated, or at least of a low enough impedance across the audioband to minimize any such effects, then there should be no problems. But if, as would appear to be the case, the power supply is the first area of an amplifier to be compromised during the design phase, in the need to keep costs down—why go to the expense of a transformer, capacitors, etc., capable of giving the current required at maximum signal voltage, if that current will only rarely be required?—then signal modulation of such factors as power-supply impedance may well occur. With a class-A design—where, as *Gramophone* magazine's Geoffrey Horn once put it, "the output

MEASUREMENTS

To take these 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). Before doing the testing, I ran the Musical Fidelity AMS100 at one-third its rated power for 60 minutes, which thermally is the worst case for an amplifier with a class-A/B output stage. However, an amplifier with a class-A output stage runs cooler when under load. At the end of that period, the chassis was warm, with a temperature of 104°F (40°C), though the heatsinks were hotter, at 116°F (46.6°C). Without any signal fed to the amplifier, the heatsink temperature slowly rose to 120°F (48.6°C). The AMS100 is not an amplifier you can hide in a closet—even if you have a closet big enough.

The voltage gain was the same for both balanced and unbalanced inputs, at 29.9dB, which is 3dB higher than the US norm. Both inputs preserved absolute polarity (*ie*, were non-inverting), the XLRs being wired with pin 2 hot. The input impedance was close to specification at low and middle frequencies, at 48k ohms unbalanced and balanced for each leg, but dropped at 20kHz to 39k ohms balanced and 17k ohms unbalanced.

The AMS100's output impedance (including 15' of speaker cable) was low across most of the audioband, at 0.08 ohm. However, this rose to 0.22 ohm at 20kHz, which restricts the amplifier's bandwidth into lower impedances. While the small-signal frequency response is down by just 0.17dB at 20kHz and by 3dB at 170kHz (fig.1, blue and red traces), it is –0.5dB at 20kHz into 4 ohms (cyan and magenta traces) and –0.9dB at 20kHz into 2 ohms (green trace). However, the variation of the

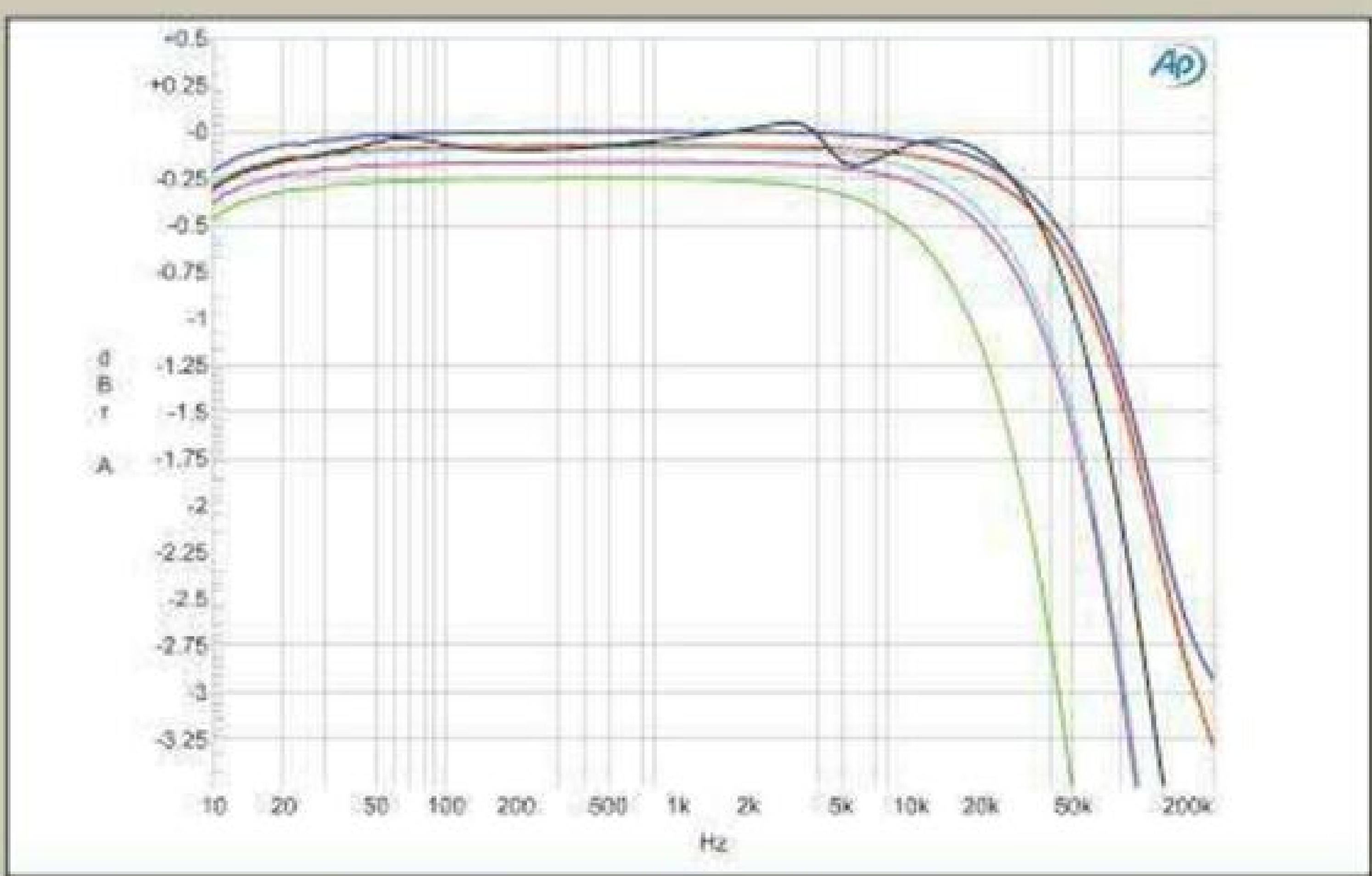


Fig.1 Musical Fidelity AMS100, frequency response at 2.83V into: simulated loudspeaker load (gray), 8 ohms (left channel blue, right red), 4 ohms (left cyan, right magenta), 2 ohms (green). (0.25dB/vertical div.)

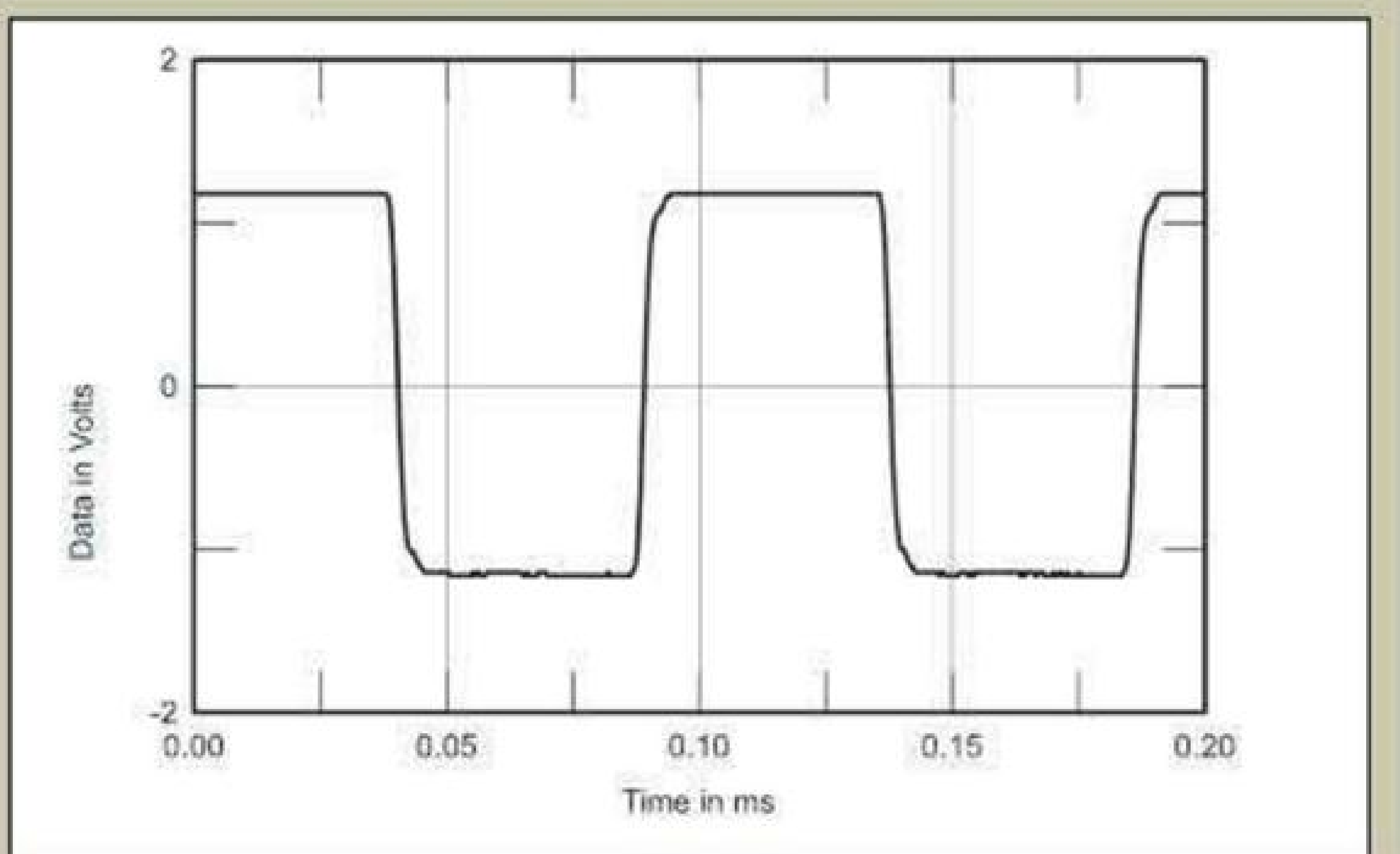


Fig.2 Musical Fidelity AMS100, small-signal 10kHz squarewave into 8 ohms.

[devices] dissipate more watts when silence reigns than when the entire London Symphony Orchestra lets fly with all they have"–if the power supply is compromised, it just can't cope: hum and noise join in not only with the LSO, but also during silences. Class-A operation thus mandates well-sorted power-supply design and implementation.

But, as I mentioned earlier, there is a price to pay for all this good stuff. Because a class-A circuit conducts all the time, even when there is no signal, it is very inefficient, and the wasted power is dissipated as heat. This requires a power supply larger than would be dictated by the demands of the signal alone, and demands an effective method of dissipating the heat. The theoretical maximum efficiency of a class-A stage handling signal is 50%. A class-B circuit, however, wastes no power when there is no signal, and can reach a maximum efficiency of 78.5% when handling a signal, meaning that such amplifiers can be lighter (and cheaper).

The continuous power requirement of class-A operation places severe demands on the specification of the output transistors. The transistors of a class-A amplifier capable of 10W output must dissipate 20W (assuming the theoretical 50% efficiency). If two transistors are used, each therefore must be capable of continuously dissipating 10W. If the same two transistors are used as a class-B push-pull pair to give the same 10W maximum output, the maximum power dissipation in the transistors occurs at about one-third full power; in this case, around 4W. For the class-B amplifier,

Balanced and unbalanced inputs; two pairs of speaker terminals for each channel.

measurements, *continued*

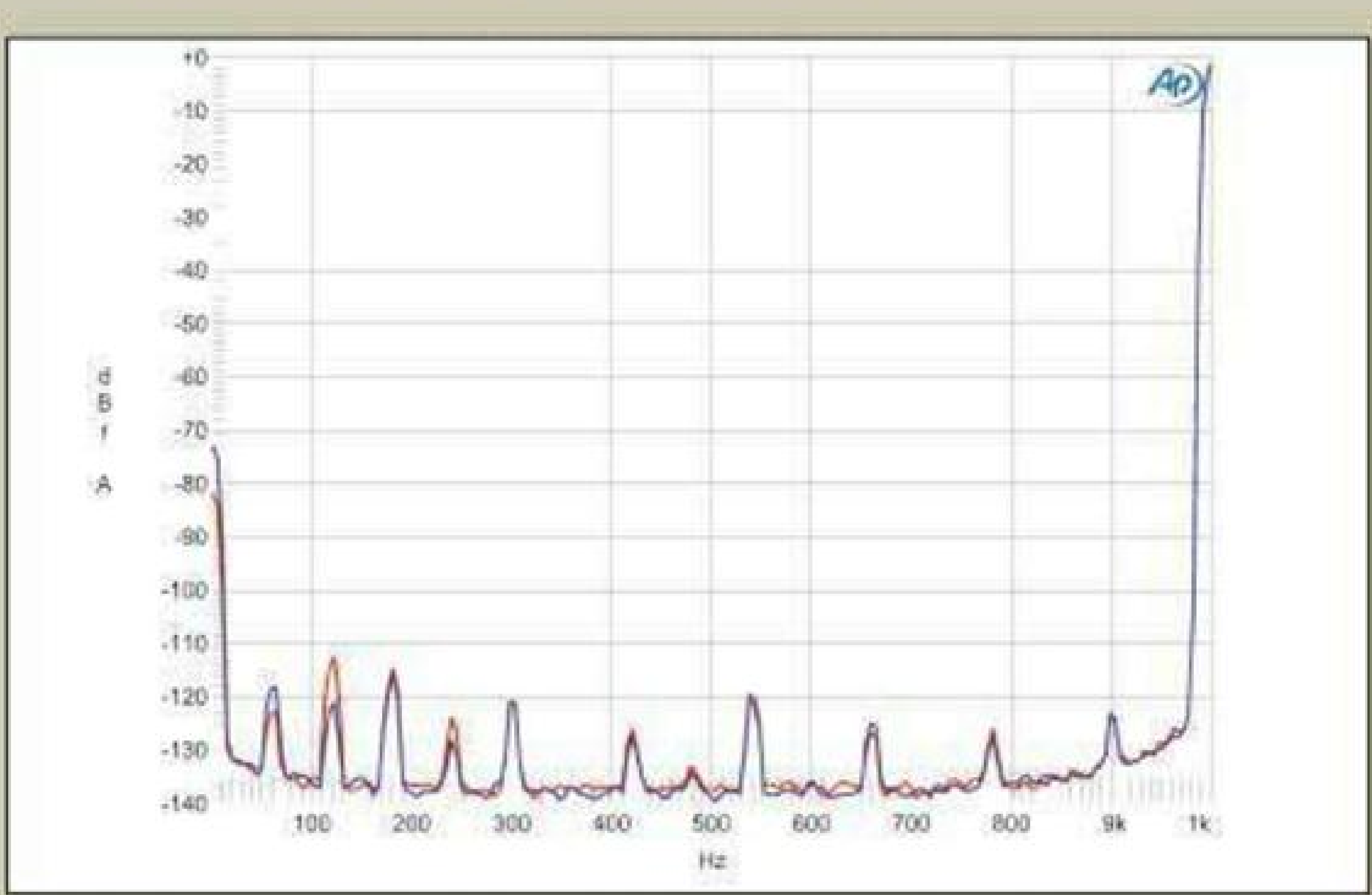


Fig.3 Musical Fidelity AMS100, spectrum of 1kHz sinewave, DC–1kHz, at 50W into 8 ohms (linear frequency scale).

response with our standard simulated loudspeaker was minimal, at ±0.1dB (gray trace). The wide bandwidth into 8 ohms gives rise to a well-formed 10kHz squarewave, with neither overshoot nor ringing evident (fig.2).

Channel separation (not shown) was excellent at >100dB below 800Hz in both directions, and was still 80dB at 20kHz. The unweighted wideband signal/noise ratio was not as good as I was expecting from a class-A design, at 76.8dB left and 75.3dB right, both figures ref. 1W into 8 ohms. A-weighting improved the ratios to a respectable 89.2 and 90.75dB, respectively. Fig.3 reveals that the AMS100's low-frequency noise floor has some supply-related spuriae: the tones at 120 and 240Hz stem from the full-wave supply and are a little higher in the right channel than the left; those at 60 and 180Hz and higher may well

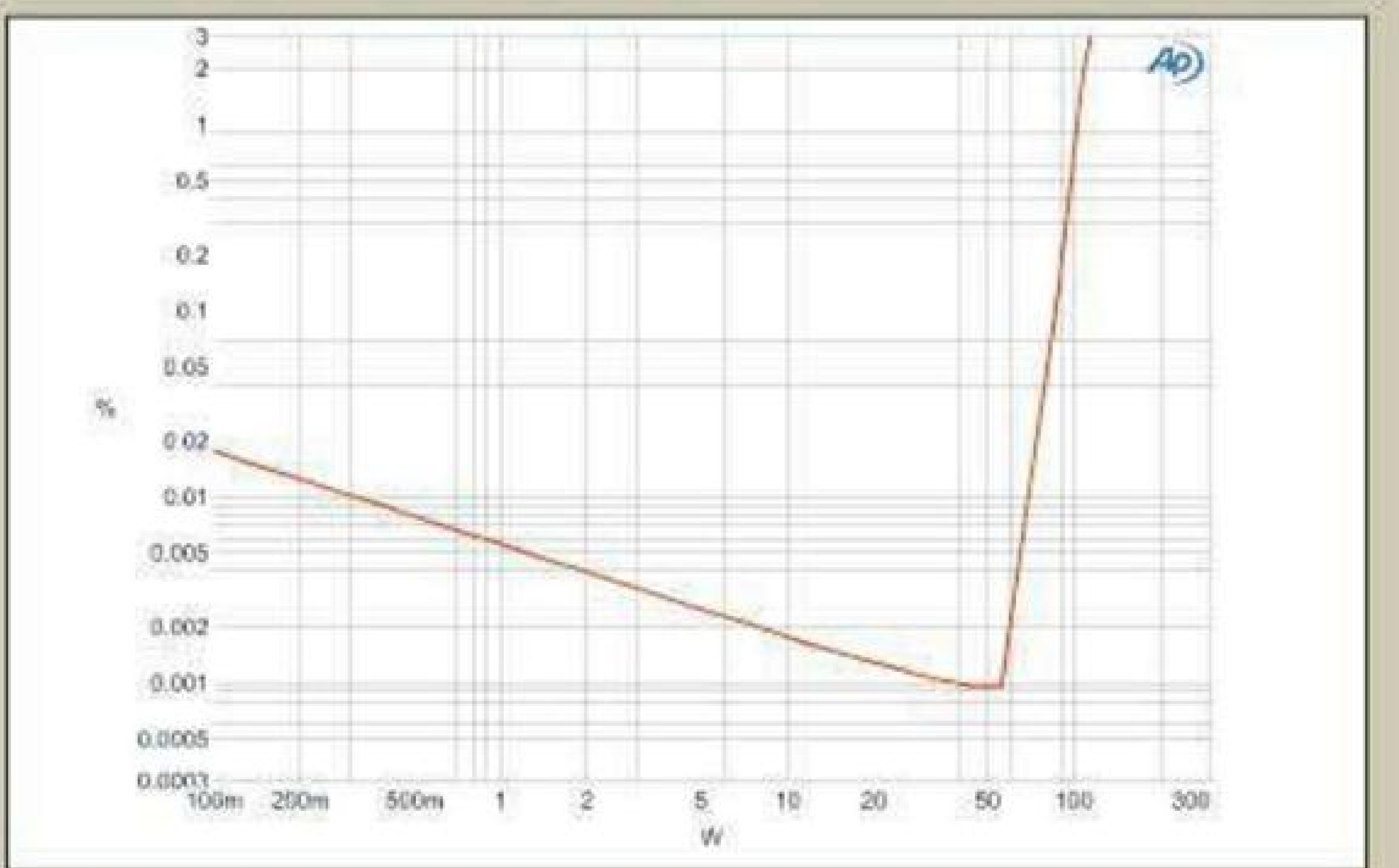


Fig.4 Musical Fidelity AMS100, distortion (%) *vs* 1kHz continuous output power into 8 ohms.

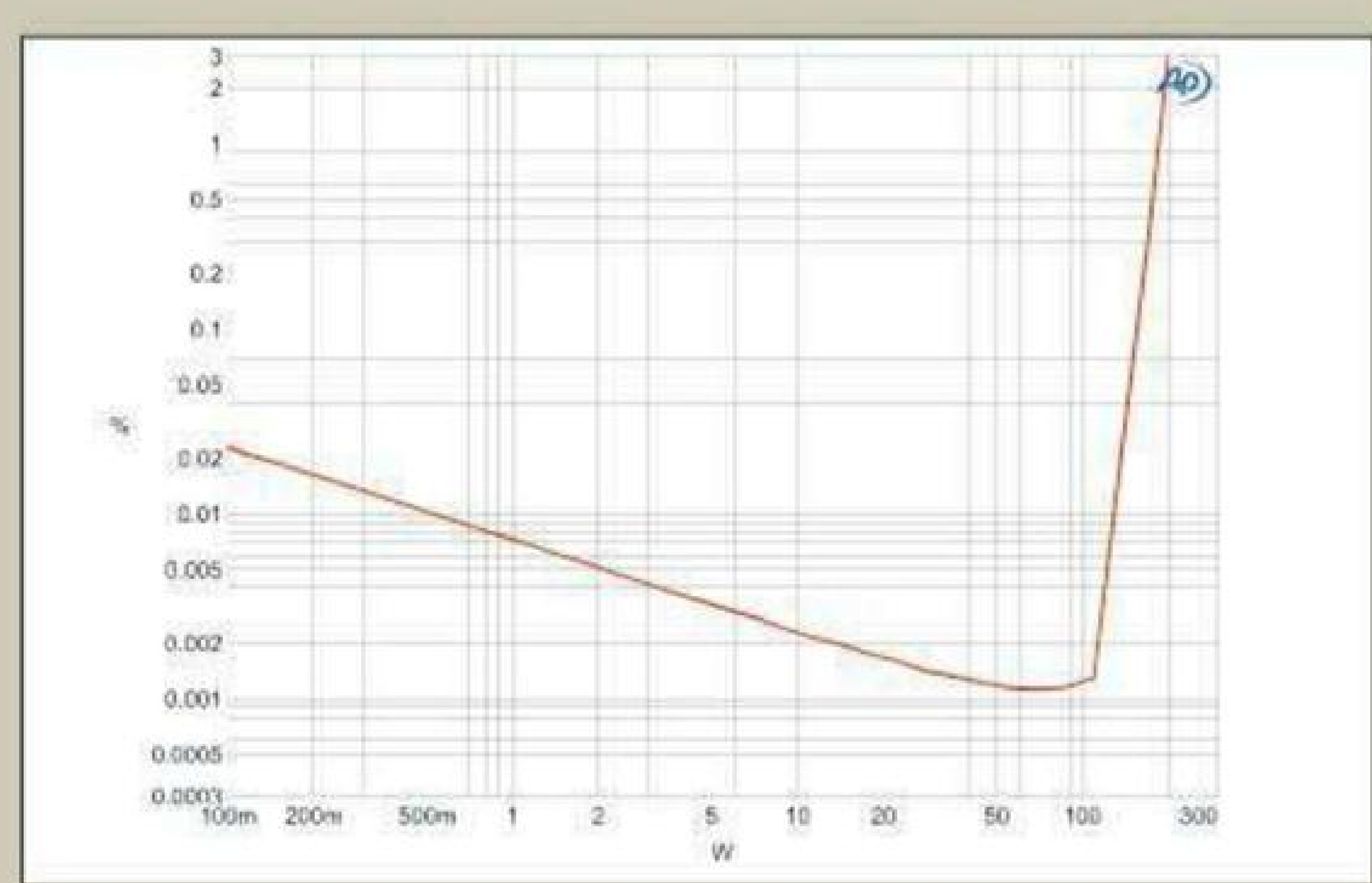


Fig.5 Musical Fidelity AMS100, distortion (%) *vs* 1kHz continuous output power into 4 ohms.

each transistor need dissipate only 2W and can be less highly specified. Alternatively—and more realistically—for the same investment in transistors, a class-B amplifier can be designed to be capable of some five times the output power of an equivalent class-A design.

It's not surprising, therefore, that the output stages of 99.99% of commercially available power amplifiers are run in class-A/B.

The AMS100

The AMS100 is basically a scaled-up version of Musical Fidelity's 50Wpc AMS50, a sweet-sounding amplifier that I used to drive Sonus Faber speakers at a "Loudness Wars" demonstration I did at Denver store Listen-Up in May 2010. Like the AMS50, the AMS100 is a bridged design with both hot and cold speaker terminals for each channel each driven by a complete mono amplifier. But whereas the AMS50 has a single power transformer and a single bank of eight pairs of electrolytic capacitors to supply the positive and negative voltage rails for both the hot and cold amplifiers, the AMS100 has a separate transformer and a bank of 16 supply capacitors for *each* channel's amplifier. (A quarter of these capacitors can be seen under the wire-mesh grilles set into the amplifier's top plate.) In addition, these two capacitor banks are each fed rectified DC via a hefty dual bifilar-wound choke that should both filter and cancel ripple on the two voltage rails. Musical Fidelity claims that these chokes reduce ripple on the DC rails by a factor of 88—*ie*, a very useful 39dB!

The AMS100's power supply thus has four transformers, four chokes, and 64 smoothing caps, which accounts for the amplifier's bulk. The 20 pairs of output devices for the four individual amplifiers are mounted on black-finned heatsinks that run the full height and depth of the chassis. The front panel has a central black section on which pairs of tiny LEDs indicate standby (red), operation (blue), and thermal overload (no idea what color; they never lit up); these LEDs flank a circular, dashpot-style On/Standby pushbutton.

The rear panel sports two pairs of WBT binding posts for each channel to the sides, and, above the central master AC switch and 15A IEC AC inlet, pairs of RCA and XLR jacks for unbalanced and balanced drive. There is also a 12V DC trigger jack and a toggle switch to select balanced or unbalanced inputs.

Listening

The Musical Fidelity AMS100 is a massive beast. It sat between the speakers, and the only concession I could make to practicality was to rotate the amplifier onto its side, then back down onto a small, wheeled, carpet-covered dolly—easier to say than do—so that I could move it around as needed and, more important, raise the amplifier off the carpet to give its heatsinks room to breathe. (The dolly was big enough to support only the AMS100's front and middle pairs of feet; I doubt the lack of support for the rearmost two feet affected the sound quality.)

I drove the AMS100 with balanced signals, and used it to listen to all of the speakers that have passed through my hands for measurement the past few months, and that needed to be listened to by a second set of ears. But to audition the AMS100 itself, I used the

measurements, *continued*

be due to magnetic leakage from the massive power transformers into the chokes used to smooth the DC voltage rails. Nevertheless, all these spuriae lie at >120dB ref. maximum power, and so should be inaudible.

Figs. 4 and 5 plot the percentage of THD+noise in the Musical Fidelity's output against output power into 8 and 4 ohms, respectively. We define clipping as the power level at which the THD+N reaches 1%; these graphs confirm that the AMS100 meets its 100Wpc (20dBW) specification into 8 ohms, but clips at 185Wpc into 4 ohms (19.7dBW). It also clips at 295Wpc into 2 ohms (18.7dBW). I don't hold the wall voltage constant for these tests; it was 120.2V AC with the amplifier quiescent, dropping slightly to 120.1V at clipping into 4 ohms with both channels driven or into 2 ohms with one channel driven. The downward slope of the traces in these graphs suggests that the actual distortion is buried under the noise floor right up to the point where the waveform begins to square, so I plotted how the THD+N percentage changed with frequency at 20V output, which is equivalent to 50W into 8 ohms, 100W into 4 ohms, and 200W into 2 ohms. The results are shown in fig.6—the distortion is very low, at <0.001% at low and middle frequencies into the higher impedances, but it does rise above 1kHz, due to the usual reduction in negative feedback that results from the circuit's restricted open-loop bandwidth. Even so, it is still just 0.011% at 20kHz.

I averaged 64 readings to examine the waveform of the THD+N spuriae, but even then, what appears to be

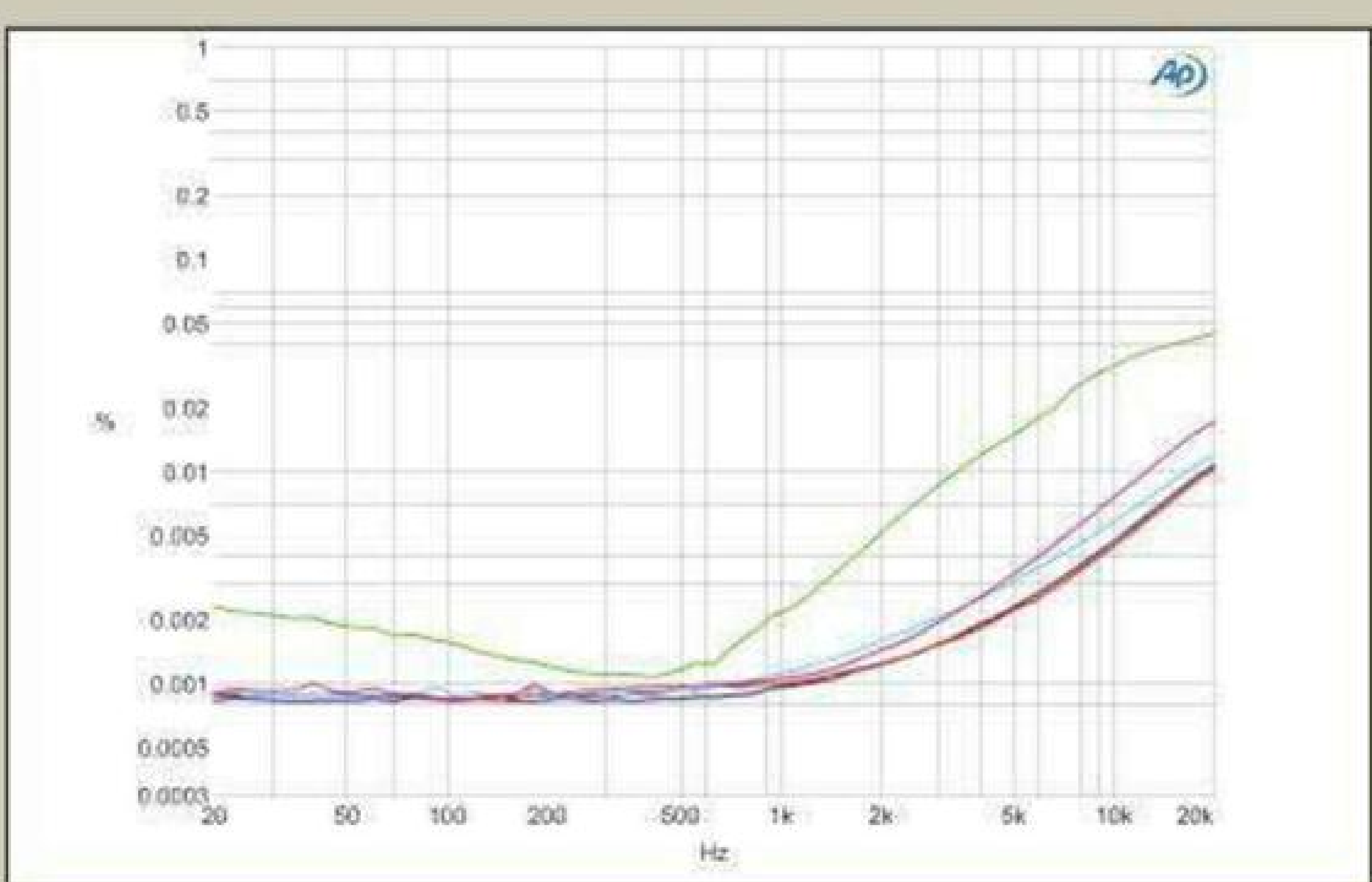


Fig.6 Musical Fidelity AMS100, THD+N (%) *vs* frequency at 20V into: 8 ohms (left channel blue, right red), 4 ohms (left cyan, right magenta), 2 ohms (green).

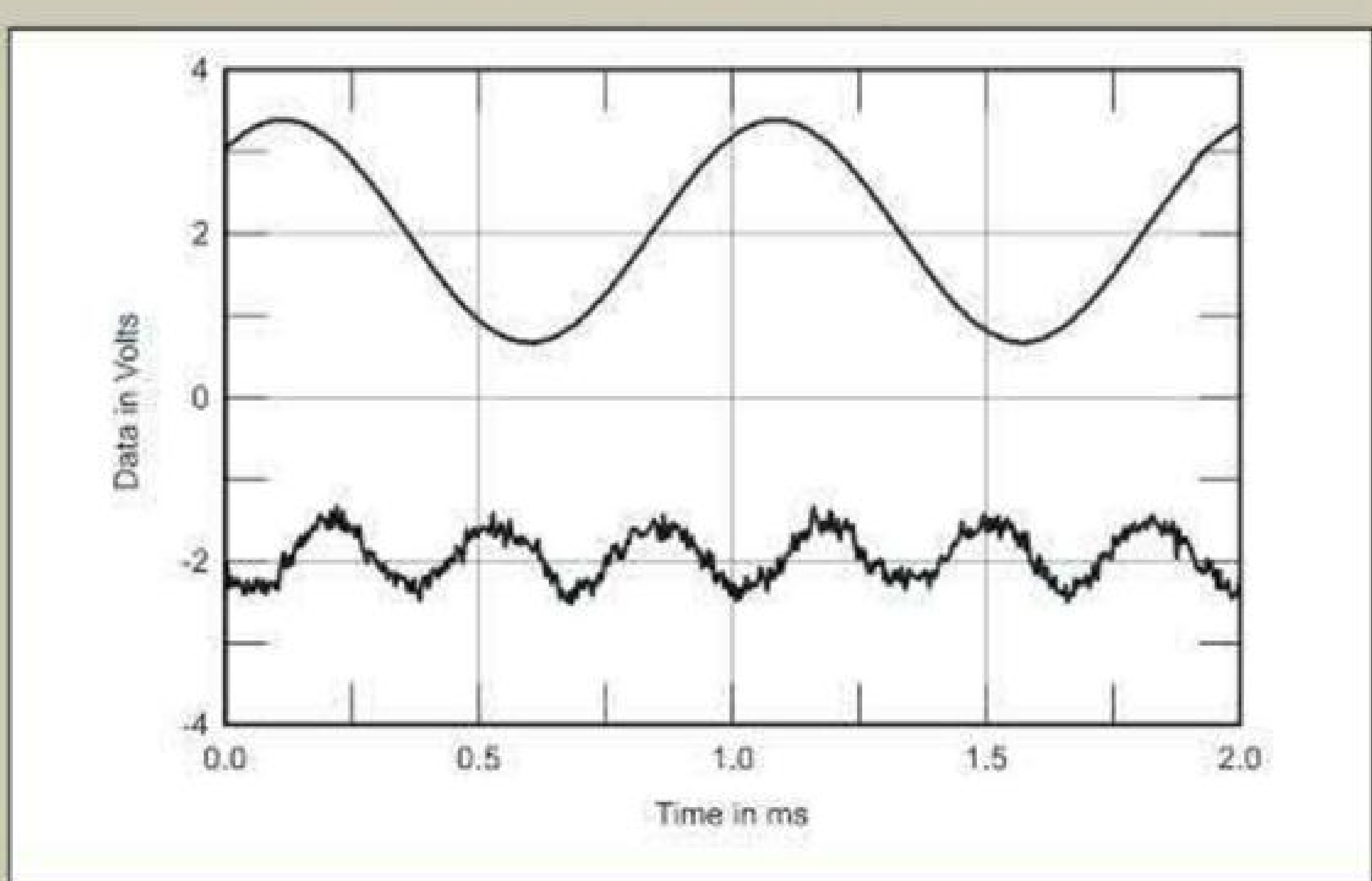


Fig.7 Musical Fidelity AMS100, 1kHz waveform at 50W into 8 ohms (top), 0.00092% THD+N; distortion and noise waveform with fundamental notched out (bottom, not to scale).

Harbeth P3ESR and Rogers LS3/5a minimonitors, as well as the Vivid B-1s, which John Marks raved about in the March 2011 "The Fifth Element."

It seemed an unlikely match, but my 30-year-old LS3/5as sang with the AMS100. The speakers seemed to disappear, transforming their end of my room into a clean, rectangular window on the recorded acoustic with every recording I played, and giving no clues that the music was being generated by a tiny pair of speakers (provided I kept a careful ear on the playback level). And the details of those acoustic spaces were laid delightfully clear. During the review period I mastered jazz group Attention Screen's new live CD, *Takes Flight at Yamaha* (Stereophile STPH021-2). As I described in the May issue, in the article on the making of this recording, I decided to use a touch of artificial reverberation to "glue" the mix together. The resolving power of the LS3/5as driven by the AMS100 allowed me to quickly zero in on the optimal setting of the Metric Halo reverb engine I was using. (Following the release of the CD, I married a 48kHz downconversion of the 24/88.2k master file for one improvisation, "13 Trojans of Vundo," to the video that was shot at the concert: www.youtube.com/watch?v=K6o8NKY3du8. Check it out.)

The AMS100's resolution of fine detail was especially noticeable with Burt Bacharach's main theme for *Casino Royale* (24/96 ALAC file, ripped from Columbia /Classic Records HDAD 2007). Other than Herb Alpert's double-tracked flugelhorn in the center of the stage,[1] this 1967 recording is dual-mono rather than stereo, with twin tunnels of sound in the left and right speakers, yet readily audible were such details as the studio acoustic around the mono drum kit in the left channel, and the quiet rolling on a xylophone in the right. With the even-more-resolving Vivid B-1 speakers, the reverb that occasionally envelops the chimes and guitar in the title track of Cornelius's *Sensuous* (CD, Everloving EVE016) pushed the soundstage far behind the front wall of my listening room and across the street behind it. And the sampled drums in track 2, "Fit Song," demonstrated that the AMS100's 100W speed limit was no impediment to its achieving frightening impact with the Vivid speakers (the LS3/5as and Harbeths, of course, not so much).

THERE WAS **A SEDUCTIVE SWEETNESS** TO THE MUSICAL FIDELITY'S MIDRANGE.

There was a seductive sweetness to the Musical Fidelity's midrange. I've mentioned before that I use, as a reference for midrange purity, a 1998 recital by the late mezzo-soprano Lorraine Hunt Lieberson accompanied by pianist Roger Vignoles (CD, Wigmore Hall Live 0013). This recording places Hunt Lieberson well in front of the piano without obscuring

1 Before people write in to tell me that HA was playing a trumpet on this track, I feel his tone is too round, too bugle-like to be a trumpet. But I could be wrong.

measurements, *continued*

mainly third-harmonic distortion is overlaid with noise (fig.7). FFT analysis (fig.8) confirms that the subjectively innocuous third harmonic is predominant—if anything at –106dB (0.0005%) can be called "predominant." High-frequency intermodulation distortion at the same peak signal level was also very low (fig.9), though it did begin to rise with even a small increase in power (fig.10) or decrease in load impedance.

Like other Musical Fidelity power amplifiers, the AMS100 offers excellent measured performance, especially very low static distortion. But the use of class-A bias for its output stage means that its impressive bulk conceals power delivery that is relatively modest when compared to that of its siblings. —John Atkinson

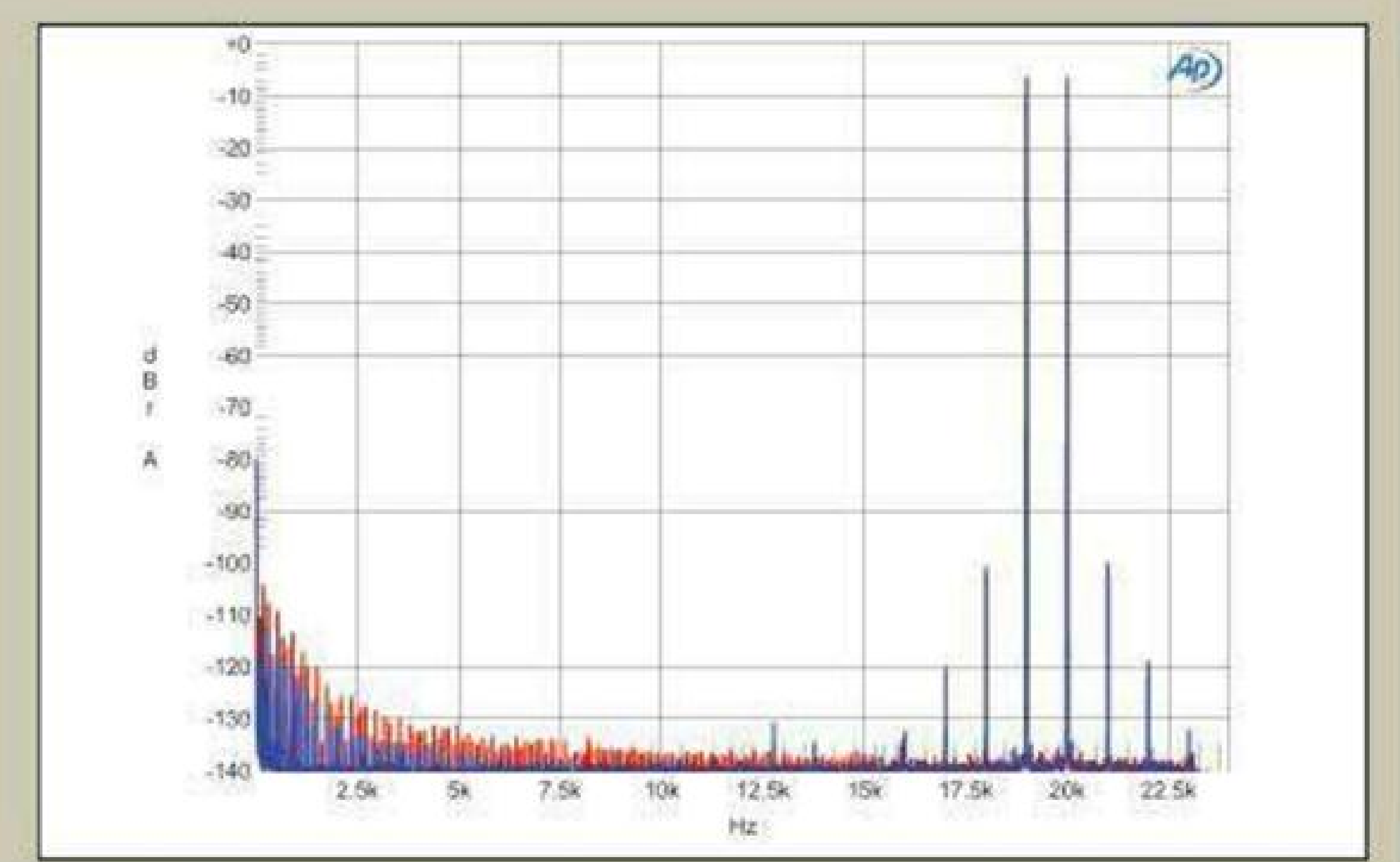


Fig.9 Musical Fidelity AMS100, HF intermodulation spectrum, DC–24kHz, 19+20kHz at 50W peak into 8 ohms (linear frequency scale).

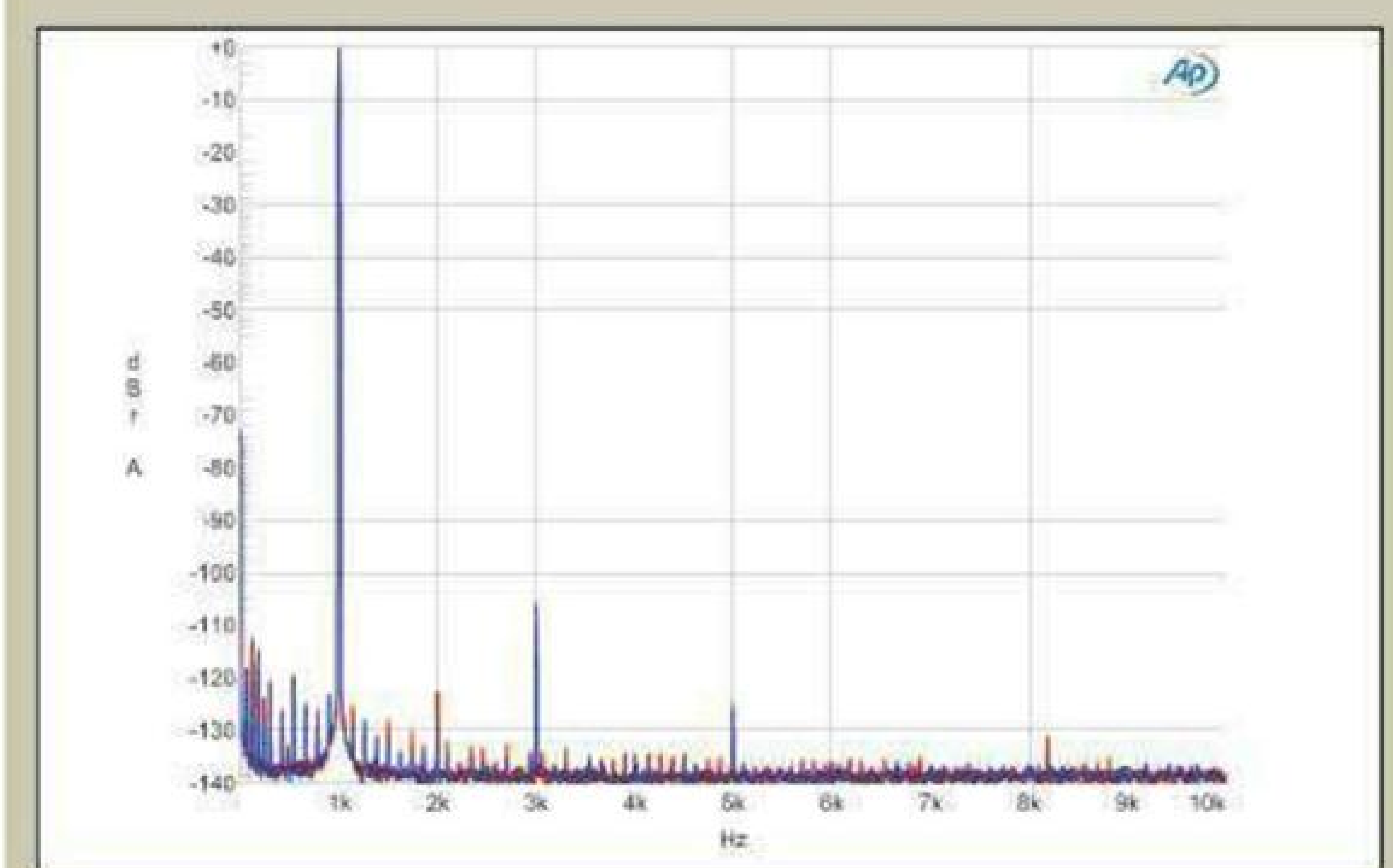


Fig.8 Musical Fidelity AMS100, spectrum of 1kHz sinewave, DC–10kHz, at 50W into 8 ohms (linear frequency scale).

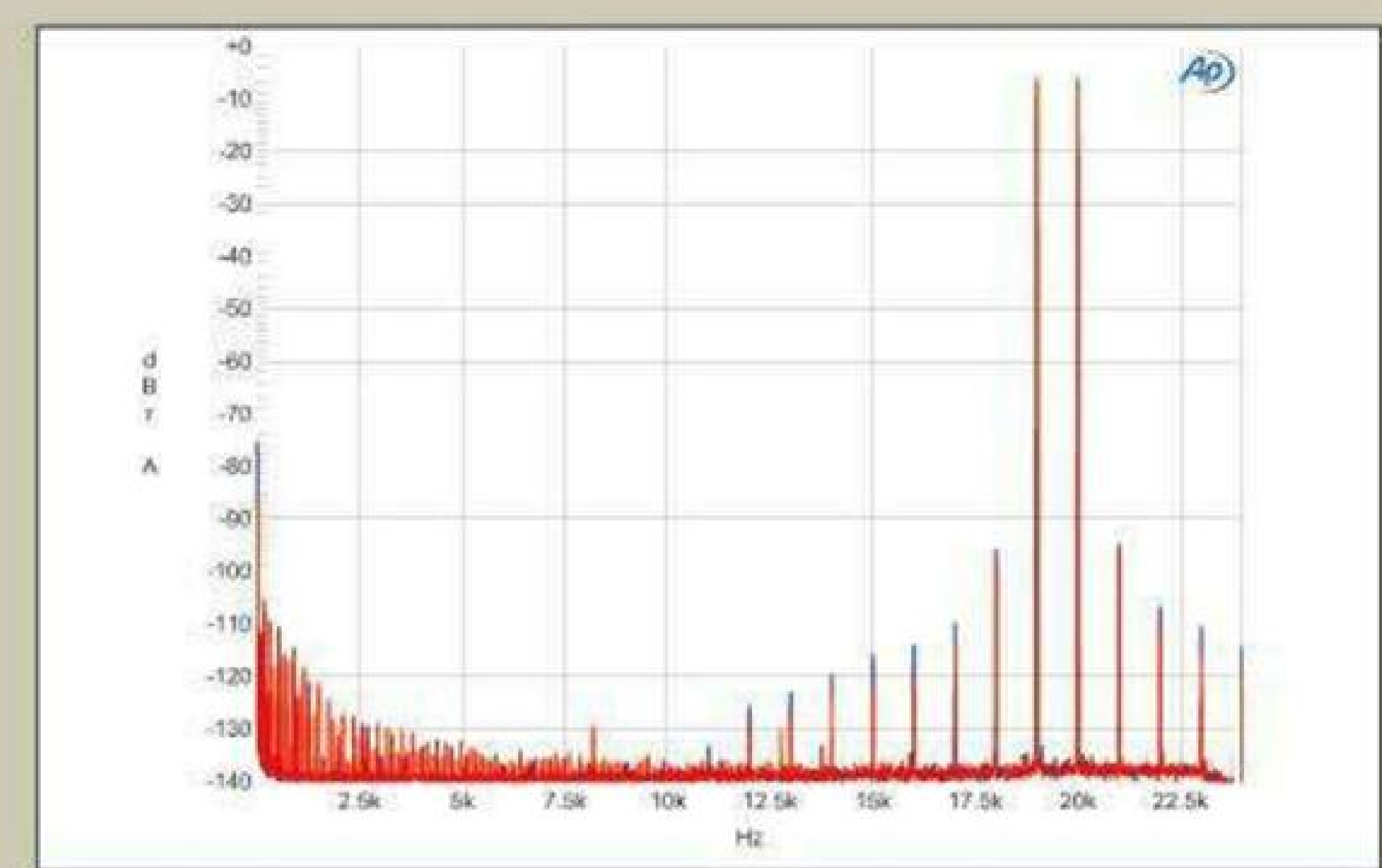


Fig.10 Musical Fidelity AMS100, HF intermodulation spectrum, DC–24kHz, 19+20kHz at 68W peak into 8 ohms (linear frequency scale).

the instrument, and the third of Mahler's five *Rückert Lieder*, "Liebst du um Schönheit," with its appoggiatura-laden vocal line, sent shivers down my back when reproduced by the little Harbeth P3ESRs driven by the AMS100.

This sweetness meant that the Musical Fidelity could cope with poor recordings. I've been listening a lot this past spring to the Buffalo Springfield's 2010 Bridge School Benefit Reunion concert (see http://tinyurl.com/234fywx), which I downloaded a while back (no longer available, I fear). The sound of the downloads is bootleg-poor. But with the Harbeths powered by the AMS100, all that could be forgiven and forgotten. Stephen Stills has no voice left, but he still managed to make "Bluebird" ascend to the heavens; Neil Young rocked it to the rafters on "Mr. Soul"; and Richie Furay's "Kind Woman" reminded me that he was always the best singer of the group. This is what great hi-fi does: It allows you to bypass the foibles and failings, so that the music is channeled directly to your soul.

Comparisons

During the time I had the Musical Fidelity AMS100 in house, I also had available the 600W Classé CT-M600 monoblocks, which I reviewed in the March 2011 *Stereophile* ($13,000/pair, see http://tinyurl.com/6fjnpb9); and the 440W MBL Reference 9007 monoblocks, which Michael Fremer reviewed in September 2006 ($42,800/pair, see http://tinyurl.com/63mrz5d). Yes, these are significantly more powerful amplifiers than the Musical Fidelity, but each pair of monoblocks is physically less than half the AMS100's size, and they do bracket its price ($19,999) in logarithmic fashion.

When he reviewed the MBL 9007, MF found it to be "a somewhat cool customer," less "ripe" than some other amplifiers he's heard. "While never bright, hard, or brittle," he wrote, "the overall presentation was nevertheless oriented more toward rhythmic drive, transient speed, and clarity than toward harmonic richness or textural suppleness." This was very much how the MBLs sounded in my system, though the combination of the 9007s and the Vivid B-1s was too much of a good thing. The MBL was a little more forward in the low treble than the AMS100, and as a result less forgiving of the B-1s' balance with overbright recordings. The amplifiers offered similar senses of musical flow, but the AMS100 was definitely sweeter in the highs than the German amplifier. In direct comparisons, however, the AMS100's bass was a bit too warm, and as much as I appreciated its dynamics, the MBL offered more ultimate slam.

The AMS100 *by* Musical Fidelity.

The Classé CT-M600s have been my amplifiers of choice for the past year, getting what I felt was the best from every speaker with which I used them. When I listened to "Autumn Leaves," from Cannonball Adderley's *Somethin' Else* (24/96 ALAC file, ripped from Blue Note/Classic DAD 1020), the Classés offered better upper-bass definition of the double bass, and very slightly more upper-frequency energy with Miles Davis's trumpet and Adderley's alto sax, but the amplifiers were otherwise very close. The Musical Fidelity sounded slightly sweeter in the treble, however, more forgiving than the MBLs or Classés.

I then listened to the CD-definition master of my forthcoming release of pianist Robert Silverman performing Robert Schumann's *Symphonic Études*. The left-hand register of Robert's Steinway sounded very slightly more veiled with the Musical Fidelity driving the Vivid speakers compared with the Classé CT-M600s, but actually not quite as rich as with the MBL 9007s—something I had not anticipated. But the MBLs again excelled in clarity of line in the treble. The Classés are still my go-to amplifiers for overall neutrality, but there was something very seductive about the Musical Fidelity's sound that I shall miss, now that the advent of summer mandates their return to the distributor.

Summing Up

Musical Fidelity's AMS100 is magnificent. It is also silly. It is the best-sounding amplifier I have heard from the British company: while it doesn't have the sheer slam of their Titan, which I hear regularly in Mikey Fremer's system, its highs have a sweetness that escapes the Titan. It costs a hair short of $20,000 and it weighs as much as I do, but it is restricted to 100Wpc into 8 ohms. (Its shipping crate weighs more than almost all 100Wpc amplifiers.) It consumes electricity as if "peak oil" were merely a liberal myth—even in standby, its power consumption exceeds the 1W EEC regulation—and it runs so hot that I had to plan my late-spring listening sessions with an eye on the weather forecast. As I said, silly. But magnificent. ■

ASSOCIATED EQUIPMENT

DIGITAL SOURCES Ayre Acoustics C-5xe^{MP} & DX-5 universal players; Apple G4 Mac mini running OS10.5.8, iTunes 10, Pure Music 1.80; Shuttle PC with Lynx AES16 and dual-core AMD Athlon processor running Windows 7, Foobar 2000, Adobe Audition 3.0; dCS Debussy, Benchmark DAC1, Logitech Transporter D/A converters; Halide S/PDIF Bridge, Musical Fidelity V-Link USB-S/PDIF converters.
PREAMPLIFIERS Simaudio Moon Evolution P-8, Ayre Acoustics K-5xe^{MP}.
POWER AMPLIFIERS Classé CT-M600, MBL Reference 9007 monoblocks.
LOUDSPEAKERS Audience Clairaudient 2+2, BBC LS3/5a, Harbeth P3ESR, Linn Majik 140, Thiel SCS4T, Vivid B-1.
CABLES Digital: DH Labs Silver Sonic AES/EBU; AudioQuest Coffee, Belkin Gold USB; prototype AudioQuest FireWire 400. Interconnect (balanced): AudioQuest Wild. Speaker: AudioQuest Wild, Cardas Neutral Reference, Audience Au24e. AC: PS Audio Lab, manufacturers' own.
ACCESSORIES Celestion Si 24" speaker stands; Target TT-5 equipment racks; Ayre Acoustics Myrtle Blocks; ASC Tube Traps, RPG Abffusor panels; Shunyata Research Dark Field cable elevators; PS Audio Power Plant 300 at 90Hz (preamp), Audio Power Industries 116 Mk.II & PE-1, APC S-15 AC line conditioners (not power amps). AC power comes from two dedicated 20A circuits, each just 6' from the breaker box.
—John Atkinson