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EQUIPMENT REPORT

Classé
CT-M600 & CA-M600
MONOBLOCK POWER AMPLIFIERS

JOHN ATKINSON

On the face of it, the power amplifier has the simplest conceptual task of any audio component. Fed an audio signal at its input, all it has to do to satisfy the demands for current made by the loudspeaker is to modulate a high-voltage voltage supply with that signal. Yet power amplifiers vary enormously in their ability to perform that task without editorializing. As a result, when I find an amplifier that appears to step out of the way of the music in the manner I desire, I make the commitment, I buy it, and I stick with it.

DESCRIPTION Solid-state, fan-cooled monoblock power amplifiers. Rated output: 600W into 8 ohms (27.8dBW), 1200W into 4 ohms (27.8dBW). Peak output voltage: 226V p–p, 80V RMS no load; 206V p–p, 73V RMS into 8 ohms. Frequency response, CT-M600: 1Hz–80kHz, +0/–3dB. Frequency response, CA-M600: 1Hz–100kHz, +0/–3dB. Voltage gain: 29dB into 8 ohms, balanced and unbalanced. Input sensitivity: 2.86V for full power. Input impedance: 50k ohms balanced and unbalanced. Output impedance: 0.03 ohm at 1kHz. Harmonic distortion: <0.002% at 1kHz, balanced; <0.004% at 1kHz, single-ended. Intermodulation distortion: >100dB below fundamental into 8 ohms, balanced/single-ended; >90dB below fundamental into 4 ohms, balanced/single-ended. Signal/noise: 120dB ref. peak output into 8 ohms (22kHz measurement bandwidth). Power consumption: 440W at ⅛ power into 8 ohms, <1W (standby).
DIMENSIONS **CA-M600** (each): 17.5" (440mm) W by 17.52" (450mm) D by 8.8" (278mm) H. Weight: 88 lbs (39.9kg) net, 100 lbs (45.4kg) shipping. **CT-M600** (each): 19" (483mm) W with faceplate by 18.625" (473mm) D by 7" (177mm) H. Weight: 89 lbs (40.5kg) net, 109 lbs (49.5kg) shipping.
FINISH Black and brushed aluminum.
SERIAL NUMBERS OF UNITS REVIEWED CA-M600: 2150079, 2150082. CT-M600: 2030117, 2030119.
PRICES CT-M600: $13,000/pair. CA-M600: $14,000/pair. Approximate number of dealers: 108.
MANUFACTURER Classé Audio, 5070 François Cusson, Lachine, Quebec H8T 1B3, Canada. Tel: (514) 636-6384. Fax: (514) 636-1428. Web: www.classeaudio.com.

Though I have occasionally been seduced by tube amps, only to fall out of love after a while, the task of providing the necessary grunt to my speakers has been almost entirely assigned to solid-state designs. A quarter-century ago, the original Krell KSA-50 was a constant in my system. This was replaced by a pair of Mark Levinson No.20 monoblocks, through their No.20.5 and No.20.6 incarnations; then, in 1998, I purchased the pair of Mark Levinson No.33H monoblocks that had been reviewed by Wes Phillips in January 1998.

The No.33Hes were in constant use for the next decade, until fall 2008, when one failed. Getting it fixed has been on my to-do list ever since; meanwhile, this terminal procrastinator has been experimenting with a number of possible replacements, the most promising of which was Ayre Acoustics' MX-R monoblock, which Wes reviewed in April 2007.

Then, at the 2010 Consumer Electronics Show, I was introduced to the first of a new series of amplifiers from Montreal-based Classé Audio, the CT-M600 monoblock—which, at least on paper, looked like a contender.

A Classé Act

Costing $13,000/pair and offering 600W into 8 ohms, the CT-M600 is aimed at the home-theater market—the "CT" stands for "Custom Theater"—and is a mundane-looking black box with a detachable rack-mount front panel that matches the styling of Classé's CT-SSP preamplifier-processor, which recently impressed Kal Rubinson (see www.stereophile.com/content/music-round-45-page-3). The beauty resides inside.

One of the reasons I committed to the Krell and Levinson designs was their use of class-A operation for the output stages. Up to their continuous current limit, a class-A amplifier's output transistors are fully turned on all the time. As well as the devices thus being in thermal equilibrium and therefore immune from having their transfer function thermally modulated by the signal current, the nonlinearities that result from switching the devices on and off during every cycle of the signal are sidestepped. Electronically, this is an elegant solution; practically, it is the opposite, in that two-thirds of the power drawn by the amplifier from the wall is wasted in the form of heat. And environmentally it is a disaster, at least in summer, as you waste even more electricity by having to run your air-conditioning to counteract the amplifier's waste heat.

With the CT-M600, Classé took a different approach to ensure that the output transistors operate in a thermally stable environment. Instead of conventional, massive external heatsinks, the CT-M600's devices are attached to an aluminum tunnel that runs the entire depth of the chassis. The inside surface of the tunnel is stuffed with multiple aluminum fins of relatively low mass to dissipate heat—their total surface area is said to be 31 square feet—and a fan draws in air from a concealed slot in the front panel and exhausts it from a rear-panel vent. In itself this is not new, but the key to what Classé calls the Intelligent Cooling Tunnel, or ICTunnel ("icy tunnel"; get it?), is to take advantage of the low thermal mass of the

MEASUREMENTS

I carried out a complete set of tests on the Classé CT-M600, repeating some of the tests on the CA-M600. (The CA-M600 basically performed identically, other than a very slightly wider small-signal bandwidth.) To perform the 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 Classé CT-M600 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. At the end of that period, the chassis was warm, with a temperature of 90°F (32°C). Though the front-to-back fan was running fast, it was not particularly noisy, and the expelled air was warm rather than hot.

The voltage gain into 8 ohms was to specification at 29.0dB into 8 ohms for both balanced and unbalanced inputs. Both inputs preserved absolute polarity (*ie*, were non-inverting), the XLR jack being wired with pin 2 hot. The unbalanced input impedance at low and midrange frequencies was lower than specified, at 25.5k ohms, which will not be a liability; the balanced input impedance in the same frequency regions was 51.2k ohms. At 20kHz, however, the unbalanced input impedance had dropped to 13k ohms, the balanced to 20.5k ohms.

The CT-M600's output impedance was low, at 0.09 ohm (including 6' of speaker wire) over most of the audioband, rising very slightly at 20kHz to 0.12 ohm. As a result, the modification of the amplifier's frequency response due to the interaction between this impedance and that of our standard simulated loudspeaker (see www.stereophile.

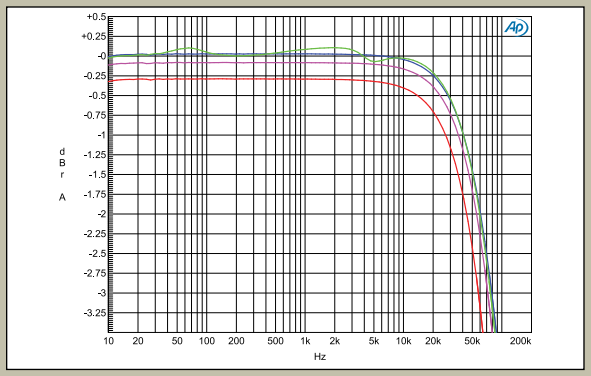

Fig.1 Classé CT-M600, frequency response at 2.83V into: simulated loudspeaker load (green), 8 ohms (blue), 4 ohms (magenta), 2 ohms (red). (0.25dB/vertical div.)

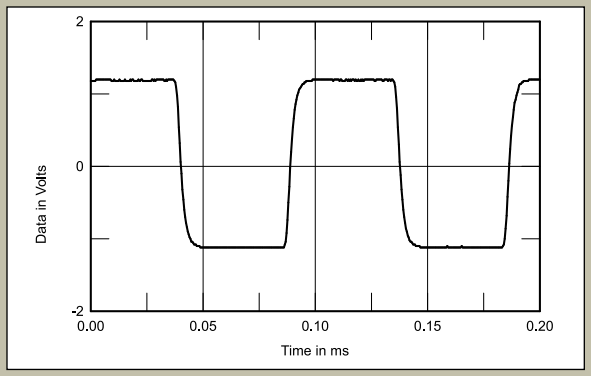

Fig.2 Classé CT-M600, small-signal 10kHz squarewave into 8 ohms.

heatsink array inside the tunnel by allowing a microcontroller, fed by pressure and temperature sensors, to actively control the operating temperature. The output devices thus continually run at their optimal temperature regardless of the signal's voltage and current conditions.

In standby mode, the amplifier consumes only 0.5W. When you first switch on the amp from standby with the front-panel switch, the fan briefly operates at full speed, then turns off to allow the amplifier to reach thermal equilibrium in 11 to 12 minutes. (An infrared thermometer indicated that the output devices remained at a constant 91.4°F, or 33°C.) In the months I used the CT-M600s, I never heard any noise from the fans, even when playing music at party levels. And an advantage of the internal heatsinking is that the amps can be directly stacked, one on the other. This is obviously a major benefit for home-theater systems, but the saving in real estate was very useful even in my music-only room. The only downside to the vertical stacking was that even though the bottom amp was raised from the floor on a short wooden stand, its fan pulled in more carpet fluff and cat hair than the upper amp; after several weeks, the front-panel LED flashed red and blue to let me know the filter needed cleaning. (The CT-M600's protection circuitry also monitors the AC mains and signal input and output parameters and signals problems to the user with the LED.)

A large toroidal transformer behind the front panel supplies power to three stacked printed-circuit boards behind the transformer. The bottom two boards carry multiple storage capacitors, the top board the relay and housekeeping circuitry. All the audio circuitry, including the 36 output devices, is carried on two six-layer boards mounted either side of the fan tunnel. This allows signal paths to be very short, minimizing any parasitic effects and keeping the amplifier's noise floor very low. The circuit is new rather than developed from earlier Classé designs. Both balanced and unbalanced inputs are provided, but Classé warns that operation from the unbalanced RCA jack is not quite as immune from RF interference as from the balanced XLR. (If the RCA input is used, a jumper needs to be inserted between pins 1 and 3 of the XLR, to tie half of the balanced circuit to ground.) There are two pairs of shrouded speaker terminals to allow easy biwiring, and the amplifier offers a full array of trigger inputs and outputs, Classé's own CAN-Bus control protocol, and IR Remote repeaters, as well as USB and RS-232 ports.

IN THE MONTHS I USED THE CT-M600S, **I NEVER HEARD ANY NOISE FROM THE FANS,** EVEN WHEN PLAYING MUSIC AT PARTY LEVELS.

com/content/real-life-measurements) was less than ±0.1dB (fig.1, green trace). The CT-M600 rolls off smoothly above the audioband, reaching –3dB at 80kHz, as specified. (The CA-M600's response was –3dB at 96kHz, almost as specified.) The amplifier's reproduction of a 10kHz squarewave thus has slightly rounded transients (fig.2), but is commendably free from any overshoot or ringing. The 1kHz squarewave response was essentially perfect (not shown).

The Classé CT-M600 is among the quietest amplifiers I have measured. Its wideband, unweighted signal/noise ratio (with the input shorted and ref. 1W into 8 ohms) was a superb 79.6dB. This increased to 93.1dB when the measurement was restricted to the audioband, and 95.8dB when an A-weighting filter was switched into circuit. For reference, the respective S/N ratios for the Bryston 7B SST2 (http://tinyurl.com/26zj3hq) were 75.6dB, 92dB, and 95.7dBA; for the Ayre Acoustics MX-R (http://tinyurl.com/24lwrne), 79.6dB, 90dB, and 92.5dBA; for the Musical Fidelity Titan (http://tinyurl.com/285h4vo), 83.5dB, 93.4dB, and 96.1dBA; and for the MBL 9007 (http://tinyurl.com/2dzyj5y), 90.9dB, 97.4dB, and 100.6dBA. It is no coincidence that these are all very powerful amplifiers. And with the very high power, this low noise floor endows these amplifiers with an enormous capability for dynamic range. The Classé is no different. It clips at 700W into 8 ohms (see next paragraph), which is equivalent to 56V RMS. Its unweighted audioband S/N ratio of 92dB, ref. 1W into 8 ohms, is therefore equivalent to 117dB when referred to the power at clipping, which is within spitting distance of the specified 120dB. The CT-M600 joins

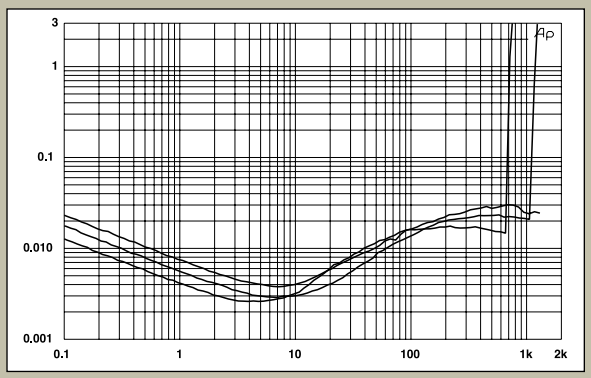

Fig.3 Classé CT-M600, distortion (%) *vs* 1kHz continuous output power into (from bottom to top at 300W): 8, 4, 2 ohms.

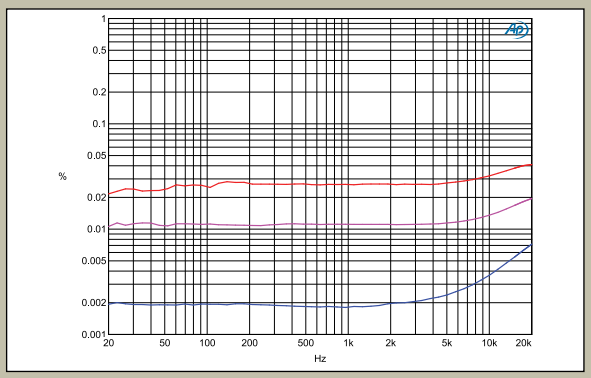

Fig.4 Classé CT-M600, THD+N (%) *vs* frequency at 20V into: 8 ohms (blue), 4 ohms (magenta), 2 ohms (red).

Classé provided me with two sets of accessory feet ($140) to use with the CT-M600s, which use Navcom inserts to provide isolation from vibration.

Delta Force

Several months after I had received the CT-M600s, Classé sent me a pair of CA-M600s. This is the same amplifier, but packaged in Classé's traditional Delta-series enclosure, with its brushed-aluminum front panel curved round to form the side panels. The fan pulls in air from a square slot concealed on the black front-panel insert. I studied both models with their vibration-damped tops removed; under the skin, the two appeared identical, the only apparent difference being the orientation of the toroidal transformer: vertical in the CT-M600, on its side in the 100mm-taller CA-M600. The more domestically acceptable styling of the CA-M600 adds $1000 to the price of a brace of amps.

Sound Quality

I used first the CT-M600s, then the CA-M600s, for a total of nine months. In that time I used the amplifiers with a wide variety of loudspeakers, from the current-hungry Focal Maestro Utopia IIIs (reviewed in July 2010), the miniature and exquisite Harbeth P3ESRs (reviewed in August 2010), to the supersensitive, horn-loaded Acapella High Violoncello IIs (reviewed in September 2010) and the weird and wonderful Gradient Helsinki 1.5 dipoles (reviewed in November 2010).

ASSOCIATED EQUIPMENT

DIGITAL SOURCES Ayre Acoustics C-5xe^{MP} universal player; dCS Puccini SACD player with U-Clock; Apple G4 Mac mini running OS10.5.8, iTunes 10, Pure Music 1.6; Shuttle PC with Lynx AES16 and dual-core AMD Athlon processor running Windows 7, Foobar 2000, Adobe Audition 3.0; dCS Debussy, Esoteric D-07, Benchmark DAC1, Logitech Transporter D/A converters; Halide S/PDIF Bridge USB-S/PDIF converter.
PREAMPLIFIER Simaudio Moon Evolution P-8.
POWER AMPLIFIERS Parasound Halo JC 1 monoblocks, Simaudio Moon Evolution W-7, NAD M2.
LOUDSPEAKERS Harbeth P3ESR, Acapella High Violoncello Mk.II, Gradient Helsinki 1.5, Focal Maestro Utopia III.
CABLES Digital: Stereovox XV2 electrical S/PDIF, DH Labs Silver Sonic AES/EBU, AudioQuest Coffee and Belkin Gold USB. Interconnect (balanced): AudioQuest Wild. Speaker: AudioQuest Kilimanjaro & Wild. 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 (pre-amp), 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

measurements, *continued*

that select group of amplifiers that can do justice to the demands of true high-resolution recordings.

Fig.3 plots the THD+noise percentage in the amplifier's output against power. The Classé easily exceeds its 600W into 8 ohms (27.8dBW) rating, clipping at 700W into 8 ohms (28.5dBW). (We define clipping as being when the THD+N reaches 1%.) It fell a little short into 4 ohms, however, clipping at 1100W (27.4dBW) rather than the specified 1200W (27.8dBW). This is probably because, with the large current draw, the AC wall voltage had dropped from 119 to 115V. (I don't keep the AC voltage constant during testing, feeling that allowing the wall voltage to be affected by the amplifier's demands for current more truly reflects the reality of its use.) The trace in fig.3 that shows how the amplifier performs into 2 ohms cuts off at 1200W (24.8dBW), below the level where it actually clips and equivalent to a sustained current of 24.5A. This is because the Classé's protection circuit kicked in at this point, turning the amplifier off and causing the front-panel LED to flash red. Removing, then reinstating the AC supply allowed the CT-M600 to be turned on again, apparently none the worse for wear.

The shape of the traces in fig.3 suggests that the actual distortion starts to rise from the noise floor around 10W or so. I therefore plotted the manner in which the THD+N percentage changed with frequency at 20V, to be sure of looking at true distortion. The results are shown in fig.4. The CT-M600 offers superbly low distortion into 8 ohms over almost the entire audioband, with only a slight rise apparent above 5kHz. This is obviously a circuit with a wide open-loop bandwidth. The THD does

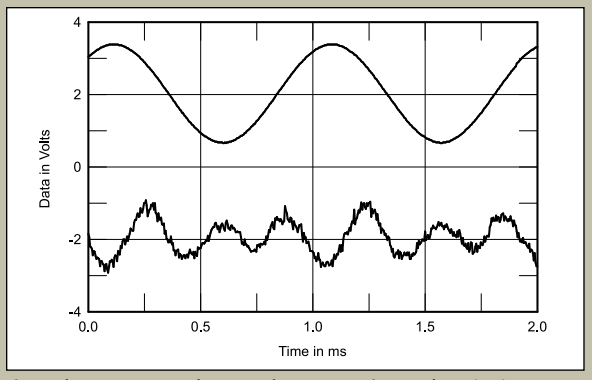

Fig.5 Classé CT-M600, 1kHz waveform at 25W into 4 ohms (top), 0.0013% THD+N; distortion and noise waveform with fundamental notched out (bottom, not to scale).

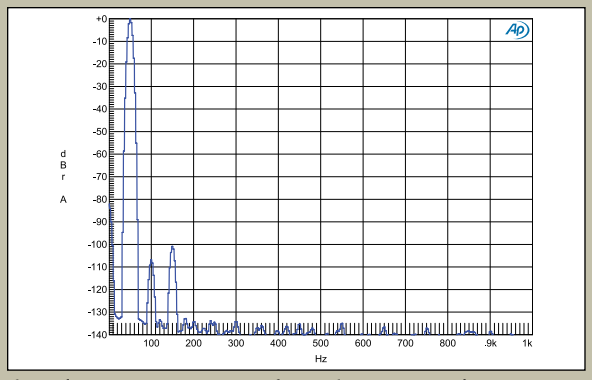

Fig.6 Classé CT-M600, spectrum of 50Hz sinewave, DC–10kHz, at 50W into 8 ohms (linear frequency scale).

Following the return of the Gradients, I returned to the Harbeths to review some digital source components. In all that time, I never felt I had a handle on the sound of the Classé amplifiers.

And as I prepare to send this review off for copyediting, I still don't. In either of its guises, the 'M600 is the consummate chameleon.

Yes, I could draw comparisons with other high-performance amplifiers. The Parasound Halo JC 1 monoblock, for example, sounded more intense in the treble. But that doesn't mean the Classé sounded dull. Far from it. Yes, it had a firmer grip on the Focal's big woofers than did the Simaudio Moon Evolution W-7, but that doesn't mean it sounded lean. Far from it. Yes, I enthused about the transparency of the NAD M2 Direct Digital amplifier (reviewed in March 2010) fed straight digital data via S/PDIF. But that doesn't mean the 'M600s didn't sound transparent. Far from it. Yes, one reason I had bought the No.33Hes was the enormous soundstage they threw, but that doesn't mean the Classés' soundstage was any less expansive than my memory of the Levinsons'. Far from it.

Whatever speakers I used with the Classé monoblocks, each pair of speakers sounded more like themselves than they did with other good amplifiers. Whatever recordings I played through the 'M600s sounded more like themselves. With both speakers and recordings, it was if the colors in the sonic picture were more intensely saturated. The amplifiers' deathly quiet level of background noise allowed them to step out of the way of musical details that I have rarely experienced from electronics. Their enormous dynamic range allowed musical climaxes to be reproduced in full measure, even with modest speakers that you'd think would be overtaxed.

As I finish writing this review, the CA-M600s are driving the Harbeth P3ESRs. The front-end is the dCS Debussy processor taking USB data from my Mac mini running PureMusic with AudioQuest's new Coffee cable. There's no preamp in the system. I'm using the Debussy's own volume control, with balanced AudioQuest Wild cables feeding the amplifiers and AudioQuest Wild speaker cables hooking up the Harbeths. Paul Simon is singing "Hearts and Bones," ripped in Apple Lossless from *Negotiations & Love Songs* (CD, Warner Bros. 25789-2). It is hard to believe the hi-fi experience can get any better than this. I know that's not the way the world is, baby, but at this moment, it is all I need.

Conclusion

There seems to be a feeling in some quarters of audiophilia that to get state-of-the-art amplifier sound and performance, you need to pay many tens of thousands of dollars for a product made in tiny numbers from an equally tiny company. By contrast, the Classé CT-M600 and CA-M600 come from a mainstream manufacturer, though they are still expensive amplifiers. But they are nowhere near as expensive as the artisanal models, and they are the best-sounding amplifiers I have auditioned in my system. It is going to be difficult to let them go. Maybe I won't.

increase as the load impedance decreases. However, the only harmonic present to any significant degree is the subjectively innocuous third (fig.5). (Note that I averaged 64 readings to generate this graph, in order to let the harmonic spuriae emerge from the noise floor.[1])

Spectral analysis reveals that there is some second harmonic present at a lower level (fig.6). You can also see that with the FFT length chosen, the higher-frequency noise components are at or below –140dB in this graph. Increasing the signal level to just below visible waveform clipping on the oscilloscope raised the level of the second harmonic by 6dB and the third by 20dB, and tiny amounts of the fourth and fifth harmonics can now be seen (fig.7). But that this is still an extraordinarily linear power amplifier is also evident in the spectrum of its output while it reproduces an equal mix of 19 and 20kHz tones at a power level close to visible waveform clipping into 4 ohms (fig.8). This is a maximally stressful test for an amplifier, yet the Classé produced just 0.001% of the 1kHz difference product. Even the higher-order components at 18 and 21kHz were more than 82dB down from full scale. (Ignore the little blip in the noise floor around 14kHz in this graph, which seems to be a measurement artifact.)

The Classé CA-M600 and CT-M600 offer superb measured performance. It doesn't get any better than this.

–John Atkinson

1 Each doubling of the number of data captures increases the uncorrelated noise level by 3dB but the correlated distortion by 6dB, thus dropping the noise contribution by 3dB. (For the averaging, I trigger the 'scope with the unfiltered waveform so that it starts each capture at exactly the same point in time.)**–John Atkinson**

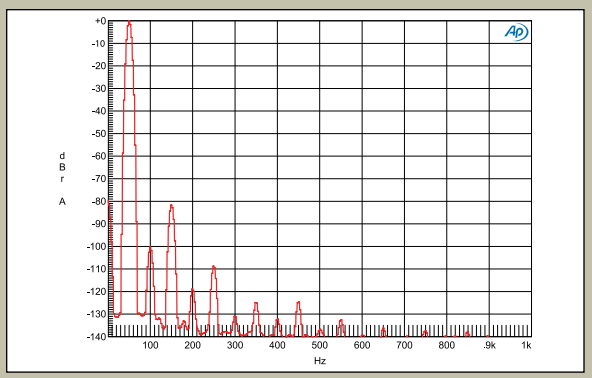

Fig.7 Classé CT-M600, spectrum of 50Hz sinewave, DC–10kHz, at 395W into 8 ohms (linear frequency scale).

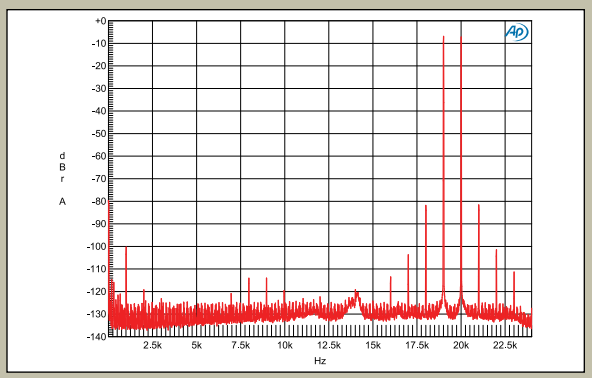

Fig.8 Classé CT-M600, HF intermodulation spectrum, DC–24kHz, 19+20kHz at 650W peak into 4 ohms (linear frequency scale).