consumeR
PRODUCTS REVIEWED

Reference MM de CAPO Speaker

Reviewed by Joseph D'Appolito and Ken and Julie Ketler

PHOTO 1: MM de CAPO loudspeaker on stand. ***(Photos by Ken and Julie Ketler).***

PHOTO 2: MM de CAPO rear (left) and front (right).

Reference 3A, 342 Frederick St., Kitchener, Ontario, N2H 2N9 Canada; 519-749-1565, Fax 519-749-2863, www.reference3a.com.

I ran a series of impedance, frequency response, and distortion tests on the MM de CAPO loudspeaker from Reference 3A. *Figure 1* is a plot of system impedance magnitude. At low frequencies the plot displays the double peaked curve of a vented system. The impedance minimum of 5.24Ω at 45Hz indicates the vented-box tuning frequency.

There is a second local impedance minimum of 5.04Ω at 210Hz. Impedance phase lies between +40° and –47° over the full audio range. Fortunately, these rather large phase angles occur at relatively high impedance values. With minima in the range of 5Ω, Reference 3A's 8Ω rating for this system seems a bit high.

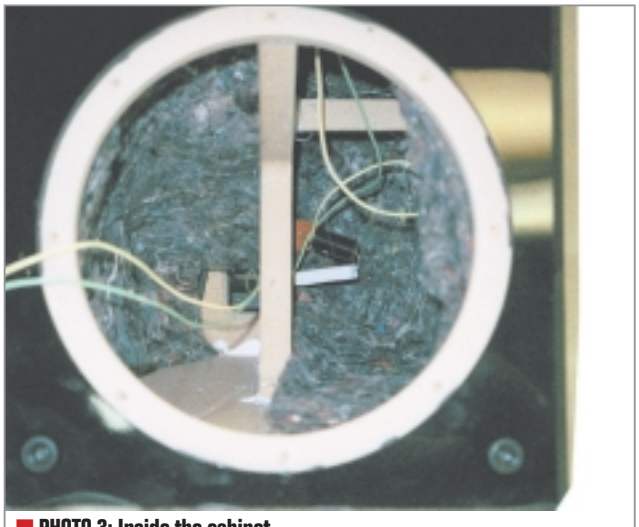


PHOTO 3: Inside the cabinet.

FREQUENCY RESPONSE

The MM de CAPOs are supplied in mirror-image pairs. The manual states that the speakers are optimally set up with the speakers facing forward (no toe-in). The two speakers and the listening position should be set up to form an equilateral triangle. This implies an optimum listening axis 30° off the on-axis position. Polar responses taken every 10° confirmed that the 30° off-axis position produced the smoothest response.

Figure 2 shows the MM de CAPO's full-range frequency response at the 30° position. This response is obtained as a combination of the far-field quasi-anechoic response and properly summed near-field woofer and port responses. The microphone was placed along the baffle centerline at a distance of 1.2m to produce the far-field response. The near- and far-field responses were then spliced together at 210Hz to produce the full-range response.[1]

The response shown in *Fig. 2* has been normalized to 1m to obtain system sensitivity. Sensitivity averages 86.6dB in the two oc-

ABOUT THE AUTHOR

Joseph D'Appolito, regular contributor and author of many papers on loudspeaker system design, holds four degrees in electrical and systems engineering, including a Ph.D. Previously, he developed acoustic propagation models and advanced sonar signal processing techniques at an analytical services company. He now runs his own consulting firm specializing in audio, acoustics, and loudspeaker system design. A long time audio enthusiast, he now designs loudspeaker systems for several small companies in the US and Europe.

taves between 500Hz and 2kHz. This is substantially less than the 92dB figure quoted on the spec sheet for the MM de CAPO. Response does reach a level of 91dB at 680Hz, but it shelves down to 85dB at 2kHz. Relative to the midband average level, the low frequency –3dB point is 45Hz. There is also broad response peak of about 2dB centered on 90Hz.

The MM de CAPO has two pairs of binding posts for bi-wiring. This allowed me to measure the response of the individual drivers. The result is plotted in *Fig. 3*. Crossover occurs between 2.2 and 3kHz. There is no woofer crossover network. The woofer runs full range. Woofer response simply shelves down by about 15dB above 3kHz. Tweeter response is relatively smooth, but the woofer response shows a great deal of ripple above 4kHz. This ripple also shows up in the overall system response.

CUMULATIVE SPECTRAL DECAY

The MM de CAPO's cumulative spectral decay (CSD) response is presented in *Fig. 4*. This waterfall plot shows the frequency content of the system response following a sharp impulsive input at time zero. On the CSD plot, frequency increases from left to right and time moves forward from the rear. Each slice represents a 0.06ms increment of time.

The total vertical scale covers a dynamic 32dB range. Ideally the response should decay to zero instantaneously. Inertia and stored energy that take a finite amount of time to die away, however, characterize real loudspeakers. A prominent ridge parallel to the time axis indicates the presence of a strong system resonance.

The first time slice in *Fig. 4* (0.00ms) represents the system frequency response. There are two strong ridges in the plot at 4kHz and 11.8kHz. The ridge at 4kHz takes over 2.5ms to decay. Surprisingly, both ridges come from the woofer. Tweeter decay time is quite good.

SYSTEM STEP RESPONSE

The 602's step response is shown in *Fig. 5*. The rise time is somewhat slower than many other speakers I have tested; however, the woofer and tweeter arrive at the same time and rise together. The overall step response is the best I have measured in this series of tests. The excess group delay (plot not shown) is 100µs or less from 300Hz to 20kHz. The MM de CAPO is essentially time-coherent.

POLAR RESPONSE

Polar response is examined in *Figs. 6–10*. *Figure 6* is a waterfall plot of horizontal polar response for the left-side speaker. The curves are plotted in 10° increments from 60° left (–60°) to 60° right (+60°) when facing the speaker. All off-axis plots are referenced to the +30° response, which appears as a straight line. (Remember the +30° position is the preferred listening axis.)

The plotted curves show the change in response as you move away from the 30° line. Smaller positive angles and negative angles move the listener outside of the primary listening area.

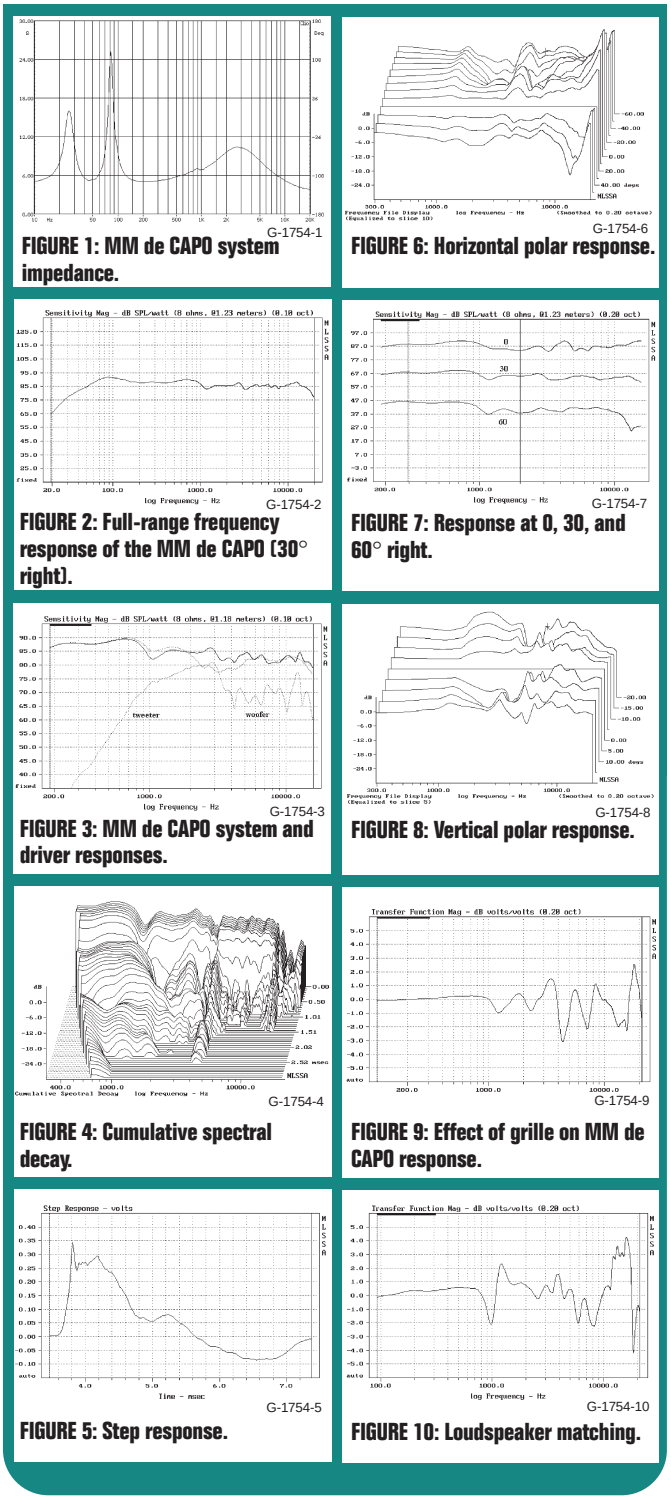
The responses above +30° are relatively smooth replicas of the 30° line. This should produce good stereo imaging for listeners between the speakers. However, the curves do degenerate rapidly as one moves beyond the span of the speakers. This will produce wall reflections with a much different spectral balance than the first arrival sound. I suspect the perceived spectral balance will be very room dependent. Responses at 0, +30 and +60° are plotted in *Fig. 7*. The 30° curve is seen to be the smoothest response.

Without building a special jig to obtain the required compound angle, I could not measure response changes in the vertical plane containing the 30° off-axis position. For this reason, vertical responses were measured in the on-axis plane. The changes observed should be similar to those seen at the 30° position.

Figure 8 is a waterfall plot of vertical polar response. Responses are shown in 5° increments from 20° below (–20°) the tweeter axis

TECHNICAL DATA

Type of speaker:	Medium-size monitor
Music peak power:	120W peak
Music impulse power:	80W
Continuous power rating:	60W
Frequency response:	44–20kHz ±3dB
Efficiency:	92dB 1W/m
Recommended amplifier:	5–100W
Crossover frequency:	3.000Hz (tweeter only)
Impedance:	8Ω nominal
Woofer:	21cm, direct coupled
(no crossover)	
Tweeter:	26mm latex-coated silk dome with closed back chamber
Weight net:	20kg/43 lbs
Dimensions:	38cm/15″ high, 28cm/11″ wide, 33cm /13″ deep at the base
Finish:	Gloss black



G-1754-1
FIGURE 1: MM de CAPO system impedance.

G-1754-6
FIGURE 6: Horizontal polar response.

G-1754-2
FIGURE 2: Full-range frequency response of the MM de CAPO (30° right).

G-1754-7
FIGURE 7: Response at 0, 30, and 60° right.

G-1754-3
FIGURE 3: MM de CAPO system and driver responses.

G-1754-8
FIGURE 8: Vertical polar response.

G-1754-4
FIGURE 4: Cumulative spectral decay.

G-1754-9
FIGURE 9: Effect of grille on MM de CAPO response.

G-1754-5
FIGURE 5: Step response.

G-1754-10
FIGURE 10: Loudspeaker matching.

CRITIQUE

Reviewed by Ken and Julie Ketler

Located in Ontario, Canada, Reference 3A claims over 30 years of loudspeaker design and innovation. Their current product line consists of five models of loudspeakers, each demonstrating a propensity toward the high end. Although mentioning "high end" equipment may fend off some budget-minded music lovers, Reference 3A has produced a "moderately priced" loudspeaker—the MM de CAPO, which deserves consideration from anyone who is passionate about music listening.

The MM de CAPO is a bi-wireable two-way rear-vented system, which utilizes an 8″ (203mm) woven carbon woofer, a 1″ (26mm) soft textile dome tweeter, and no crossover! Well, almost. This is really a low-calorie crossover—not quite fat free!

Although the woofer is designed to require no electronic filtering to achieve its rolloff slope and frequency, the tweeter has an impedance-compensated first-order circuit. Reference 3A claims that this configuration provides a frequency response of 44Hz–20kHz and a smooth phase response that is constant within ±10°. The rated sensitivity is a healthy 92dB (1W/1m), which makes this a very good candidate for those readers with lower-powered amplifiers. Quality versus quantity, don'tcha' know?

FIRST IMPRESSIONS

This speaker has a footprint of 15″ (38cm) (H) × 11″ (28cm) (W) × 13″ (33cm) (D). Most reasonable human beings might be somewhat hard-pressed to call this a "mini-monitor," however, it's a nice size and should be easy to integrate with any modern decor. The first thing that a person with an eye for furniture will notice about the enclosure is its mirror-smooth glossy black finish. Very attractive indeed. The front face is sloped in order to time-adjust the two drivers...and it looks pretty cool, too!

Since the MM de CAPO weighs 60 lbs (27Kg) per pair (we weighed them), it's not difficult to see why the deliveryman was cursing our name as he walked down our steep driveway and hopped back into his truck. Such a heavy enclosure may be bad for the back, but is likely to be good for music. Such thick walls will tend not to vibrate and impose a sonic signature of their own. As a result, the woofer is allowed to do its own job.

Ah, yes, the woofer—the first noticeable thing was that the phase plug in the center is anchored to the driver frame/magnet and not the cone, i.e., it does not move. The fibrous texture of the woven carbon material appears to be a great scheme for damping driver resonances and breakup modes.

The inside of the cabinet is built like a house! It has plenty of bracing and is just plain solid. Reference 3A's choice of internal wiring is a bit surprising. They use what appears to be just flopsy #18 AWG hook-up wire, not quite what you might expect from a high-end company.

Also, the enclosure has a generous amount of damping material, but when we gazed in, we noticed it was loosely covering the bass reflex vent of one of the loudspeakers.

COMPANY SETUP RECOMMENDATIONS

The user guide accompanying the MM de CAPO loudspeakers is a mere four pages of text, but it includes a great deal of information regarding room positioning/acoustics, height, cables, and amplifiers. Reference 3A suggests putting the MM de CAPO on stands approximately 26″ high and forming an equilateral triangle with the listening position. They do not recommend toeing-in and stress that "early reflections will collapse the soundstage." Reference 3A also mentions that the MM de CAPO doesn't "lack bass performance when placed a meter or two out from the walls."

OUR SETUP

We mounted the MM de CAPOs just as Reference 3A suggested with respect to our listening position. We drove them with both tube (Valve Audio Laboratory VAA-100, 30W) and solid-state (AudioSource Amp Two, 80W) amplifiers on separate occasions and compared them to many different pairs of custom-built speakers. During casual listening sessions, we played many of our own personal CDs, but for level matching and critical evaluation, we used the *Hi-Fi News & Record Review's* CD Test Disk III. Here's what we found:

EVALUATION

TEST 1
TRACK 2—Jerusalem/Parry
JK: The MM de CAPO loudspeakers have a very smooth and full stereo sound in this piece. All the instruments sound bright and clear.
KK: Excellent front-to-back depth, the Philharmonia Chorus sounds very large.

TEST 2
TRACK 4—Trumpet Concerto in C/Vivaldi
JK: I am able to place where the trumpets are playing in this most beautiful piece (simply my favorite, maybe that makes me biased, nah). When the entire orchestra joins in with the trumpets, the room is filled with a very rich and full sound as if I am witnessing the show live.
KK: The string sections have a nice three-dimensional "silky" quality. But I must disagree with my beautiful wife, though. To my ears, the stereo placement of the two trumpets in this piece is slightly smeared amid the wide soundstage (she's probably just biased).

TEST 3
TRACKS 5/6—Peter & the Wolf (narr)/Prokofiev
JK: During the clarinet solo, the instruments sound as though they are coming from the back of the speakers instead of from the front. I enjoy predictability, so this "hidden" sound bothered me a bit. Yet, I know many people opt for this effect.

The tympani and drum ensemble sounds loud and clear, filling the room with a rich, fat sound. As I listen very critically, I do find that the tympani sounds a little "echo-like" as if it's being "filtered." Even though this piece does have a full stereo sound all together, the stereo placement is difficult to hear.
KK: The sibilance of Sir John Gielgud's voice is very smooth and intimate. The oboe, clarinet, and bassoon all have a realistic breathy quality. The horns, however, lack the brassy "zing" that is present in this recording. The tympani and bass drum sound very deep and dynamic, but the attack of the mallets hitting the drum skins is veiled due to a somewhat boomy bass overhang. The tambourine during the "procession" leaps forward right out of the speakers!

TEST 4
TRACK 7—Welcome, Welcome/Purcell
JK: The violins appear to be playing on the left and the singers are rich-sounding in the middle. The overall sound is very full, filling the space in front of me in an arch shape.
KK: The vocals sound very nice in this piece and seem to come from behind the speakers. The smooth drone of the chamber organ is deep and encompassing.

TEST 5
TRACK 10—Corkhill (piece 2)
JK: The drums sound lower-pitched than they do with our speakers; both sound very different as if the drums were playing in different octaves. This piece proves to be a very interesting comparison with very contrasting results. Similarly though, in this piece, both speakers have a great stereophonic effect.
KK: Fourteen seconds into this all-percussion piece, there erupts a burst of snare and bass drums that scares the whoopee out of me every time! Very dynamic. Again, however, the impact of the bass drum (left channel) is somewhat softened and the snares are missing some "bite."

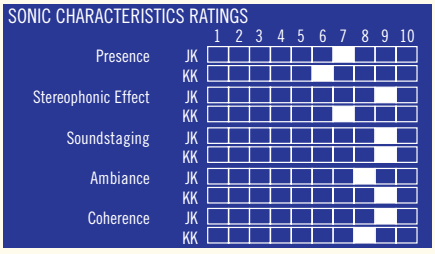
TEST 6
TRACK 14—Rio Napo RSS Demo
JK: This funky piece has a full 3-D sound with the MM de CAPO speakers. The music circles the room with a pleasant soft sound, which is very enjoyable to listen to.
KK: The de CAPO really shines on this track. Its 3-D soundstaging is absolutely super! The somewhat chubby bass quality of this loudspeaker sounds perfect with this pop-style tune.

FINAL THOUGHTS

Overall, the MM de CAPO provides a very wide soundstage that appears to originate from far outside the confines of the enclosure. Its response is smooth and unfatiguing while providing great detail in the upper high frequencies. Low frequencies are definitely prominent, however, somewhat undefined and occasionally boomy.

On various rock and jazz tracks, the MM de CAPO lacks "thwack," most notably on snare drums. On rapid bass progressions, it is occasionally difficult to distinguish individual notes. With more mellow jazz and various classical pieces, the MM de CAPO sounds full-bodied and clear with no noticeable flaws.

For listeners who enjoy a larger-than-life soundstage and are currently set up with an active crossover and subwoofer, the MM de CAPO will provide you a potentially wonderful listening setup. Those of you who own low-powered amplifier configurations (single-ended triodes, for example) will be pleasantly surprised with the sensitivity and fullness of this comparatively compact system.



ABOUT THE AUTHORS

Julie and Ken Ketler are the proud parents of an eleven-month-old boy, Thomas Anthony. Julie is a first-grade teacher who is on a long hiatus to be a full-time mom, and Ken is a technical writer for a chemical lab equipment company in Mass. Thomas enjoys listening to music with his parents and occasionally even sings along.

to 20° above it. Response changes very rapidly as one moves above or below the horizontal plane. This is a direct consequence of the broad driver frequency overlap.

HARMONIC DISTORTION

Harmonic distortion tests were run at an average level of 90dB SPL. Ideally, harmonic distortion tests should be run in an anechoic environment. In practice, it is important to minimize reflections at the microphone during these tests. Out-of-phase reflections can produce false readings by reducing the level of the fundamental while boosting the amplitude of a harmonic. In order to reduce the impact of reflections, I placed the microphone at 0.5m from the loudspeaker.

Second-harmonic distortion was below 1% over most of the audible frequency range. Below 100Hz second-harmonic distortion did rise to 3.6%, but this is still a low figure. Third-harmonic distortion was 1% or less over the full audio range. This is an excellent result.

INTERMODULATION DISTORTION

I next measured intermodulation distortion. In this test two frequencies are input to the speaker. Intermodulation distortion produces output frequencies that are not harmonically related to the input. These frequencies are much more audible and annoying than harmonic distortion.

Let the symbols f_1 and f_2 represent the two frequencies used in the test. Then a second-order nonlinearity will produce intermods at frequencies of $f_1 \pm f_2$. A third-order nonlinearity generates intermods at $2f_1 \pm f_2$ and $f_1 \pm 2f_2$.

I first examined woofer intermods by inputting 900Hz and 1kHz signals at equal levels. These frequencies should appear predominantly in the woofer output. I adjusted total SPL with the two signals to 86dB at 1m. Because steady tones are used in the IM test, I believed it safer to use a lower power level to prevent possible tweeter damage.

Principal woofer IM products occurred at 800, 1100, 1900, 2800, and 2900Hz. Total IMD was 1.1%. This figure is one of the highest measured in this series of tests. Much of this distortion arises in the tweeter due to the slow rolloff of its 6dB/octave crossover that lets too much low frequency energy into the tweeter.

I measured tweeter intermods with a 10kHz and 11kHz input pair also adjusted to produce 86dB SPL at 1m. I observed IM products at 8, 9, and 12kHz. Total distortion was 0.2%. When frequencies are limited to those the tweeter is designed to handle, tweeter distortion performance is quite good.

The last IM test examines cross-intermodulation distortion between the woofer and tweeter using frequencies of 900Hz and 10kHz. (A 1kHz signal would produce intermods that fall on harmonic distortion lines, confusing the results.) In typical systems with woofer and tweeter crossovers, the crossovers should prevent high-frequency energy from entering the woofer and low-frequency energy from entering the tweeter. In the case of the MM de CAPO, IM products appeared at 8.2, 9.1, and 10.9kHz at a level of 0.2%. In absolute terms this may be an acceptable figure, but the majority of the systems I have tested typically produce values in the range of 0.05 to 0.07%.

ADDITIONAL TESTS

I conducted all of the above tests with the grille off. *Figure 9* shows the MM de CAPO's system response with the grille on relative to the response with the grille off. That is, it plots the change in response under the two conditions. Below 1kHz the grille has little effect. Above 1kHz, however, the grille causes ragged response deviations of +2.5 to −3dB. As usual, the grille has only cosmetic value.

Two samples of the MM de CAPO system were available for testing. All of the tests described so far were conducted on one sample. Frequency response matching of the pair is shown in *Fig. 10*. This is a plot of the response difference between the first and second samples. Between 1 and 10kHz the two speakers match within 2dB. Above 10kHz matching degrades to ±4dB.

CLOSING COMMENT

The MM de CAPO is the first speaker I have tested that is essentially time-coherent, but this attribute comes at a price, namely, poor polar response and somewhat higher distortion. I leave the audible consequences of these results to the reviewer. ❖

Manufacturer's Response:

Reference 3A (initially known as 3A of France) has been in the forefront of innovative loudspeaker design for over 30 years. Some of its complex designs utilized concepts and ideas not well known 20-30 years ago. A 3-way design with motional feedback technology called Master Control is still used in many homes and studios around the world, even after 26 years. Also from the same era is the Triphonic, a self-powered coffee table sub-satellite system, one of the first of its kind.

A few years ago, Reference 3A adopted a simpler approach to enhancing loudspeaker performance. By removing the crossover from the main driver, the company addressed the potential damage complex crossover networks imposed on the flow of the musical signal. This required a new, hand-built driver tuned to cover a wide range. The other approach was to emphasize the actual listening process and not rely solely on measurements. Necessary adjustments to the design would be made mainly according to listening tests.

Reference 3A MM de Capo is the latest model following this approach. It is tuned by ear to elevate the enjoyment of music. With coherent and balanced presentation, these units are crafted to allow the listener to enjoy music for much longer periods without the listening fatigue. The drivers are still hand-built by the designer and founder of Reference 3A, Daniel Dehay, in Europe.

As for Julie and Ken Kelter's subjective listening tests, I like Julie's (perhaps biased) comment, describing a crescendo from Vivaldi's Trumpet Concerto in C: "When the entire orchestra joins in with the trumpets, the room is filled with a very rich and full sound as if I am witnessing the show live."

I would like to clarify one small point regarding the MM de Capo's internal wiring. The wires are actually the best and most expensive 16 AWG wire van den Hul, in the Netherlands, produces. They are MCS-16 matched crystal silver conductors with high-grade Teflon® insulation.

A note on testing: The MM de CAPO was tested in the laboratories of Audio and Acoustics, Ltd. using the MLSSA and CLIO PC-based acoustic data acquisition and analysis systems. Acoustic data was measured with an ACO 7012 ½″ laboratory-grade condenser microphone and a custom-designed wideband, low-noise preamp. Polar response tests were performed with a computer-controlled OUTLINE turntable on loan from the Old Colony division of Audio Amateur Corporation.

REFERENCES

1. J. D'Appolito, *Testing Loudspeakers*, Audio Amateur Corporation, Peterborough, NH, 1998.