EQUIPMENT PROFILE

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DAHLQUIST M907i SPEAKER

Manufacturer's Specifications

System Type: Box-style, three-way, acoustic suspension.

Drivers: 10-in. (254-mm) cone woofer, 5-in. (127-mm) cone midrange, and 1-in. (25.4-mm) dome tweeter.

Frequency Range: 30 Hz to 24 kHz.

Sensitivity: 88 dB SPL at 1 meter for 2.83 V rms at 1 kHz.

Crossover Frequencies: 400 Hz and 3.5 kHz.

Impedance: 8 ohms nominal, 6 ohms minimum.

Recommended Amplifier Power: 40 to 150 watts per channel.

Dimensions: 27 in. H × 13½ in. W × 10⅞ in. D (68.6 cm × 34.3 cm × 27.6 cm).

Weight: 40 lbs. (18.2 kg).

Price: $1,000 per pair.

Company Address: 601 Old Willets Path, Hauppauge, N.Y. 11788.

For literature, circle No. 93

Dahlquist is best known for its series of Phased Array loudspeaker systems, which started with the Model DQ-10 in 1973. In designing these systems, Jon Dahlquist paid very close attention to loudspeaker time behavior and baffle diffraction effects. The result of these concerns was a very distinctive design with an open-air look, consisting of a rectangular grille frame in front of a broad, shallow woofer enclosure which was surmounted by a set of small, staggered baffles holding the other drivers.

Dahlquist was formed in 1973 by Saul Marantz, now retired, and Jon Dahlquist, who just recently sold the company to Carl Marchisotto, Michael Russo, and associates. Marchisotto, who currently is president, has been with the company since 1976 and has designed all of its current products.

The loudspeaker evaluated in this review is from Dahlquist's box-style "M series" monitor system line, which represents a major departure from the phased-array "DQ" line. The current line of monitors, launched in 1987, comprises four systems ranging from a small two way speaker with a 6½-inch woofer (M903) to a much larger, floor-standing, three-way design utilizing four drivers (M909).

The system reviewed here, the M907i, is Dahlquist's second largest monitor, a three-way design using a 10-inch woofer in a somewhat large bookshelf-sized enclosure of about 1½ cubic feet (42 liters). The manufacturer has placed great emphasis on minimizing the "boxy" sound of the system and calls its enclosure the "Un-Box." The company's stated goal is controlling diffraction by the use of a "unique combination of carefully selected materials, critical panel bracing, and selective damping, all of which reduce coloration."

The 5-inch midrange is loaded by a cylindrical duct that Dahlquist says "provides an aperiodic termination combined with controlled dipole radiation." The tweeter is a standard-design, 1-inch, soft-dome direct radiator. Both units are manufactured by the Danish company VIFA. The 10-inch woofer is manufactured by Dahlquist.

The systems were delivered with Dahlquist's substantial Model ST-9 wood speaker stands. Due to its slanted top surface, the stand aims the system's axis upwards at an angle of about 3.5°. This built-in angle slants the main axis of the system (chosen here to be a point halfway between the tweeter and midrange) directly toward the ears of a listener seated 3 meters away. A standing listener, at the same distance, would be above this axis by about 13°.

The M907i systems I evaluated were finished in a very nice-looking white oak veneer, as were the stands and grille trim. Walnut veneer is also available as a standard finish. The handsome grille frames were made of ⅝-inch-thick wood with oak trim on the sides. The grille is attached to the front of the cabinet with plastic studs that protrude from the front panel and engage holes in the grille frame. The grille is held off the front panel by about ¼ inch, presumably to reduce grille diffraction effects. The surface of the front panel is covered with a thin felt-like material composed of "thousands of black fibers electrostatically aligned on the baffle board." This was done, according to Dahlquist, to add absorption and reduce diffraction of sound on the cabinet's surface.

An examination of the inside of the box, with the woofer removed, revealed ¾ × 2-inch, on-edge wood braces running up and down the sides of the enclosure. All box panel surfaces were ¾-inch particleboard or plywood. Good workmanship was evident. Acoustic damping consisted of a large, 3-inch-thick fiberglass blanket running across the box and centered between the vertical braces.

Most of the exposed surfaces on the sides, top, and bottom of the cabinet were covered with 1⁄16-inch-thick sheets of an inert black material, which I assumed is a form of vibration damping. A call to Carl Marchisotto revealed that it is a proprietary vibration-damping material that he described as a "tangential extension damping pad." He stated that it is very "lossy" for motion that tends to compress or elongate the material, and small amounts of this material worked very well in damping the motion of the cabinet's side walls.

A large tube, 4¾ inches in diameter, connects the front and back panels of the cabinet, just behind the midrange driver. In addition to acting as a very rigid front/back brace, it also acts as a sub-enclosure for the midrange driver. A smaller tube, 4 inches long with a 1-inch inner diameter, vents this sub-enclosure outside through the back panel. Some fiberglass damping surrounds this tube in the sub-enclosure.

The rear panel contains the recessed input connectors (five-way binding posts spaced for double-banana plugs) along with fast-blow fuses for the woofer (3 amperes, equivalent to about 70 watts into 8 ohms) and for the tweeter (0.8 ampere, about 5 watts into 8 ohms). The crossover is fairly complex, consisting of 15 components—four air-core inductors (one large and three medium), four capacitors, and seven 5-watt power resistors. No tweeter level control is provided. The crossover was hand-wired on a ¼-inch piece of hardboard, 5 × 10 inches, attached to the rear panel. All connections to the drivers were soldered (no clips), using 18-gauge stranded wire.

Measurements

The Techron TEF System 12 Plus Time Delay Spectrometry (TDS) analyzer was used for most of the measurements in this review. The tests were performed at a number of locations, including my own listening room, Crown International's microphone test chamber, and outdoors on my driveway. The system was evaluated using elevated free-field, near-field, and ground-plane techniques.

The test of on-axis frequency response was conducted at a distance of 2 meters, on an axis halfway between the tweeter and the midrange driver, normal to the front baffle.

A first measurement made on the tweeter's axis was quite rough and depressed in the upper crossover region. The lower I moved the test microphone, the better the response was. I finally chose a point halfway between the midrange and the tweeter. The input level was 2.83 V rms, which corresponds to a level of 1 watt into the manufacturer's nominal 8-ohm rated impedance. The on-axis response was corrected to the standard distance of 1 meter for display of the data. A one-tenth octave filter was used to smooth the response.

Figure 1 shows the on-axis frequency response of the M907i both with and without its grille, measured at 1 meter for a 1-watt input. Aside from the rise above 9 kHz, the response without the grille is moderately flat (±3 dB) from 42 Hz to 9 kHz, with some roughness in the middle and high frequencies between 1 and 8 kHz. The grille adds additional roughness to the response above 1 kHz. Averaging the axial response over the range of 250 Hz to 4 kHz yields a sensitivity of approximately 87 dB SPL, a reasonable match for the manufacturer's rating of 88 dB SPL at 1 kHz.

A separate test, comparing the axial response of both right and left speakers (not shown), yielded a moderately good match of about ±1 dB over the frequency range from 100 Hz to 15 kHz. One woofer of the pair was about 1 dB hotter than its mate.

The woofer's excursion capability was assessed by sweeping with a constant-voltage, high-level sine wave covering the low-frequency range. The woofer did not exhibit any "dynamic offset" or "oil-canning" effects. (See the September 1989 issue, page 90, for more information on the "oil-can effect.") The maximum linear excursion capability of the woofer was about ±0.2 to ±0.25 inch (0.4 to 0.5 inch, peak to peak). The woofer has an effective radiating diameter of about 8¼ inches, and even though it is nominally a 10-inch unit, it is mounted in a 12-inch diameter frame. A hardboard reducer ring couples the frame to the smaller cone. Marchisotto stated that mounting the smaller cone in a larger basket makes it easier to assemble parts that would yield a quality, high-excursion driver.

The box was well sealed and had no leaks, even at high levels and low frequencies. The box side walls were quite

The driver Dahlquist uses as a midrange in the M907i has enough excursion capability to be used as a respectable woofer in a small two-way.

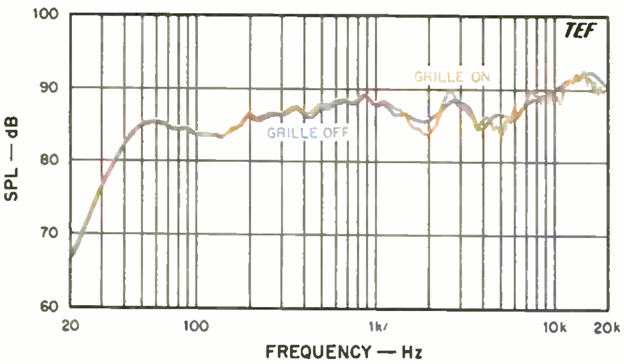


Fig. 1—On-axis frequency response with input of 2.83 V rms, equivalent to 1 watt into the rated 8-ohm impedance.

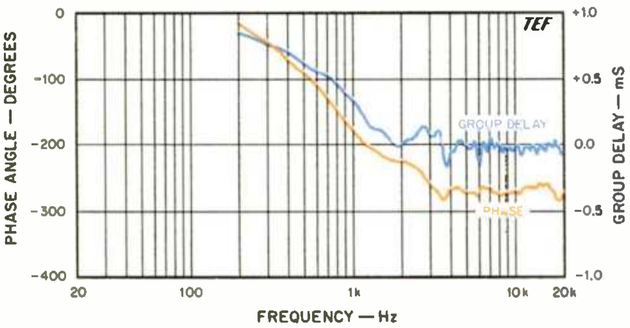


Fig. 2—One-meter, on-axis phase response (left-hand scale) and group delay (right-hand scale), with the delay adjusted for the tweeter.

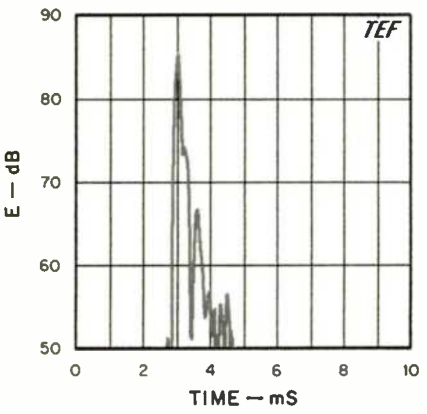


Fig. 3—One-meter, on-axis energy/time curve.

rigid and displayed minimal vibration. At high levels, there was a slight buzz, in the range between 155 and 185 Hz, which seemed to come from inside the box.

Figure 2 shows the on-axis phase and group-delay responses of the system, corrected for the time arrival of the tweeter. The phase response exhibits a total phase rotation of only 110° between 1 and 20 kHz, a commendably low amount. The group delay indicates that the midrange trails the tweeter by about 0.13 mS (130 µS), which corresponds to a distance of 1.8 inches (46 mm). At the 3.5-kHz crossover point, this offset represents approximately 0.47 wavelength or 168°.

Figure 3 shows the 1-meter, on-axis, 1-watt, energy/time curve (ETC) for a test signal swept over the range from 200 Hz to 10 kHz. Be aware that this ETC represents essentially the midrange and tweeter's response only and emphasizes energy in the range of 2 to 9 kHz. The response is satisfactory except for a minor delayed peak, 20 dB down, about 0.56 mS after the main arrival (equivalent to a 7.6-inch difference in path length). This delayed peak may result from reflections or diffractions from the cutout hole for the midrange driver; the timing is correct for this possibility. Disconnecting the tweeter by removing the fuse (fuses make disconnecting drivers very easy!) revealed that the midrange output indeed lagged the tweeter by 128 µS.

The off-axis response of the system was measured in two different ways. The first method displays the data in a "three-dimensional" TEF format, and the second method closely follows the way the on- and off-axis response curves are measured and derived at the Canadian National Research Council's test facilities (see the September 1989 issue, page 75, for more information).

Figures 4 and 5, respectively, show the "3-D" horizontal and vertical off-axis frequency response of the M907i. These curve sets were derived from response measurements made at 5° increments along the major horizontal and vertical planes of the system. No additional smoothing was done on these curves except for the fairly high-resolution smoothing by the constant 300-Hz bandwidth of the TDS data gathering process. Note that these plots have a logarithmic frequency scale and that all curves have been referenced (normalized) to the on-axis frequency response. As a result of this normalization, the on-axis response curve is shown as a straight line. Using the normalized format is beneficial because it clearly indicates the differences between the on- and off-axis curves, with the intrinsic response of the system eliminated.

The horizontal "3-D" off-axis curves in Fig. 4 indicate fairly smooth off-axis behavior, with high-frequency coverage up to 12.5 kHz out to about 50° off axis. This indicates that the M907i will have a large stereo imaging area and that pointing or aiming the speaker will not be needed.

The vertical off-axis curves in Fig. 5 clearly indicate the effects of the crossover in the range from 1.5 to 6 kHz. A deep off-axis depression zone exists in the crossover response region at angles between 5° and 25° *above* the axis. At corresponding angles below the axis, response is quite smooth in the same frequency range (not clearly shown in this plot). This indicates that Dahlquist's ST-9 stand ought to be used.

For a system with a 10-inch woofer, overall distortion was quite low through most of my tests and was mainly low-order harmonic.

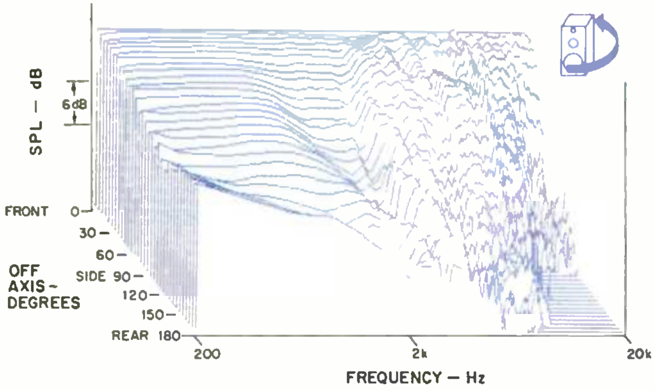


Fig. 4—Horizontal off-axis responses taken from the rear, around the side, to the front of the system. Results have been normalized to the on-axis response; see text.

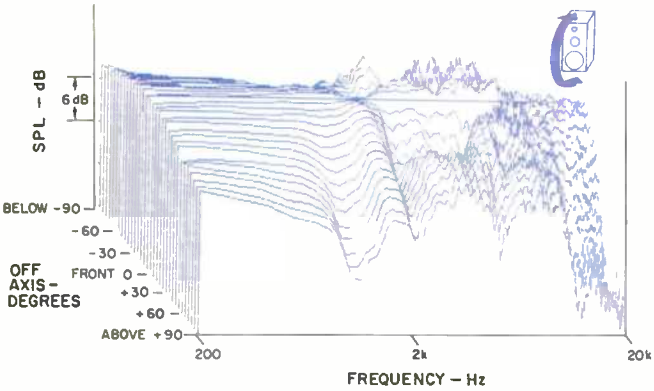


Fig. 5—Vertical off-axis responses taken from below, up the front, and to the top of the system. Lobing error is evident through the crossover region from 1.25 to 6 kHz, and there is a hole, centered at 3.5 kHz, in the region from 10° to 20° above axis; see text.

The very asymmetrical behavior of the vertical frequency responses indicates that the woofer and tweeter are significantly out of phase acoustically in the crossover region. This denotes a high amount of lobing in the crossover frequency region. A separate measurement of tweeter and midrange individual magnitude/phase responses (not shown) revealed that the drivers were indeed quite out of phase, about 90° to 150° between 2.5 and 5 kHz. (This explained why measurements on the tweeter axis do not yield a reasonably smooth frequency response.) The phasing was such that the unavoidable crossover directional lobe is aimed downwards at about 15°, with the null aimed *upwards* at about the same angle. This amount of vertical lobing and its upwards orientation will cause a very irregular upper midrange response in the direct sound for listeners who are standing.

Electrical measurements of the crossover voltage drive (not shown) established that the tweeter was rolled off below 4 kHz at 6 dB per octave. The midrange was rolled off below 800 Hz at 6 dB per octave and above 4 kHz at 12 dB per octave. The woofer had a 6-dB octave roll-off above 400 Hz. Note that the total crossover response is the combination of both the crossover electrical drive *and* the drivers' acoustical response.

Figures 6 and 7, respectively, show the mean horizontal and vertical on- and off-axis response curves of the system, measured and derived in the manner of the NRC tests. These responses were derived from the previous "3-D" data by calculating response averages of several adjacent curves in specific on- and off-axis angular regions. This spatial averaging (rather than frequency averaging or smoothing) tends to suppress the effects of localized response aberrations due to diffractive effects without minimizing overall frequency response problems exhibited over broad angles. Mean axial responses were calculated separately for horizontal and vertical planes by averaging all the individual responses in a ± 15° window. The mean off-axis responses were computed separately in both the horizontal and vertical directions from the 30° to 45° and the 60° to 75° off-axis curves.

The mean horizontal response curves are shown in Fig. 6. The mean axial horizontal response curve is somewhat flat, although moderately rough, falling within a ± 3.5 dB envelope out to 20 kHz (± 2.5 dB if the broad peak at 15 kHz is excluded). This curve represents the average frequency balance within ± 15° of the axis horizontally but on-axis vertically. The irregular 30° to 45° response fits in a tighter envelope of ± 2 dB out to 12 kHz. The 60° to 75° response fits in an envelope of ± 2 dB out to 8 kHz, where the level drops quite rapidly at higher frequencies. The fairly smooth wide-angle horizontal response indicates that the M9071 should maintain stable images over a fairly broad horizontal listening area.

The mean vertical responses are shown in Fig. 7. These curves are significantly rougher than the just-previous horizontal responses. The lobing or out-of-phase effects just above the axis, included in the ± 15° averaging, affect the mean axial vertical response (top curve) quite strongly. The mean off-axis responses (middle and bottom curves) are also significantly rougher than the horizontal curves and

The M907i handles enough power to generate sound levels greater than 120 dB SPL in the upper bass and 110 dB SPL at frequencies above 48 Hz.

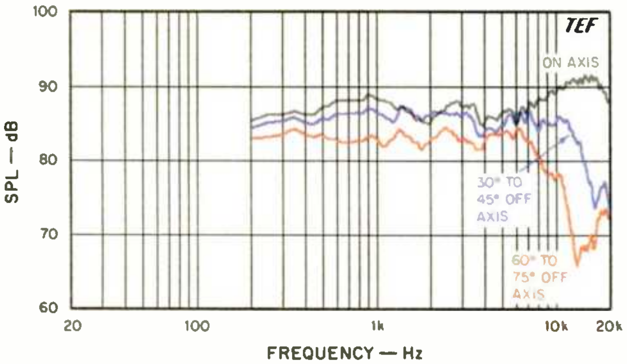


Fig. 6—Mean horizontal responses, derived from data of Fig. 4.

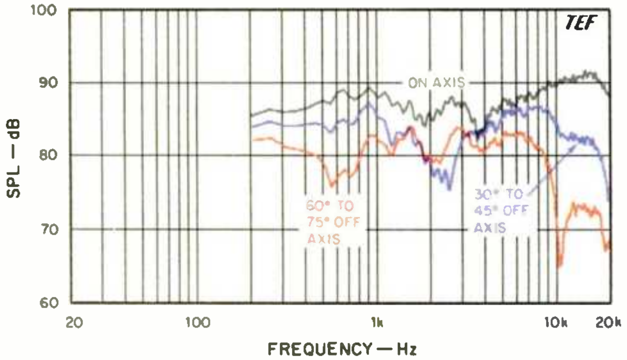


Fig. 7—Mean vertical responses, derived from data of Fig. 5.

include effects of both the woofer/midrange and midrange/tweeter crossovers. The lobing due to the upper crossover is quite apparent in the 30° to 45° response as an octave-wide hole centered at 2.3 kHz.

The effect of the cylindrical duct loading on the midrange was assessed by making separate near-field measurements on the midrange driver and the output of the tubular duct on the rear of the enclosure. An examination of the inside of the cylindrical sub-enclosure revealed that it is essentially a form of vented-box (bass-reflex) loading of the midrange. A direct hookup to the midrange, with a high-level sine-wave sweep, indicated that the box resonance frequency was about 85 Hz. This is the frequency where the tuning minimizes the excursion of the midrange. This tuning frequency is much too low to have any effect within the operating frequency range of the midrange driver. Near-field response sweeps of the midrange, conducted with the system's vent tube both covered and uncovered, showed absolutely no change in its output at frequencies above 200 Hz (not shown). The vent did affect the driver's output in the range from 50 to 200 Hz, however, by a maximum of about 1 dB.

While the box tuning that resulted from the tube had no effect within the midrange's operating frequency, a near-field response measurement taken at the tube's outlet, behind the enclosure, showed that the tube itself did have appreciable resonant output within the driver's operating range. This took the form of a narrow, half-wave organ pipe resonance, with a high Q (about 9) at 1,360 Hz and a peak some 12 dB below the output of the midrange. The second and third overtones of the tube's resonance were also clearly evident. This is definitely not aperiodic (nonresonant), as claimed. On theoretical grounds, I suggest covering the tube or stuffing it so that it can't radiate into the room; however, I couldn't hear any difference from doing this.

This 5-inch driver, even though it is used here as a midrange, could be used as a very respectable bass speaker in a small two-way system due to its roughly 0.3-inch, peak-to-peak excursion capabilities. The driver is hardly being exercised in the M907i.

Figure 8 shows the input impedance of the M907i, plotted over the range from 20 Hz to 20 kHz and with a logarithmic vertical scale covering 1 to 100 ohms. A minimum impedance of 5.1 ohms at 80 Hz, and a maximum of 20 ohms at the low-frequency closed-box resonance of 43 Hz, were measured.

The complex phase (Nyquist) polar plot of the impedance, covering the range from 10 Hz to 30 kHz, is shown in Fig. 9. The polar curve is quite well behaved, with no minor loops. This indicates that there are no spurious higher order resonances in the cabinet or in the woofer's moving system. The flattened corners and sharp bends of the large, low-frequency resonance circle are caused not by the speaker system but by my measurements, which under-sampled the response data. I should have decreased the width of my analysis sweep to get higher resolution in this particular frequency area.

The maximum positive (inductive) phase angle of 32° was attained at 38 Hz. The maximum negative (capacitive) phase angle of −40° was reached at 51 Hz. These moderate maximum phase angles will present no problems to any reasonably well-designed amplifier. The impedance of the M907i is quite well behaved.

Figure 10 shows the 3-meter room curve of the system, located in the right-channel stereo position, with the test microphone placed at ear height, on the sofa, where the listener normally sits. The system was swept from 100 Hz to 20 kHz with a 2.83 V rms sine-wave signal (equivalent to 1 watt into 8 ohms). The resultant SPL can be read directly off the graph. Also shown is a sixth-octave, smoothed version of the curve. The parameters of the TDS sweep were chosen to include the direct sound plus 13 mS of the room's first reflections. This amount of room sound represents approximately the effective averaging of the human ear, with its emphasis on the direct sound plus early energy arrivals. In general, the curve is well behaved except for a rough upper midrange and a high-frequency rise between 8 and 20 kHz. The effect of the floor-bounce reflection is clearly seen at about 370 Hz; the height of the woofer heavily influences the frequency of this effect.

My early listening disclosed good control of the lateral soundstage and a top end whose forward sound made my reference system seem dull.

The distortion characteristics were measured in two different ways, by obtaining three spectra for single-frequency harmonic distortion versus power and by running an IM distortion versus power measurement.

Figures 11, 12, and 13, respectively, show the single-frequency harmonic distortion spectra versus power level for the musical notes of E_1 (41.2 Hz), A_2 (110 Hz), and A_4 (440 Hz). These curves indicate the level of harmonic distortion generated by the system with the application of a single-frequency sine wave at power levels covering the range of 0.05 to 50 watts (−13 to 17 dBW, a 30-dB dynamic range). The power levels were computed assuming the rated impedance of 8 ohms. I choose to limit the maximum power to 50 watts, not because of excessive distortion but because the woofer is protected with a 3-ampere fuse. This theoretically limits the system to roughly 70 watts into 8 ohms. (By Ohm's Law, power equals I^2R, so 3 amperes squared times 8 ohms equals 72 watts.) Neither the woofer nor the tweeter fuses blew during these tests or the tests of IM and peak power.

The curves were run by successively increasing the sine-wave input level in 1-dB increments (each step about 26% higher in power than the previous level). At each power level, a swept spectrum analysis was done over a frequency range covering up to the fifth or sixth harmonic. Two precision 1-dB/step attenuators were used in the setup—one in the send path and one in the receive path—to ensure that the power level steps were accurate. The receive attenuator provides a constant fundamental level to the spectrum analyzer so that distortion percentages can be directly read off the plotted data scales.

Figure 11 shows the harmonic data for E_1 (41.2 Hz). The nonharmonically related spikes at lower power levels are due to background noise in the test setup and were not generated by the speaker. The narrow, constant-height ridge at the left of the display, seen in Fig. 11 and in the following two Figures, is a test artifact and not due to the system under test. The ridge is due to spectrum residuals of the fundamental signal. At lower power levels, the second and third harmonics predominated. At higher levels, these were joined by the fourth, fifth, and sixth harmonics. The distortion levels shown are reasonable for a 10-inch driver at such power levels. Remember that an output of 50 watts generates SPLs in excess of 100 dB (that's loud!) in the low-frequency and mid-band ranges of this system.

The harmonic data for A_2 (110 Hz) is shown in Fig. 12. The data shows that only the second and third harmonics were significant. The second harmonic increases gradually with power, reaching a level of 7.6% at 50 watts. The third harmonic is quite low over most of the range and reaches a level of only 1.3% at 50 watts.

Figure 13 shows harmonic measurements for A_4 (440 Hz). Again, the predominant distortion is a low amount of second and third harmonics, with negligible amounts of higher order distortion.

Figure 14 shows the IM created when the Dahlquists were fed a 440-Hz (A_4) tone and a 41.2-Hz (E_1) tone at equal power levels. The IM distortion gradually rises with power, reaching about 5% at 20 watts and 11% at 50 watts. The first-order ($f_2 \pm f_1$) and second-order ($f_2 \pm 2f_1$) side frequen-

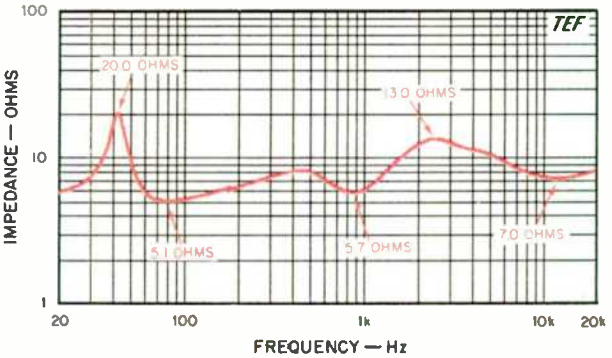
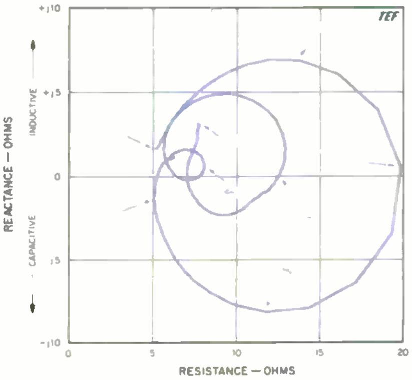


Fig. 8—Magnitude of impedance. Note the logarithmic impedance scale.

Fig. 9—Complex impedance.



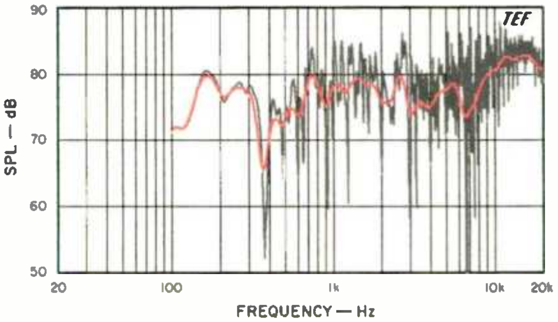


Fig. 10—Three-meter room response containing direct sound plus 13 mS of room reflections. Irregular curve is raw data, smooth curve is sixth-octave average; see text.

Except on loud, low organ notes that few systems can handle adequately, these speakers sounded clean at all playback levels.

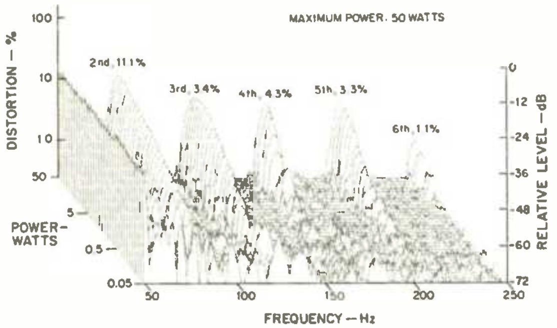


Fig. 11—Harmonic distortion products for the tone E_1 (41.2 Hz).

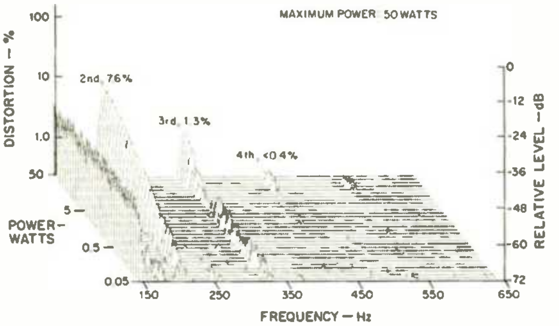


Fig. 12—Harmonic distortion products for the tone A_2 (110 Hz). Only the second and third harmonics were significant in this power range.

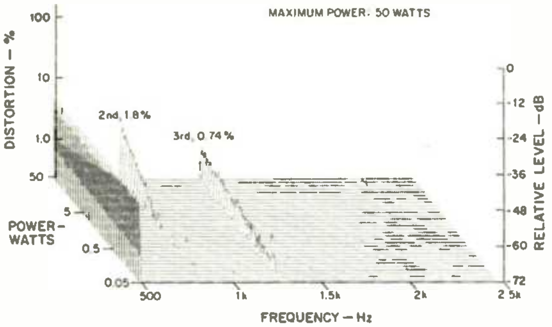


Fig. 13—Harmonic distortion products for the tone A_4 (440 Hz). Only relatively low amounts of second and third harmonics are evident; other distortion products were below the 0.2% measurement floor.

cies predominate in this power range. These levels of IM distortion are reasonable for a system having a woofer diameter of 10 inches.

Overall, the distortion measurements on the M907i are quite low and are reasonable for a three-way system with 10-inch woofer.

Figures 15 and 16 show the short-term, peak power input and output capabilities of the system, as a function of frequency. The tests were run by applying a shaped, third-octave tone-burst signal consisting of 6½ cycles of a sine wave shaped using a Hamming raised-cosine envelope. The resultant test signal covers a third-octave bandwidth and has a time duration that increases as the frequency goes down. The burst is presented at such a low duty cycle that the long-term thermal characteristics of the speaker under test are not exercised. The test consisted of evaluating the maximum peak input power-handling capacity and maximum output peak sound pressure levels at all the third-octave center frequencies between 20 Hz and 20 kHz. A very powerful amplifier, which can generate 5,500 watts peak (+37 dBW, ±210 V into an 8-ohm load), was used to drive the system. The peak input power was calculated by squaring the measured peak driving voltage and dividing by the rated 8-ohm impedance.

The test sequence consisted of determining how much of the special test signal could be handled by the speaker, at each frequency, before either the output sounded audibly distorted or the acoustic output waveform appeared distorted on a 'scope, whichever occurred first. At each frequency, I recorded the maximum peak input voltage and the corresponding generated peak output sound pressure level at 1 meter. At low frequencies, the 'scope waveform defined the power limit, while at higher frequencies the audible effects defined the limit. I found that I was aurally quite tolerant of rather high distortion levels (primarily second and third harmonic distortion) at low frequencies but was very critical of even slight audible distortion at mid and high frequencies.

Figure 15 shows the maximum peak electrical input power-handling capacity of the M907i. The peak input power-handling capacity is seen to rise with frequency until about 400 Hz, where it levels out at about 4.5 kW. Above 4 kHz, the power is limited to 5.5 kW due to clipping of the test amplifier! A slight depression at 2.5 kHz is noted, in the low end of the tweeter's range, presumably due to tweeter excursion limitations. The system cannot handle more than about 12 watts below 25 Hz for moderately clean output. It can actually handle more power than the curves show but at the expense of much greater distortion and possible risk of damage at higher frequencies.

Figure 16 illustrates the maximum peak sound pressure levels the system generated at a distance of 1 meter, on axis, for the levels shown in Fig. 15. Also shown is the "room gain" of a typical listening room at low frequencies. This adds about 3 dB to the response at 80 Hz and 6 dB at 30 Hz. (The room gain data was taken from a paper by Martin Colloms given at the Symposium on Perception of Reproduced Sound in Denmark in 1987. This and many other very informative papers are included in *Perception of Reproduced Sound*. This book, which was reviewed in the April

The M907i has good dynamics and lots of bite, along with a smooth bass and realistic presentation of everything from coughs to concertos.

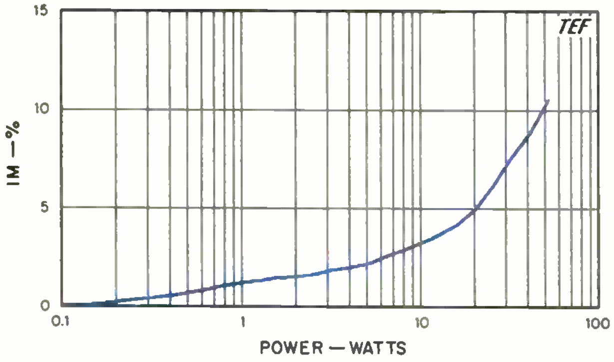


Fig. 14—IM distortion produced by mixing A_4 (440 Hz) and E_1 (41.2 Hz) in equal proportion; see text.

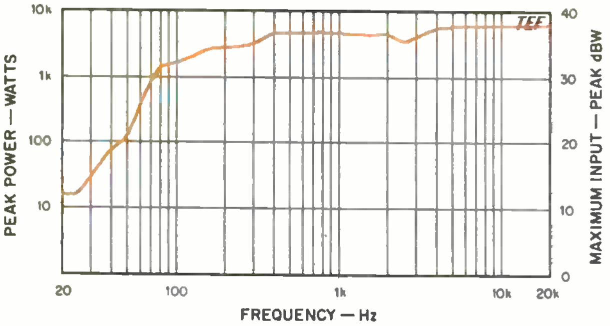


Fig. 15—Maximum peak input power for moderately clean output; see text.

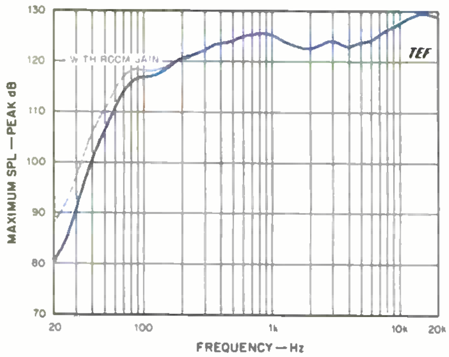


Fig. 16—Maximum peak sound output, measured at 1 meter on axis, for the input levels shown in Fig. 15. The curve for room gain shows low-frequency augmentation by a typical listening room. With room gain, the system can generate peak levels in excess of 120 dB SPL at frequencies above 180 Hz and 110 dB SPL above 48 Hz; see text.

1989 issue of *Audio*, is available from Old Colony Sound Lab, P.O. Box 576, Peterborough, N.H. 03458. I highly recommend it for any serious student of loudspeakers and the subjective evaluation of reproduced sound.)

With room gain, a single system can generate very respectable peak levels, in excess of 120 dB SPL above 180 Hz and 110 dB SPL above 48 Hz. Of course, a pair of these systems, operating with mono bass, will be able to generate levels some 3 to 6 dB higher in the critical low-frequency range. (Read Bert Whyte's "Behind The Scenes" in the June 1990 issue for some very pertinent comments on bass reproduction and the significance of the low-frequency thresholds at 110 and 120 dB SPL.)

Use and Listening Tests

Listening was conducted in my new listening room. It is fairly large, having a volume of about 3,400 cubic feet. The room is approximately 15½ feet wide, 8 feet high, and 27 feet long. Its floor is carpeted, and it has normal living-room furnishings. The short wall is filled with deep, floor-to-ceiling bookshelves and an equipment cabinet. Listening equipment consisted of an Onkyo Grand Integra DX-G10 CD player, a Krell KSP-7B preamp, a Krell KSA-200B power amplifier, and Straight Wire Maestro interconnects and speaker cables. Most of my listening evaluation was done before the measurements were made on the speakers.

In its two-page instruction guide, Dahlquist presents very general recommendations for positioning the systems. The instructions suggest that the speakers will "perform best with plenty of 'air' around them" and that one shouldn't place them less than 6 inches away from the wall or pack them tightly against furniture. All listening was done with the systems placed on the supplied Model ST-9 stands.

The speakers were placed well out in the room, 6 feet away from the short wall, and separated by about 8 feet. This left a space of about 4 feet from the side walls. The systems were aimed horizontally at my normal listening position so that I was on the midrange/tweeter axis of the enclosure. Most listening took place on the sofa, about 10 feet away.

My initial exposure to the systems disclosed a well-controlled lateral soundstage with good smoothness but with a forward-sounding top end that emphasized instruments having appreciable high-frequency content, such as cymbals or tambourines, and sibilant sounds in the human voice. The high-frequency emphasis bordered on spittiness on such selections as "Bird on a Wire" by Jennifer Warnes on the B & K Pro Audio sampler (CD-4090). However, the elevated high-frequency response of the systems was quite revealing on a number of the selections I auditioned. It was quite easy to become accustomed to the high-frequency lift; it made my reference systems sound dull in comparison!

The systems sounded very clean at all playback levels, with the exception of selections with very high-level, low-frequency content such as the organ version of *Pictures at an Exhibition* (Dorian DOR-90117); few systems can handle this disc adequately! Even with this CD, the systems did a very respectable job on the organ pedal notes at reasonable playback levels. With more contemporary source material—such as rock/pop with high-level, higher frequency bass—the systems did an extremely good job at high levels.

The Dahlquists did very well in the areas of clarity, bass response, low distortion, high maximum output, and good time/phase response.

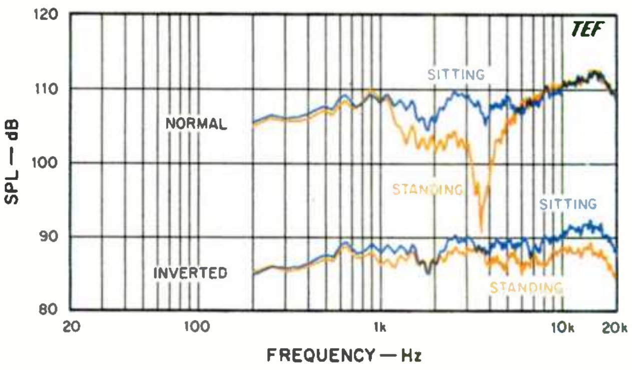


Fig. 17—Derived frequency response curves for seated and standing listeners with speakers in normal and inverted positions. The curves for the upright speaker position have been raised 20 dB for clarity. The response for standing listeners is considerably flatter with the system inverted; see text.

On Bob Mintzer's Big Band disc, *Incredible Journey* (dmp CD-451), the systems exhibited good dynamics, with lots of "bite" on the horns and a smooth bass line. The systems were quite revealing on the recording of Mozart's Piano Concerto No. 13 included in *Midsummer Mozart Festival Orchestra—Live* (Bainbridge BCD-6273). This disc, recorded live with the Colossus system, is very smooth, natural, and realistic sounding. The Dahlquists reproduced the occasional live cough and the applause at the end of the last cut with quite good realism.

On pink noise, the systems barely passed the walk-around, stand-up, sit-down test to check evenness of coverage. The side-to-side coverage was quite good, but major changes in upper midrange timbre were heard when I moved up and down. In contrast, my reference systems' tonal quality changes very little with changes in listening height.

The measurements showed something that my earlier listening tests could not—that the system had a much smoother response at angles below its center axis than above. I then did a series of listening tests with the systems inverted rather than in the normal configuration, which greatly improved two areas of performance—the rough upper midrange and the boosted high frequencies. Though brighter than the reference when I listened seated, the Dahlquist was quite close to the reference when I stood up, so that it easily passed the stand-up, sit-down test when inverted.

These lobing changes and their effects on frequency response are, paradoxically, due to Dahlquist's long-standing emphasis on linear phase response. The M907i's curves for phase angle and group delay show far less phase rotation than do those of the NHT Model II reviewed in the July 1990 issue, for example. If you were to reverse the tweeter's polarity, you would get a good deal of improvement in the midrange/tweeter crossover region in an upward direction. This doesn't change the upper bass response, but the phase linearity would suffer. Unfortunately, in speaker design, it's not possible to optimize any one thing without adversely affecting others.

This will become clearer when you look at Fig. 17, which shows unsmoothed response of the system, both upright and inverted, taken at angles corresponding to listeners sitting and standing 3 meters away. (The top set is raised 20 dB for clarity.) These curves were derived from the previous off-axis curves, rather than being new measurements, but they do correspond to what I heard, which is that the speaker is much smoother when it is inverted. For sitting and standing, the regular curves correspond to vertical angles of 0° and +12.5°, respectively, while the inverted curves are for −5° and −15°.

Since woofer height changes when the system is inverted, the upper bass response will change as well, depending on room conditions. In my room, the systems' low end was affected primarily in the range from 80 Hz to 220 Hz by two third-octave-wide dips of 3 to 5 dB. However, this same configuration also yielded much better reproduction of the up and over illusions on the Listening Environment Diagnostic Recording test. (This test is track #51 of the Prosonus *Studio Reference Disc* and track #11 on Chesky Records' *Jazz Sampler & Audiophile Test Compact Disc, Vol. 1*, Chesky JD37). To convincingly reproduce these effects of the LEDR test requires a system that has smooth upper midrange response, particularly in upward directions that contribute to ceiling reflections. With this arrangement, the Dahlquist systems also did a particularly good job with the a cappella choir of the Cambridge Singers' disc, *A Portrait of the Cambridge Singers* (Collegium CSCD 500).

To sum up, I have mixed feelings about the Dahlquist's M907i speakers. They made very good account of themselves in the areas of innovative enclosure design and cosmetics, bass response, clarity, low distortion, high maximum output, and well-behaved time and phase response but came up short in emphasis of high frequencies and poor vertical coverage. However, inverting the systems removed my objections to the vertical coverage and minimized the high-frequency emphasis somewhat. You definitely need to audition these systems for yourself to decide whether they fit your needs. *D. B. Keele, Jr.*