# "HIGHLY RECOMMENDED!"

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*"The Studio/100 delivers an excellent combination of attributes."*

**The New Studio/100**
*(Improved over version reviewed for even etter sound.)*

by D.B. Keele, Jr.

The last Paradigm speaker I tested, the Eclipse/BP, was a bipolar system. But the Studio/100, which comes from this Canadian company's new Paradigm Reference division, is a conventional, front-radiating design. The four speakers in the Reference division's Studio series, of which the Studio/100 is the top model, are meant to compete with high-end models while selling for relatively modest prices.

To achieve the Reference Studio series' goals, Paradigm—which makes all its own drivers, crossovers, and cabinets—concentrated on the speakers' sound, as judged by double-blind listening tests, and not on fancy features that don't directly contribute to the sound. Though the company has extensive engineering and R&D facilities, it also uses the findings of Canada's National Research Council. Through its studies, the National Research Council has found that listeners prefer speakers that have flat and smooth on- and off-axis frequency response (particularly through the mid-range), smooth total energy response, and low distortion.

The Reference Studio/100 is a three-way, floor-standing system that uses four drivers: two vertically stacked 8-inch woofers in a vented enclosure, one 6-inch midrange in a sealed enclosure, and a 1-inch tweeter. The cabinet is only 10-1/4 inches wide but is 16-1/4 inches deep. A long port tube, with a large diameter and flared ends, emerges just below the woofers. It tunes the vented box to 20 Hz, which lets the Studio/100 generate usable power down to 17 or 18 Hz—uncommonly low, even for subwoofers. Tuning the system this low raises the risk of increased distortion at higher frequencies, where most of the bass energy in recordings typically resides. For this reason, designers of vented boxes usually choose higher tuning frequencies, between about 32 and 45 Hz; this minimizes bass distortion on most music.

The Studio/100's long-throw woofers and midrange driver have damped, mineral- and mica-loaded polymer cones, which

are said to provide smooth, uncolored response. These drivers also have large magnet assemblies with symmetrical field geometry, high-temperature multi-layer voice-coils, damped butyl-rubber surrounds, and diecast aluminum frames.

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The tweeter has a low-mass aluminum dome with a textile suspension. Its voice coil is wound on a ventilated aluminum former and is cooled with magnetic fluid. The tweeter's faceplate is tapered, to minimize diffraction and to smooth on- and off-axis response.

Paradigm says it designs its drivers to have near-ideal response instead of designing crossovers to correct the drivers' flaws. This allows the use of simple crossover networks. The company states that its crossovers are phase coherent, quasi-Butterworth designs built with high-quality, close-tolerance components. The Studio/100's crossover is on two small PC boards, one each for the high and low frequencies, and is on the rear of the input connector cup. It contains 10 components: two resistors, four inductors, and four capacitors. The woofers are connected in parallel and driven by a second-order low-pass filter. The midrange driver is fed by a bandpass network consisting of second-order low- and high-pass filters. The tweeter crossover is a second-order high-pass filter. The midrange and tweeter are connected in opposite polarity to the woofers. Heavy-gauge copper cable is used for all internal connections, and the gold-plated input terminals can accept cables of large diameter. The terminals allow bi-wired or bi-amplified connections; straps are provided for conventional, single-cable, wiring.

The Studio/100 was designed to sound best with its grille on. The grille fits flush with the drivers, to minimize edge diffraction and smooth the response.

*"… very broad horizontal and vertical coverage … The Paradigms did particularly well with the percussion and high-frequency sounds … response was smooth and extended … bass response on this music was very satisfying; the Paradigm's delivered a lot of punch and articulation."*

Like the Eclipse/BP, the Studio/100's cabinet uses a bracing system that Paradigm calls the Cascade™ Enclosure. Three large, full-perimeter shelf braces (effectively, shelves with large holes) connect the Studio/100's front, back, and side panels. Vertical braces lock the shelf braces to each other and to the cabinet's top and bottom. This assembly is said to be very rigid and strong. The cabinet stands on gold-plated, solid-brass, adjustable feet that have sharp spikes and locking collars.

## MEASUREMENTS

I measure anechoic frequency response with and without a speaker's grille and usually find that leaving the grille on makes the response rougher. But with the Studio/100, I got much smoother and flatter response with the grille on (Fig. 1). Without the grille, there's a fairly sharp dip of about 6 dB at 6.9 kHz and a shallow dip at 1.9 kHz. With the grille, the curve is significantly smoother between 1 and 10 kHz but has a slight depression, two-thirds of an octave wide, just above 10 kHz. This curve fits a tight, 4.5 dB, window between 39 Hz and 20 kHz, essentially meeting Paradigm's specification; between 41 Hz and 10 kHz, the curve fits a much tighter, 3 dB window. Bass response is quite extended: 3 dB down at about 40 Hz, 6 dB down at 37 Hz, and 10 dB down at about 30 Hz. In a typical listening room, a pair of Studio/100's would provide even greater low-frequency output and extension.

The Studio/100's sensitivity, averaged from 250 Hz to 4 kHz, measured 87.8 dB, essentially as specified. The right and left speakers matched fairly closely, ±0.6 dB from 100 Hz to 16 kHz. Above 16 kHz, however, one speaker's output rose above its mate's, becoming 4 dB louder by 20 kHz.

*"The Paradigm Studio/100 is one of the few speakers that can properly reproduce the low, 22-Hz note on track 4 of Respighi's 'Pines of Rome' (London 410145). Even fewer can do justice to the 17-Hz organ pedal note on track 2 of Saint-Saëns Symphony No. 3 (Philips 412619), but the Studio/100 succeeded here as well."*

Figure 2 shows the Studio/100's phase and group-delay responses, referenced to the tweeter's arrival time, as well as the speaker's waveform phase. The phase curve is quite smooth and well behaved. The group-delay curve, averaged between 1 and 3 kHz, indicates that the midrange is delayed about 0.36 millisecond relative to the tweeter. This is caused partly by electrical delay in the crossover and partly by misalignment of the driver's acoustic centers. The curve of waveform phase indicates whether waveshapes will be preserved in specific frequency ranges. The Paradigm's waveform phase continually changes with frequency, never remaining at or near 0° or 180°. Therefore, waveforms will not be preserved over any significant bandwidth. This behavior, however, is very typical of speakers not specifically designed to maintain waveform phase.

Figure 3 shows the Studio/100's off-axis response over a range of horizontal angles (the bold curve at the rear of the graph is the on-axis response). These curves are very well behaved and exhibit no high-frequency rolloff above 10 kHz in the main horizontal listening window (within ±15° of the axis). The curve-to-curve uniformity is excellent.

The Studio/100's vertical off-axis response is shown in Fig. 4 (on-axis response is the bold curve near the center of the graph). Response in the main vertical listening window (within ±15° of the axis) is very uniform on-axis and above the axis. Below the axis, there's a slight depression between 1 and 3 kHz, just below the upper crossover

(not clearly seen, because the curves in front of it are higher). Above and below the main listening window, the response exhibits a deep dip at about 2 kHz.

*"The Studio/100's also reproduced the orchestral passages … very well – smoothly and cleanly and with a broad, accurate soundstage."*

At low frequencies, the Studio/100's impedance magnitude (Fig. 5A) has the normal double-peak characteristic of a vented enclosure. But in this speaker, the first peak is below the audio band, at 12 Hz; the second peak is at 39 Hz; and the dip between them is at 20 Hz, the frequency to which the vented box is tuned. These measured frequencies are significantly lower than in most other speakers. After reaching a minimum of 3 ohms at 95 Hz, the Studio/100's impedance rises smoothly and reaches a peak of 16.6 ohms at 2.8 kHz, just below the upper crossover. The Studio/100's impedance phase (Fig. 5B) reaches its minimum of -33° (capacitive) at 55 Hz and its maximum of +50° (inductive) at about 600 Hz. These values, along with the speaker's low (3-ohm) minimum impedance, indicate that the Studio/100 will be a moderately difficult load for most amplifiers; I would definitely not recommend wiring two pairs of Studio/100's in parallel.

The Studio/100's cabinet was quite rigid; there were no significant side-wall resonances. The 8-inch woofers had a generous excursion capability of about 0.55 inch, peak to peak, and overloaded quite gracefully. I noted no dynamic offset at any drive level or frequency. The vented enclosure reduced the woofers' excursion by about two-thirds at 20 Hz, the enclosure's resonant frequency, a sign that the woofer is very well loaded. (I tested excursion by temporarily covering the vents.) Noise and turbulence from the vent were among the lowest I've measured, even when I fed the speaker high power at the enclosure's 20-Hz resonant frequency.

Figure 6 shows the Studio/100's 3-meter room response, with both raw and sixth-octave-smoothed data. Overall, the averaged curve is quite well behaved and balanced, and it does not have any extreme peaks or dips. Aside from a peak at 290 Hz, the averaged curve fits a fairly tight, 8-dB, window, including a slight reduction in level above 6 kHz.

*"These Paradigms reproduced the loud, massive chords with great authority and did not diminish the power of the composition, the performer, or the piano he played."*

In Fig. 7, the Studio/100's E1 (41.2-Hz) harmonic distortion, the most prominent component (reaching a high 24% with an input of 100 watts) is the third harmonic. This is a sign of symmetrical excursion limiting. The other harmonics, though lower, are still relatively high. Despite fairly high distortion at E1, the Paradigm speaker sounded fairly clean, thanks to low levels of higher-order harmonics (not seen in the graph). As noted earlier, tuning the woofer enclosure very low, to 20 Hz, reduces the distortion at very low frequencies but does not reduce it at higher bass frequencies, such as the 41.2 Hz tone used in this test. Even so, the A2 (110 Hz) harmonic distortion (not shown) rose to only 1.4% second harmonic and 0.9% third at 100 watts. Higher harmonics were below the floor of my measuring gear. The A4 (440 Hz) harmonic distortion (not shown) was also low, with the third harmonic reaching only 2.5% and the second and higher harmonics remaining below 0.2%. The Studio/100's intermodulation distortion (IM), tested with 440-Hz (A4) and 41.2-Hz (E1) tones of equal power, reaches only 6.3% at full power (Fig. 8). This is because the Paradigm's lower crossover frequency occurs at 270 Hz, which falls between the two tones of the IM test; as a result, the woofer handles the lower (E1) tone's energy and the midrange handles the higher (A4) tone.

Figure 9 shows the Studio/100's short-term peak input and output capabilities as a function of frequency. The peak input power starts very high (450 watts at 20 Hz), falls somewhat (to 150 watts at 45 Hz), rises to a small plateau (about 1,400 watts between 100 and 160 Hz), and then rises smoothly (to 7,000 watts above 800 Hz). The high power handling at 20 Hz is a direct result of the woofer enclosure's low tuning frequency; if the cabinet were tuned higher, to a more typical 40 Hz or so, power handling would rise significantly at 40 Hz but the 20-Hz power handling would be reduced considerably. The benefits of the Studio/100's low tuning outweigh the drawbacks.

As you can see in Fig. 9, the Studio/100's peak acoustic output with room gain starts very high, at 108 dB SPL at 20 Hz, one of the highest 20-Hz levels I have measured. The peak output then rises smoothly, first reaching 121 to 123 dB SPL between 90 and 250 Hz and then rising to the high range of 125 to 126 dB at all higher frequencies. The 110-dB SPL level is reached at a very low 22 Hz, and 120 dB SPL is reached at 70 Hz. The lower the frequency at which a speaker can deliver 110 dB SPL, the better its bass output. The Studio/100's 110-dB frequency is matched by only one other speaker I've tested, the Hsu Research HRSW10 subwoofer and surpassed only by the Legacy Convergence. You don't need to use a separate subwoofer with this Paradigm!

## USE AND LISTENING TESTS

The Paradigm Studio/100's were quite simple to unpack, move around, and set up. They're just about the maximum weight and size one person can handle easily. For the money, construction quality and appearance were very good. The cabinets were vinyl-wrapped yet looked quite handsome.

The grille is designed as an integral part of the Studio/100. Without the grille, the drivers protrude from the front baffle to a distance that just equals the thickness of the wooden grille frame. When the grille is in place, the drivers' edges essentially disappear, and the front of the system forms a smooth, diffraction-free surface. The grille, which attaches with pegs that fit sockets in the baffle, was easy to remove and reinstall.

The speaker's spiked feet were also easy to attach and remove. The spikes pass through thick brass locking collars that

can be used as ordinary feet if the spikes are reversed. I used the speakers with the spikes in place. Paradigm recommends that the Studio/100's be broken in before use, so I fed them a high-level, low frequency sine wave for several hours. I used conventional (single) wiring; the rear-mounted terminals were easily accessible.

*"The Studio/100's played rock and modern country music at near-concert levels. The bass was satisfyingly gut-thumping, and I could really get into the large-scale presentation."*

The owner's manual folds out into six 8-1/2 x 11-inch pages, one side in English and the other French, and covers all models in Paradigm's Studio series. It discusses the listening room, speaker location, connections (including a chart of suggested cable size versus length), prevention of speaker damage, bi-wiring and passive bi-amping (driving the speaker's high and low sections with separate amplifiers but without an external electronic crossover). Paradigm recommends aiming the speakers toward the listener (which I did in my listening tests) and spacing them somewhat closer together that I normally do—6 feet apart for a distance of 9 feet from listener to speaker. (I normally space speakers 8 feet apart and sit 10 feet away).

Spoiled by the performance of the speakers I tested for *Audio* last month, the KEF Model Fours (which cost about three times as much as the Studio/100's), my expectations for the Paradigm's were not very high. Boy, was I surprised! From the beginning, the Studio/100's made an extremely favorable impression. They rattled my windows and doors on music that had high levels of low bass yet accurately reproduced the subtle nuances and room ambience of well-recorded chamber music.

On Pat Coil's excellent jazz/pop album *Schemes and Dreams* (Sheffield Lab 10042-2-F), the Studio/100's sound and spectral balance were very similar to those of the B&W 801 Matrix Series 3 speakers I used for comparison. The Paradigm's did particularly well with the percussion and high-frequency sounds on this disc; their response was smooth and extended, without the hardness I've heard from some metal-dome tweeters. Their bass response on this music was very satisfying; the Paradigm's delivered a lot of punch and articulation at only slightly lower levels than the B&W's did. The Latin horns on track 6 were loud, clean, and pure, and their presentation was properly up-front. I had to turn the Paradigms down by about 2 to 2.5 dB so that they would not be louder than the B&W's. The Studio/100's also had very broad horizontal and vertical coverage. With pink noise, the Paradigm's went as far up and down the scale as the B&W's, sounding just slightly different from the 801's; a bit of tonality was evident in the midrange that the B&W's did not exhibit. On the stand-up/sit-down test, the Paradigms' fine performance equaled that of the B&W's. With band-limited pink noise, the Studio/100's clean output at the lowest (20 Hz) third-octave band equaled that of the best systems I have tested. There was less wind noise and turbulence from the Paradigm's port than from the B&W's played at the same level. The Paradigm's output in the next few third-octave bands was also extremely good. However, I noticed some limiting of the output at 32 and 40 Hz as compared to the B&W's output.

*"Well-recorded female vocals … were quite realistic, and the Studio/100's reproduced the delicate hall reverberations with a spacious and uncolored immediacy."*

The Paradigm Studio/100 is one of the few speakers that can properly reproduce the low, 22 Hz note on track 4 of Respighi's "Pines of Rome" (London 410145). Even fewer can do justice to the 17-Hz organ pedal note on track 2 of Saint-Saëns' Symphony No. 3 (Philips 412619), but the Studio/100 succeeded here as well. When I play these two CD's through most speakers, I either don't hear this bass or hear intermodulation distortion of the higher frequencies. The Studio/100's also reproduced the orchestral passages on these discs very well–smoothly and cleanly and with a broad, accurate soundstage.

*"… the Paradigm's low bass response is superior, bordering on phenomenal (pipe-organ aficionados, take note). The Studio/100 delivers an excellent combination of attributes. It can play loud and clean while maintaining superb overall sound quality, has extended bass response, and also looks quite good – all for a reasonable price."*

These Paradigm speakers handled the extreme dynamics of the Rachmaninoff piece (track 18) on Antonin Kubalek's fine piano CD. *My Gift to You* (Dorian DOR-90218), very well. These Paradigm's reproduced the loud, massive chords with great authority and did not diminish the power of the composition, the performer, or the piano he played. The Studio/100's played rock and modern country music at near-concert levels. The bass was satisfyingly gut-thumping, and I could really get into the large-scale presentation.

Well-recorded female vocals, such as on *Jewels of the Polish Baroque* (Dorian Discovery DIS-80136), were quite realistic, and the Studio/100's reproduced the delicate hall reverberations with a spacious and uncolored immediacy. The trumpets on track 7 were particularly effective: I heard no trace of hardness.

Reviewing two excellent systems in a row, the KEF Model Fours and these Paradigm's, has made my job very enjoyable. The Studio/100 has many of the same fine qualities as the Model Four, but its price is far lower. And the Paradigm's low bass response is superior, bordering on the phenomenal (pipe-organ aficionados, take note). The Studio/100 delivers an excellent combination of attributes. It can play loud and clean while maintaining superb overall sound quality, has extended bass response, and also looks quite good—all for a reasonable price. Highly recommended!

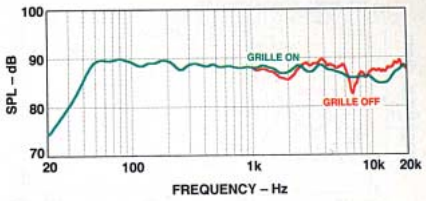



Fig. 1—One-meter, on-axis frequency response.

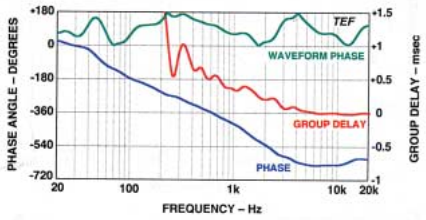



Fig. 2—On-axis phase response, group delay, and waveform phase.

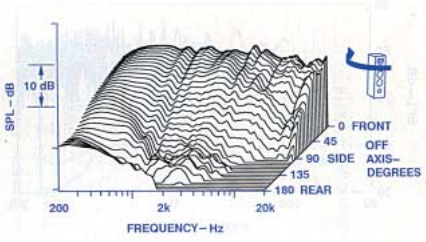



Fig. 3—Horizontal off-axis frequency response.

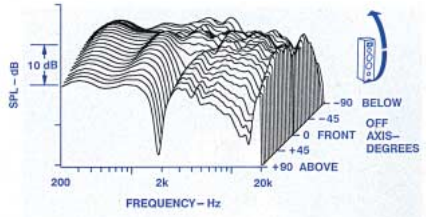
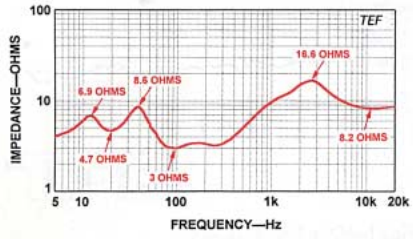
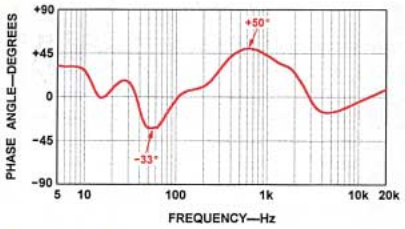



Fig. 4—Vertical off-axis frequency responses.




A




B

Fig. 5—Impedance magnitude (A) and phase (B).

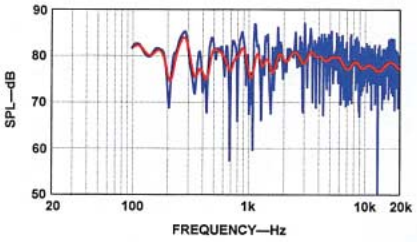



Fig. 6—Three-meter room response.

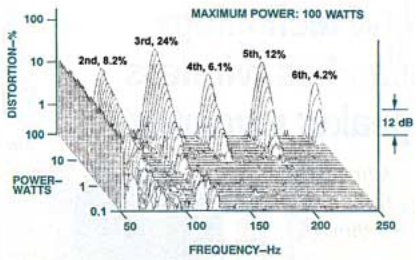



Fig. 7—Harmonic distortion for $E_1$ (41.2 Hz).

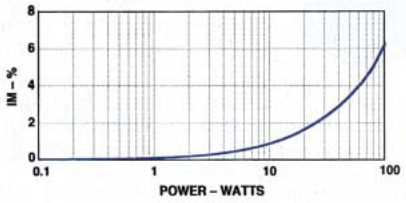



Fig. 8—IM distortion for $A_4$ (440 Hz) and $E_1$ (41.2 Hz) tones of equal power

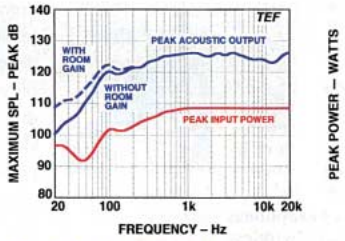



Fig. 9—Maximum peak input power and sound output.