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Equipment Report

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Paradigm Reference Studio/100 loudspeaker

It may come as a surprise to relative newcomers to the field of audio, but some loudspeaker manufacturers are manufacturers in only a limited sense. They buy drivers, off-the-shelf or custom-built, from companies like VIFA, SEAS, Focal, etc.; cabinets from a woodworking shop; and crossovers from an electronics subcontractor. While the system design will have taken place in-house, actual manufacturing is restricted to assembling the components, perhaps tweaking the crossover, and final QC. Even some highly successful loudspeaker manufacturers use this approach, which can work well as long as the suppliers do their jobs properly.

Still, if you want to make certain that a job is done properly, you do it yourself. This means manufacturing drivers, cabinets, and crossovers in-house, which gives you control of every stage of each operation. The downside is that, in order to make this process economically feasible, it must be done on a large scale, with expertise in several areas.

Paradigm is one of the few speaker manufacturers with the resources to take such a "vertically integrated" approach to manufacturing. Virtually every part of every speaker bearing the Paradigm logo is made in their own manufacturing facilities. They even machine the metal molds that they then use to make the plastic parts. The manufacturing enterprise is supported by an extensive research lab that features a *huge* anechoic chamber, as well as a listening room for double-blind listening tests.

Over the years, Paradigm has acquired a reputation for offering high-quality loudspeakers at very reasonable prices, and the company has the policy of turning profits back into research and increased automation of manufacturing facilities. Most Paradigm speakers fall into the low-priced category (eight of their models sell for less than $400/pair), but their upmarket Reference series is intended to compete with high-end audiophile speakers. The Reference Studio/100 is the top of this line, and represents everything Paradigm knows about the design and manufacture of loudspeakers.

Paradigm Studio/100 loudspeaker

Description and Design

At first glance, the Reference Studio/100 seems to be merely a mild cosmetic upgrade of the original Studio/100, reviewed by Tom Norton in August 1997 (Vol.20 No.8). The enclosure's side walls are now curved, and there are a couple of pieces of plastic trim. The speaker is still a ported three-way, and its drivers look much the same.

But there's much more to the designation than meets the eye. The speaker has gained 23 lbs—its new, 110-lb heft reflects changes in cabinet construction. Previously, there was one vertical brace, interlocking with three horizontal braces; now there are a second and third vertical brace for added strength. The midrange enclosure used to be a section of the cabinet partitioned off from the rest; now it's a separate MDF chamber attached only to the front baffle, providing better isolation from the woofer. The thickness of the side walls remains the same at ¾", and the grille thickness was changed from ½" to ⅝" to improve

Description: Three-way, four-driver, floorstanding, reflex-loaded loudspeaker. Drive-units: 1" aluminum-dome tweeter, 6.5" mica-polymer-dome midrange, two 8.5" filled polypropylene-cone woofers. Crossover frequencies (slopes): 250Hz (second-order), 2kHz (third-order). Frequency response: 39Hz–22kHz, ±2dB on-axis; 39Hz–20kHz, ±2dB, 30° off-axis. Low-frequency extension (DIN): 25Hz. Sensitivity: 88dB/2.83V/m anechoic, 91dB in-room. Impedance: 8 ohms compatible. Recommended amplifier power: 15–350W. Maximum input power: 210W (typical program source, clipping no more than 10% of the time).
Dimensions: 45½" H by 11" W by 17⅜" D. Weight: 110 lbs.
Finishes: black ash, light cherry, rosenut, all three in laminates or wood veneers. Veneers add $500/pair.
Serial numbers of units reviewed: 18369 & 18370.
Price: $1900/pair in laminate. Approximate number of dealers: 200.
Manufacturer: Paradigm Electronics Inc., 919 Frazier Drive, Unit 11, Burlington, Ontario, Canada L7L 4X8. Tel: (905) 632-0180. Fax: (905) 632-0183. Web: www.paradigm.ca.

the tweeter's dispersion in the lower part of its range.

The tweeter itself has been reworked, with new damping material, a thicker sealing plate for the damping chamber, and a slightly altered magnet structure. The midrange driver has undergone a major re-design. The magnet weight was doubled, improving efficiency and reducing distortion. The voice-coil's diameter has been changed from 1" to 1.5", but the coil still weighs the same because of the use of copper-clad aluminum wire. High-gauss, low-viscosity ferrofluid was added to the midrange driver. Only the woofer was left unchanged; still, its tuning was adjusted slightly through changes in damping material and a 2" increase in port length.

The crossover is still a simple quasi-Butterworth design, with the same crossover frequencies, but almost everything else about it is different. In particular, the midrange crossover is all new, both high- and low-pass sections being revised to take into account off-axis measurements. Similarly, the tweeter

Measurements

The big Paradigm's sensitivity measured 89.5dB(B)/2.83V/m, 1dB more sensitive than the earlier version we reviewed three years ago. This is within the margin of error of the older speaker but is still almost 3dB higher than average. The impedance, however, drops below 4 ohms between 55Hz and 210Hz, with a minimum value of 3 ohms at 90Hz (fig.1). A good 4 ohm–rated amplifier should be used with the speaker. The glitch at 26kHz in this graph's traces indicates the frequency of the metal-dome tweeter's ultrasonic resonance, but the graph is otherwise free from any evidence of resonant behavior. Fig.2 shows a cumulative spectral-decay plot calculated from the output of a simple accelerometer fastened to the center of the back panel. The earlier speaker had quite a strong mode present at 300Hz on this panel; the was much better behaved in this respect.

The saddle in the impedance-magnitude trace at 20Hz implies that the big port is tuned to a very low frequency. The speaker is also over-damped, as can be seen from fig.3, which shows the individual responses of the port, woofers, and midrange/tweeter section. Note the broad but suppressed output of the port, and the merely vestigial notch in the woofers' output at the nominal port-tuning frequency. Given the usual amount of low-frequency boost present in a typical room, this is probably a good decision.

The woofers cross over to the midrange unit at about 200Hz, with symmetrical third-order acoustic slopes. Their general output is a little higher than the reference level—this will be due partly to the nearfield measurement technique, which assumes a 2pi environment for the radiating surfaces—but the drivers are well-behaved above their passband. The midrange and low-treble regions are smooth on-axis, but the tweeter is a little "hot" in its top octave.

Fig.4 shows the response of the 1997 sample of the Studio/100, averaged across a 30° window on the tweeter axis and spliced to the complex sum of the low-frequency nearfield drive-unit responses. Fig.5 is a similar plot taken for the 2000 sample of the loudspeaker.

In broad terms, the responses of the two speakers are very similar. But if you look closely, the has a smoother, flatter treble region, and better-damped low frequencies. Both aspects tie in nicely with RD's auditioning comments.

The Paradigm's lateral dispersion (fig.6) is generally well-controlled, though there is a slight off-axis flare around 6kHz, which might make the sound too "zippy" in small, underdamped rooms. I note that RD found the speaker's mid-treble balance very neutral, however. Vertically (fig.7), the Studio/100's balance doesn't change much over quite a wide window—just as well, given that the tweeter is a rather

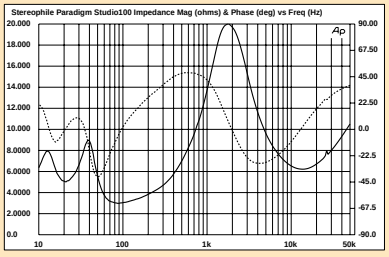

Fig.1 Paradigm Studio/100, electrical impedance (solid) and phase (dashed). (2 ohms/vertical div.)

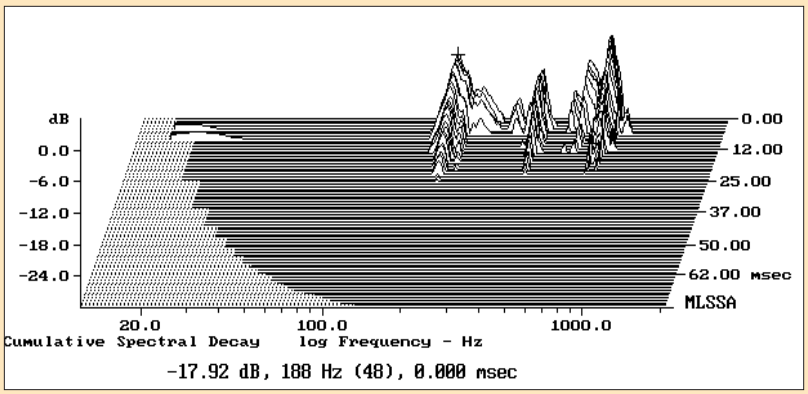

Fig.2 Paradigm Studio/100, cumulative spectral-decay plot calculated from the output of an accelerometer fastened to the cabinet back panel. (MLS driving voltage to speaker, 7.55V; measurement bandwidth, 2kHz.)

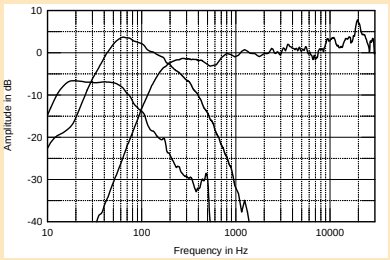

Fig.3 Paradigm Studio/100, acoustic crossover on-axis at 50", corrected for microphone response, with the nearfield midrange, woofer, and port responses plotted below 500Hz, 300Hz, and 500Hz, respectively.

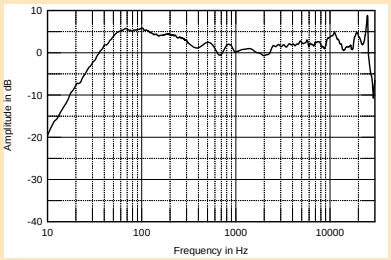

Fig.4 Paradigm Studio/100, anechoic response on-axis at 50", averaged across 30° horizontal window and corrected for microphone response, with the complex sum of the nearfield midrange, woofer, and port responses plotted below 300Hz.

high-pass was changed to blend better with the midrange, both on- and off-axis. The crossover's physical layout has been changed, with the midrange and tweeter filters moved to the top of the cabinet and the woofer filter to the bottom, reducing interference between the circuits. The crossover's inductors and resistors are much larger and are now placed farther apart for optimal cooling, and the quality of components is higher.

Despite all these changes, which represent substantial costs in development time as well as materials, the price of the Studio/100 is only $100 higher than its predecessor's—a testament to Paradigm's vertical integration of manufacturing.

The cosmetic changes themselves should not be dismissed too lightly. My impression of Paradigm's speakers has been that they may offer good sound for the money, but the look is pretty utilitarian. The Studio/100, and other speakers in the new Reference Series, change that. Although you couldn't mistake the Studio/100's wood finish (rosenut on the review samples) for something from

Measurements

high 42" from the floor.

In the time domain, the tweeter and midrange outputs are in negative polarity, as can be seen from the step response (fig.8). The lazy positive-going part of the trace at 4.5ms is due to the positive-polarity woofers. Note that the crossover and the time delay ensure that each drive-unit hands over smoothly to the next lower in frequency in this graph, which correlates with a smooth, flat frequency response. The cumulative spectral-decay plot (fig.9) is very clean, other than some low-level delayed energy at the top of the midrange unit's passband.

As we have come to expect from Paradigm, this is excellent measured performance at a very competitive price.

—John Atkinson

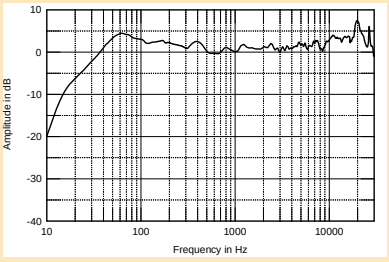

Fig.5 Paradigm Studio/100, anechoic response on-axis at 50", averaged across 30° horizontal window and corrected for microphone response, with the complex sum of the nearfield midrange, woofer, and port responses plotted below 300Hz.

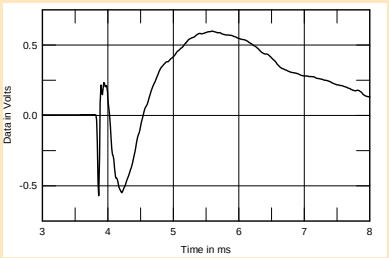

Fig.8 Paradigm Studio/100, on-axis step response at 50" (5ms time window, 30kHz bandwidth).

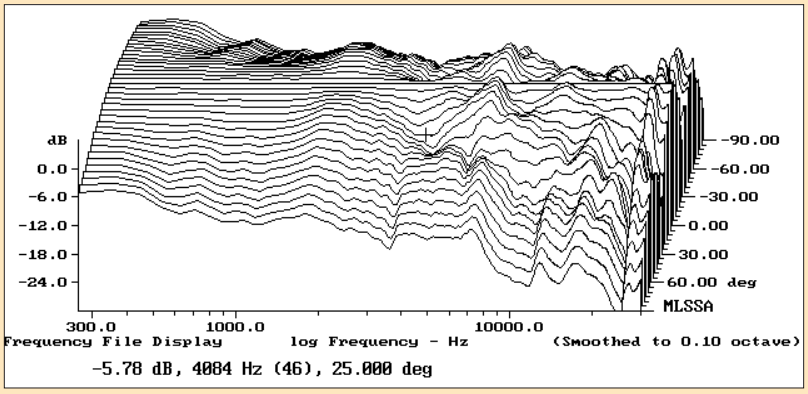

Fig.6 Paradigm Studio/100, lateral response family at 50", normalized to response on tweeter axis, from back to front: differences in response 90°–5° off-axis, reference response, differences in response 5°–90° off-axis.

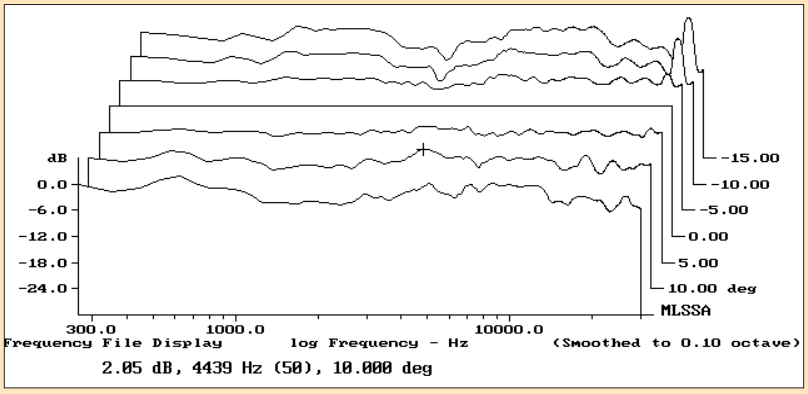

Fig.7 Paradigm Studio/100, vertical response family at 50", from back to front: differences in response 15°–5° above axis, reference response, differences in response 5°–15° below axis.

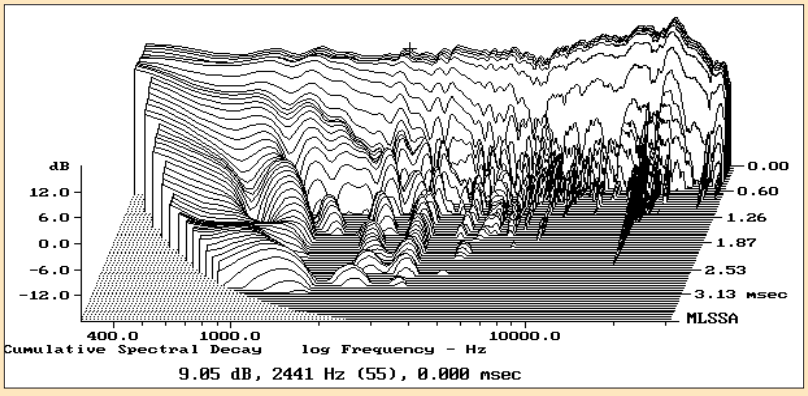

Fig.9 Paradigm Studio/100, cumulative spectral-decay plot at 50" (0.15ms risetime).

Sonus Faber, it is now quite attractive, and the curved sides soften what otherwise would be a severely boxy look. A laminate-finished version sans curved sides is available for $300 less, but I'd recommend spending the extra for the veneered version, which may also have some sonic benefits because of its thicker side walls.

Setup

Setting up speakers can be a difficult chore requiring endless tweaking of position, toe-in, and adjustment of the room's acoustical treatment. I've never encountered a speaker with which ¼" made the difference between sonic disaster and Nirvana, but speakers definitely vary in terms of how critical setup parameters are to optimal sound quality.

The Reference Studio/100 v.2s turned out to be exceptionally unfussy to set up. I plunked them down in what is my more-or-less standard position: along the long wall of my 16' by 14' by 7.5' listening room. With a bit of tweaking, I had the speakers form an angle of about 70° from the listening seat, with the front of the speaker out about 40" from the back wall and the tweeter about 35" from the side wall. Toe-in was not critical; I aimed speakers almost—but not quite—at the listening seat. Once I was satisfied with the basic setup, I installed the spikes and locknuts. The speaker is provided with four spikes, which are hidden by what look like gold-plated feet but are actually large locknuts.

The Studio/100's five-way binding posts appear to be the same as the ones that Tom Norton complained about: able to be tightened only by hand and too thick for many audiophile spade lugs, they still worked fine with the Nordost bananas that I use. Paradigm recommends biwiring, and that's how I listened to the Studio/100 v.2s. The grille is an integral part of the front-baffle design, so it's intended to be left on; I listened to the speaker with the grille off just long enough to confirm that the sound was, indeed, better focused with the grille on.

The Studio/100's bass performance was also first-rate: extended and powerful.

I used both solid-state (Bryston 9B-ST and Thule PA-250B) and tube (Balanced Audio Technology VK-60) power amplifiers; although all the amplifier-speaker combinations worked well, the Bryston gave the best overall results, keeping the bass under control while providing a clean top end. Paradigm recommends a break-in period of about 50 hours; indeed, the sound had become more open and relaxed after about that long.

Sound

According to Scott Bagby, head of Paradigm's design team, designing the Reference Studio/100 was, to a large extent, a process of elimination. The extensive measurements and listening tests were aimed at identifying problem areas, measurable and/or audible, in the speaker's behavior, with changes then made to reduce or eliminate these problems. Presumably, if you eliminate all the unwanted resonances and colorations, what remains is a speaker that just reproduces the input rather than having a sound of its own.

That's pretty much what I heard when I listened to the Studio/100. In my experience, every speaker has *some* sort of distinctive sonic character that becomes evident sooner or later, but I had a difficult time getting a sense of the Studio/100's. Its top-to-bottom tonal balance was exceptionally even, with no part of the spectrum given undue prominence. The midrange, in particular, had a most pleasing neutrality, which allowed the distinctive quality of voices and instruments to be preserved. The treble was not quite as silky-smooth and airy as that of the $10k/pair Vienna Acoustics Mahler (see my review in the April 2000 *Stereophile*), but was at least on a par with such topnotch competitors in its own price range as the Hales Revelation Three ($2195, reviewed in February 1998, Vol.21 No.2), and beat the Hales in the avoidance of sizzle at high levels.

In his review of the original Studio/100, Tom Norton noted an occasional edge in the mid-treble; this seems to have been tamed in the. Vocal sibilants—which I find to be the most revealing indicator of problems in a speaker's treble response—were presented cleanly, without exaggeration or noticeable softening. The top end was even sweeter when the speaker was driven by the Balanced Audio Technology VK-60 tube amp, at the cost of some loss of bass control.

The Studio/100's bass performance was also first-rate: extended and powerful, the quality of the bass approaching that of the $7995/pair Dunlavy SC-IV/A, which has dual 10" woofers in a much larger cabinet. The Studio/100 had no trouble coping with my usual bass test pieces. The synthesizer note at the beginning of track 7 of Mickey Hart's *Planet Drum* (Rykodisc RC-10206) energized the air most convincingly, and bass drums had proper weight.

My listening room's acoustics seem to interact in unpredictable ways with speakers that have extended bass response: with some (*eg*, the Dunlavy SC-IV/A), the bass is quite smooth; with others (*eg*, the Vienna Acoustics Mahler), I've had audible peaks and/or suckouts, even when—as in the case of the Mahler—independent quasi-anechoic measurements indicated no problem in the speaker's bass response. My room's interaction with the Studio/100 was fortuitous: bass extended to the mid-20Hz range, and what I know to be the room's 50Hz standing wave was not noticeable as such.

Although there are still audiophile speakers that sound comfortable only up to moderate levels, one of the more positive effects of the advent of home theater has been that most speaker man-

Associated Equipment

Analog source: Linn LP12 turntable (fully updated), Ittok tonearm, AudioQuest AQ-7000nsx cartridge.
Digital source: PS Audio Lambda II transport, Muse Two Ninety-Six digital processor, Illuminati Orchid digital link.
Preamplifier: Convergent Audio Technology SL-1 Ultimate.
Power amplifiers: Bryston 9B-ST, Thule PA250B, Balanced Audio Technology VK-60.
Cables: Interconnects: Nordost Quattro Fil, TARA Labs The Two. Speaker cables: Nordost SPM Reference, TARA Labs The Two. AC cord: TARA Labs Decade.
Accessories: Argent RoomLenses (5), PS Audio P300 Power Plant AC synthesizer (used with analog and digital sources, preamplifier), Bright Star Little Rock atop CD transport, Nordost PP4 Ti and PP4 Al Pulsar Point component supports, Arcici Suspense Rack, PolyCrystal amplifier stand, Furutech RD-1 CD demagnetizer.

–Robert Deutsch

ufacturers are developing products capable of higher SPLs, even when the speaker is designed primarily for stereo use, as is the Studio/100. (The word from Paradigm is that more than half of the Studio/100s sold end up in home-theater systems.)

The Studio/100 not only sounded good at low to moderate levels, but maintained its composure at levels where most speakers sound strained. Assuming that the amplifier is up to the task (the best amplifier I had on hand for high-level listening was the Thule PA-250B in its 250Wpc stereo mode), turning up the volume — within reason — resulted in the Studio/100 just playing louder, but without audibly compressing or acquiring a hard edge. If anything, the speaker sounded a bit reticent at lower levels, becoming more lively when supplied more power. At high levels, the Studio/100 sounded more comfortable than the Dunlavy SC-IV/A or the Hales Revelation Three. Among products of my recent acquaintance, the only speaker that outpointed it in this respect was the Vienna Acoustics Mahler.

As far as soundstaging and overall transparency went, the Studio/100 v.2s made a good showing without being in the very top class. Their soundstage was wide and deep (when the recording had this information), and the sound had a generally open quality, seeming to originate in space rather than being confined to the speakers. The Dunlavy SC-IV/As give even greater specificity and three-dimensionality to images within the soundfield, but the differences are fairly small — and the gap in price is wide. Listening position was less critical than with the Dunlavy and other speakers that specialize in pinpoint imaging, with a good semblance of a soundstage being evident even when I listened considerably off-center.

Prior to my experience with the Reference Studio/100, the best speaker I had encountered in this price range was the Hales Revelation Three. I still hold the Revelation Three in high regard, but now I'd have to say that the Studio/100 offered a somewhat different but equivalent set of virtues. Both speakers are exceedingly neutral in tonal balance, the Paradigm perhaps even more than the Hales. (That is, if memory serves; I didn't have the Hales around for comparison.) The Hales can sound a bit sizzly on top when driven hard, a problem avoided by the Paradigm; in fact, the Paradigm generally sounded more comfortable than the Hales at high levels. However, I remember the Hales as having a somewhat more immediate, more dramatic presentation at moderate levels than the Paradigm, which could sound a bit polite and reticent at these levels. The Paradigm pulled ahead in the low bass, which had greater weight and extension.

Paradigm's Studio/100 is most certainly a serious high-end contender, and a formidable one for just about any speaker in its price range.

I'd have a tough time choosing between these speakers. I strongly advise anyone considering the Hales Revelation Three to also give a good listen to the Paradigm Reference Studio/100 — and vice versa.

Conclusions

Audiophiles can be a snobbish lot, prone to select products on the basis of exclusivity and prestige rather than just performance. Paradigm speakers are widely available, and most of them are relatively inexpensive, which could lead some audiophiles to dismiss the Reference Studio/100 out of hand as a high-end contender. Nor is the Studio/100's perceived audiophile credibility helped by the fact that dealers tend to demonstrate it with moderately priced electronics.

But Paradigm's Studio/100 is most certainly a serious high-end contender, and a formidable one for just about any speaker in its price range and even well above. While the Studio/100 is forgiving of less-than-pristine electronics, it benefits from being combined with a topnotch digital source, electronics, and cables. Although I didn't have a pair of the original Studio/100s available for comparison, there is every indication that the represents a significant improvement over the speaker that had Tom Norton asking — rhetorically — whether it was the best speaker in its price range. As Tom noted, this question is impossible to answer, given the number of speakers out there, and given that the definition of what's "best" is inevitably complicated by individual preferences about the importance of different sonic attributes.

But if tonal neutrality is at the top of your list of priorities for speaker performance, and you want a speaker that can play loud without sounding stressed, then you really *must* listen to the Reference Studio/100. You may well decide that it is, indeed, the best speaker in its price range.

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