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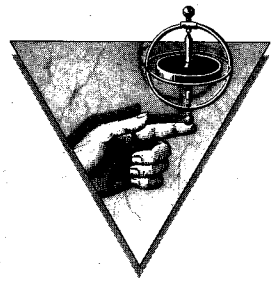


EQUIPMENT REPORTS

INFINITY IRS EPSILON LOUDSPEAKER

Thomas J. Norton

Four-way, floorstanding loudspeaker system. Drivers: 12", servo-controlled cone woofer in sealed enclosure, planar-magnetic lower midrange (L-EMIM™), midrange (EMIM™), and two planar-magnetic tweeters (EMITs™). Also includes Servo Control Unit and crossover unit with bass level, low bass, and midbass contour controls. Crossover frequencies: 150Hz, 500Hz, 3kHz. Frequency response: 25Hz-35kHz ±1.5dB. Sensitivity: 86dB/W/m. Nominal impedance: 4 ohms. Amplifier requirements: 150W minimum. Dimensions: 59" H by 18" W by 15" D. Weight: 150 lbs each. Serial numbers of units tested: loudspeakers, 011A/B; Servo Control Unit, N/A. Price: $14,000/pair inc. Servo Control Unit. Approximate number of dealers: 23. Manufacturer: Infinity Systems, Inc., 20630 Nordhoff St., Chatsworth, CA 91311. Tel: (818) 407-0228. Fax: (818) 993-7614.

Like all companies that have been in business long enough to become fixtures in the marketplace, Infinity has seen its share of changes. It has long been that audio rarity—a company with one foot in the High End and one in the mass market. For the past few years, however, and despite continuing production of the now-classic IRS in its Series V incarnation, Infinity's mass-market foot has been the more firmly planted. Infinity, now a large company, is part of an even larger conglomerate, Harman International.

Cary Christie, one of Infinity's cofounders and the only one still working with the company (though now as a consultant heading his own, independent Christie Designs), has been quietly building the foundation for a whole new generation of Infinity high-end designs (see my interview with Christie, also in the January 1995 *Stereophile*). Some of his work—new electromagnetic induction drive-units used in a monopolar arrangement with the back wave absorbed—was incorporated into the Infinity Renaissance. Now, with the new IRS Epsilon, we can take a better look at what Christie and Infinity have been working on for the past several years.

The Epsilon is a massive yet sleek one-box loudspeaker which makes use of updated drive-units that echo longstanding Infinity design concepts: planar drivers and servo-controlled woofers. Its 150 lbs per side seemed like more as we unboxed and wrestled it into my listening room. The Epsilon doesn't take up much floor space, and looked reasonably svelte once in its ready-to-crank position, but it definitely doesn't take easily to being moved once it's set up—and this has as much to do with sound as with size.

DESIGN

The Epsilon's bass chores are handled by a heavy-duty 12" driver with a 3-lb ceramic magnet, over-large (8") spider, 1.5"-long voice-coil, and greater-than-1" peak-to-peak excursion capability. The cone is composed of Injection Molded Graphite—a combination of oriented graphite fibers and polypropylene which, according to Infinity, provides an optimum blend of strength, rigidity, mass, and damping.

This driver is mounted in a relatively small sealed enclosure. To get the desired extension and low-bass distortion, a servo feedback network is used. But while an amplifier is an integral part of most servo subwoofer designs (as in Velodyne, Genesis, Mirage, and earlier Infinity designs), the Epsilon requires separate woofer amplification. This is a mixed blessing, as we shall see.

The Epsilon system includes both a Servo Control Unit (SCU) and cables to link the SCU to a special input on the back of the speaker cabinet. This in turn is connected to an internal servo network which is linked to an accelerometer mounted at the apex of the woofer's cone. The accelerometer senses the motion of the cone, which is then compared with the amplifier output. If the two disagree, a correction signal is generated by the servo, which not only lowers bass distortion, but boosts the bass output to correct for the typical low-bass rolloff found in any real-world loudspeaker/cabinet configuration.

The system preamplifier's outputs are connected to the SCU inputs; outputs from the latter feed the amplifiers for the woofer and the top-end sections of each loudspeaker (fig.1). The Epsilons *must* be bi-amped, therefore. The signal destined for the woofer amplifier is low-pass-filtered and modified within the SCU, as called for by the Servo Control system. The full-range and unmodified top-end amplifier also passes through the SCU, but only as a hookup convenience. The crossovers for the upper-range drivers are passive, and located within the Epsilon's enclosure.

The upper-range drivers that take over from this Servo-Controlled woofer at 150Hz are similar in design to the EMITs (ElectroMagnetic Induction Tweeter) and EMIMs (ElectroMagnetic Induction Midrange) of past Infinity high-end

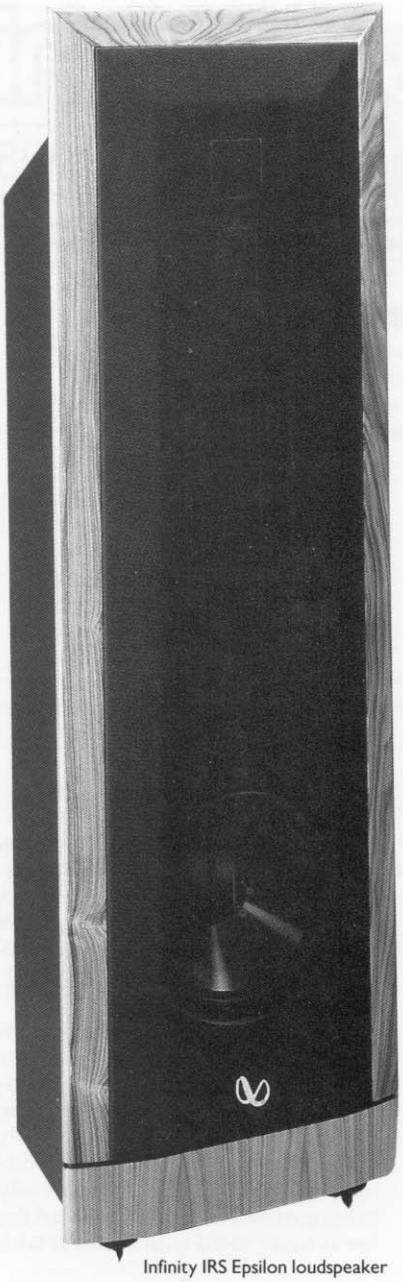
designs. But both the drivers and their applications have undergone considerable refinement and modification. Their diaphragms are made of laminates of polyimide film, pressure-sensitive adhesive (with damping properties), and an etched, aluminum voice-coil.[1] The EMIM and L-EMIM drivers are about 1½ times the thickness of a human hair; those of the EMIT are less than half that. The EMIT also incorporates a specially developed fabric acoustic filter for smooth horizontal-dispersion characteristics.

Though many audiophiles are fans of dipole-radiating loudspeakers, this type of design has its problems: placement sensitivity, dipolar cancellation of low frequencies, and frequency-response anomalies resulting from the rear radiation as it bounces off the front wall, then combines in a time-delayed fashion with the output from the front. Infinity avoids or minimizes these problems by absorbing the rear radiation of the naturally dipolar EMITs and EMIMs—a technique they first used in the Renaissance loudspeakers. The entire top half of the cabinet, above the sealed-subwoofer enclosure, is an open baffle filled with absorbing material designed both to damp the rear radiation *and* prevent it from reflecting through the thin, low-mass laminate diaphragms. The sole exception to the monopolar, front-radiating design is in the mid- and upper treble; a second EMIT is mounted at the top and rear of the enclosure to enhance the speaker's power response in the upper two octaves.

The Epsilon's cabinet is substantial. The woofer enclosure is made of *high*-density fiberboard: 1″ thick, except for its 3″-thick (!) front baffle, a thinner, vertical extension of which is used to mount the remaining mid- and upper-range drivers. This sub-baffle is moderately sculpted and covered with acoustic felt to minimize diffraction. The front baffle is framed in an attractive Santos Palasander wood finish resembling rosewood. The grillecloth isn't readily removable.

According to Infinity, premium-quality parts and high-quality internal cabling are used in the crossover network. Each driver has its own isolated, glass-epoxy crossover circuit board. A unique aspect of the Epsilon's design is the use of two 9V batteries per loudspeaker to bias the joining point of a series/parallel set of capacitors in the tweeter network; this is said to noticeably improve the top end. The battery bias is applied through a high (5 megohm) resistor, limiting the demand on the batteries. As a result, the batteries' active life expectancy is equivalent to their shelf life—about two years.

The Epsilon's rear panel has two pairs of top-quality WBT input jacks, and control switches to adjust the relative balance of the EMITs (three positions) and EMIMs (two positions each). The audible effect of these controls—specified as no more than 1dB—is subtle but significant. Less subtle but no less important are the three controls provided on the SCU for overall woofer level, bass contour, and midbass contour.



Infinity IRS Epsilon loudspeaker

The Epsilons' large, adjustable feet cover equally heavy-duty spikes, which should be used except where there's risk of damage to tile or wood floors. Large locking rings, which secure the feet or spikes after the loudspeaker is leveled, are the best-thought-out such devices I've ever seen.

Setup

Connecting all the pieces of the Epsilon system—SCU, amplifiers, and loudspeakers—while a bit complex, is fairly straightforward. Nevertheless, you *must* know with absolute certainty the polarity of the amplifiers driving the subwoofers—whether or not they invert phase or, in the case of the balanced hookup, which pin is referenced as positive. A switch on the back of the SCU is set by the user or installer to correspond to the non-inverting or inverting nature of the woofer amplifiers. If set incorrectly, the feedback loop won't operate properly, possibly resulting in damage to the loudspeaker, the amplifier, or both.

Needless to say, the gains of the left and right upper-range amplifiers must be closely matched; the same is true for the woofer amps.[2] But it's also important that the gains of the woofer and upper-range amplifiers be within 6dB of each other, or adjustable to within that range. Controls on the SCU can compensate for up to 6dB of gain difference between these amps, but no more. In addition, the voltage gain of the woofer amplifiers must also be within the 21–39dB range for proper setup—which includes almost all available power amps.

I encountered four problems in my efforts to get all of this right. First, the manual states that you can use any combination of balanced and unbalanced cables. Specifically, it should be possible to run balanced cables from the preamp to the SCU and unbalanced cables from the SCU to the amplifiers (or vice versa). Not so. When I first set up the Epsilons, I used exactly that configuration, and the bass was oppressively dominant. What was probably happening was that the internally bypassed connection for the top-end amplifiers was linking only one leg of the SCU's balanced input to its unbalanced output, negating any balanced-link gain advantage there. At the same time, the SCU's low-pass, active woofer circuitry was making full use of the potential 6dB–greater gain available with a balanced input. I cured the problem by using an all-balanced setup.

I originally intended to use two KSA-300Ses to drive the Epsilons, but the second problem resulted from my attempt to use a Krell KSA-300S to drive the woofers. In the Krell, the output stage's bias current is adjusted to progressively higher plateaus, depending on the demands of the program material. Circuitry within the amplifier "anticipates," almost instantaneously, the need to raise the bias. The woofer servo feedback loop, however, was immediately forcing the bias level on the Krell bass amp up to its maximum level, accompanied by alarming excursions of the woofer cones. It's possible that the action of the servo circuitry was hyperactively triggering the sensing circuits in the Krell that adjust

1 The current running through this flat, etched voice-coil interacts with magnets placed on both sides of the film to cause the diaphragm to vibrate.

2 While the woofer amplifiers will likely be different from the upper-range amplifiers, I can't imagine anyone paying $14,000 for these loudspeakers and then using *different* amplifiers on the left and right channels.

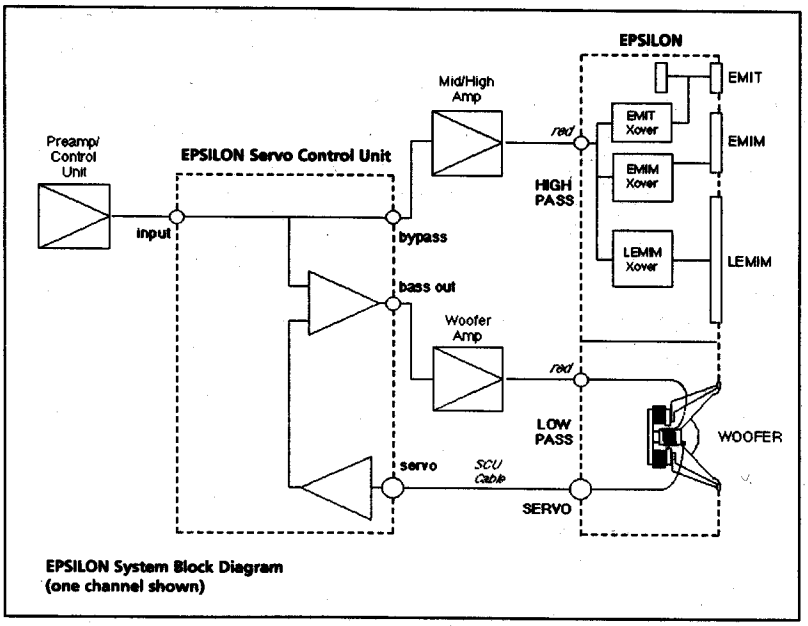


Fig.1 Infinity Epsilon, system block diagram showing servo connection (one channel shown).

its bias upward. I understand that Infinity is working with Krell to fix this incompatibility.

For most of my listening, therefore, I used a pair of Classé M-700 monoblocks to drive the Epsilons' woofers—and here encountered the third problem. After setting up the SCU for the appropriate gain using the *rear*-panel control, as described in the owner's manual, I fired up the system, only to be greeted by a crescendoing squeal from the woofers. I killed the power to the amps before any damage was done. The problem was cured by backing off the SCU's rear-panel control by several decibels below the recommended value.

A fourth problem—the source of which I hadn't yet determined at the time of writing—involved externally triggered transient spikes in the woofer circuitry, which I discovered when I turned on the fluorescent lights *in the kitchen* and heard a pop from the Epsilons' woofers in the listening room—15′ away, and on a different electrical circuit. I dashed into the listening room and found the woofers pumping back and forth in large (but fortunately progressively damped) excursions. I noted the same phenomenon when I turned on the overhead fan or plugged in a lamp in the listening room itself; and, to a lesser degree, when I touched the equipment rack and dissipated a small static charge. In the year that I've been using this listening room I've never encountered any such power or static-related problems.

All of this means that you should be prepared to lean a bit more heavily than usual on your dealer in choosing appropriate associated components for use with the Epsilons, and in setting the whole thing up. In fact, my most serious reservations about the speakers are about this very complexity of setup. None of these "problems" would likely exist had the system been designed and furnished with a dedicated bass amplifier.

This would, of course, result in an increase in price, and the amplifiers would have to be designed to handle high sound levels in a large room. While Infinity's decision to allow the user to provide the bass amplifiers is defendable, there's no denying that it puts significant demands on users and dealers if the system is to perform as designed.

System

I listened to the Epsilons with the Krell KPS-20i CD transport feeding a Mark Levinson No.35 D/A converter through Kimber AGDL digital coaxial cable. TARA Labs Master RSC (unbalanced) connected the Levinson converter to a Rowland Consummate preamp. Amplifiers were a Krell KSA-300S stereo amplifier for the midrange and top end, and a pair of Classé M-700 monoblocks for the bass. I briefly used an NAD 208 and Krell KSA-300S for the bass, and a pair of Pass Laboratories Aleph 0 monoblocks for the mids and highs—when I was able to pry them away from DO, whose review of them will appear in an upcoming issue of *Stereophile*. Interconnects and speaker cables included balanced Monster M-1500 from preamp to SCU, balanced Cardas Hexlink from SCU to top-end amp, balanced Aural Symphonics from SCU to bass amps, and Monster M1.5 from amps to loudspeakers. The M1.5 alternated on the top end with a pair of Monster Sigma loudspeaker cables.

Sound

The hardest loudspeaker to review is the one that's difficult to criticize. The Epsilon is, for the most part, hard to review.

Compared with the Energy Veritas v2.8, the Infinity sounded less airy, open, and spacious. The Energy sounds more majestic, with greater "bloom"—certainly due at least in part to its more-than-generous bottom end—and every bit as dynamic as the Epsilon; perhaps even more so. The NHT 3.3 has, subjectively, the deepest, most potent, extreme bass of the speakers that have spent time in my listening room. The Epsilon does have some dynamic limitations at the very bottom end on the most demanding program material, a point upon which I will shortly expand.

Yet it's the Epsilons to which I would turn, without question, if I wanted to know what's going on in a recording—and if I wanted the most accurate, uncolored bass and midrange, and the cleanest, most pristine, least "electronic"-sounding treble. Thanks to its wide range of available adjustments (particularly for the bass), the Epsilon is the most likely of the three speakers to sound its best in a variety of rooms.

I haven't always been a fan of Infinity using planar midranges and tweeters in their loudspeakers. I've always liked the generally open, exciting, punchy sound, but hadn't particularly cared for the usually too-crisp, etched quality. The latter is *not* a quality of the Epsilons. In fact, when I heard the prototypes at last year's Winter CES, I was underwhelmed. If anything, they were too *closed-in* and lacking in openness. I'm happy to report that this is also not evident in the production version.

From the upper bass to the top treble, the Epsilon's balance was just about spot-on. Instrumental textures and timbres flowed naturally and easily. For example, the dynamics on David Buechner's superb recording of Gershwin solo piano works (Connoisseur Society CD 4191) were first-rate, the balance had just the right degree of warmth, and the whole was wrapped in the natural acoustic of the recording. The top-end balance was close to perfect, with a realistic but not overdone sparkle. From the natural woodwinds and brass on Stravinsky's *Ebony Concerto* (Reference RR-55CD) and the metallic, crisp percussion and more gutsy brass of the Eastman Wind Ensemble on the Mercury Living Presence *Hands Across the Sea* album to the clean, thrilling buzz and snap of guitar strings on David Wilcox's *Home Again* (A&M 75021 5357 2), the Epsilons presented a wealth of natural, unhyped detail.

Voice was also extremely well-served by the Epsilon's natural, uncolored midrange. From Mary Black to Cyndee Peters, Gordon Lightfoot to the King's Singers, the presentation was realistic and convincing. Not that *all* such recordings are beyond criticism over the Infinitys. The Epsilons didn't exaggerate excessive sibilance, but neither did they hide it. For example, for all its well-deserved audiophile popularity, I find that Holly Cole's voice on *Don't Smoke in Bed* (Manhattan B21Z-81198) hews too closely to the

well-worn "eat the microphone" syndrome; though far from the worst I've heard, the sibilants are just too hot. The Epsilons brought this out, but without adding any apparent editorial comment of their own. Nor were all male vocals free of chestiness. Again, on the best recordings, where the miking has been done with some intelligence, the balance of the Epsilons was excellent.

The Epsilons' soundstage was wide and reasonably deep. I've heard more precise soundstaging from small, narrow-baffled boxes, but the spatial perspective of the Epsilons, if not absolutely pinpoint, was nevertheless realistic. When I began my listening, I aimed the Epsilons almost straight ahead, with only a small toe-in. The soundstage was wide enough, but lacked the sort of specificity I prefer. I ended up toeing them in considerably, despite Infinity's claim that the Epsilons are less likely than other loudspeakers to need this. As usual, this toe-in increased the center-stage focus at some sacrifice to soundstage size—a tradeoff that I don't mind. In this context, however, image width and depth were fine—especially on recordings recorded with an ear toward a believably layered, dimensional sound (*eg*, the Connoisseur Gershwin disc, and the *Sneakers* soundtrack, Columbia CK 53146).

The Epsilons driven by the Pass Aleph 0 single-ended, solid-state monoblocks continued to sound remarkable. While my auditioning with the Alephs was too brief for me to state definitively whether I preferred them to the Krell KSA-300S in this application—the Krell certainly left little to be desired—the former did appear to be incredibly fine amplifiers. They do run *very* hot, however—one shut down twice after several hours of use—but were easily reset by merely being turned off, then on again. Perhaps setting them up side-by-side resulted in a bit too much heat buildup, though they otherwise had plenty of ventilation.

The overall performance of the Epsilons, from the upper bass to the top of the treble, was nothing less than superb. If I could criticize anything, it might be that slight lack of spaciousness at the very top of the treble range. But the Energy Veritas v2.8s produce enough space to let the Starship *Enterprise* reach warp speed; had I not been listening to them extensively just prior to the Epsilons, it's unlikely that I'd have thought this quality worthy of comment.

The Bass, the Bass

At its best, the bass performance of the Epsilon was absolutely stunning. With the best material, it combined tightness with extension in an extremely rare manner. I found no better example of this than the *Patriot Games* soundtrack (RCA 66051-2), on which the Epsilons sounded wondrous—I don't know any other word to describe them. As before, the top end was clean and detailed without any artificiality not present in the recording, and the midrange was open, transparent, and uncolored.

I've heard this recording numerous times—occasionally with more deep-bass extension to below, say, 30Hz—but *never* have I heard it with this much tightness and sheer punch. The first drum whacks in "Attack on Ryan's House" set me back in my chair. The Epsilon simply excelled at this sort of percussive impact. Bass drum on the best recordings had an all-too-rare clarity that was a delight to hear.

The Epsilon's very clean-sounding bottom region may appeal to listeners who have avoided large loudspeakers in the past because of their perceived "big," exaggerated bass. Properly set up, the Epsilon didn't suffer from this. It did have a touch of warmth on much material, but just enough to keep the sound from becoming lean and antiseptic.

Though the Epsilon's bass extension was plenty deep, it wasn't *quite* the equal of the NHT 3.3's, which is otherwise unable to match the Epsilon's low-frequency definition. Though the NHTs were no longer available to me for direct comparison, I do recall their bottom end being somewhat more potent in Jean Guillou's organ adaptation of Mussorgsky's *Pictures at an Exhibition* (Dorian DOR-90117). The Epsilon had plenty of power from 30Hz up, but that guttural growl I recall from the NHT—at least on organ—was slightly subdued. Nevertheless, the Epsilon's bass was undoubtedly extended: my chair—sitting on a slab floor—was vibrating. On the stunningly recorded Rutter *Requiem* (Reference RR-57CD), the bottom organ pedals, while subtle, nevertheless made a more potent, dramatic statement through the Epsilons than through the Energy v2.8s.

The bass controls on the Servo Control Unit contributed significantly to the effectiveness of the Epsilon's bass. Used in concert, they helped establish a proper system balance. I tweaked them over a wide range of material, then pretty much left them alone. I turned back the mid-bass contour a few decibels, and the low-bass contour control up by about the same amount. This gave me the best combination of tight mid- and upper bass and low-end extension.

In another room, or at a different position within the same room, I would expect the optimum settings to be different. The same goes for the overall bass level, which for me worked best at 0dB (despite a difference in gain between the Krell and Classé amplifiers). Proper setting of overall bass balance is critical to one's total perception of a system's sound; it's difficult with most loudspeakers to adequately control this. (While changing the placement helps, it's rarely enough.) Such controls as those on the Infinity—Okay, it's equalization. So what?—helped tremendously in getting things right.

There was a drawback to the Epsilon's bass: It needed all of the power I could feed it. Remember, the servo network functions, for all intents and purposes, as a bass equalizer. According to a figure in Infinity's own White Paper on the Epsilon project, this results in a bass boost of 8dB at 30Hz, and *17dB* at 20Hz. In the latter case, all else being equal, a 200W demand in an unequalized system would translate to 10,000W in a system with this much bass boost! Fortunately, there's little program material with flat response to 20Hz. At a more reasonable 30Hz, the Epsilon's required 8dB boost still translated to nearly 1300W to satisfy the equivalent of a normal system's 200W demand.

Before settling on the Classé M-700 amplifiers, but after the bass episode with the Krell, I tried driving the bottom end of the Epsilons with an NAD 208, which puts out a specified short-term power of 750Wpc into 4 ohms. It worked fine until serious demands were made of it, after which it gave up, turning the opening drum strokes on the *Jurassic Park* soundtrack (MCA MCAD-10859), for example, into a flatulent T-Rex. And while the Classé sailed through this passage with nary a problem, it still ran out of steam on some material—even with its rated 1400W capability (into 4 ohms). In the climax to Weinberger's Polka and Fugue from *Schwanda the Bagpiper*, on *Pomp & Pipes* (Reference RR-58CD), the bass in the left channel abruptly fell apart on the most challenging passage. To be fair, the Energy Veritas v2.8 had also had difficulty traversing this track, but the breakup there had been a little less obvious.

For those looking to use the Epsilons in an audio/video system, the sustained bass thud from the falling boulder in *Aladdin*'s "Cave of Wonders" scene (if you've seen it, you *know* what I'm referring to) caused a breakup that made me lunge for the volume control—again, in the left channel. Though the Epsilons survived to fight another day, I can't say the same for my nerves. This exceptionally difficult test was traversed without incident at the same or higher level (in a larger space) by the B&W THX subwoofers. The B&Ws (evaluated in a different room, it must be emphasized) can't match the tightness or punch of the Epsilons' woofers (though they're nonetheless commendable in these qualities), but *do* appear to be less susceptible to dynamic-range limitations on killer video sound-effects and *very* challenging music passages.

Remember how a servo system operates? As the driver/enclosure system tries to give up producing sound below the system resonance (in the case of the Epsilon's sealed-cabinet system, dropping off at a rate of 12dB/octave), the servo says DON'T STOP! and increases the drive level to the woofer to compensate—thus the

heavy low-frequency boost typical of a servo design in a normal-size enclosure. Clearly, if nothing is done and the program material continues to demand high levels of low frequencies, a servo system will either run out of available amplifier power, or the driver will destroy itself trying to respond to the servo's demands.

Obviously, a servo system must incorporate low-frequency limits to keep this from happening; below a certain frequency, it simply ceases asking for more. If not carefully chosen, these limits can get you into trouble. I once heard even the IRS—an early version—overload on the cannon shots from Telarc's version of the *Overture 1812* at an admittedly high level in a large CES demo room. And that design has *how many* low-frequency drive-units. . .?

The Epsilon has a high-pass filter in the SCU's bass channel to provide the necessary limiting, but the above observations tell me that the limits chosen may be insufficient. An outboard subwoofer would solve the problem, and, again, the Epsilon will handle with ease 99% of the material fed into it. But we expect that last 1% from $14,000/pair speakers—especially when less expensive systems will deliver it.

The Epsilons *did* have excellent bass qualities, but when they ran out of headroom, they did so abruptly and jarringly. All of this reinforces the case for using a dedicated amplifier with a bass servo system. With a careful balancing act, the designer can then trade off bass extension, (known) amplifier power, cone excursion, system sensitivity, and limiting to obtain the desired results within the capabilities of the chosen system design. Requiring the user to provide the bass amplifier puts an important aspect of the design beyond the designer's control.

Nevertheless, used within its still generous limits, the quality of the Epsilon's bass was outstanding.

Measurements

JA measured the Infinity Epsilon and provided me with the results after my auditioning was complete.

The sensitivity of the Infinity Epsilon measured effectively to specification at a calculated 85.5dB/W/m (B-weighted). The impedance of its woofer section (fig.2) indicates a cabinet tuned to about 38Hz. The load is relatively benign, never dropping below 4 ohms. However, the inevitable rise in impedance at resonance requires me to modify slightly a couple of statements I made in the main text of the review. Note that, between 20Hz and 30Hz, the impedance varies between just over 5 ohms and 9 ohms. This means that the power available from an amplifier will be less than the latter's 4 ohm rating—which may partially explain the amplifier/Epsilon combination's unfulfilled demand for more power in the low-bass region on particularly demanding material. Note also the small ripples in the response above 100Hz—these are usually indicative of cabinet resonances.

The impedance of the upper-range drivers (fig.3), however, *does* drop below 4 ohms. In particular, the dip to 2.8 ohms just above 200Hz, combined with a significantly capacitive phase angle in this region, makes the Epsilon a challenging load for its upper-range amplifier. Low-powered tube amplifiers, or any amplifier uncomfortable with a load dropping below 4 ohms, should not apply.

Fig.4 shows the FFT, nearfield responses of the woofer (left) and L-EMIM (right). The curve also shows the action of the woofer and midbass controls. The action of the former is quite subtle (though more significant as you get on the steep slope of the curve below about 30Hz), giving -6dB points ranging from 24Hz to 26Hz with a slight change in the amount of energy prior to the rolloff. The midbass contour control gives a boost or cut of up to 3dB but covers quite a narrow frequency range. This, though, is in a region where room resonant problems are common. The acoustic crossover to the L-EMIM, at 150Hz, is as specified.

The overall combined frequency response of the Infinity Epsilon, averaged across a 30° horizontal window, is shown in fig.5. Here, the response below 312Hz is the complex sum of the nearfield outputs of the woofer and the L-EMIM; the response above 312Hz was taken at 45" at a height of 37", my seated ear height. The response holds up remarkably well to below 30Hz, and is extremely smooth across the full frequency range. The shallow depression centered at about 5–6kHz, combined with the rolloff above 10kHz, may explain my comments about the slight lack of "air" in the Epsilon's subjective performance. Otherwise, there is little here to criticize. As JA said, this is an impressively engineered speaker.

The action of the L-EMIM, EMIM, and EMIT level switches with the Epsilon's on-axis response subtracted, shown in fig.6, is very subtle—consistent with Infinity's specifications. The effects of the controls *were*, however, audible.

The horizontal and vertical response families are not shown here. The horizontal response was noncritical within a ± 10° window. The off-axis vertical responses, relative to the response on the 37" axis, were very smooth. Sitting considerably lower resulted in a dip at about 3.5kHz (the crossover region between the H-EMIM and the L-EMIM); sitting higher brought up the treble region somewhat. This only became evident at heights above 45"—an impractically high listening height (unless you listen on a bar stool).

The impulse response on the L-EMIM axis is shown in fig.7. Ringing is notably absent here, though it's evident

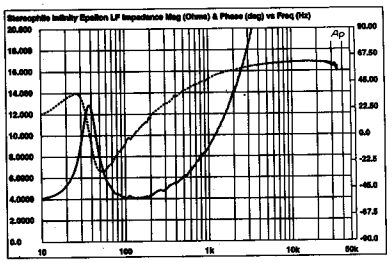


Fig.2 Infinity Epsilon, woofer electrical impedance (solid) and phase (dashed) (2 ohms/vertical div.).

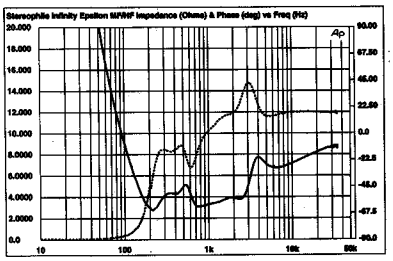


Fig.3 Infinity Epsilon, mid/treble array electrical impedance (solid) and phase (dashed) (2 ohms/vertical div.).

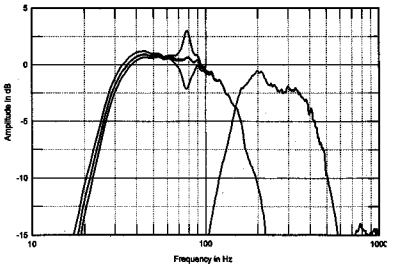


Fig.4 Infinity Epsilon, nearfield woofer and L-EMIM responses showing effect of Woofer control set to "0" and "±5" and Mid-Bass Contour control set to "0" and "±3" (5dB/vertical div.).

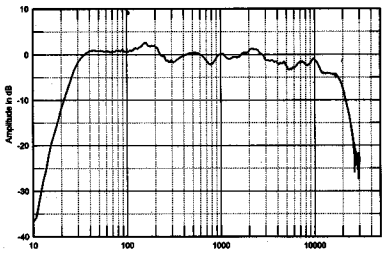


Fig.5 Infinity Epsilon, anechoic response on L-EMIM axis, 37" from floor, at 45" averaged across 30° horizontal window and corrected for microphone response, with complex sum of nearfield woofer and L-EMIM responses below 312Hz.

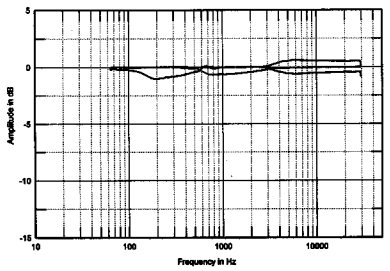


Fig.6 Infinity Epsilon, effects of L-EMIM, H-EMIM, and EMIT switches, normalized to response on L-EMIM axis (5dB/vertical div.).

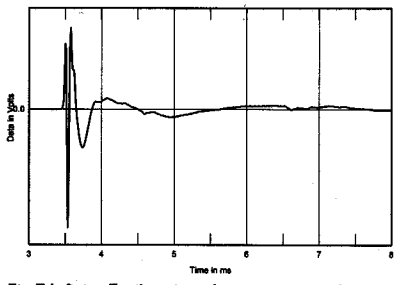


Fig.7 Infinity Epsilon, impulse response on L-EMIM axis at 45" (5ms time window, 30kHz bandwidth).

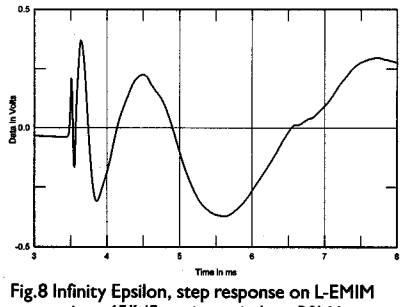


Fig.8 Infinity Epsilon, step response on L-EMIM axis at 45" (5ms time window, 30kHz bandwidth).

that the system is not time-aligned. The latter is clearer in fig.8 (the step response taken at the same location). There's a slight delay between the arrival times of the EMIT and the EMIM, followed in another millisecond or so by the L-EMIM, and another 3ms later by the woofer. All the drive-units appear to be connected with the same (positive) acoustic polarity.

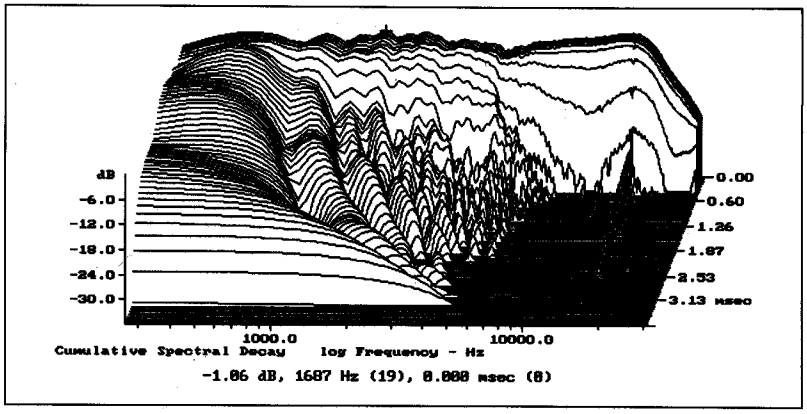


Fig.9 Infinity Epsilon, cumulative spectral-decay plot at 45" (0.15ms risetime).

Finally, the cumulative spectral-decay, or waterfall, plot is shown in fig.9. The behavior here is excellent, particularly at the top of the range, where there's almost no visible hash. (Ignore the ridge just below 16kHz, which is due to our measurement computer's screen.) A bit of resonant behavior is evident in the low and mid-treble, but this is relatively innocuous, being very low in level.

This is a first-rate set of measurements—certainly among the best we've measured, and consistent with the Epsilon's superb listening quality.

Conclusion

The Epsilons were difficult to criticize. Certainly, I would stack them up against any of the other Class A contenders, though, because of the deep-bass limits on their bass dynamic-range capabilities, they'd have to go in the "Restricted-LF" category. Whether or not that limitation is due to available amplifier power or system limits becomes a moot point when 1400W doesn't seem to be quite enough power.

Nevertheless, the Epsilon can't be ignored—it definitely belongs in Class A. And for those unable to afford them, less expensive siblings using much of the same technology will certainly follow. In the meantime, Disneyland may no longer have E-ticket rides, but Infinity sure does: the Epsilon. S