"... THE SERVO-15 RULES."

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"The Servo-15 will do things that no other subwoofer I've heard will ... especially play very loud and clean at the lowest frequencies."

by Andrew Marshall

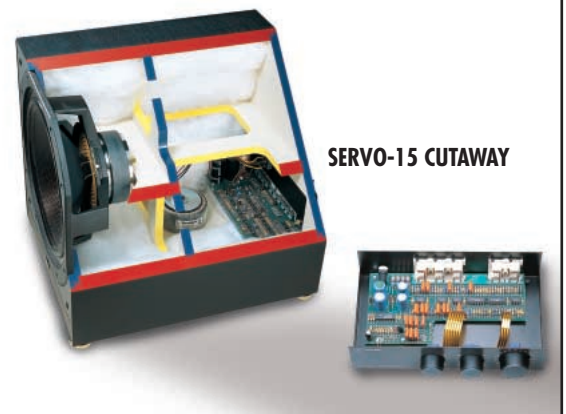

Servo-15

Though subwoofer/satellite systems are most often thought of as home theatre oriented, pure audio systems can also benefit from extended bass. In fact, the new *Servo-15* is at least as much an audiophile subwoofer as a home theatre one, its ability to reproduce the very lowest audible frequencies not generally a requirement for film sound effects. Here we've paired it with the smallest of the Reference models, the *Studio/20*, though the *Servo-15* was also auditioned in other contexts as well. A vital link between the two is the *X-30* electronic crossover, which comes with the sub, and allows listening position control of sub level, upper crossover frequency, and phase.

The *Studio/20* uses the same tweeter and bass/midrange drivers found in the *Studio/80* (Reviewed Summer/96), an aluminum dome tweeter with a high-temperature voice coil and ferrofluid cooling, and a 6 1/2" driver with a die-cast vented aluminum basket and mica-loaded polymer cone. The enclosure is rear ported, and our review pair were finished in a very nice rosewood veneer.

The *X-30* is one of the neater little packages of electronics I've encountered lately, and I've been using it with several subwoofers in both audio and home theatre systems. The most complex of Paradigm's sub controllers, it has 3 rotary controls on the front panel. The largest at right is volume, the next over adjusts the upper frequency limit of signal fed to the sub between 40 and 160 Hz, with an 18 dB/octave slope above, while the third adjusts the sub's phase relative to the main speakers or a second sub. A small LED at bottom left front panel indicates when a signal is passing through the crossover.

The rear panel is all gold-plated RCA jacks, inputs at left with sub outputs beside (the phase control affects only one



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of these). The other 3 sets provide outputs to the main speakers with cutoff frequencies with lower rolloffs (18 dB/oct again) at 50, 80, or 120 Hz. Looking inside, we see a very neat circuit board covered with high quality parts, which should argue well for the acoustic transparency of this little box.

"Together this system was sheer synergy, the bass output of the Servo-15 prodigious and extended when and if necessary, and the Studio/20 able to also play at very high volumes cleanly. There was an ease and freedom from compression … combined with great tonal accuracy."

The New Studio/20
(Improved over version reviewed for even better sound.)

The object of its affection, the *Servo-15*, has been a kind of Hollywood epic for *Paradigm*, over two years in the making, with much rethinking of the traditional design goals for subwoofers. In a data sheet on this product, the problems created by very powerful amplifiers driving massive cones is succinctly dealt with: 'Increasing mass, however, means much greater cone momentum. This added momentum makes it much more difficult for the cone to start quickly and virtually impossible for it to stop at the end of a bass note. While a higher mass cone can provide deeper bass, distortion is notably higher, making the bass sound thick and rather poorly defined. In addition, a higher mass cone reduces the bass driver's sensitivity, and, since there is a power handling limit to any driver, this ultimately limits the in room sound power capability of the driver."

"Impressive as the Sunfire is, it's simply not in the same league in the lowest octave at high levels … the Servo-15 was clean to over 90 dB even at 20 Hz, but the Sunfire started to rattle at this abuse. … for clean bass to lower than you can hear and louder than you can stand, the Servo-15 rules."

The approach of adding a servo to compare the driver's movement continuously to the input signal has been used by many subwoofer makers, and most I've heard were somewhat slow and unrealistic in sound. The challenge for *Paradigm* was to re-examine every aspect of the equations involved in a servo sub, and go over the development process every time they changed any parameter of weight, mass, speed of accelerometer or driver, et cetera, all the equations changed, too. A particular problem down the stretch, I'm told, was the surround material, which had to be very solid, but also flex with the large excursions of the 15" cone and its massive voice coil.

It's intriguing that the solutions to the same problem were so radically different for Scott Bagby and his team, and Bob Carver. In the *Sunfire* we find a kind of brute force miniaturization, while here we have something that looks like a fairly conventional subwoofer, but in almost every respect, isn't.

The reason most servo subs are slow is that their drivers, accelerometers, and electronics are slow: they're always trying to catch up to the input signal, the driver being told to do what it should already have done. In order to gain the necessary speed and control, the *Paradigm* engineers developed what they describe as a "precision instrumentation grade accelerometer" that "continuously monitors the output of the bass driver", which is very light and stiff, having a Kevlar fibre reinforced cone. The comparator which controls the 400-watt rms amplifier "accurately compares the output of the subwoofer to the input signal and makes instantaneous corrections." If this all sounds a bit unspecific, it's because there are quite a few proprietary aspects to this design, some awaiting patents.

However, the illustrations supplied allow us a pretty thorough look inside the *Servo-15*. The cutaway picture of the sub

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shows its internal bracing and sectioning, with amplifier and toroidal transformer securely bolted to the bottom inside. Interesting to note in the cross-section of the driver is the large central vent to allow full freedom of movement of the cone, the massive magnet encircling the voice coil rather than inside it. Most woofers build up quite a bit of air resistance behind the dust cap, and some makers, *Dynaudio*, for example, put air

vents in theirs; the solution here is an ingeniously straightforward one that allows freer and faster response of the woofer. You can also see the accelerometer under the cap.

One thing about subwoofers that I like is that their performance is pretty easy to quantify because they operate over a relatively narrow frequency range. Sometimes too narrow a range, since most wimp out at the very bottom. If you've read the *Sunfire* review already, you know how I feel about *that*.

> *"… the Servo-15 mates well with the Studio/20, which is itself a really remarkable speaker. … an extremely linear midrange and treble … axial performance is very linear, the Studio/20 radiating a very uniform frequency balance into the room."*

Well, there's no wimping here, just wump. Looking at the top left corner of the frequency chart, it can be seen that the *Servo-15* is still going strong at 20 Hz. In fact, as my turntable verified, it's still very much there in the 12-14 Hz region; though so well isolated by a solid shelf and *AudioPrism Isobearings* that you can bang the shelf around it while an LP plays, when I cranked up the *Servo-15*, I got acoustic feedback, the interaction of the arm/cartridge resonance with the subwoofer's extraordinary deep bass output. This was never the problem with the *Sunfire*.

The measurement, seen mated with the *Studio/20* PNS curve, is also a Pink Noise Sweep, but in this case, the average of 5 of these to clearly show the response without all the small peaks and dips you normally see at these low frequencies on a spectrum analyser. Set up optimally to mate with the *Studio/20s* running over their full range, the *Servo-15* is ±2 dB or better across the bass range in the nearfield. Right are measurements of the sub adjusted to the highest, mid and lowest crossover settings of the *X-30*; it is flattest in the mid position, offering some extra oomph at the very bottom in the lowest *X-30* crossover position of 35 Hz, as well as some attenuation in the mid-bass region, something that might be desirable in some rooms.

It can be seen that the *Servo-15* mates well with the *Studio/20*, which is itself a really remarkable speaker. Rolling off quite gradually for a ported design, the *Studio/20* has usable response to 30 Hz, down 8 dB in the PNS. Its lower midrange/upper bass are up a couple of dB, with an extremely linear midrange and treble; on the PNS it is ±2 dB over most of the range, and almost as flat in the quasi-anechoic measurement below, though showing some extreme top end rolloff, perhaps because of the phase cap on the metal dome tweeter. The axial performance is very linear, the *Studio/20* radiating a very uniform frequency balance into the room.

The *Studio/20's* impedance was quite well controlled, with a low of 5 ohms at 200 Hz. The phase angle varies by about ±45° in the midrange, indicating a higher order crossover. A quite sensitive speaker, the *Studio/20* will play loud with a low-powered receiver, but probably won't be crazy about tubes.

Together this system was sheer synergy, the bass output of the *Servo-15* prodigious and extended when and if necessary, and the *Studio/20* able to also play at very high volumes cleanly. There was an ease and freedom from compression that usually is heard only from a very large speaker system, combined with great tonal accuracy.

The *Servo-15* will do things that no other subwoofer I've heard will (though there are a few more subs out there to audition, I admit), especially play very loud and clean at the lowest frequencies. Impressive as the *Sunfire* is, it's simply not in the same league in the lowest octave at high levels; using our own T&R CD's 100-to-20 Hz tones with each clearly showed this: the *Servo-15* was clean to over 90 dB even at 20 Hz, but the *Sunfire* started to rattle at this abuse. Mind you, it's still pretty impressive for a box that size. But for clean bass to lower than you can hear and louder than you can stand, the *Servo-15* rules.

The *Studio/20* is a very fast speaker in terms of transients, and images well, but, as befits its budget status, is not as transparent as some of the other speakers reviewed here. However, its neutrality with female voice, and accurate timbre with both voices and instruments make it a remarkable value, the nice cherry veneer is a welcome bonus.