Subwoofers

Earthquake SuperNova MKIV-15

By Steven Stone • September, 2002

Boom. Thud. Crash. What would a movie be without low-frequency effects? Even non-macho films like *Sense and Sensibility* have their share of carriage-wheel rumblings and horse-hoof thuds. Without a serious subwoofer that extends down to a solid 30Hz, and preferably even lower, a home-theater system can hardly be called "high-end."

Fortunately for aficionados of the subterranean, there exist companies like Earthquake Sound, which since 1986 has dedicated itself to the art of reproducing low frequencies. The SuperNova MKIV-15 represents Earthquake's latest thinking on what should go into a flagship subwoofer. After carefully checking my house's foundations for potential cracks and my walls for loose spots, I was fully prepared to find out if the MKIV was the best subwoofer in the known galaxy.

Earthborn Technology

Back in the early 1960s, Anthony Hoffman (the H in KLH) developed a mathematical formula that became known as Hoffman's Iron Law. Thiele and Small later refined the law's mathematics. The Iron Law states that the efficiency of a woofer system is directly proportional to its cabinet volume and the cube of its cutoff frequency (the lowest frequency it can usefully reproduce). To reduce the cutoff frequency from 40Hz to 20Hz you need to increase the enclosure volume by eight times. In other words, to produce half the frequency at the same output level you need a very big box. You can get around this by accepting a much lower efficiency, but this requires both a very large amplifier and a driver that can handle a lot of power, move a lot of air (requiring a long excursion), and do both while generating very little distortion.

A so-called reflex design provides a way around the Iron Law. A hole, or port, in the speaker enclosure loads the driver, reducing its excursion at the low end of its operating range. Below this range, the port itself contributes much of the system's output. One variation on this design uses a passive radiator in place of an open port or vent. A passive radiator is essentially a speaker without a drive mechanism (no magnet or voice-coil) that moves in sympathy with the vibrations and pressure created by the active speaker. By changing the size of the port—or the size and mass of the passive radiator—you can control the frequencies augmented by a reflex system.

Unfortunately, a reflex enclosure has its own set of compromises, including phase and group-delay anomalies and (in the case of a port) vent noise, which add to the woofer's total distortion. Ever since the introduction of the first ported enclosure in 1934, speaker designers have tried to come up with solutions to reduce these problems.

Earthquake has come up with a patented design that, according to the company, solves the problems and carries the technology to a higher level: a passive radiator tuned to a much lower frequency than other subwoofers. The Earthquake SuperNova subwoofer is said to combine the linearity of a sealed box with a ported design's advantages in dynamic ability and size.

The SuperNova MKIV-15 employs a 15-inch passive radiator capable of 4 inches of peak-to-peak movement. Because passive radiators are generally enclosed in a metal basket that limits their motion, they can't accomplish this feat. Also, conventional passive radiators do not move symmetrically in both directions; their outward motion differs from their inward motion. Earthquake's designer, Joseph Sahyoun, created an entirely new design, the Symmetrically Loaded Audio Passive System (SLAPS), that is said to solve both problems. The SLAPS passive radiator eliminates the need for a metal basket, and produces a device whose movements forward and back are symmetrical. It uses two flat diaphragms back-to-back, spaced by about an inch. Each diaphragm is composed of a special multi-layer polyether draw material that combines flexibility with strength, and uses a large-diameter (1.75 inches) roll in its surround material so that it can move the necessary 2 inches to produce a clean 15Hz.

The passive radiator is tuned to 17Hz , a full octave below the sealed cabinet's resonance point. This is said to eliminate most of the problems associated with a ported design. Group delay (in which some frequencies reach your ears before others) and phase-shift effects are moved to much lower frequencies, where their negative effects become inaudible. Because of the SLAPS design, the SuperNova's phase response and time alignment are said to match those of a sealed cabinet, but with the greater dynamic ability and smaller size of a ported design.

Equally innovative technology can be found in the SuperNova's 15-inch MAGMA active driver, an unconventional motor design featuring double-stacked, high-gauss, 1.5-inch-high magnets; a 7-inch-diameter, epoxy-coated, chill-plated super spider; copper-wound, high-temperature voice-coils 3 inches in diameter and 1.85 inches long; and a foam surround of 1-inch-thick single-layer, thermally pressed polyether. These make it possible for the driver to achieve extreme excursions of 19-21mm without physical deformation or losing reactive electromagnetic coupling. This heavy-duty driver looks as if it could be used for launching mortar shells.

The MKIV's 580W internal amplifier is a class-D, high-efficiency digital design. Not only is it much more efficient than a more conventional class-A/B amp, but it runs far cooler, eliminating the need for a large external heatsink. Optical Distortion Limiting (ODL) circuitry, another patented Earthquake process, converts the incoming analog signal to light, then optically couples it to the driver stage. The ODL circuit acts as an automatic and instantaneous input limiter, making it impossible for input signals of excessively high levels to clip the amplifier.

Earthquake offers three versions of the MKIV SuperNova. The standard model comes in black ash. Model P has a hard-shell finish of black polyurethane that resembles a flat black crinkle-coat. Finally, there's an "Uptown" version with a piano-gloss finish—and fabric grilles for those who feel it unseemly to look at a naked driver.

Earthquake has instituted some major topological changes since my review of their SuperNova Mk.II, which appeared in the February 1999 Guide. The passive driver is no longer on the side of the cabinet but on the rear, opposite the active driver. The Mk.II's controls and input-output connections were on its bottom; on the MKIV, they're on the side. These changes make the MKIV much easier to use—you don't have to turn it upside down to adjust or connect it.

The MKIV's control panel provides connections for line-level and high-level inputs. A pair of line-level RCA outputs permits daisy-chaining multiple MKIVs, if you wish. Controls include a volume-level knob, a 24dB/octave crossover knob for adjusting the low pass filter between 50 and 150Hz, a 0°/180° phase switch, and On/Off. In the On position, the SuperNova goes into standby mode when no signal has been detected for 30 minutes.

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