

## R<sup>R</sup> Rave Reviews

Earthquake Sound makes a wide range of electronic components for the car audio, architectural audio and professional audio industries. They manufacture products on an OEM basis which are sold under other brand names and they make some of the world's most powerful subwoofers.

The Earthquake Sound SuperNova MKII reached 113 dB at 35 Hz. This was the highest output level delivered by any subwoofer we had tested up until that time. When Earthquake set out to make an even more powerful unit, they wanted to produce a subwoofer with fewer sonic compromises – one that actually sounded better, not simply one that played louder. The SuperNova Millennium 15 accomplishes this goal by employing some interesting engineering innovations.

Vented subwoofers, which include those using passive radiators, can usually play louder than sealed enclosure designs because of reduced cone excursion at or near the system tuning frequency. The downside is that vented designs can't equal the transient response of sealed-enclosure subwoofers and typically have twice the phase shift and twice as much group delay. ( See the Sunfire Architectural True Subwoofer review for further details) Joseph Sahyoun, of Earthquake Sound, envisioned a vented subwoofer tuned to a subsonic frequency so that these phase and group delay problems could be shifted down in frequency into a range where they would be inaudible. He suspected that a vented subwoofer designed in this way could offer the high output capability of a typical vented system, along with the speed and linear-phase characteristics of a sealed system, within the audible range. Carrying out this concept proved to be harder than expected. A port would be too long to fit in a compact enclosure, and conventional passive radiators were not up to the task.

Reaching a tuning frequency of 15 Hz or so, which is about an octave below the sealed system resonance, required the development of a new type of passive radiator. This patented design is called SLAPS, for Symmetrically Loaded Audio Passive System. The SLAPS passive radiator allows diaphragm excursion of up to 4-inches with symmetrical loading of the active driver on both inward and outward strokes. Now I will explain why it was necessary to invent SLAPS.

### How low can you go?

A subwoofer vent tuned to a very low frequency will be very large, just like an organ pipe designed to play a very low tone. The vent contains a volume of air that resonates at the chosen tuning frequency. The lower this frequency, the greater the volume of air required. As the system is tuned to lower and lower frequencies, eventually a point will be

reached where the vent will be too large to fit within the subwoofer enclosure.

A passive radiator works just like a vent or port. The mass of the moving element ( passive diaphragm) replaces the mass of air in the vent. You can't make the air in a vent heavier, but the diaphragm of a passive radiator can be weighted to tune it to a lower frequency . The vent (port) has to get longer and longer to lower the tuning frequency, but a passive radiator can stay the same size and just be made heavier. That's not all there is to it, though.

As the tuning frequency of a passive radiator gets lower, the required excursion ( or travel) of the diaphragm gets larger. Conventional passive radiators have frames or baskets, much like active drivers and the diaphragms are suspended at the outer circumference by the surround, with a pleated spider connected to the basket acting as a spring to center and return the diaphragm to its resting position. The spider limits the diaphragm excursion and can exhibit non-linear characteristics, providing unequal resistance to inward movement and to outward movement as excursion increases.

### Slaps

The SLAPS passive radiator has no spider or basket to limit diaphragm travel, and it uses a special double surround to provide perfectly symmetrical resistance to inward and outward movement. The surround has a half-roll shape facing outward like a conventional passive radiator, plus a half-roll facing inward towards the interior of the enclosure. These two push-pull surround sections are spaced about an inch apart and are made of material with a tapered cross section to provide perfectly symmetrical spring action to restore the diaphragm to its resting position with equal resistance to inward or outward movement over a very long range of travel. This surround design prevents any rocking motion, even when the diaphragm is weighted in the center, and eliminates the need for a spider and basket.

The SLAPS passive radiator loads the MAGMA15 active driver symmetrically to help keep its long voice coil centered in the gap. This has the effect of extending the linear travel capability of the active driver, while permitting extremely long travel and high output from the passive diaphragm. The combination of the specially-designed Magma active driver and SLAPS passive radiator allows the system to be tuned to an infrasonic frequency, producing a phase response curve that looks like a sealed enclosure design, above 20Hz.

The SuperNova Millennium should have the phase characteristics (above 20Hz) and ultra-deep bass extension of a sealed box subwoofer, along with the power and high output capability of a vented subwoofer. Let's see how it actually performs.



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Enclosure Type: Vented (passive radiator)  
Driver (s): 1x15" active, 1x15" passive  
Amplifier Power: 580 watts, Class D  
High-pass Filter:  
Line-level 70Hz at 6dB/octave  
Speaker level: none  
Low-Pass Filter: 24dB/octave variable  
from 40 Hz-120Hz  
Dimensions (wxhxd in inches): 20x17.5x18  
Weight (lbs.): 110

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