Prospectus: XBL^2 Loudspeaker Technology

Summary

Extremis Audio LLC's (d.b.a. Adire Audio) patented* XBL^2 loudspeaker technology creates higher audio output at lower distortion over a more-extended frequency range (both high and low) than all other loudspeaker structures, yet requires only small key modifications of three parts, usually at a significant bottom-line savings for the delivered product.

* Allowance granted to claims in December, 2005; patent number expected soon.

Abstract

Adire / Extremis Audio's XBL^2 technology is a radical rethinking of how a loudspeaker (motor) should operate, and reaps many significant benefits from the results. The acronym stands for e**X**treme **BL L**inearity, describing the unprecedentedly-constant driving force an XBL^2-enabled loudspeaker motor can generate over long cone travel (excursion), in contrast to other current motor structures. This constancy of force minimizes distortions (2- to 4-fold or more), thereby increasing clarity and making the sound natural and effortless, while the increased cone travel (typically 2-fold) allows for increased output in all frequency bands, in particular allowing the bass response to extend deeper without driver overload or distortion. XBL^2 is relatively easy and inexpensive to add to existing drivers, typically requiring two machining cuts in steel and matching of the voice coil to the cut dimensions. The gains from XBL^2 are typically so great that the loudspeaker designer is freed to alter the system in other beneficial ways to match, e.g. one driver unit becomes capable of doing the work of two and reducing overall driver count, and/or the bandwidth becomes greater making crossover design simpler, etc. There are numerous savings obtained by addition of XBL^2 to a driver, especially if some of the massive gains in output potential are traded for smaller and/or lighter driver components; these include smaller component size, lighter system weight, and lower materials cost.

Detailed Description

Adire / Extremis' XBL^2 is easy and cost-effective to implement. It is, in essence, two (or more) equal magnetic gaps matched to a voice-coil just long enough to span the midpoints of those gaps. The standard implementation, starting from an existing driver, requires three specific modifications: a groove in the inner (gap) edge of the top plate, a matching groove on the facing surface of the central pole piece (core), and a short voice-coil spanning the midpoints of the two separate gaps created by the opposing grooves (see drawing below).

While any existing driver could simply be machined to form this structure, the most common approach to making an XBL^2 driver is to increase the thickness of the top plate

by 25% or more to allow a reasonably-wide groove to be cut into its inner face. The core often does not need lengthening, because the magnet thickness is often reduced, allowing the same core (or even shorter) to extend the same amount past the top plate as in the original non-XBL^2 unit. The groove depths are roughly the same as the top-plate-to-core gap, though slightly deeper grooves can sometimes improve performance at the extremes of excursion.

Other means of construction work as well, including stacking thin top plates of differing inner diameters; drivers of both machined and stacked structures have been in the field since 2002. It is also clear that XBL^2 can be added to anything from giant subwoofers to the smallest tweeters, with or without shielding, and in any type of structure, including those with rare-earth magnets (e.g. Nd-Fe-B), internal-magnet cup structures, etc. Furthermore XBL² drivers can be manufactured by any driver production line in existence today; it does not require extra steps, changes in assembly steps/processes, nor any exotic materials or glues. Standard driver production tools and magnetizers are all that are required.

XBL^2 creates higher output of lower distortion across a wider frequency range. It was the result of research into creating a lower-distortion, more linear loudspeaker driver. It was seen that the major source of distortion came from the BL factor (motor-force) decreasing continually as the voice-coil moved away from its rest position, and XBL^2 was invented to prevent this decrease, making the motor force constant over the usable driver excursion.

However, it was quickly realized that the same approach gave huge increases in linear excursion capability while remaining at low distortion; the two are inextricably related in XBL^2. For marketing purposes, Adire Audio chose to pursue the ultra-high-excursion car- and home-subwoofer market first, where the huge excursion would reap maximum media coverage. Starting with the introduction of the Brahma series of woofers in 2002 and continuing through the present, the highest-excursion driver in the world has been an XBL^2 unit. From the ultra-excursion market, XBL^2 has gained a cult-like following among audio enthusiasts and hobbyists for both sheer output and for output quality, and this created great anticipation for the evolution of XBL^2 into smaller drivers, e.g. small woofers, midranges, and even tweeters.

This progression has created the Extremis 6.8, a 7-inch mid-woofer that boasts more output than most 10-inch subwoofers, while playing midrange with greater grace, finesse, and sheer musicality than the (prior) top units on the market. The CSS FR125S 4-inch driver is the first single driver ever to cover the 60 Hz to 20 kHz range at normal listening levels, with excursion besting many highly-regarded 10-inch woofers. Most recently, a 3-inch subwoofer has been created for a client requiring 30 Hz output in a small form factor, with a full-range variant good to 20 kHz planned. The existing subwoofer variant tested exceedingly well in the hands of the top driver testing and characterization firm in the world, Klippel GmbH (Dresden, Germany); in fact, they asked to keep one sample as an example of a very-well designed driver with very low distortion artifacts from any of the common mechanisms.

Other benefits of XBL² include:

- Lower baseline of moving mass for a given excursion level. Because of the shorter voice coil needed for a given level of stroke, the moving mass contribution from the voice coil is greatly reduced. Lower moving mass is not always required; however having a lower baseline allows the driver designer to add mass as required in more appropriate locations where rocking and cantilevering are reduced. Lower mass also means a higher efficiency, as moving mass is the dominant factor in the efficiency of the driver.

- Lower inductance. A short voice coil means fewer turns of wire, reducing the inductance of the driver. Voice coil inductance is typically the main limiting factor in high frequency extension; lowering the inductance by a factor of two will double the high frequency extension of the driver.

- Lower flux modulation. A lower inductance means the magnetic field created by the voice coil is reduced. This will lower flux compression and flux modulation in the driver, resulting in a reduced need to use high-cost flux-modulation corrections such as copper or aluminum rings or counter wound coils.

- Resistance to scraping/rocking. Shorter voice coils mean reduced radial displacement for a given angular rocking of the driver. The gap can be narrower for a given dynamic clearance, meaning higher flux levels can be achieved; alternatively for high-rocking drivers the gap can be left unchanged and greater clearance is achieved.

- Lowered tolerances required in production. The crucial dimensions in an XBL² motor are the sizes and position of the rebates, and the length of the voice coil. The rebates are either cut, stamped, or forged in to the steel during production, all of which are high-tolerance production steps by nature (typical forging/stamping/cutting tolerances are within 0.010", within the tolerance required for XBL²). Voice coil length is easy to achieve by all voice coil winding facilities, as that is also computer controlled, and winding can be controlled down to 1 turn in 10,000.

- Lower production cost. Because of the use of a much shorter than normal voice coil, the cost of the voice coil can be greatly reduced. Additionally, a much shorter magnet stack is required for a given mechanical stroke clearance level. The result is that the price of raw materials in the motor can be lower than an equivalent-stroke overhung or underhung motor.

- Smaller motor. Since the voice coil is less than the height of the top plate, a shorter stack of magnets is required for a given clearance level; in fact, for a given amount of stroke the XBL² motor will be 10-25% shorter. Additionally, because of the high utilization of flux (typically 70% of the total flux in the system) a smaller diameter magnet can be used to reach a target gap flux level.

Conclusion

Adire / Extremis feels that most, if not all, common-use loudspeaker drivers would benefit by inclusion of XBL^2, and will work with licensees towards incorporating it into appropriate products across the entire product line for the greatest gain of the licensee. Adire / Extremis provides software tools and training to make design as easy as designing non-XBL^2 drivers and often easier, able to hit spec with the first prototype. The licensee can "own" and brand the technology as they see fit, requiring only display of the patent number, and/or can reap existing appreciation in the market by referencing the names XBL^2 and/or Adire and/or related products of Adire if so desired.

Side-on cut-away view of XBL^2 driver