

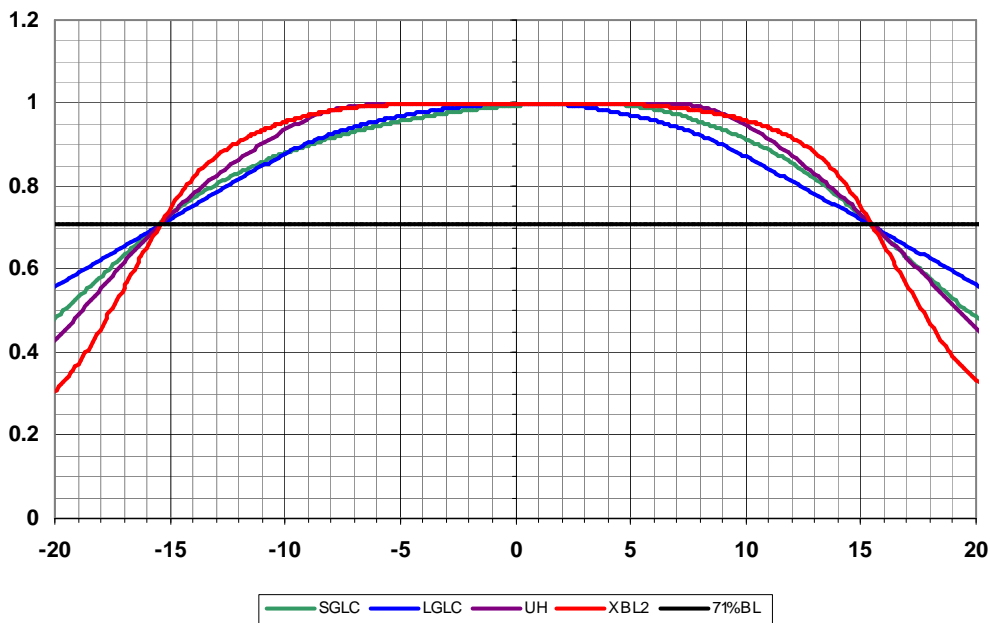


Acoustic Development International has developed a new **patented⁽¹⁾** technology for linearizing loudspeaker drivers called XBL (**eXtreme BL Linearity**). This proven technology greatly flattens the BL curve (motor strength) over the majority of the driver’s usable excursion, with typically no net increase in production cost. The flatter BL curve means lower distortion (see Dr. Wolfgang Klippel, et al).

The graph to the right shows an FEA comparison of the BL-versus-excursion of several driver motor topologies. These are the traditional short-gap/long-coil (SGLC), new-style long-gap/long-coil (LGLC), traditional underhung (UH), and our revolutionary XBL motor topology. Each motor was optimized for a “typical” subwoofer Xmax value of 15.4mm one way, linear.

As shown in the graph, the XBL motor offers much flatter BL. In fact, the XBL motor has less than a 5% BL decrease over 24mm of total excursion, while the other topologies range from 12 to 18mm for the same BL decrease. When XBL has decreased 10%, the other motors have decreased between 18 and 23%. XBL motors offer significant advances in BL linearity, meaning shorter coils and top plates can be used when targeting a specific operating range. Typically an XBL motor uses the shortest voice coil length of any topology for a 10% BL variance.

Normalized BL versus excursion comparison



Motor	Top Plate	Voice coil
SGLC	0.31"	1.43"
LGLC	0.80"	1.53"
UH	1.10"	0.51"
XBL	0.85"	0.62"

The top plate and coil lengths for these example motors are summarized in the table to the left. The XBL motor uses a voice coil nearly as short as that of the traditional underhung unit, which yields the typical advantages of an underhung design: low moving mass and low inductance. At the same time, the XBL motor is considerably flatter in BL, has equivalent excursion, and uses a much shorter top plate than the underhung unit (which greatly reduces the production cost).

Compared to the overhung designs, the shorter coil length means more mechanical clearance in the motor and higher tolerance of rocking, meaning dual spiders are not required for high excursions. Combine this with a flatter BL curve, lower inductance, and lower moving mass and the advantages of XBL over overhung topologies - both performance and price - are readily apparent.

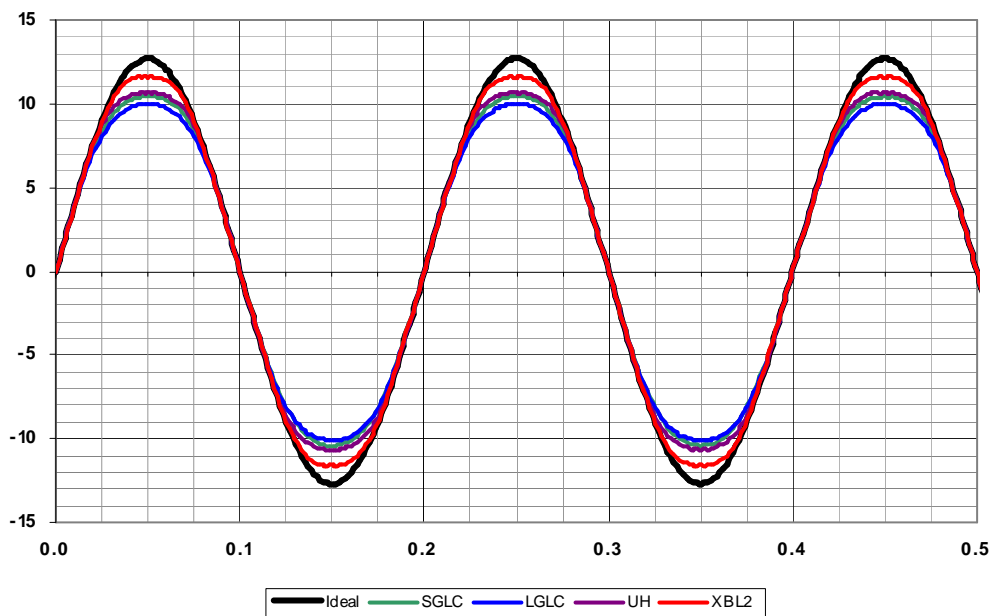
(1) US Patent 7,039,213

XBL is trademark TM ADI

XBL reduces distortion. Keeping the BL flat means more constant motor force at excursion, which means better tracking of large-signal inputs. The graph below shows the output waveform for each of the above motors, when trying to follow an ideal $\pm 12.7\text{mm}$ excursion signal. As shown, **XBL** best tracks the input signal when the target excursion is still well within the “usable” excursion limits of the driver (rated X_{max} of 15.4mm). As is evident, the **XBL** motor is much closer to the input signal.

Waveforms at $12.7\text{mm } X_{\text{max}}$

This advantage translates into directly measurable and audible reductions in distortion. For the example motors analyzed in this paper, the distortion figures are given for $\pm 10.8\text{mm}$ excursion (70% of X_{max}). The **XBL** motor has less than 30% of the distortion present in the other motors.



XBL motors are useful for all audio transducers. While this example has focused on woofers, the advantages are also applicable for midranges and tweeters. In fact, the low inductance and moving mass of this motor are extremely beneficial in wideband transducers. Typically, **XBL** will halve the inductance of a comparable-excursion overhung motor, which can result in adding a full octave of extension on the high end. Add in the lower moving mass from the short coil, and the driver designer has a greater degree of flexibility in driver creation.

THD at $10.8\text{mm } X_{\text{max}}$	
SGLC	3.5%
LGLC	4.4%
UH	4.0%
XBL	1.0%

SUMMARY OF BENEFITS

- **Flatter BL**
- **Lower Distortion**
- **Low Inductance**
- **Low Moving Mass**
- **Reduced Clearance Issues**
- **Applicable to All Drivers**
- **Little or No Production Cost**

XBL represents a major step forward in loudspeaker design. It is implemented in a wide variety of drivers ranging from extreme-excursion subwoofers (with one way linear stroke to 60mm), to midranges, full range drivers, tweeters, and microdrivers as small as 16mm in diameter. Any existing driver can be adapted to use **XBL** with the benefits measurably and audibly apparent.