SPECIFICATIONS

WF211PA01/02 8¼” die cast frame, paper cone PA mid/woofers, 4/8 ohm

The 8¼” transducers WF211PA01 (4 ohm) and WF211PA02 (8 ohm) were the first products by Wavecor dedicated for Public Address audio systems. They merge the well-known audiophile sound qualities of a typical Wavecor transducer with the common virtues of PA transducers with high sensitivity, high power handling, low distortion, and true-to-the-source sound reproduction.

FEATURES

- Balanced Drive motor structure for optimal drive force symmetry resulting in largely reduced even order harmonic distortion
- Alu shorting ring on center pole below and above air gap to reduce voice coil induction, reduce variation of voice coil induction as a function of voice coil position, and reduce flux variation induced by voice coil current. All with the purpose of reducing large-signal distortion
- Large motor with 2.5” voice coil diameter for better control and power handling
- Cone made of light and stiff paper formula for high efficiency and uncoloured sound
- Rigid die cast alu chassis with extensive venting for lower air flow speed reducing audible distortion
- Vented voice coil former for reduced distortion and compression
- Vented center pole with dual flares for reduced noise level and compression at large cone excursions
- Heavy-duty black fiber glass voice coil former to reduce mechanical losses resulting in better dynamic performance and low-level details
- Low-loss suspension (high Qm) for better reproduction of details and dynamics
- Black plated motor parts for better heat transfer to the surrounding air
- Conex spider for better long-term stability and better durability under extreme conditions

NOMINAL SPECIFICATIONS

Notes	Parameter	WF211PA01		WF211PA02		Unit
		Before burn-in	After burn-in	Before burn-in	After burn-in	
	Nominal size	8¼		8¼		[inch.]
	Nominal impedance	4		8		[ohm]
	Recommended max. upper frequency limit	3		3		[kHz]
1, 3	Sensitivity, 2.83V/1m (calculated from T/S parameters)	96.5		93		[dB]
2	Power handling, short term, IEC 268-5, no additional filtering	350		350		[W]
2	Power handling, long term, IEC 268-5, no additional filtering	200		200		[W]
2	Power handling, continuous, IEC 268-5, no additional filtering	170		170		[W]
	Effective radiating area, S_d	214		214		[cm²]
3, 6	Resonance frequency (free air, no baffle), F_s	68	59	68	59	[Hz]
	Moving mass, incl. air (free air, no baffle), M_{ms}	26		25.8		[g]
3	Force factor, Bxl	10.7		13.4		[N/A]
3, 6	Suspension compliance, C_{ms}	0.21	0.28	0.21	0.28	[mm/N]
3, 6	Equivalent air volume, V_{as}	13.6	18.2	13.6	18.2	[lit.]
3, 6	Mechanical resistance, R_{ms}	1.68	1.68	1.68	1.68	[Ns/m]
3, 6	Mechanical Q, Q_{ms}	6.7	5.8	6.6	5.7	[-]
3, 6	Electrical Q, Q_{es}	0.30	0.26	0.38	0.33	[-]
3, 6	Total Q, Q_{ts}	0.29	0.25	0.36	0.31	[-]
4	Voice coil resistance, R_{DC}	3.1		6.1		[ohm]
5	Voice coil inductance, L_e (measured at 1 kHz)					[mH]
	Voice coil inside diameter	64		64		[mm]
	Voice coil winding height	10		10		[mm]
	Air gap height	6		6		[mm]
	Theoretical linear motor stroke, Xmax	±2		±2		[mm]
	Magnet weight	1.85		1.85		[kg]
	Total unit net weight excl. packaging	5.0		5.0		[kg]
3, 5	K_{rm}					[mohm]
3, 5	E_{rm}					[-]
3, 5	K_{xm}					[mH]
3, 5	E_{xm}					[-]

Note 1 *Measured in infinite baffle.*

Note 2 *Tested in free air (no cabinet).*

Note 3 *Measured using a semi-constant current source, nominal level 2 mA.*

Note 4 *Measured at 25 deg. C*

Note 5 *It is generally a rough simplification to assume that loudspeaker transducer voice coils exhibit the characteristics of an inductor. Instead it is a far more accurate approach to use the more advanced model often referred to as the “Wright empirical model”, also used in LEAP-4 as the TSL model (www.linearx.com), involving parameters K_{rm}, E_{rm}, K_{xm}, and E_{xm}.* This more accurate transducer model is described in a technical paper **here at our web site.**

Note 6 After burn-in specifications are measured 12 hours after exiting the transducer by a 20 Hz sine wave for 2 hours at level 16/24 VRMS (4/8 ohm version). The unit is not burned in before shipping.

 For more information please visit **www.Wavecor.com**

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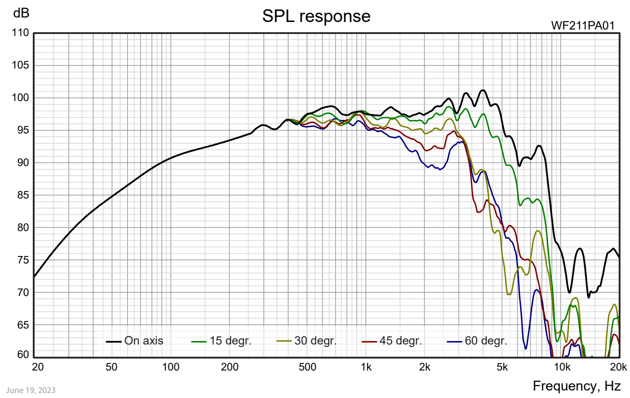
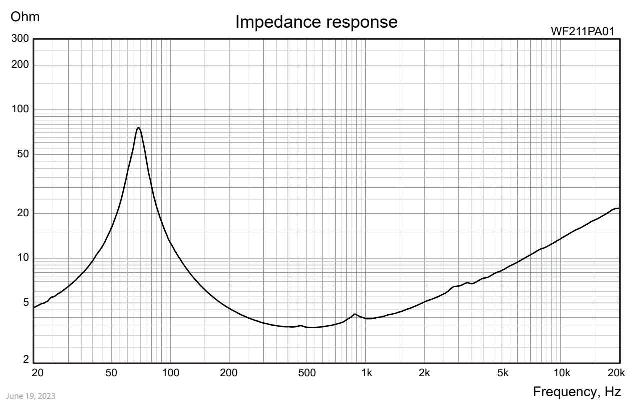


Important!

Please observe that graphs on the left side of this page and the below text files for download are actual measurements of the drivers measured in infinite baffle and without any enclosure. Measuring the drivers in a finite baffle (like the baffle of most speaker cabinets) and in any size of enclosure will lead to different response curves.

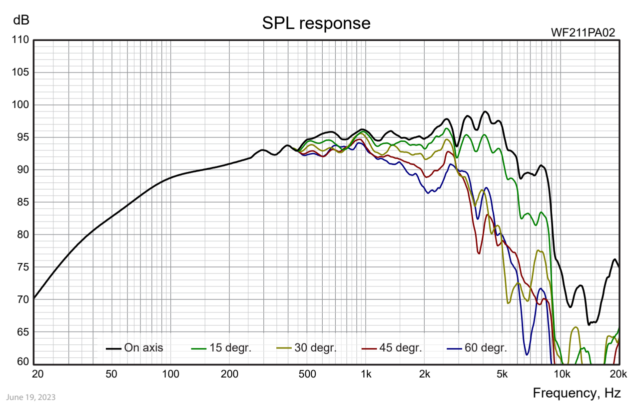
Download WF211PA01 on-axis SPL response as .txt file

Measuring conditions, SPL
Driver mounting: Flush in infinite baffle, back side open (no cabinet)
Microphone distance: 1.0 m
Input signal: 2.83 V_{RMS} LogChirp, 64k, Hanning/2
Smoothing: 1/6 oct.



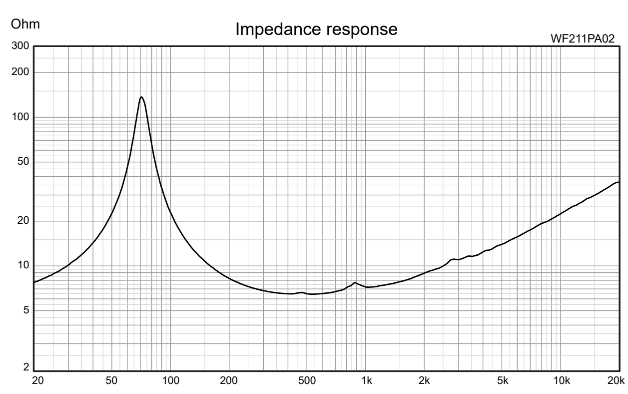
Download WF211PA01 Impedance response as .txt file

Measuring conditions, impedance
Driver mounting: Free air, no baffle, back side open (no cabinet)
Input signal: Stepped sine wave, semi-current-drive, nominal current 2 mA
Smoothing: None



DownloadWF211PA02 on-axis SPL response as .txt file

Measuring conditions, SPL
Driver mounting: Flush in infinite baffle, back side open (no cabinet)
Microphone distance: 1.0 m
Input signal: 2.83 V_{RMS} LogChirp, 64k, Hanning/2
Smoothing: 1/6 oct.

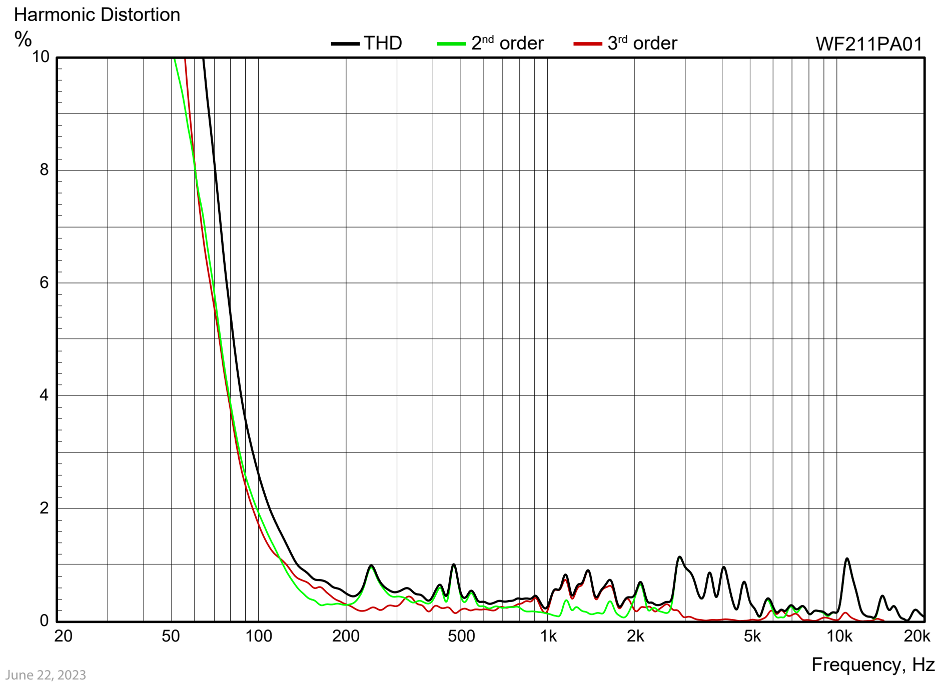


Download WF211PA02 Impedance response as .txt file

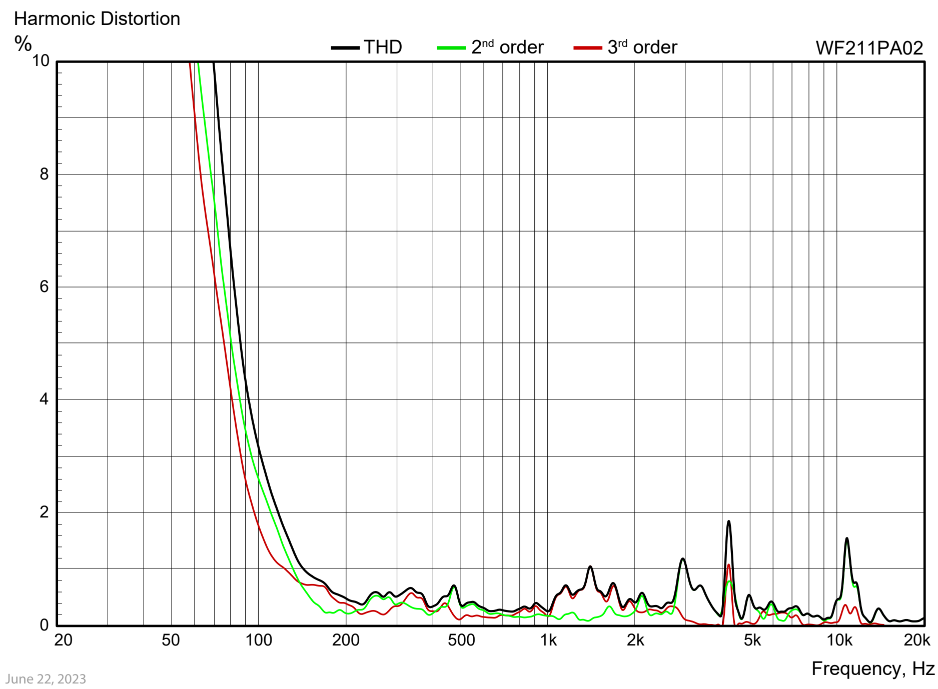
Measuring conditions, impedance
Driver mounting: Free air, no baffle, back side open (no cabinet)
Input signal: Stepped sine wave, semi-current-drive, nominal current 2 mA
Smoothing: None

SPECIFICATIONS

WF211PA01/02 8¼" die cast frame, paper cone PA mid/woofers, 4/8 ohm



Measuring conditions, distortion
Driver mounting: Flush in infinite baffle, back side open (no cabinet)
Input voltage: 8.3 VRMS
Smoothing: 1/12 oct.



Measuring conditions, distortion
Driver mounting: Flush in infinite baffle, back side open (no cabinet)
Input voltage: 10.7 VRMS
Smoothing: 1/12 oct.

SPECIFICATIONS

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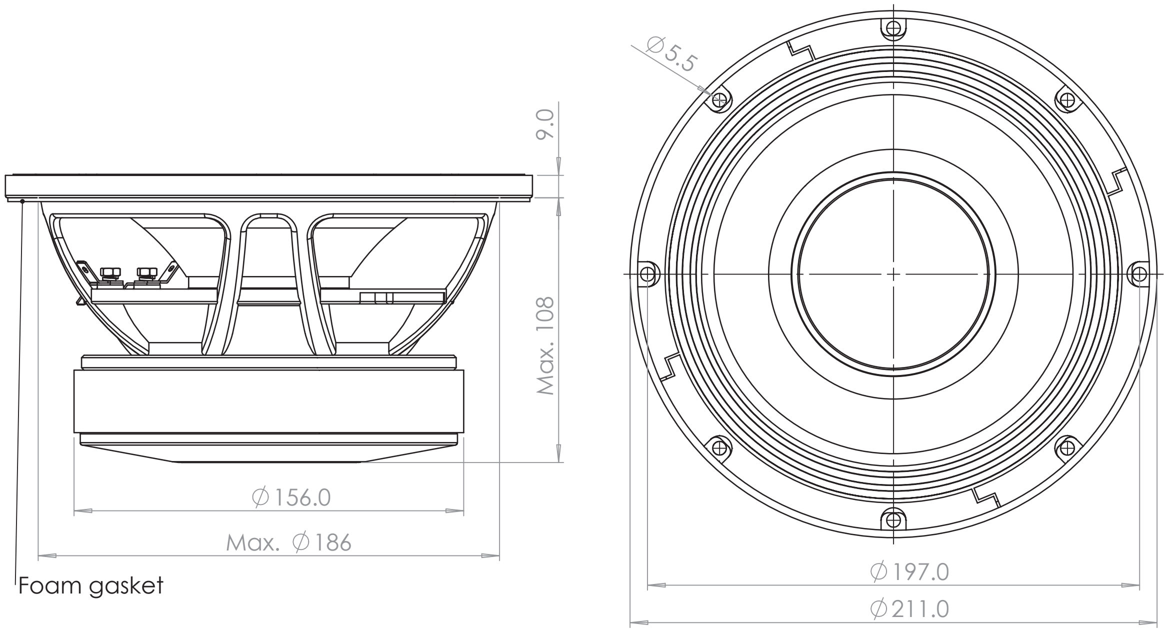
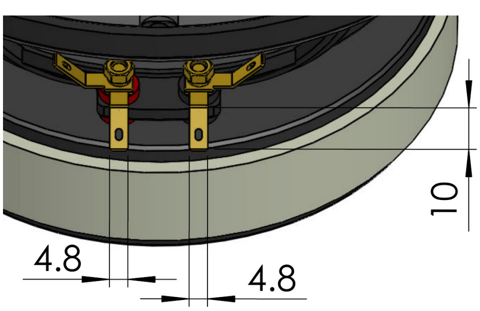
OUTLINE DRAWING (nominal dimensions)

Dimensions in mm



CONNECTIONS



PACKAGING AND ORDERING INFORMATION

Part no. WF211PA01-01	4 ohm version, individual packaging (one piece per box)
Part no. WF211PA02-01	8 ohm version, individual packaging (one piece per box)

Latest update: June 26, 2023

wavecor

BD

BALANCED DRIVE

Line of speaker units designed with

optimized motor symmetry.

The Wavecor Balanced Drive Technology

Introduction

The Balanced Drive line of loudspeaker transducers is yet another example of Wavecor paying attention to every detail.
Instead of following the common way by designing loudspeaker drivers “as usual” Wavecor have spent significant research time further optimizing one of the most important parts of a loudspeaker transducer: The motor.

The motivation for the work was our continuous search for better sound and in this project we set the target to reduce the harmonic distortion generated by non-symmetrical motor structures.
This paper uses the specific results obtain for our 7” mid/woofer WF182BD01. However, all members of the BD (Balanced Drive) product line offer the same improvements and symmetrical motor structure.

The study

Looking at a traditional transducer motor structure like shown fig. 3a below it is relatively obvious that the design probably is not ideal. One thing that comes to mind is that symmetry might be improved. We have verified this assumption with a series of simulations shown on the following pages. So does this lack of symmetry lead to any negative effects when looking at the performance of the transducer? The concern here is how the poor symmetry of the magnetic flux density curve over distance will influence the symmetry of the force factor (Bxl) as the voice coil moves to different positions. Ideally the Bxl curve should be constant as a function of voice coil position or at least symmetrical for movements in/out.
As an experiment we fed a pure 100 Hz sine wave into a spectrum analyzer. With no noise or distortion present we obtained the result shown as the black 100 Hz vertical line in fig. 1. No harmonics present. Next we manipulated the 100 Hz sine wave by compressing the positive halves of the sine wave by 50%. As shown on the following pages this is a realistic large-signal situation for a non-optimized magnet structure normally used for loudspeaker transducers. The resulting spectrum we obtained had added significant even harmonics, 2nd, 4th, etc. They are the blue lines in fig. 1. In our example the 2nd harmonic is 17dB below the fundamental corresponding to around 14% of 2nd order harmonic distortion. There is additionally noticeable levels of 4th order harmonics (2.5%). All higher order even harmonics are present as well although at lower levels.
This means we are claiming that for many existing transducers the large-signal even order harmonic distortion caused by non-symmetrical motor structures could easily reach 10-20% or even higher levels.
The conclusion of our study therefore is that creating symmetrical motor structures is a great avancement in loudspeaker transducer design.

Results

By introducing the Balanced Drive Technology Wavecor have greatly reduced the even order harmonic distortion that is present in traditional transducer motor designs.
The resulting improvements in motor symmetry are shown on the following pages. Within a wide distance interval almost perfect symmetry is obtained for the flux density curve and, more importantly, for the Force factor curve, Bxl.
We specifically used the Wavecor mid/woofer model WF182BD01/02 to generated all the curves shown below in figs. 4 to 7. Using the Balanced Drive motor technology has resulted in a Bxl curve that has non-symmetry better than +/-5% within a voice coil travel range of +/-12 mm.

The Balanced Drive design leads to one additional improvement: Due to the extension of the center pole the voice coil inductance symmetry is improved too as a function of the voice coil position.

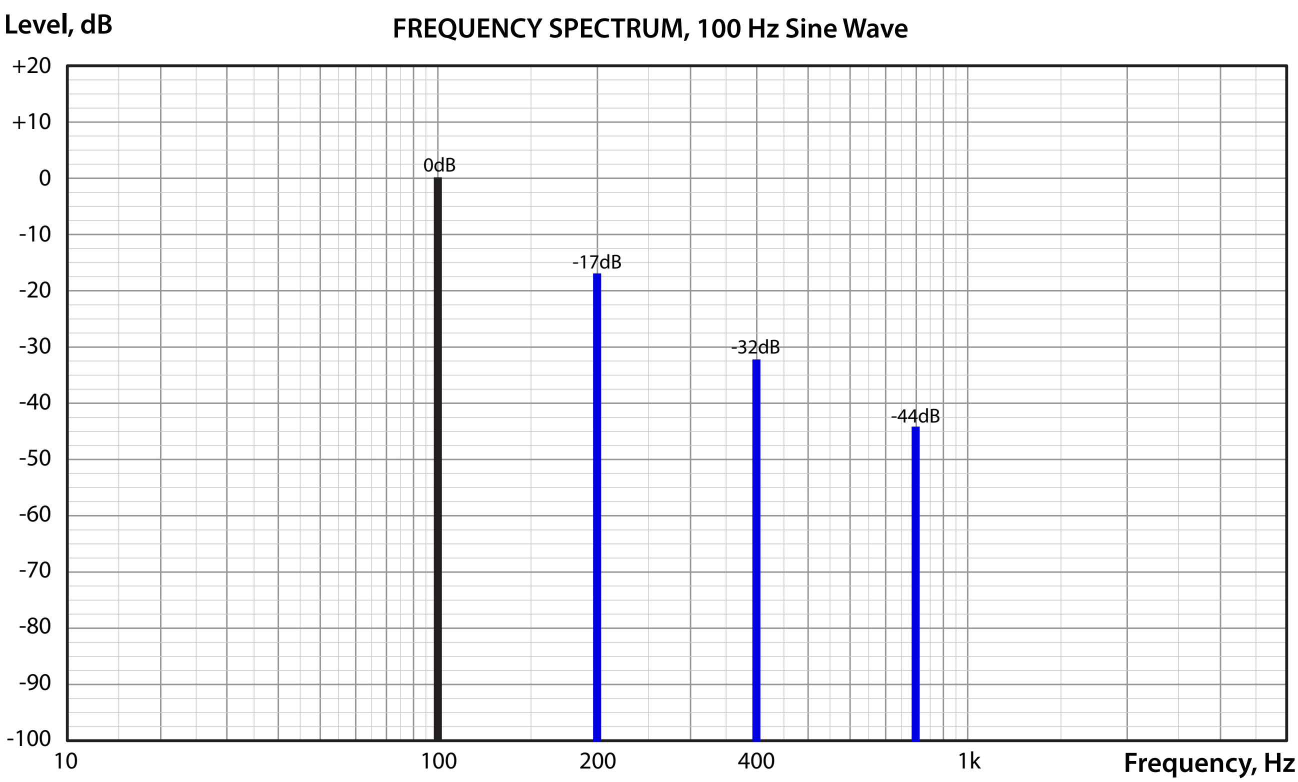


Fig. 1. *Frequency spectrum for a pure 100 Hz sine wave (black vertical line) and the even order higher harmonics (blue vertical lines) created by non-symmetrical transducer motors.*

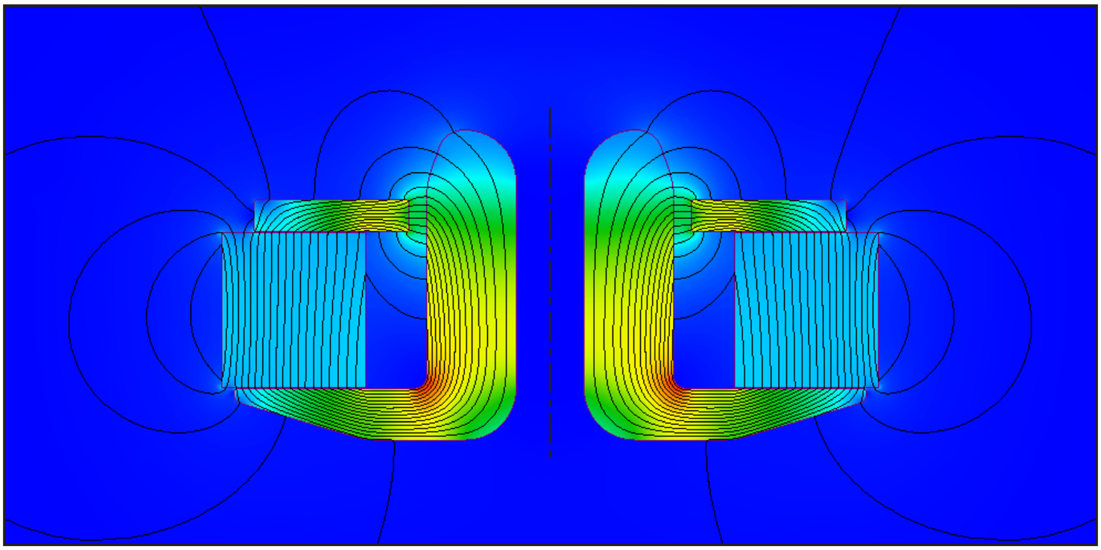


Fig. 2. *The magnetic structure of the Balanced Drive line of Wavecor transducers is optimized using advanced Finite Element Analysis software.*

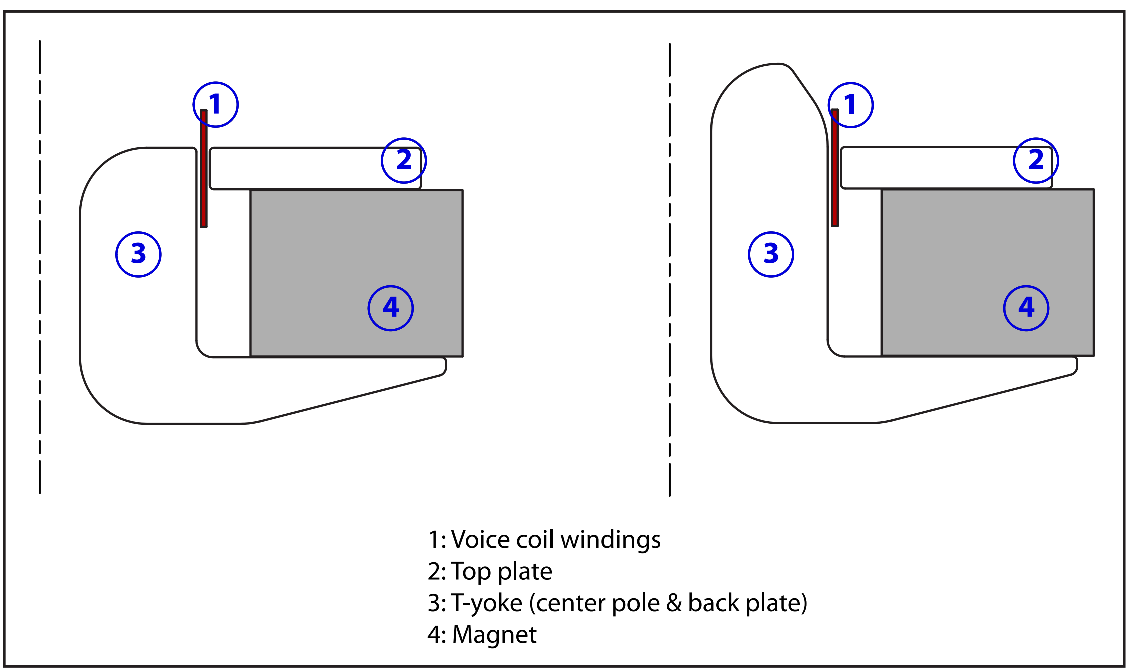


Fig. 3a (left). *Cross section of a traditional motor design.*

Fig. 3b (right). *Cross section of the Balanced Drive motor design used for woofers in the Wavecor BD line. The shown motor is the actual structure used for the Wavecor WF182BD01 mid/woofer.*

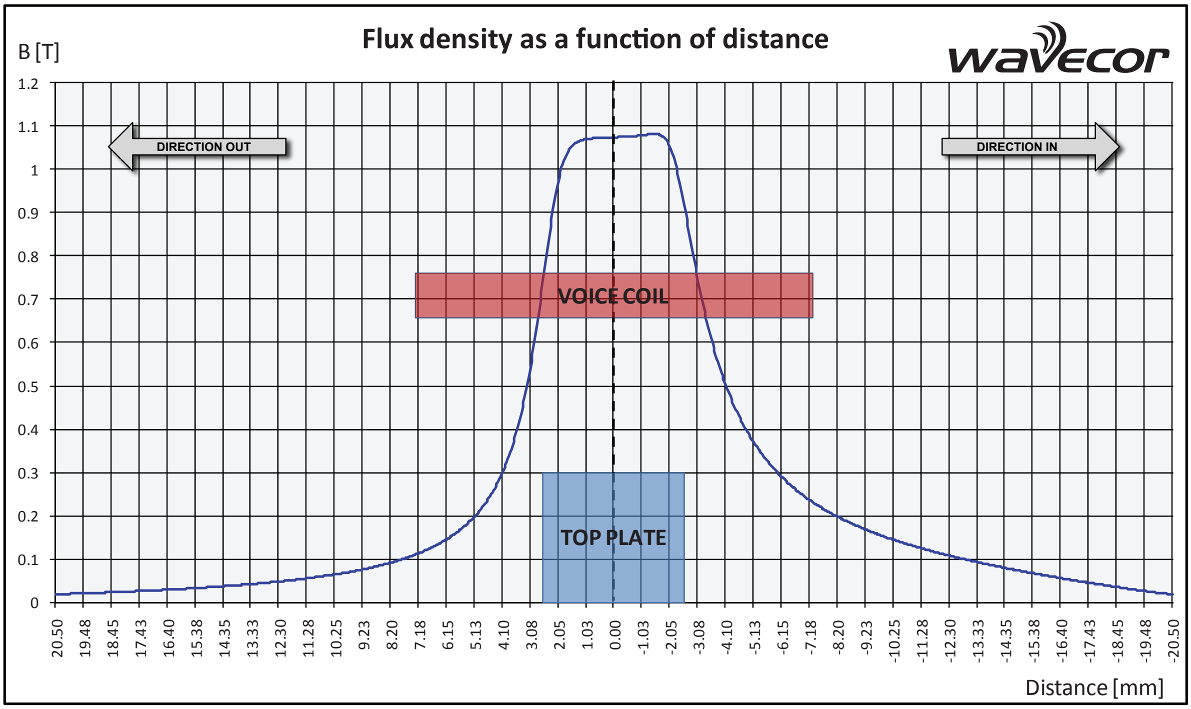


Fig. 4a. *Magnetic air gap flux density (B) distribution for a traditional magnet structure as shown fig. 3a. Notice that the curve is non-symmetrical with higher levels in the direction towards the inside of the magnet structure.*

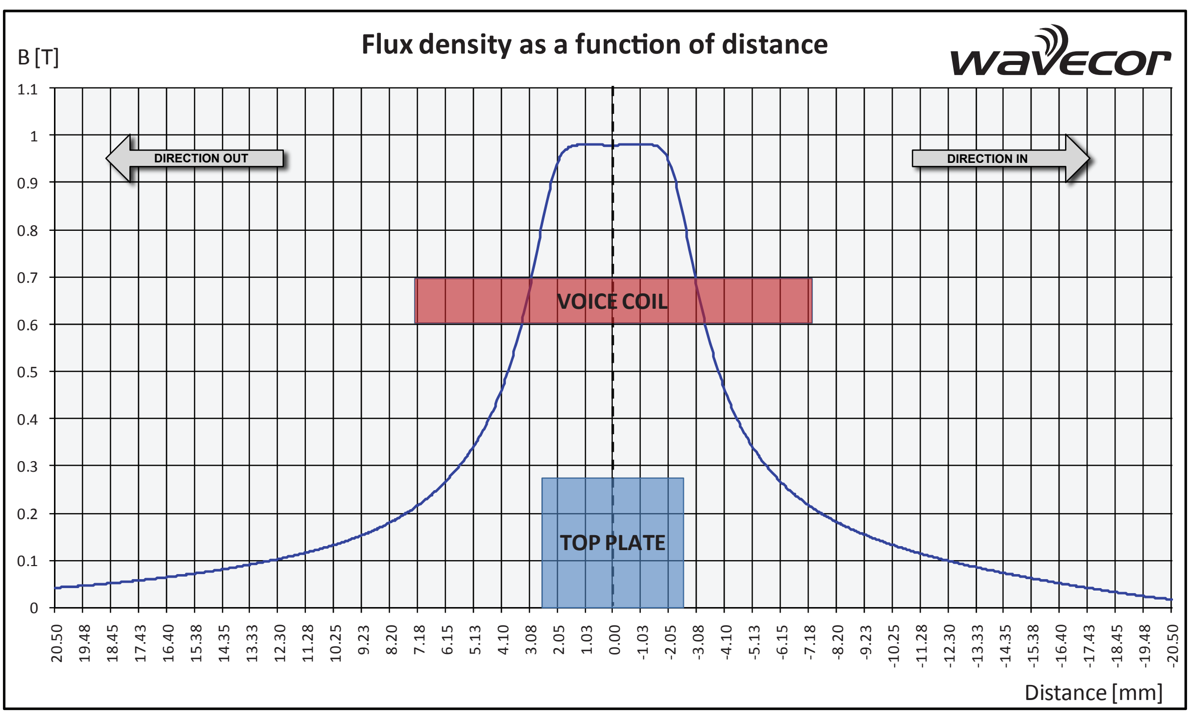


Fig. 4b. *Magnetic air gap flux density (B) distribution for the Wavecor WF182BD01 mid/woofer. The curve is almost perfectly symmetrical. The red bar shows the actual WF182BD01 voice coil and its position. The blue square illustrates the top plate, which is 5mm thick for WF182BD01.*

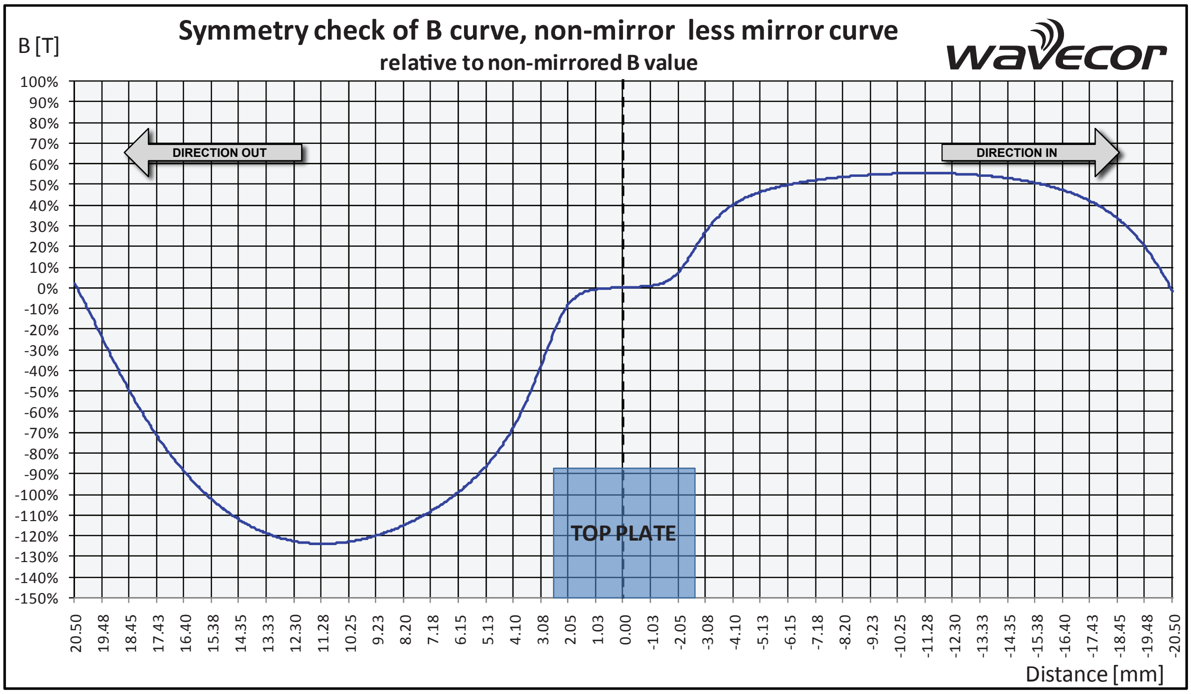


Fig. 5a. *Magnetic flux density (B) distribution for a traditional magnet structure as shown fig. 3a. The figure shows the relative symmetry as the difference when measuring B out/in, held relative to the value outwards.*

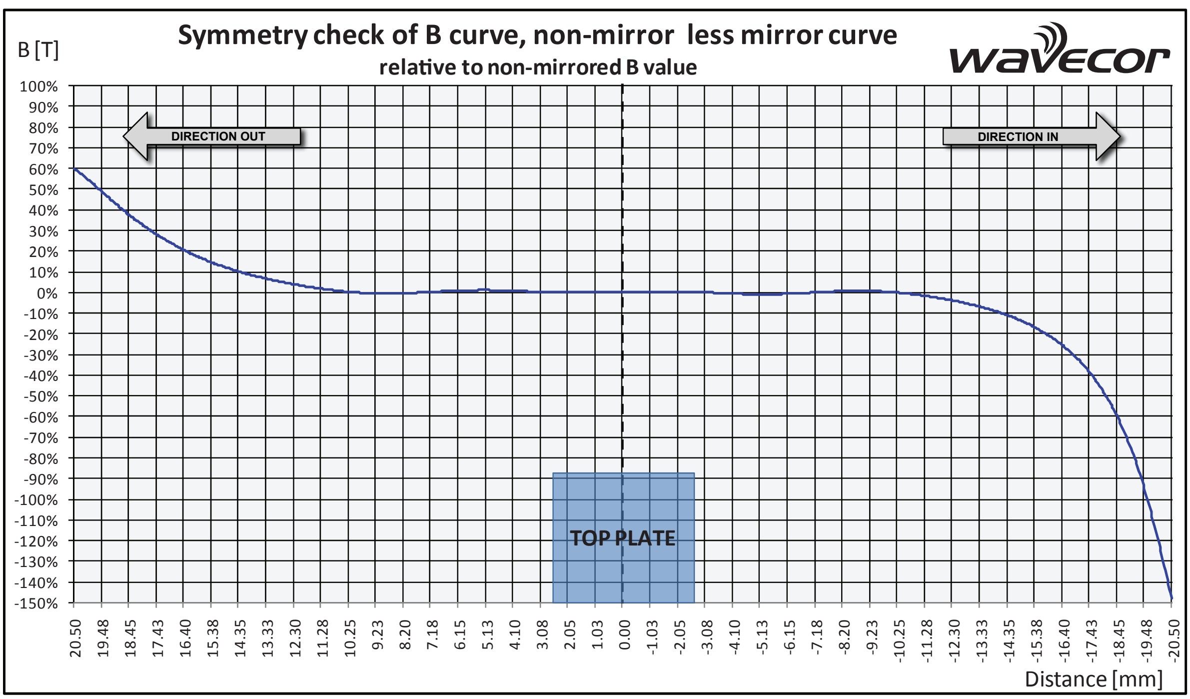


Fig. 5b. *Magnetic flux density (B) distribution for the Wavecor WF182BD01 mid/woofer. The figure shows the relative symmetry as the difference when measuring B out/in, held relative to the value outwards. Notice the very significant improvement compared to fig. 5a.*

Fig. 6a. Force factor (Bxl) as a function of voice coil position for a traditional magnet structure as shown fig. 3a. The curve is non-symmetrical and that the maximum Bxl is obtained with the voice coil positioned 1-2 mm below the center of the air gap.

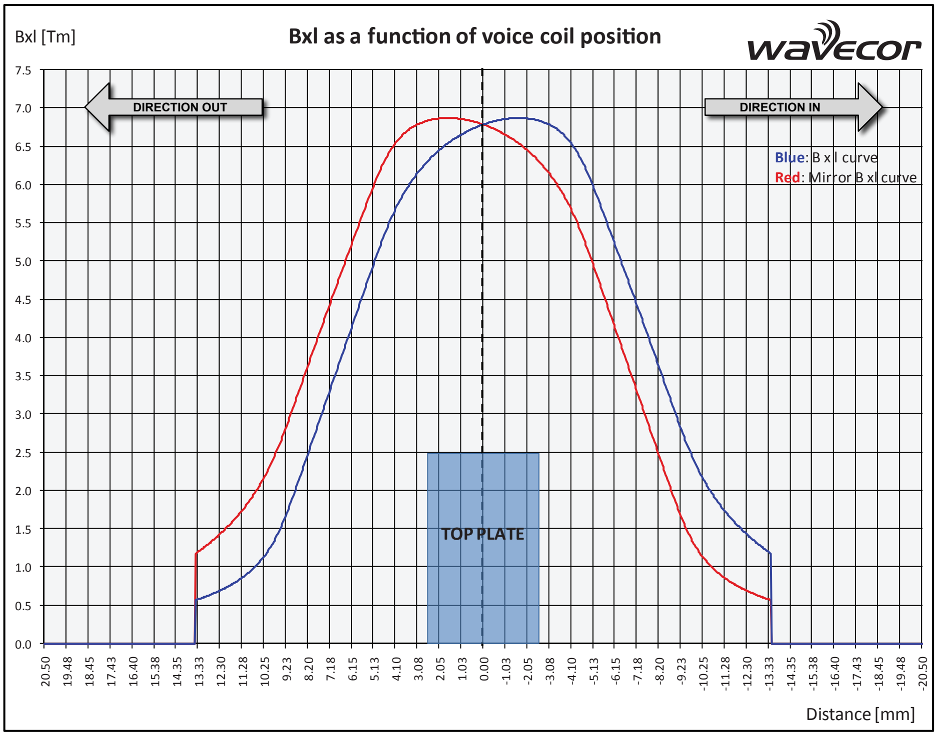
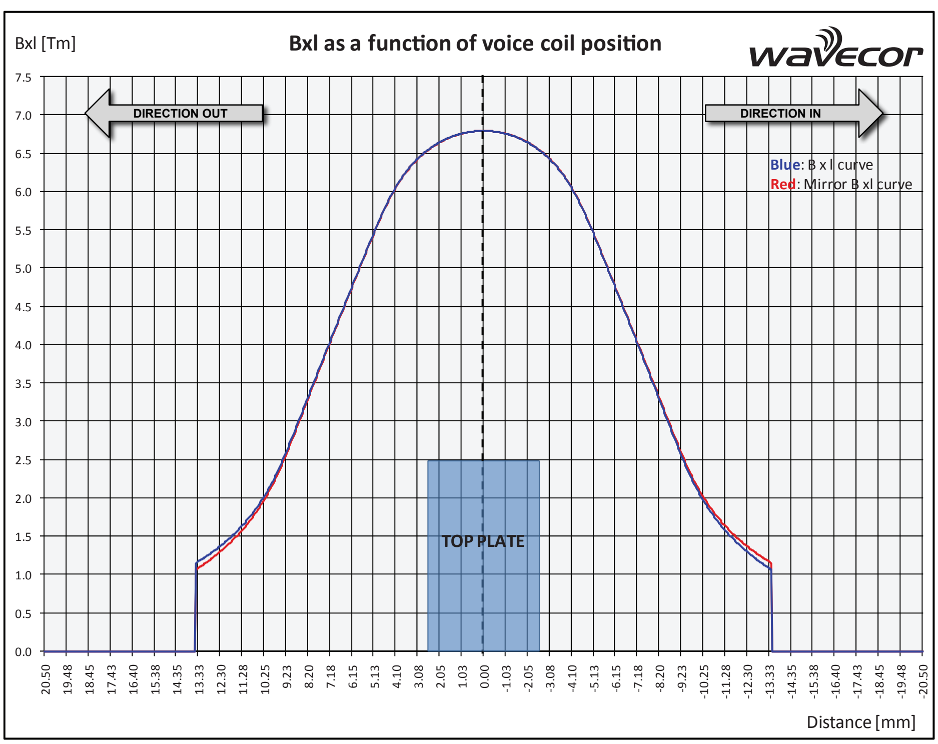


Fig. 6b. Force factor (Bxl) as a function of voice coil position for the Wavecor WF182BD01 Balanced Drive mid/woofer as shown fig. 3b. Notice that the curve is almost perfect symmetrical and greatly improved compared to the results of a traditional design as shown fig. 6a.



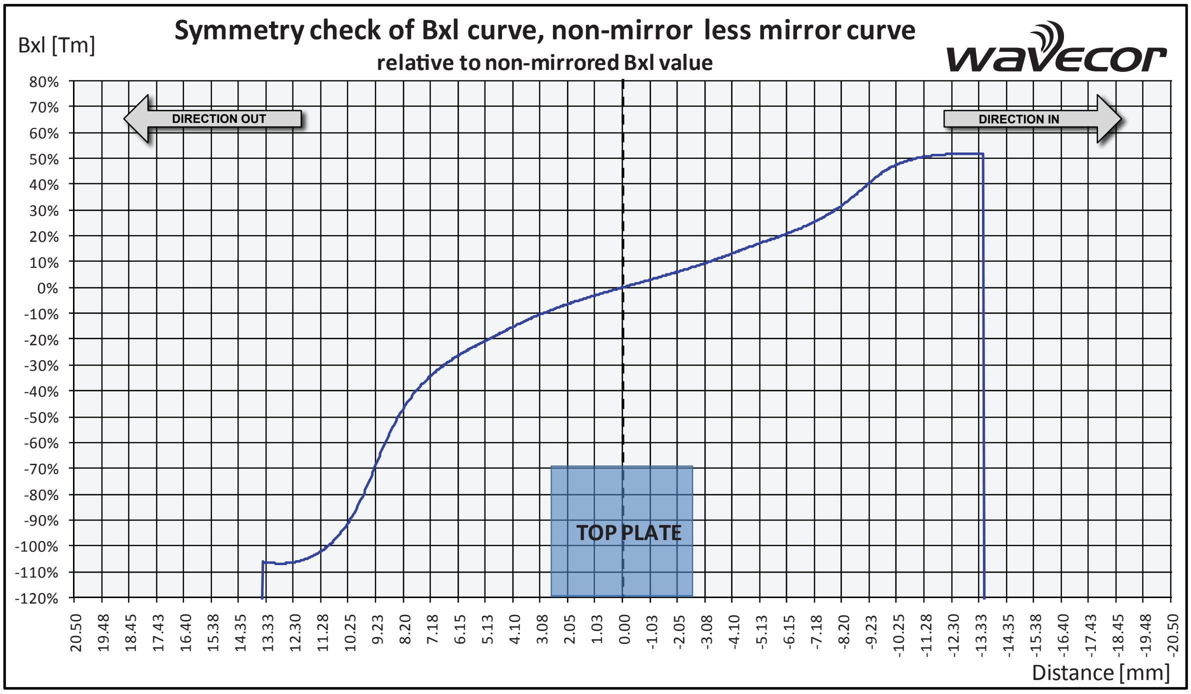


Fig. 7a. *Bxl as a function of voice coil position for a traditional magnet structure as shown fig. 3a. The figure shows the relative symmetry as the difference when measuring Bxl out/in, held relative to the value outwards.*

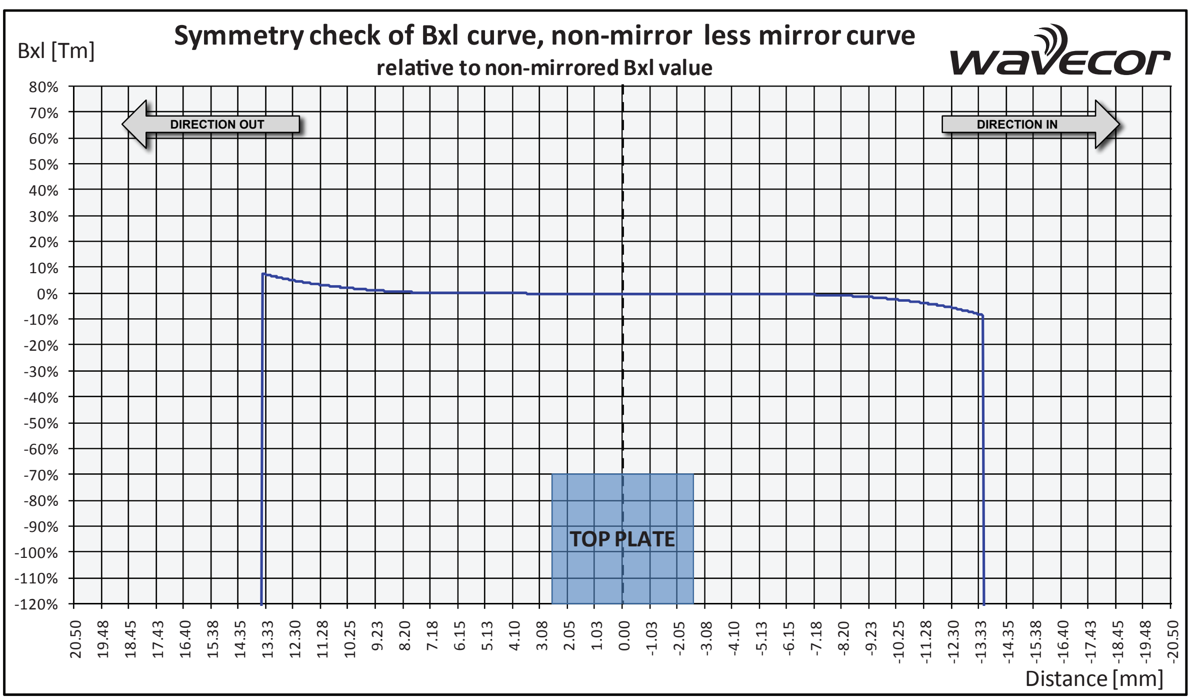


Fig. 7b. *Bxl as a function of voice coil position for the Wavecor WF182BD01 mid/woofer. The figure shows the relative symmetry as the difference when measuring Bxl out/in, held relative to the value outwards. Notice the very significant improvement compared to fig. 7a.*