SPECIFICATIONS

SW215WA01 / 02   8½" paper cone subwoofer, 4 / 8 ohm

8½" High Performance Steel Frame Subwoofer Unit.
Suitable for dedicated subwoofer applications and as low frequency transducers in 2½-, 3- and multi-way speaker systems.

FEATURES

- Balanced Drive motor structure for optimal drive force symmetry resulting in largely reduced even order harmonic distortion
- Large linear stroke, ensuring low distortion at high output levels
- Rigid air-dried paper cone to ensure piston motion even at high levels - for reduced distortion
- Rigid steel chassis with extensive venting for lower air flow speed reducing audible distortion
- Vented center pole with dual flares for reduced noise level at large cone excursions
- Heavy-duty fiber glass voice coil former to reduce mechanical losses resulting in better dynamic performance and low-level details
- Large motor structure for better control and power handling
- Built-in alu field-stabilizing ring for reduced distortion at high levels
- 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 durability under extreme conditions
- Gold plated terminals to ensure long-term trouble free connection
- Delivered with foam gasket attached for hassle-free mounting and secure cabinet sealing

NOMINAL SPECIFICATIONS

<table>
<tr><th rowspan="2">Notes</th><th rowspan="2">Parameter</th><th colspan="2">SW215WA01</th><th colspan="2">SW215WA02</th><th rowspan="2">Unit</th></tr>
<tr><th>Before burn-in</th><th>After burn-in</th><th>Before burn-in</th><th>After burn-in</th></tr>
<tr><td></td><td>Nominal size</td><td colspan="2">8½</td><td colspan="2">8½</td><td>[inch.]</td></tr>
<tr><td></td><td>Nominal impedance</td><td colspan="2">4</td><td colspan="2">8</td><td>[ohm]</td></tr>
<tr><td></td><td>Recommended max. upper frequency limit</td><td colspan="2">500</td><td colspan="2">500</td><td>[Hz]</td></tr>
<tr><td>1, 3</td><td>Sensitivity, 2.83V/1m</td><td colspan="2">89</td><td colspan="2"></td><td>[dB]</td></tr>
<tr><td>2</td><td>Power handling, short term, IEC 268-5, no additional filtering</td><td colspan="2">1,500</td><td colspan="2">1,500</td><td>[W]</td></tr>
<tr><td>2</td><td>Power handling, long term, IEC 268-5, no additional filtering</td><td colspan="2">400</td><td colspan="2">400</td><td>[W]</td></tr>
<tr><td>2</td><td>Power handling, continuous, IEC 268-5, no additional filtering</td><td colspan="2">150</td><td colspan="2">150</td><td>[W]</td></tr>
<tr><td></td><td>Effective radiating area, S_d</td><td colspan="2">206</td><td colspan="2">206</td><td>[cm²]</td></tr>
<tr><td>3, 6</td><td>Resonance frequency (free air, no baffle), F_s</td><td>33</td><td>30</td><td>35</td><td></td><td>[Hz]</td></tr>
<tr><td></td><td>Moving mass, incl. air (free air, no baffle), M_{ms}</td><td colspan="2">53</td><td colspan="2">49</td><td>[g]</td></tr>
<tr><td>3</td><td>Force factor, Bxl</td><td colspan="2">8.45</td><td colspan="2">11.4</td><td>[N/A]</td></tr>
<tr><td>3, 6</td><td>Suspension compliance, C_{ms}</td><td>0.43</td><td>0.54</td><td>0.43</td><td></td><td>[mm/N]</td></tr>
<tr><td>3, 6</td><td>Equivalent air volume, V_{as}</td><td>26</td><td>32.5</td><td>26</td><td></td><td>[lit.]</td></tr>
<tr><td>3, 6</td><td>Mechanical resistance, R_{ms}</td><td>1.0</td><td>1.0</td><td>1.0</td><td></td><td>[Ns/m]</td></tr>
<tr><td>3, 6</td><td>Mechanical Q, Q_{ms}</td><td>11</td><td>10</td><td>10.7</td><td></td><td>[-]</td></tr>
<tr><td>3, 6</td><td>Electrical Q, Q_{es}</td><td>0.51</td><td>0.46</td><td>0.52</td><td></td><td>[-]</td></tr>
<tr><td>3, 6</td><td>Total Q, Q_{ts}</td><td>0.49</td><td>0.44</td><td>0.49</td><td></td><td>[-]</td></tr>
<tr><td>4</td><td>Voice coil resistance, R_{DC}</td><td colspan="2">3.3</td><td colspan="2">6.3</td><td>[ohm]</td></tr>
<tr><td>5</td><td>Voice coil inductance, L_e (measured at 1 kHz)</td><td colspan="2">1.2</td><td colspan="2">1.7</td><td>[mH]</td></tr>
<tr><td></td><td>Voice coil inside diameter</td><td colspan="2">39</td><td colspan="2">39</td><td>[mm]</td></tr>
<tr><td></td><td>Voice coil winding height</td><td colspan="2">25</td><td colspan="2">25</td><td>[mm]</td></tr>
<tr><td></td><td>Air gap height</td><td colspan="2">5</td><td colspan="2">5</td><td>[mm]</td></tr>
<tr><td></td><td>Theoretical linear motor stroke, Xmax</td><td colspan="2">±10</td><td colspan="2">±10</td><td>[mm]</td></tr>
<tr><td></td><td>Magnet weight</td><td colspan="2"></td><td colspan="2"></td><td>[g]</td></tr>
<tr><td></td><td>Total unit net weight excl. packaging</td><td colspan="2">2.4</td><td colspan="2">2.4</td><td>[kg]</td></tr>
<tr><td>3, 5</td><td>K_{rm}</td><td colspan="2">7.0</td><td colspan="2">10.4</td><td>[mohm]</td></tr>
<tr><td>3, 5</td><td>E_{rm}</td><td colspan="2">0.68</td><td colspan="2">0.94</td><td>[-]</td></tr>
<tr><td>3, 5</td><td>K_{xm}</td><td colspan="2">6.9</td><td colspan="2">15.1</td><td>[mH]</td></tr>
<tr><td>3, 5</td><td>E_{xm}</td><td colspan="2">0.78</td><td colspan="2">0.74</td><td>[-]</td></tr>
</table>

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 10 V_{RMS}. The unit is not burned in before shipping.

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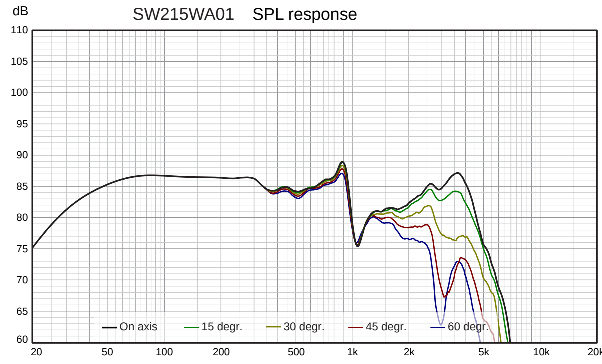
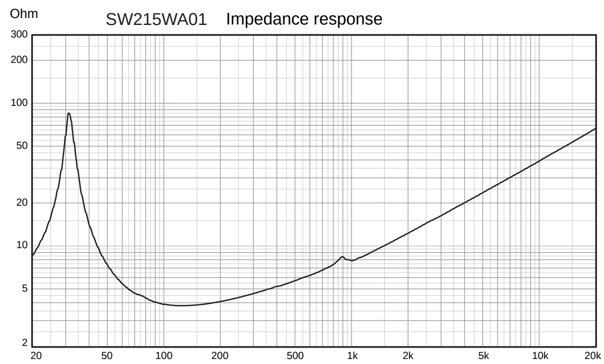
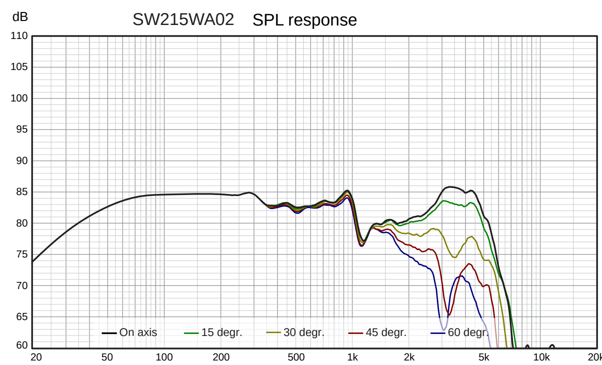


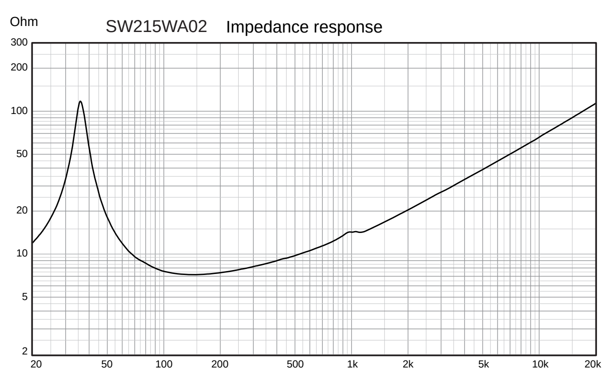
Measuring conditions, SPL
Driver mounting: Flush in infinite baffle, back side open (no cabinet)
Microphone distance: 1.0 m
Input signal: 2.83 VRMS stepped sine wave
Smoothing: 1/6 oct.



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



Measuring conditions, SPL
Driver mounting: Flush in infinite baffle, back side open (no cabinet)
Microphone distance: 1.0 m
Input signal: 2.83 VRMS stepped sine wave
Smoothing: 1/6 oct.



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

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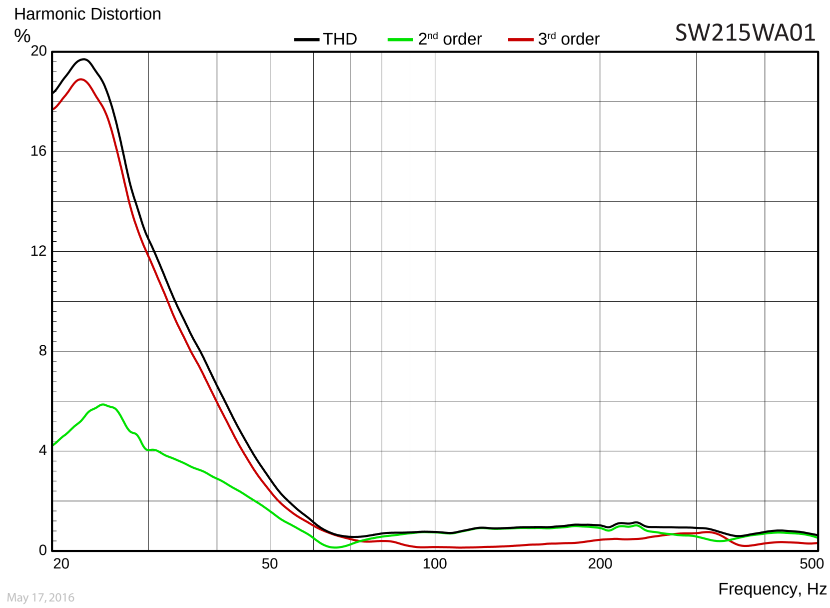
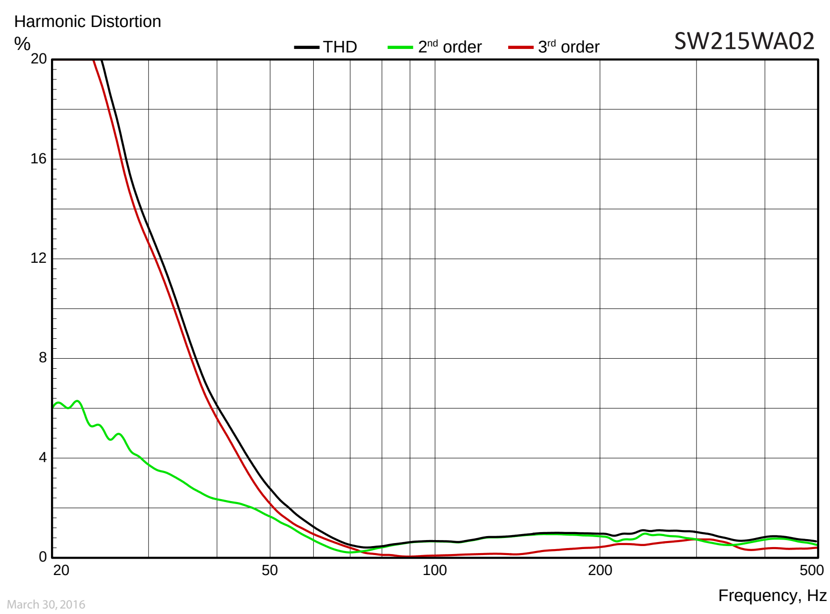


Measuring conditions, Harmonic Distortion
Driver mounting: In sealed, heavily stuffed enclosure, internal volume 29 lit., baffle dimensions 336 mm x 336 mm
Microphone distance: 0.5 m
Input signal: Stepped sine wave, 7.7 VRMS (SW215WA01) / 11 VRMS (SW215WA02)
Smoothing: 1/6 oct.



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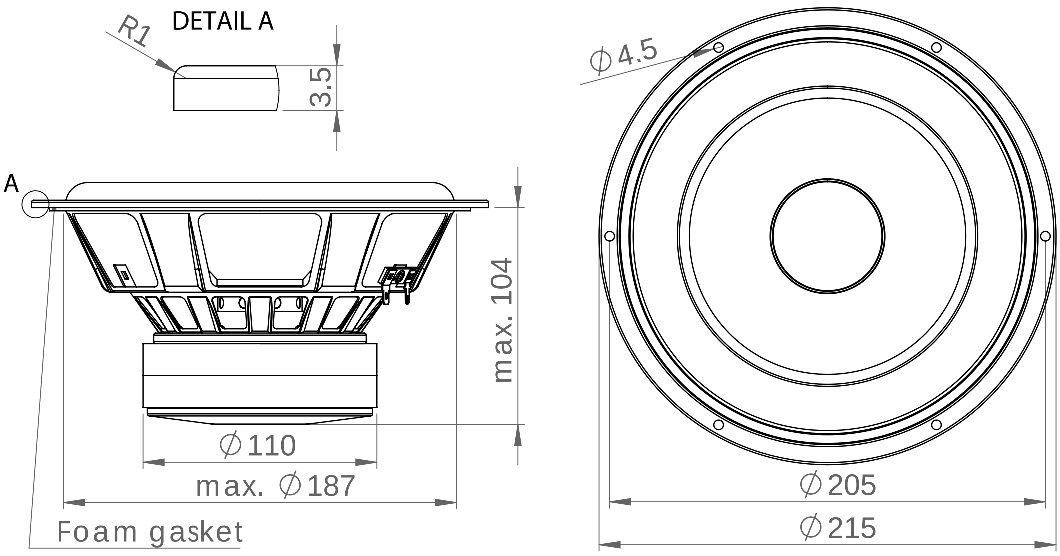
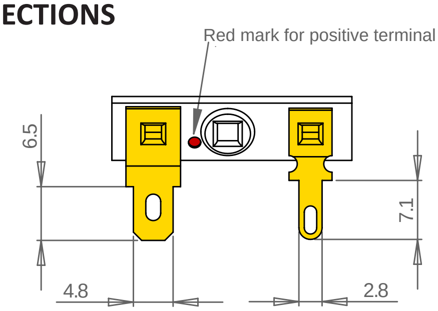
OUTLINE DRAWING (nominal dimensions)

Dimensions in mm



March 5, 2014

CONNECTIONS



Thickness, both terminals: 0.5 mm
Terminal plating: Gold

PACKAGING AND ORDERING INFORMATION

Part no. SW215WA01-01	4 ohm version, individual packaging (one piece per box)
Part no. SW215WA02-01	8 ohm version, individual packaging (one piece per box)

Latest update: Jun. 24, 2016

wavecor

BD

BALANCED **D**RIVE

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.

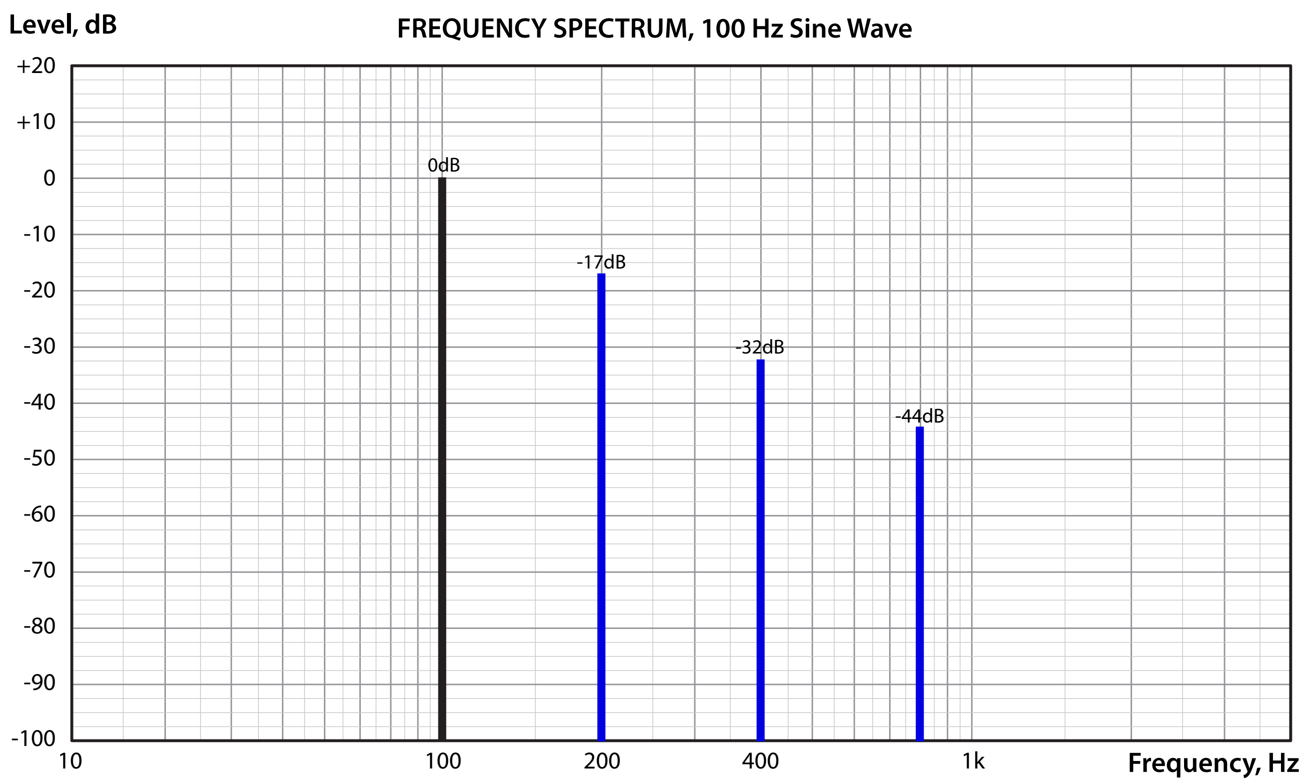


Fig. 1. *Frequency spectrum for a pure 100 Hz sine wave (black vertical line) and the even order higher harmonics (blue vertical lines) created by non-symmetrical transducer motors.*

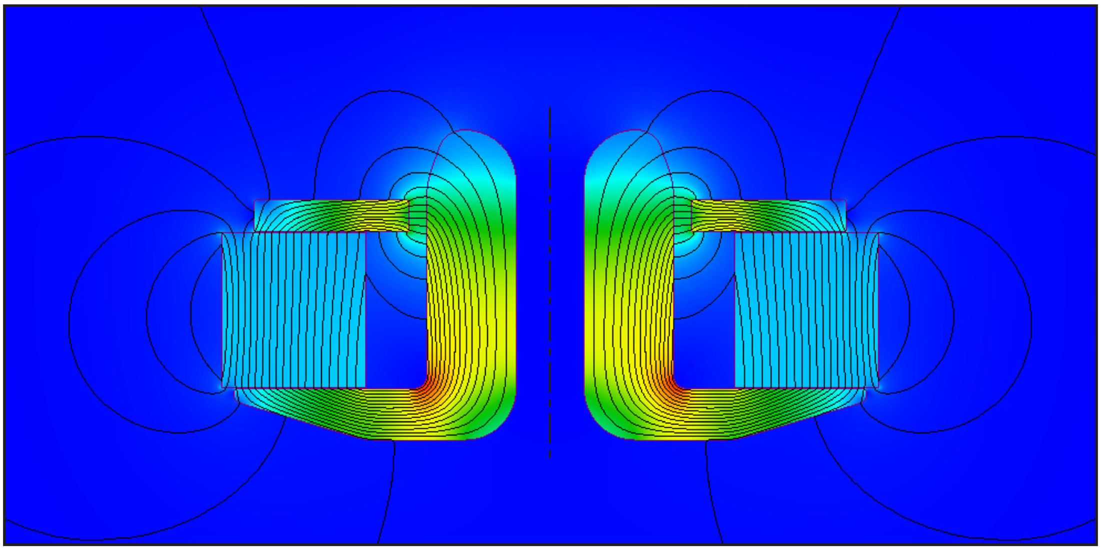


Fig. 2. *The magnetic structure of the Balanced Drive line of Wavecor transducers is optimized using advanced Finite Element Analysis software.*

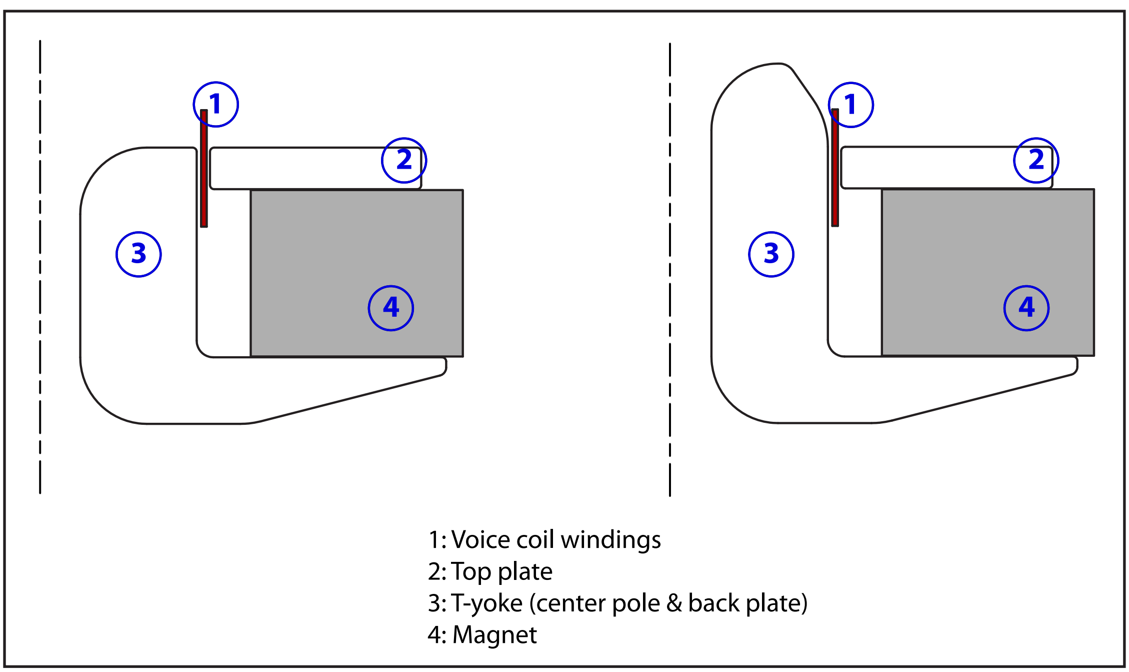


Fig. 3a (left). *Cross section of a traditional motor design.*

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.*

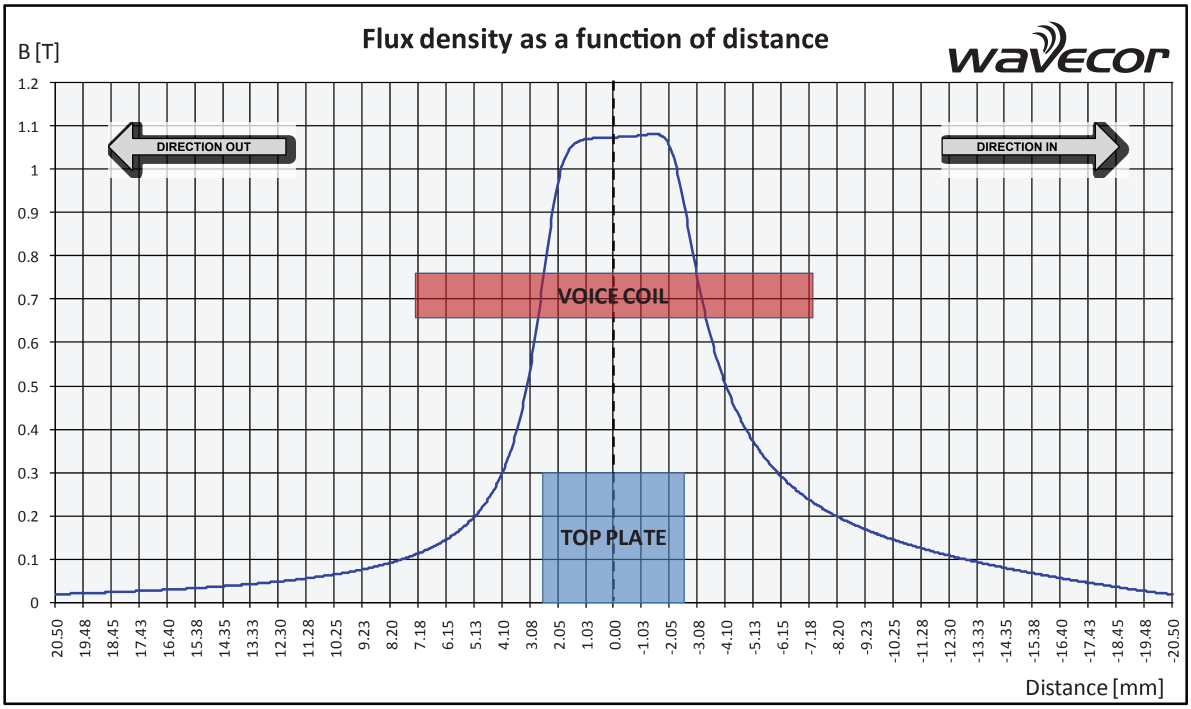


Fig. 4a. *Magnetic air gap flux density (B) distribution for a traditional magnet structure as shown fig. 3a. Notice that the curve is non-symmetrical with higher levels in the direction towards the inside of the magnet structure.*

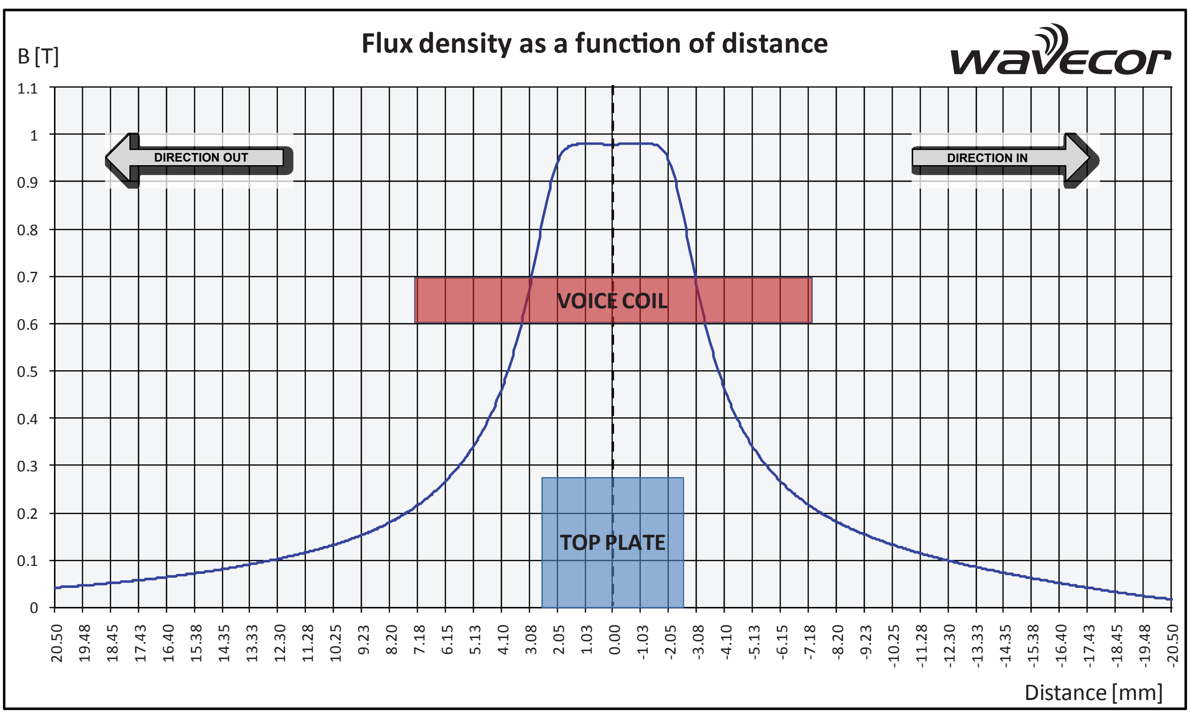


Fig. 4b. *Magnetic air gap flux density (B) distribution for the Wavecor WF182BD01 mid/woofer. The curve is almost perfectly symmetrical. The red bar shows the actual WF182BD01 voice coil and its position. The blue square illustrates the top plate, which is 5mm thick for WF182BD01.*

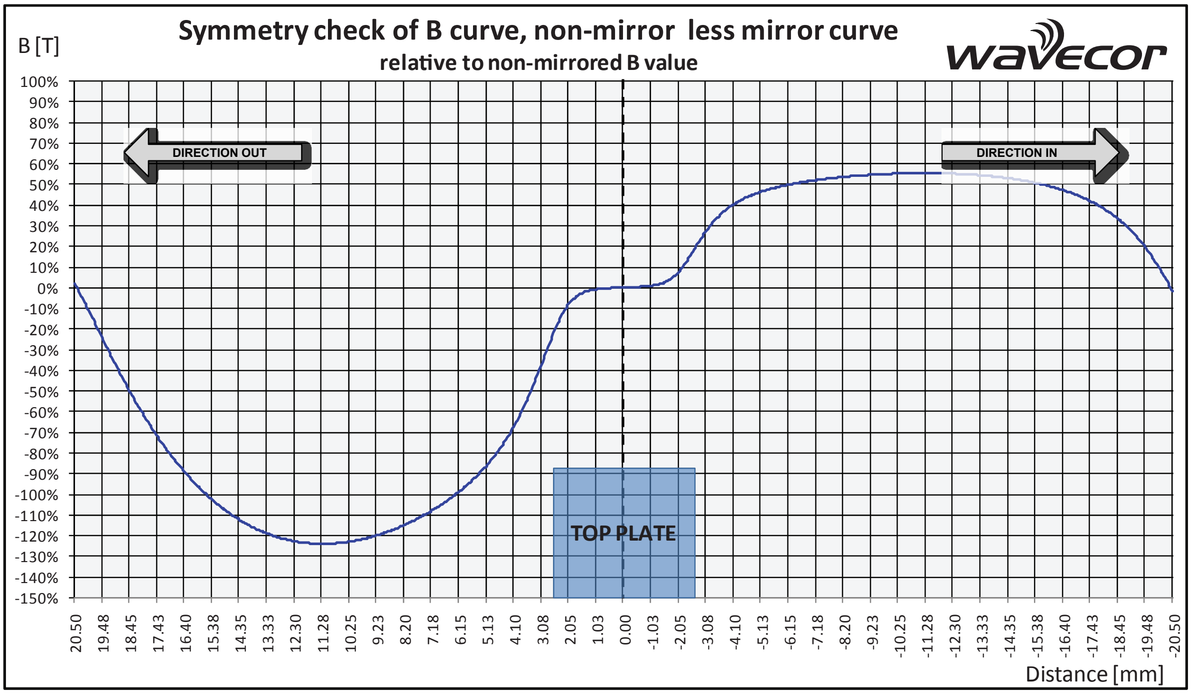


Fig. 5a. *Magnetic flux density (B) distribution for a traditional magnet structure as shown fig. 3a. The figure shows the relative symmetry as the difference when measuring B out/in, held relative to the value outwards.*

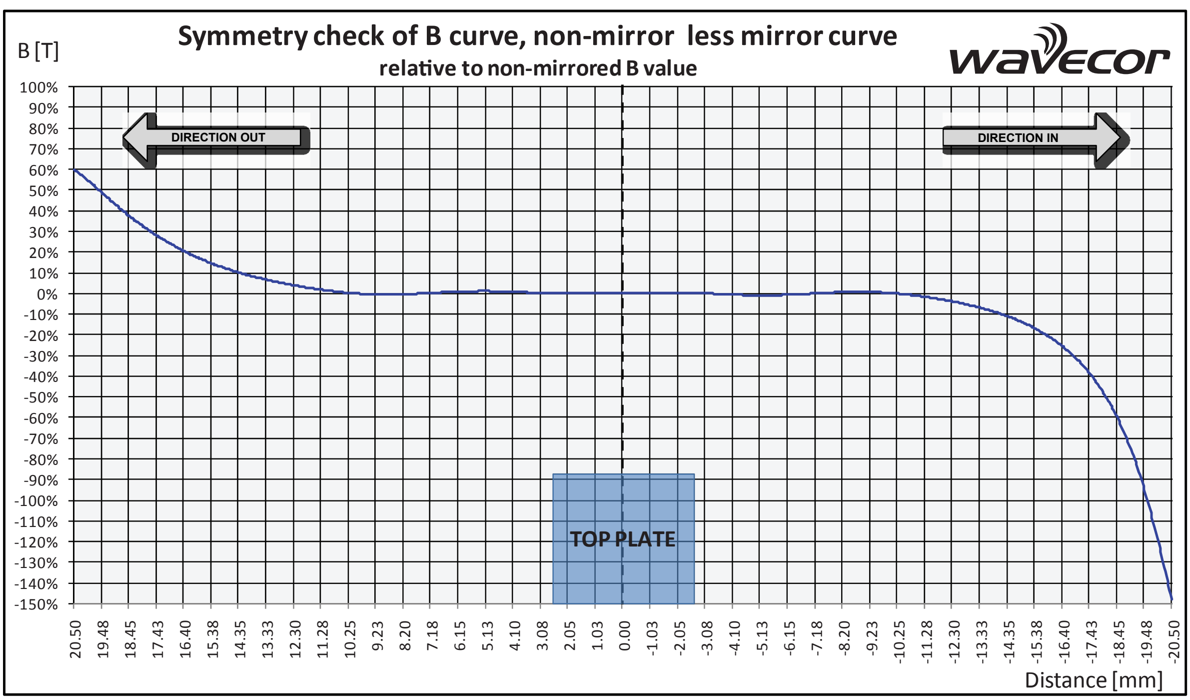


Fig. 5b. *Magnetic flux density (B) distribution for the Wavecor WF182BD01 mid/woofer. The figure shows the relative symmetry as the difference when measuring B out/in, held relative to the value outwards. Notice the very significant improvement compared to fig. 5a.*

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.

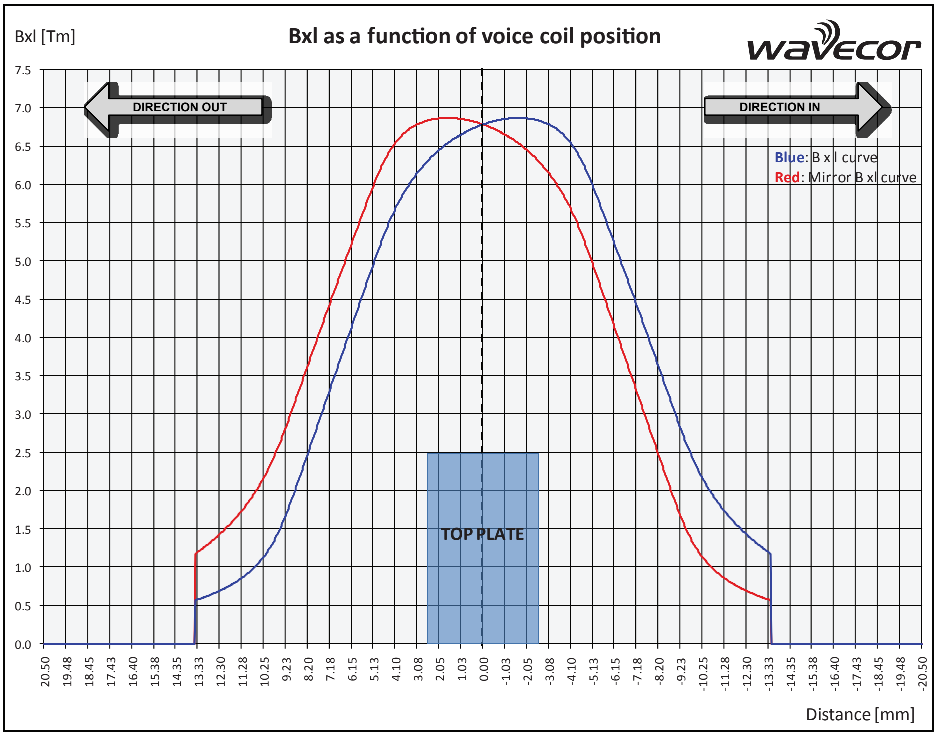
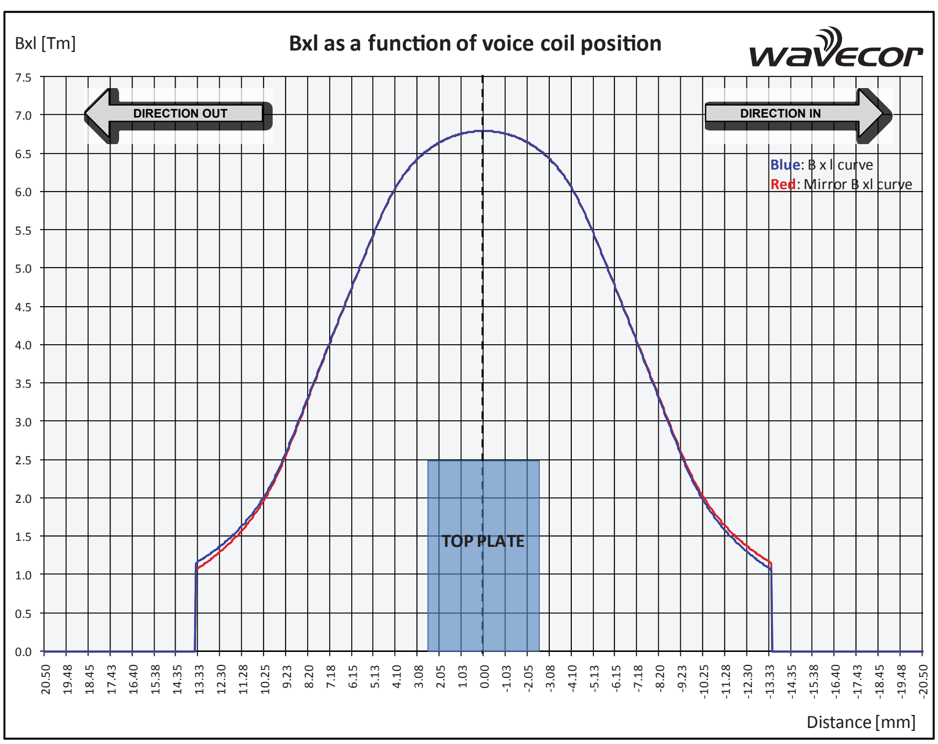


Fig. 6b. Force factor (Bxl) as a function of voice coil position for the Wavecor WF182BD01 Balanced Drive mid/woofer as shown fig. 3b. Notice that the curve is almost perfect symmetrical and greatly improved compared to the results of a traditional design as shown fig. 6a.



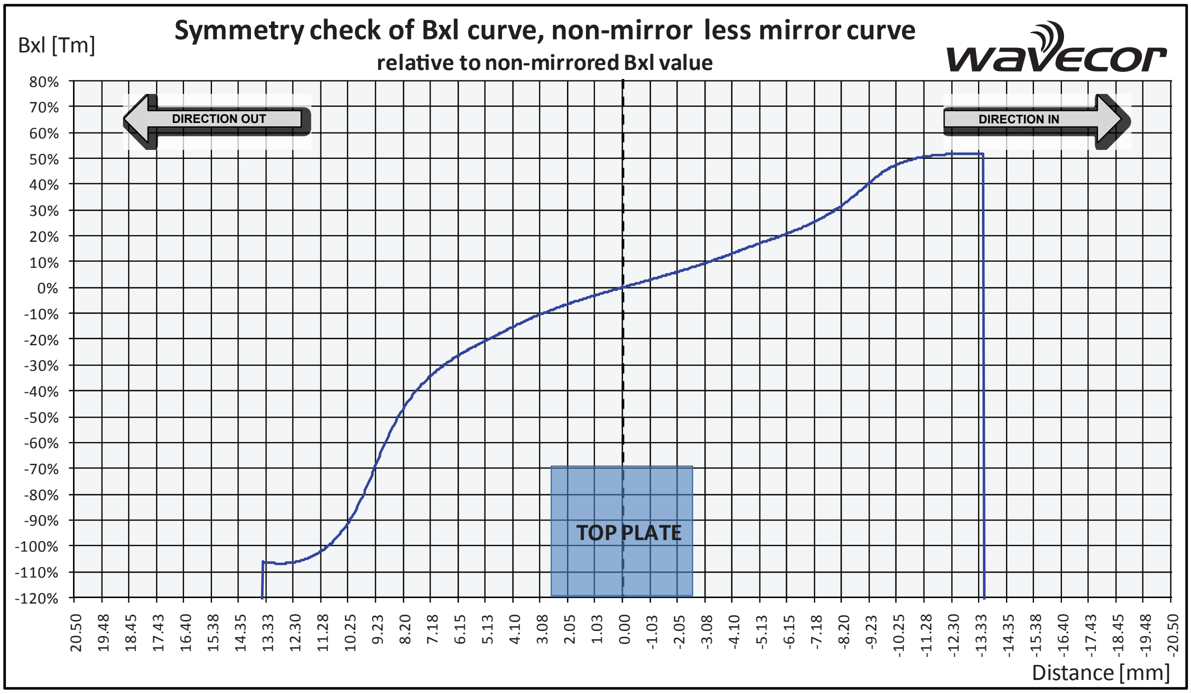


Fig. 7a. *Bxl as a function of voice coil position for a traditional magnet structure as shown fig. 3a. The figure shows the relative symmetry as the difference when measuring Bxl out/in, held relative to the value outwards.*

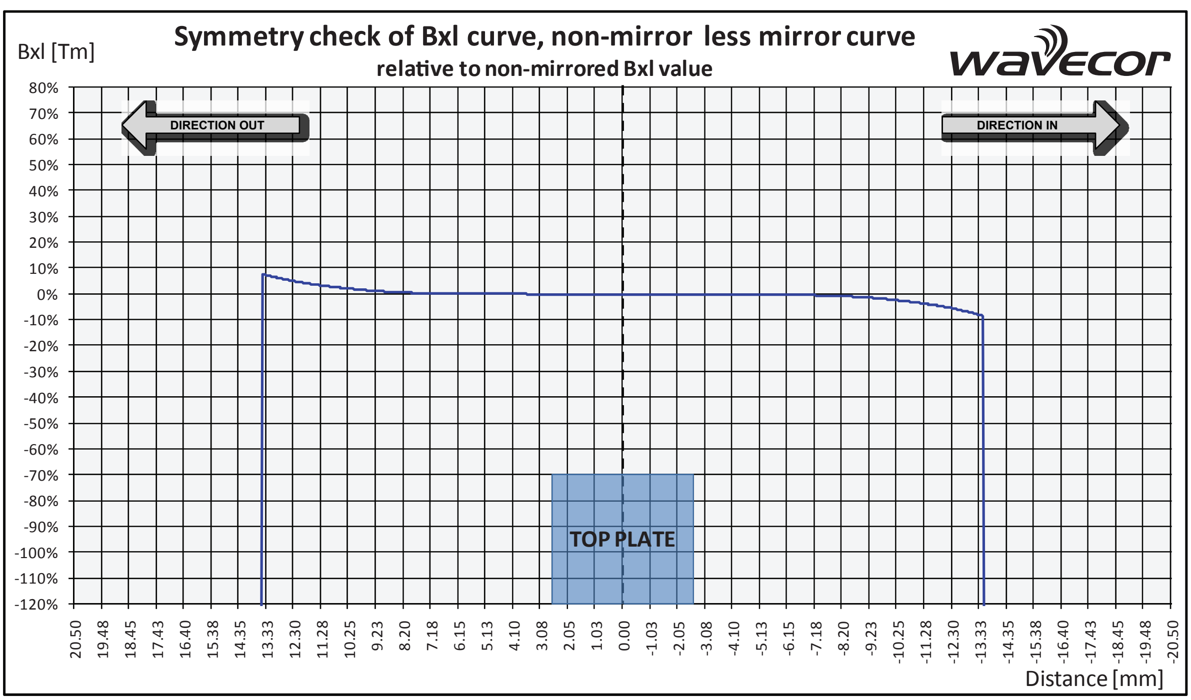


Fig. 7b. *Bxl as a function of voice coil position for the Wavecor WF182BD01 mid/woofer. The figure shows the relative symmetry as the difference when measuring Bxl out/in, held relative to the value outwards. Notice the very significant improvement compared to fig. 7a.*