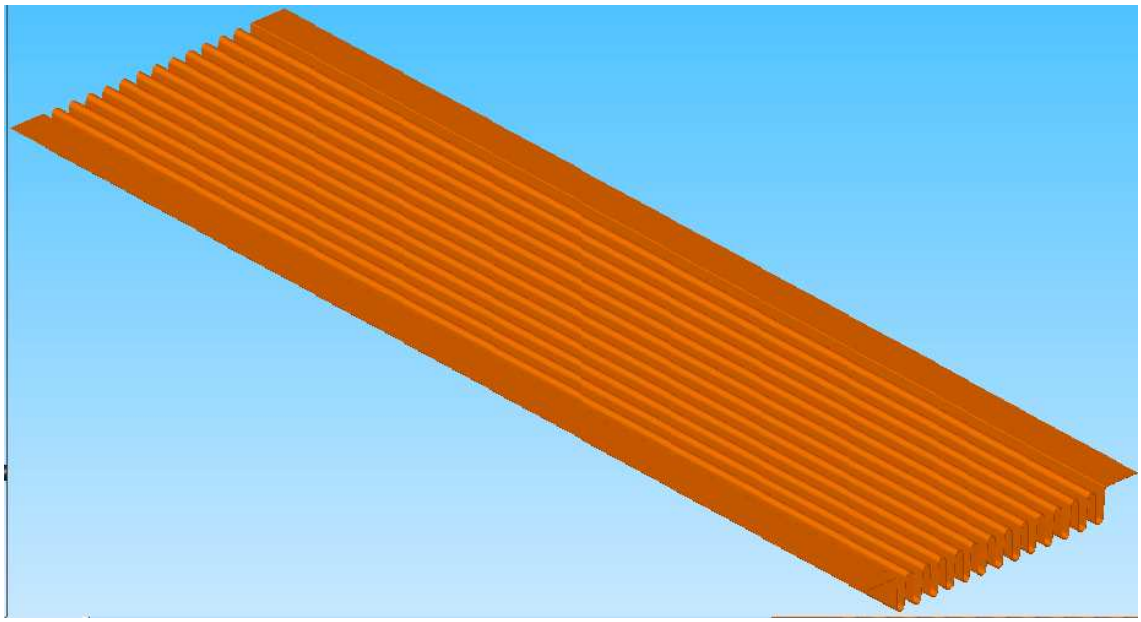
TPL-150 Pleated Diaphragm Tweeter

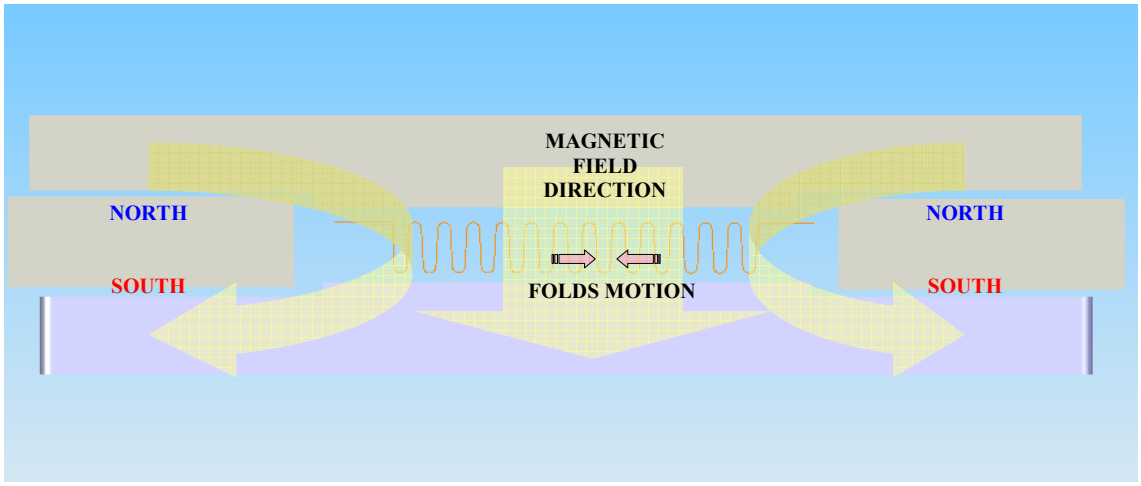
Beyma introduces a new type of component for the professional sound, bringing the highest sonorous quality of the most demanding audiophile to the world of live music.
This type of high frequency transducer is based on the AMT technology (Air Motion Transformer). In this type of transducers, invented by the German physicist Oskar Heil, the generation of the sound takes place in a very different way than habitual in ribbon tweeters. In figure one, we can see that in this device, the diaphragm is formed by longitudinal folds, like in an accordion. In the straight face of each one of these folds, there is a printed conductive copper thread.

The advantage in this type of device consist in the small and very controlled movement of each fold, accelerating the surrounding air inside each fold, which produces an almost perfect acoustical output, both in amplitude and in phase in all the radiating area of the transducer.



This diaphragm is made in Beyma, on a material able to support extreme temperatures and of a great flexibility. It is used in military and aerospace applications to manufacture flexible printed circuits. It is of great durability and reliability.

The operation principle is the same one that in a regular tweeter, but geometry is totally different:



As it is possible to be seen in this figure, the magnetic field is closed happening by where the diaphragm is located. When an alternating electrical current circulates along the copper threads of the membrane, a movement takes place in the folds from left to right. The sound wave is generated when the air between the folds is compressed.
This causes that, being the displacement of each fold very small, the air moves at great speed, producing an important sound pressure.

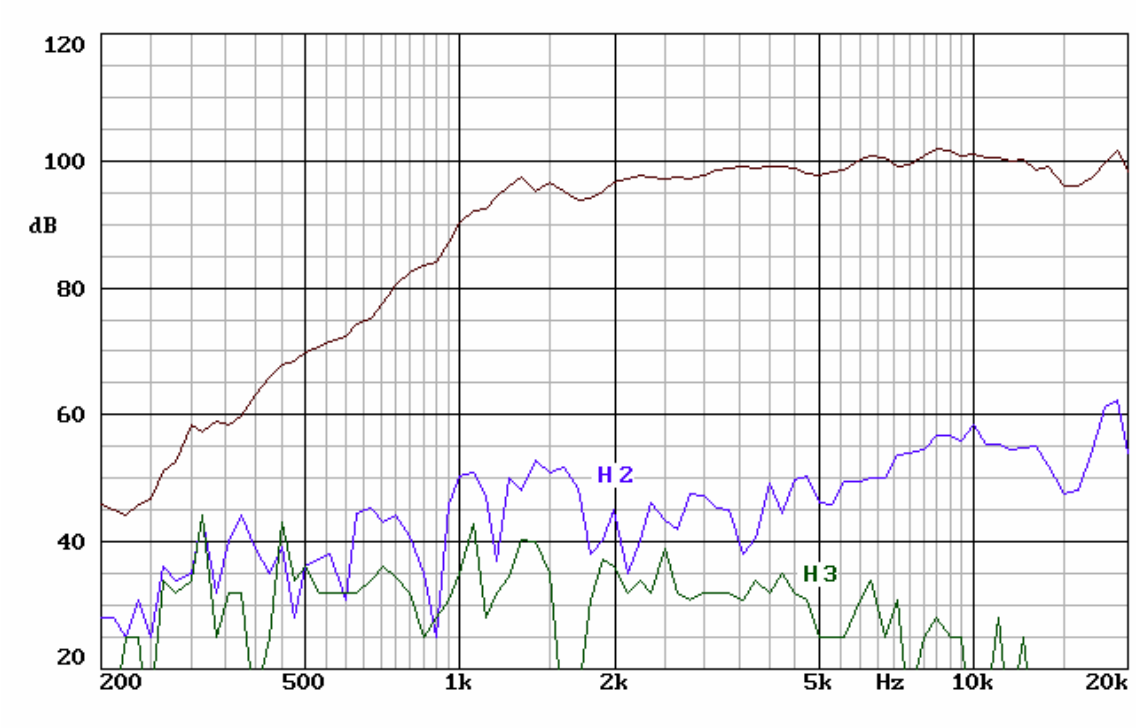
The advantages of this type of tweeter can be summarized in:

- Radiating surface four times the one of a tweeter or an equivalent compression driver, thanks to its folded geometry.
- Mobility transformer of air (Air Motion Transformer) because it causes in the air a speed four times greater than the one of the folds themselves (relation 4:1).
- This confers an enormous dynamics and an incredible transient response, vastly superior to that of any conventional tweeter, including ribbon tweeters and compression drivers.

What Beyma has done has been to develop this technology creating a component for professional use, of which would be possible to emphasize:

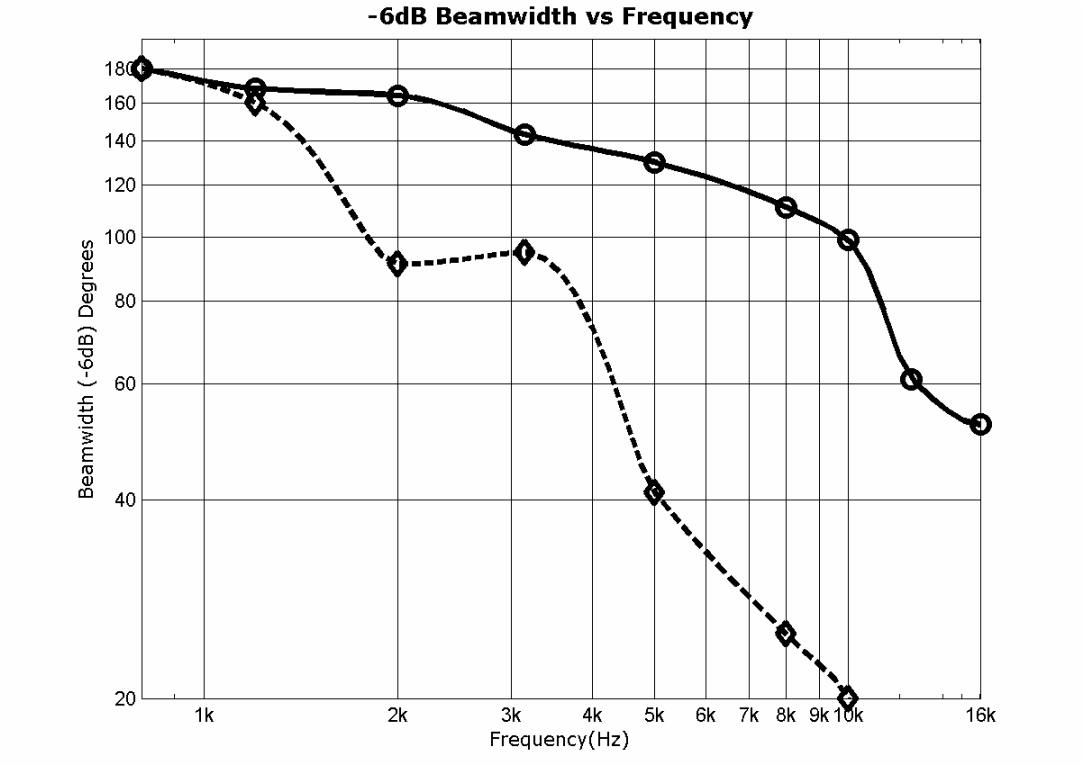
- High sensitivity: ***99 dB@1W, 1m*****.**
- Wide frequency range**: *from 1 to 23 kHz*.**
- Admissible power handling without precedents: *80 W AES*.
- ***Directly applicable for Line Array systems***, with total coherence of the wave front with no need of any adapter.
- Also suited for other conventional applications, with a ***horizontal coverage superior to 100º up to 10 kHz.***

All these characteristics make of the TPL-150 an authentic alternative to the conventional compression drivers, and contributing an enormous added value to any sound system that incorporates it. The sonic quality, timbre, definition and clarity of this transducer are simply unsurpassable.



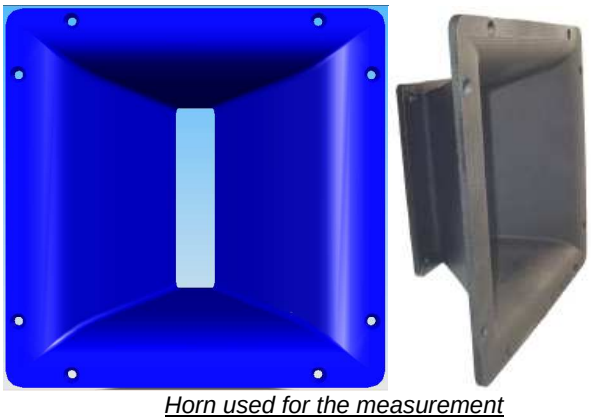
Frequency Response 1W@1m without baffle neither horn

By looking to the frequency response, although usable from 1 kHz, it may seems that the sound pressure level until 2 kHz is lower than requested for an equivalent use as a compression driver. It should be taken into account that this response is achieved without any horn or baffle, just with the unit in free air. In these conditions, the horizontal dispersion of the TPL-150 is completely awesome.

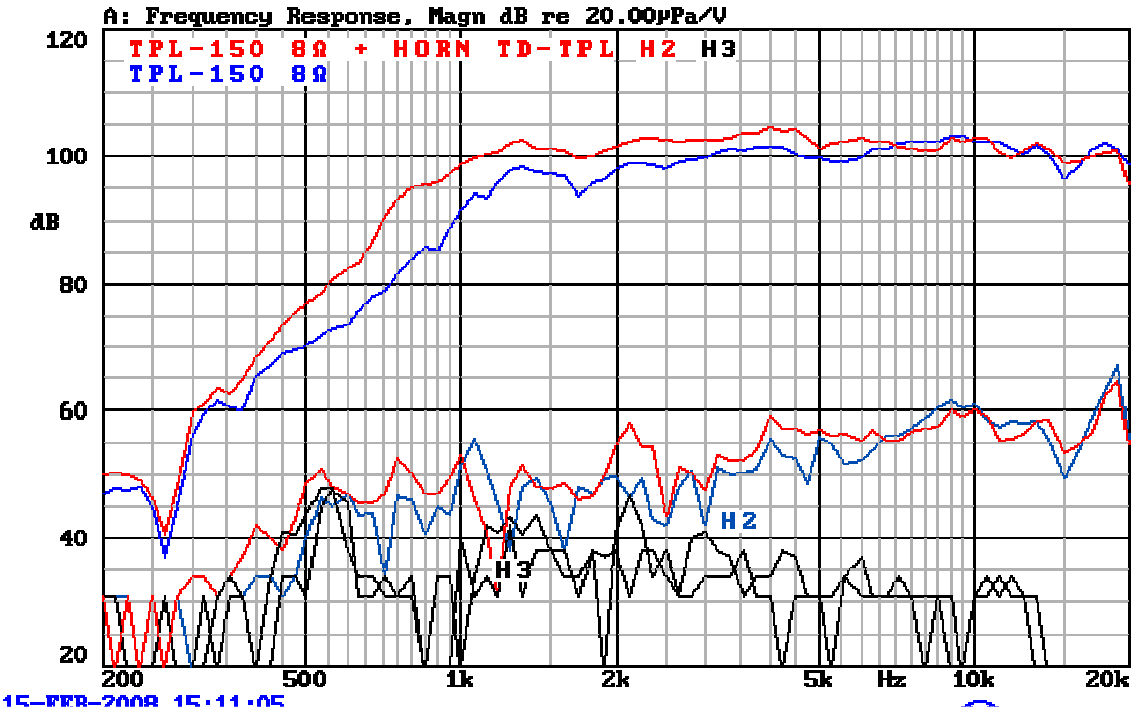


Note: heavy line, horizontal beamwidth; discontinous line vertical beamwidth.

As it can be seen in the dispersion chart, the horizontal coverage is 180º at less than 1 kHz. By using a small diffuser, limiting the coverage at those frequencies to 90º is very effective to achieve a higher SPL from 800 Hz to 5 kHz, getting more than 4 dB increment, without loosing the spectacular dispersion consistence. No compression driver with horn is able to have 100º coverage angle at 10 kHz. Next we can find a frequency response with a new horn, the TDTPL, to reinforce the low-mid band-pass of the TPL-150:



Horn used for the measurement



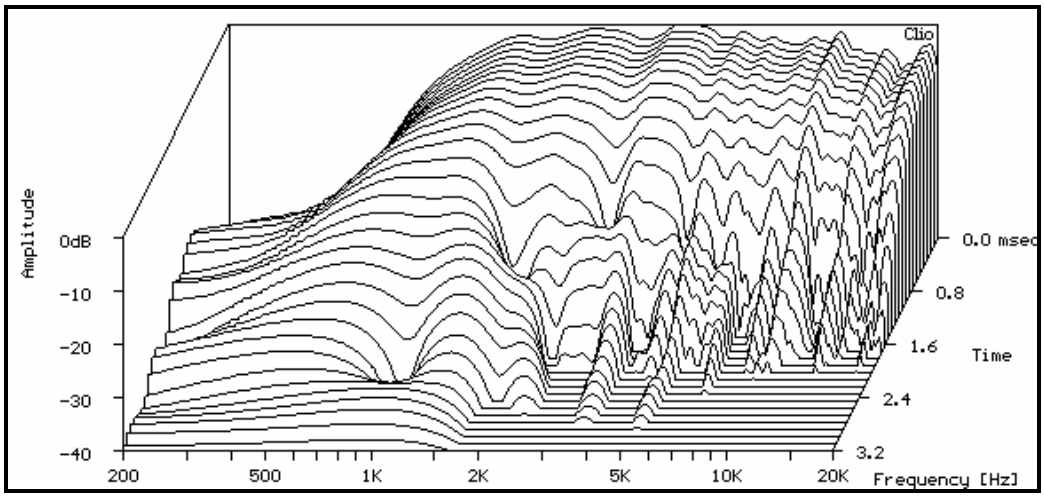
TPL-150 with/without 80ºx30º horn

With the help of this horn, the TPL-150 gets a much higher sensitivity, especially from 1 to 7 kHz, with an average sensitivity about 104 dB, and still maintains a very low distortion figure.

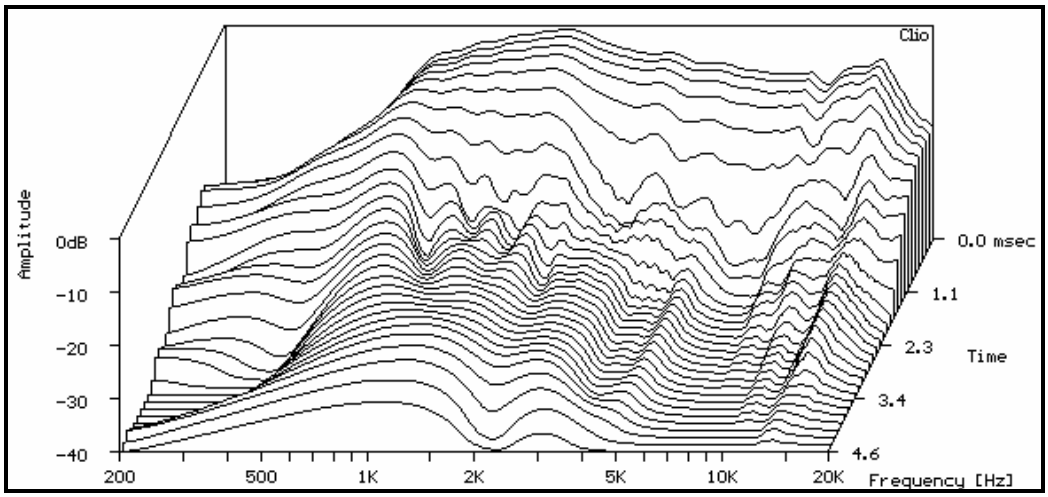
But how does the TPL-150 compare to a normal compression driver? In Beyma, we have made an extended and complete set of measurements to illustrate the superiority of the TPL over a conventional compression driver. In the next table we can compare the specifications of the TPL compared to the used compression driver in the comparison:

SPECS	COMPRESSION DRIVER	TPL-150
Power Handling	70W AES (3 in. voice coil)	80W AES
Av. Sensitivity with Horn	108 dB	104 dB
Horn Coverage	80ºx50º	80ºx30º
Voice Coil Material	Copper	Copper
X-Over frequency	0.8 kHz	1 kHz
Diaphragm Material	Ti Dome with mylar surround	Kapton

Let's start with time definition. A waterfall plot will be very self-explanatory about the difference between a dome with unavoidable resonances and time smearing and a structure where the voice coil itself is the radiating surface at the same time:



TPL-150 Waterfall, less than 2 msec. time response

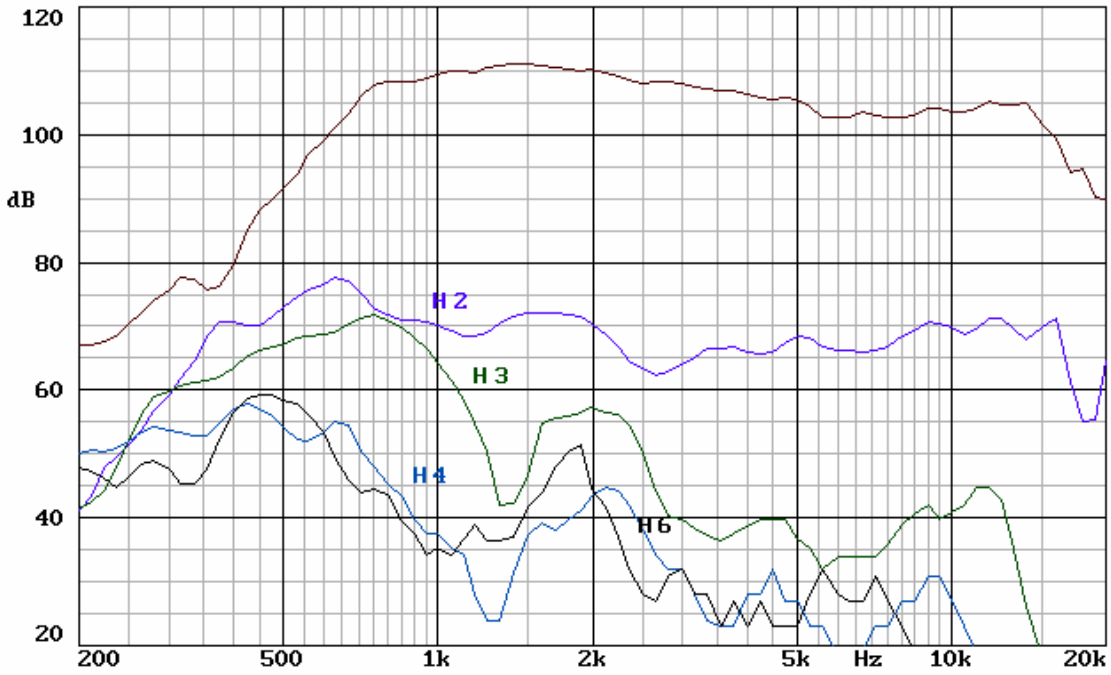


Comp. driver Waterfall, more than 5 msec. time response

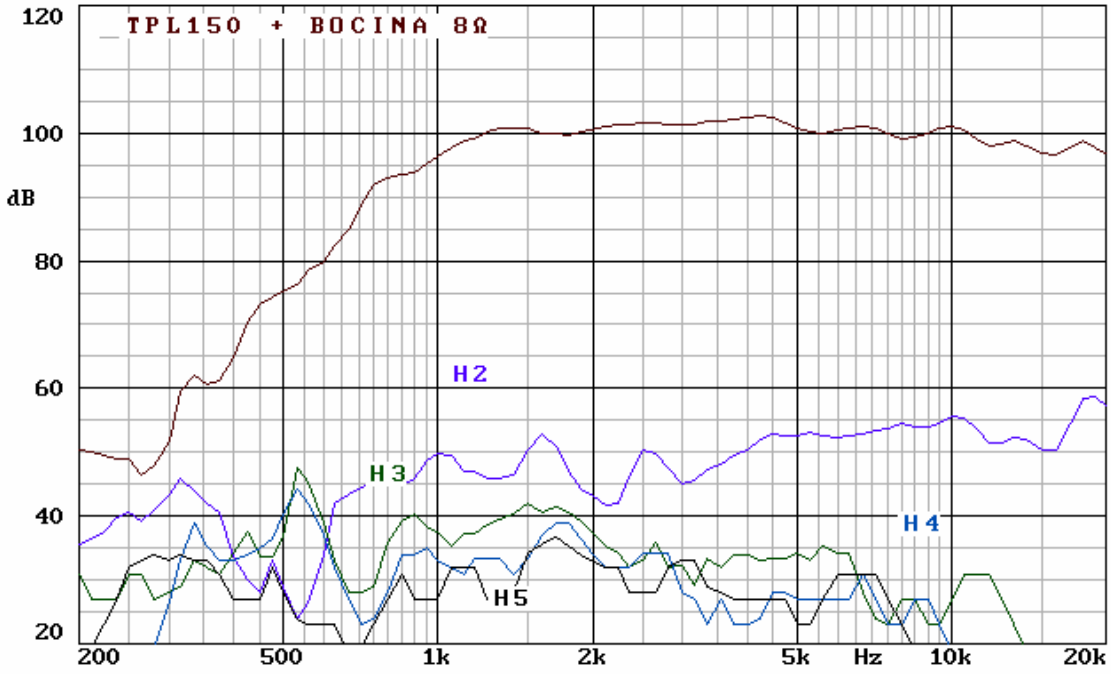
As we can see in the Waterfall measurements, almost all the energy in the TPL-150 has gone away in less than 2 milliseconds. However, if we look the compression driver response, even after 5 milliseconds, the diaphragm is still resonating, blurring the acoustic message.

What about distortion products?

Many different measurements were carried out, including but no limited to harmonic distortion, difference tone distortion, inter-modulation distortion, near field measurements and multi-tone stimulus, all of them at three different power levels, 1W, 7W and 23W AES. We can show many of all these measurements, where always the TPL-150 is clearly superior in terms of distortion.
We will start with a simple harmonic distortion, measured until the 5^{th} harmonic, as recent investigations in subjective impact of distortions suggest that higher order harmonics can be more detrimental in the appreciated quality, as they are not masked by the main response of the reproducing device.



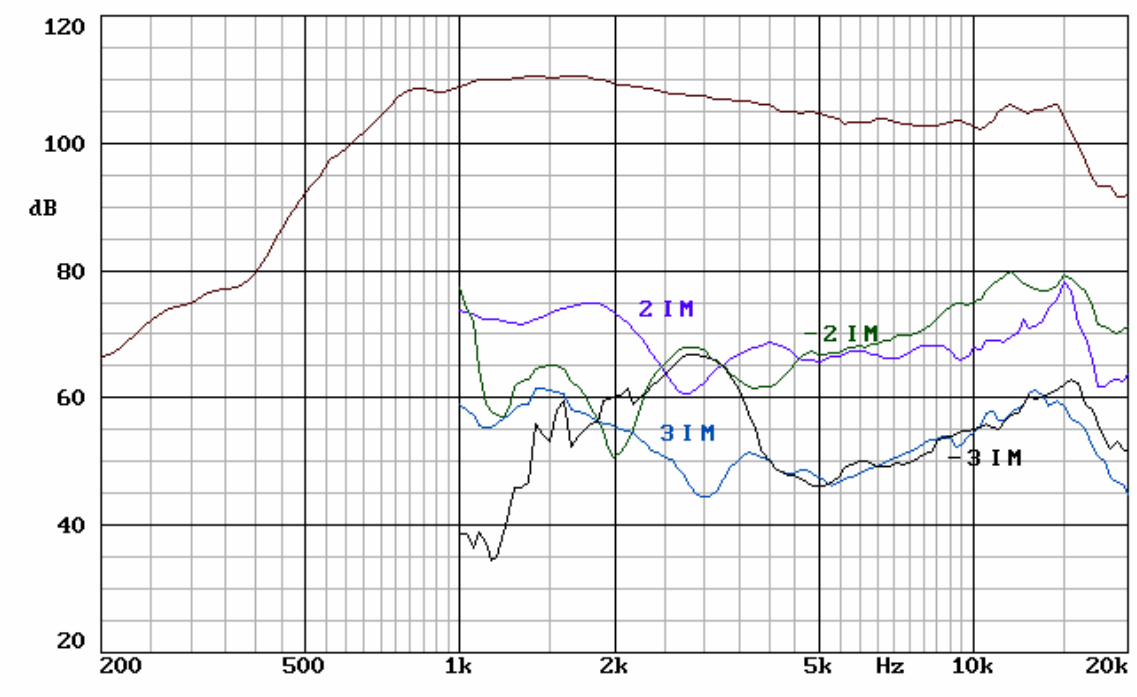
1W Harmonic Dsitortion measurement COMP. DRIVER



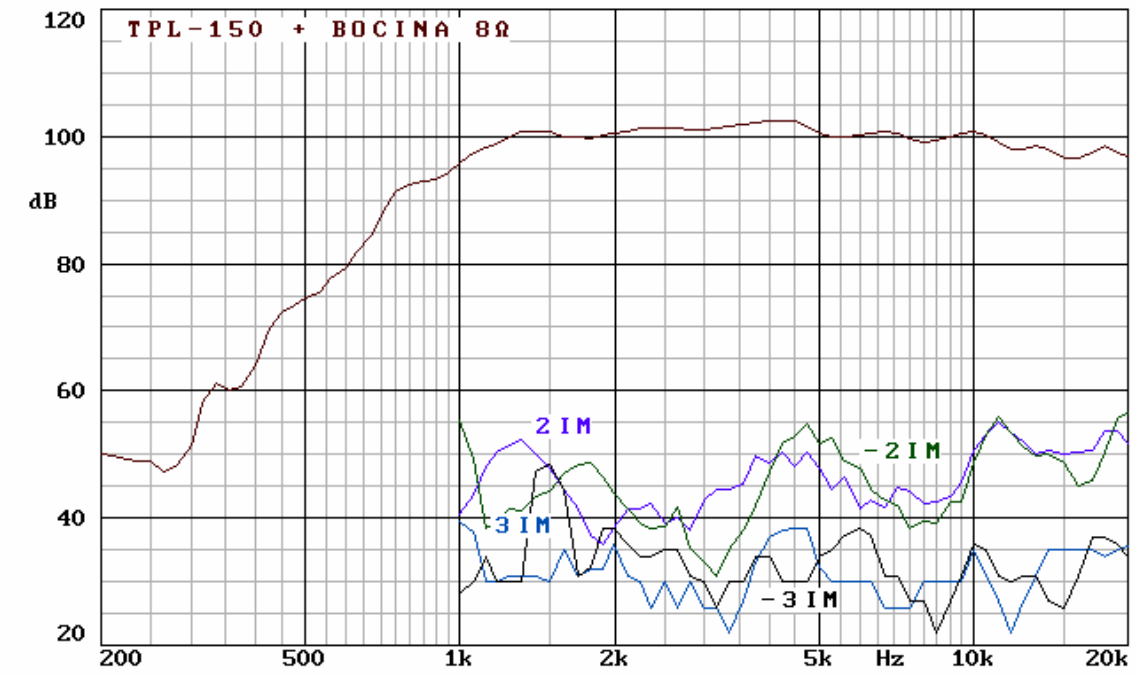
1W Harmonic Distortion measurement TPL-150

Already in this first and common measurement, a clear advantage of the TPL-150 can be observed, in terms of the relative amplitude of harmonic distortion products.

Many other distortion measurements could be included, but we will show the inter-modulation distortion, just as add-on of a more standard measurement, although not as widely used as harmonic distortion.



1W Inter-modulation Distortion COMP. DRIVER

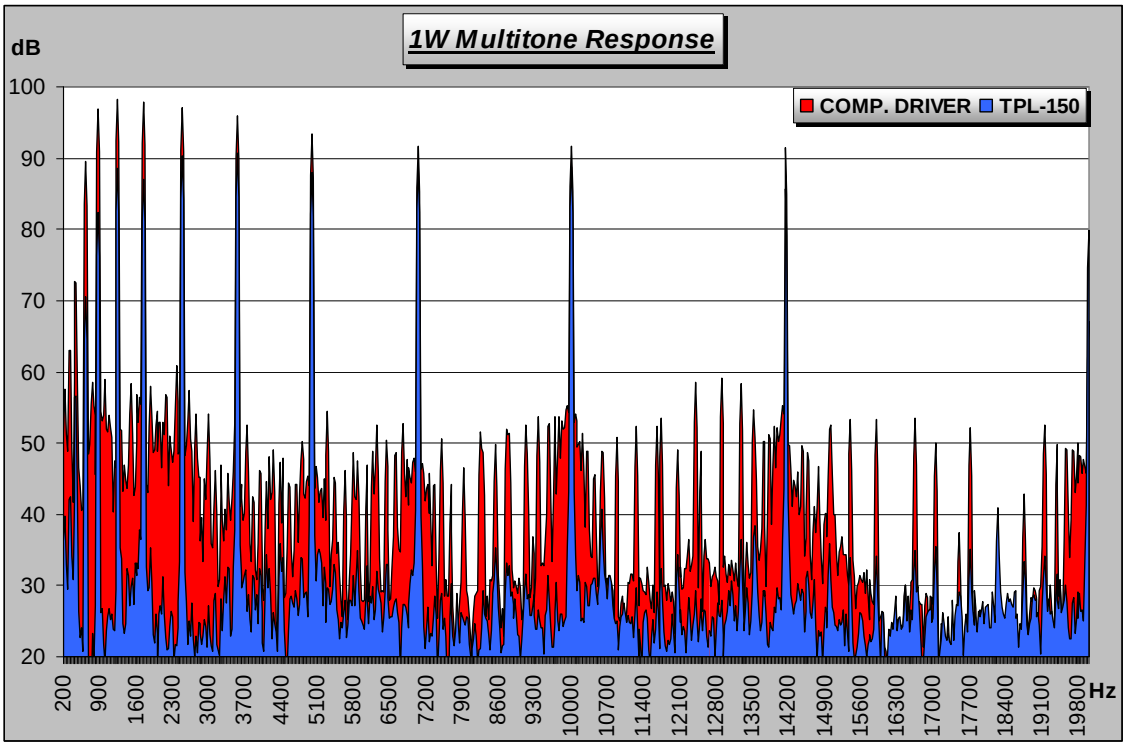


1W Inter-modulation Distortion TPL-150

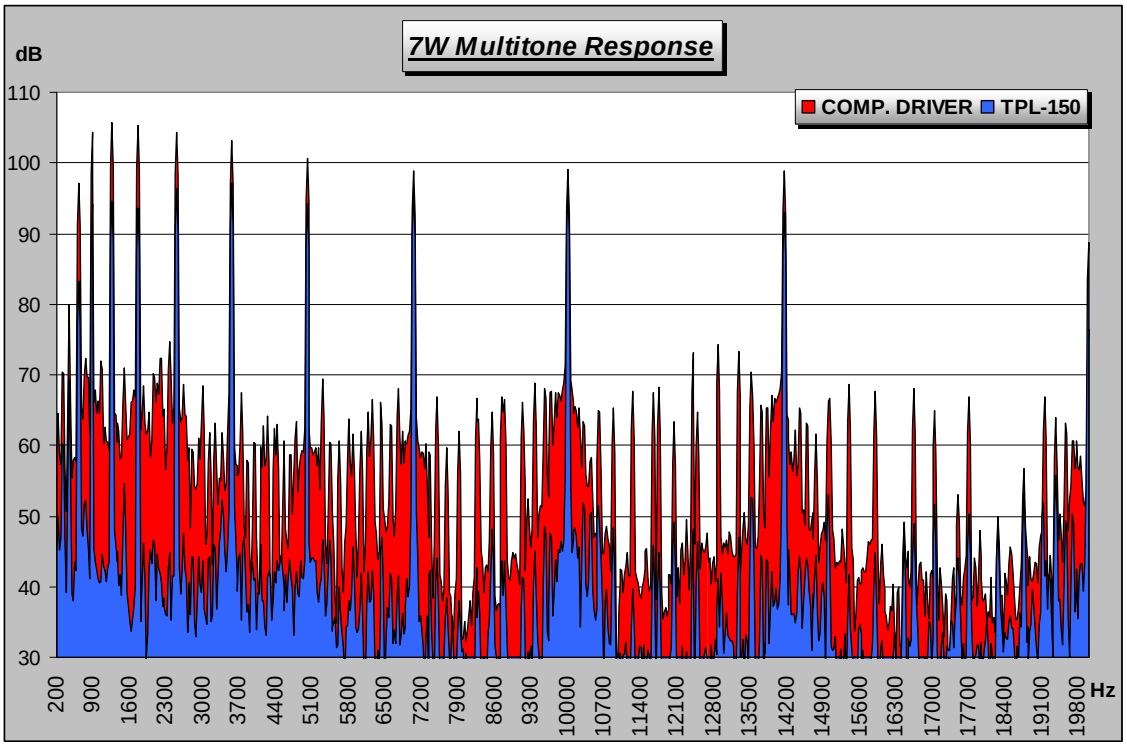
This inter-modulation Distortion is just like looking to one specific type of distortion of a multi-tone measurement, but still very interesting how low is the inter-modulation in the TPL-150 compared to the compression driver.

But one of the most spectacular measurements is the multi-tone response, as it can be more related with the behaviour of the unit with musical signals. Using various sinusoidal signals at the same time, many more inter-related distortion products arise, creating a kind of a “noise floor”, extremely interesting to compare, specially in this case.

In the graph, we can clearly see the tremendous quantity of distortion products the compression driver is creating, just with one watt. There is a S/N ratio of less than 45 dB between the main component and the distortion products, along all the band pass of the unit. If we look to the blue trace of the TPL-150, it is incredible how low the distortion is, not even possible to measure it in many frequency regions.



1W Multitone measurement



7W Multitone measurement

We can also look to the 7W measurement, where it can also be appreciated how the distortion products raises dramatically with power applied in the compression driver, while in the TPL-150, the distortion noise floor is kept proportional to the power applied.
So, not only the distortion is very low in the TPL-150, but also *it does not arise dramatically with power applied*, as a compression driver does.

As a conclusion, this new transducer will be a key component for the next level of professional sound systems of the future, in terms of sonic quality and Live Sound experience.

For more information, please visit http://profesional.beyma.com or contact beyma@beyma.com

REFERENCES

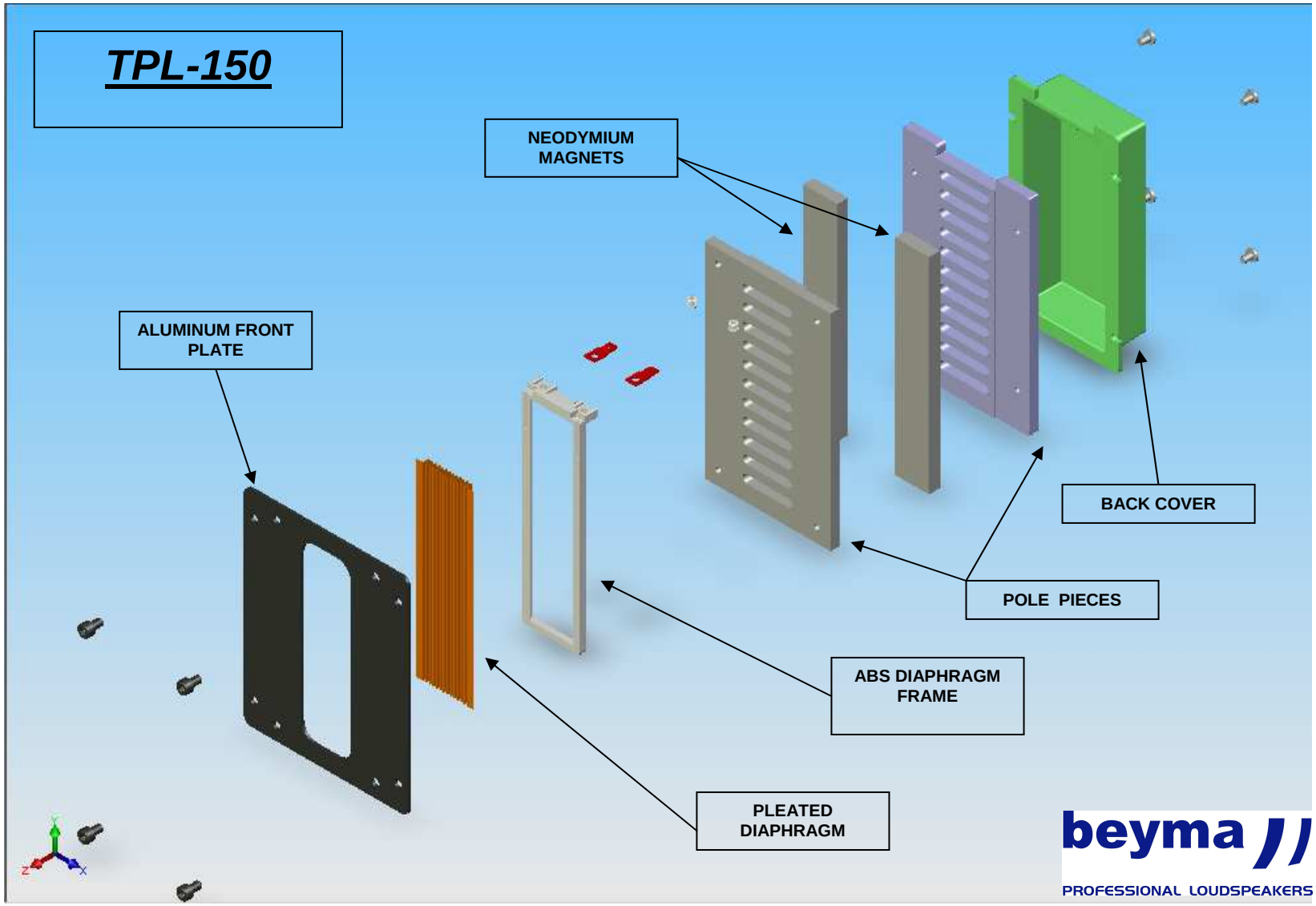
[1] S. Temme, "Why and How to Measure Distortion in Electroacoustic Transducers," presented at the AES 11th Conference on Audio Test and Measurement (Portland, OR, 1992 May 29–31).

[1] E. Czerwinsky, A. Voishvillo, S. Alexandrov, and A. Terekhov, "Multitone Testing of Sound System Components—Some Results and Conclusions, Part 1: History and Theory," *J. Audio Eng. Soc.,* vol. 49, pp. 1011–1048 (2001 Nov.).

[3] E. Czerwinsky, A. Voishvillo, S. Alexandrov, and A. Terekhov, "Multitone Testing of Sound System Components—Some Results and Conclusions, Part 2: Modeling and Application," *J. Audio Eng. Soc.,* vol. 49, pp. 1181–1192 (2001 Dec.).

[4] Czerwinski, Gene; Alexandrov, Sergei; Voishvillo, Alexander; Terekhov, Alexander "Graphing, Interpretation, and Comparison of the Results of Loudspeaker Nonlinearity Measurement" (113th Convention, October, 2002)

[5] Alex Voishvillo, "Assessment of Nonlinearity in Transducers and Sound Systems – from THD to Perceptual Models", (121st AES Convention, San Francisco, October 6, 2006, preprint 6910)


TPL-150
NEODYMIUM MAGNETS
ALUMINUM FRONT PLATE
BACK COVER
POLE PIECES
ABS DIAPHRAGM FRAME
PLEATED DIAPHRAGM
beyma
PROFESSIONAL LOUDSPEAKERS