Eighteen Sound

Single and Double Demodulating Rings

Magneto-dynamic loudspeakers are affected by a wide variety of problems related to the intrinsic distortions that they generate.

This distortion is different at small and high amplitudes. The variation from an amplitude is an indication of nonlinearities inherent in the system, and so spectral components unrelated with the applied stimulus are also generated.

The large amplitude behavior limits the acoustic output, generating audible sound unrelated to the applied signals, and creates instability overloading the speaker.

The main non linearities found in speakers are summarized below:

1. The variation of force factor due to coil winding position in the gap during displacement (Bl(x)). In cases of asymmetries on the BL(x) curve, Even harmonic distortion in the output signal are generated.
   Moreover, there is the possibility of Odd harmonic distortion generation due to the force factor BL(x) roll-off shape character.
   These distortions are related to the input signal amplitude.
   There is also a variation of the force factor (Bl(i)) due to input current (additional AC-Magnetic field superimposing to the permanent magnet DC field) that generates Intermodulation distortion products;

2. The variation of stiffness due to the suspension movement during displacement (Kms(x)); this will change the restoring force generating even harmonic distortions and/or Odd harmonic distortions based on the suspension character and symmetry.
   Furthermore, the suspensions are effected by a "creep factor" that is the lost of stiffness, control and linearity in time when the transducer is operating under significant mechanical stress.
   This effect completely changes the displacement versus time suspension behavior.
   Also these distortions are related to the input signal;

3. The variation of the inductance character due to coil position in the gap during displacement (Le(x)); this will drive to possible asymmetries if the magnetic circuit is not correctly designed with second harmonic generated and high intermodulation figures produced.
   There is an additional source of distortion due to the change of permeability in the iron μ(i), defined as "flux modulation". It refers to the variation of inductance with the input current Le(i), caused by the additional AC magnetic field that superimposes the permanent Magnet DC field, generating harmonic and intermodulation products.

The inductance of the voice coil can be consistently reduced by placing electrical conductive rings in appropriate positions around the gap; these devices work as a shorted transformer secondary circuit, so the AC field from the voice coil induces a current on them which reduces the total alternate flux and the absolute value of Le.

In order to minimize these effects, the Eighteen Sound engineers have developed the **SDR** (**Single Demodulating Ring**) and the **DDR** (**Double Demodulating Ring**) technologies.

The effects of both technologies are very beneficial: a carefully designed magnetic circuit with correct DDR or SDR position improves the symmetry of the Le(x) characteristic. In this way the Le(i) characteristic is also improved because the AC field is much smaller so, there is less flux modulation.

As a result, intermodulation and harmonic distortions are consistently reduced overall the entire reproduced audio spectrum; in fact, while the Le(x) factor should be as linear as possible in order to decrease distortion at medium-high frequencies, the Le(i) factor generates distortions in the whole audio spectrum. Hence, it must be contained as much as possible.

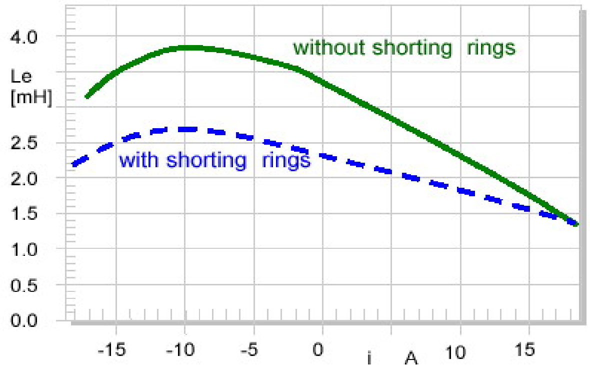

Fig 1. Coil inductance Le(I) against coil current for a magnetic circuit with and without demodulating rings technology

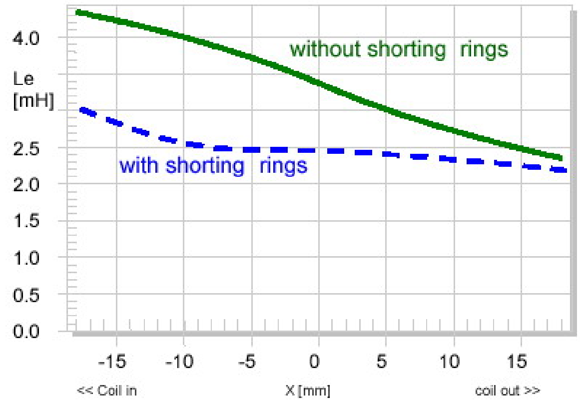

Fig 2. Coil inductance Le(x) against displacement for a magnetic circuit with and without demodulating rings technology

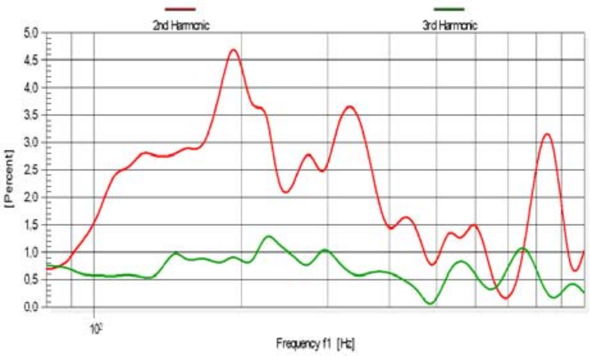

Fig 3. Harmonic distortion of a 15" woofer without demodulating rings. Free air – 20V

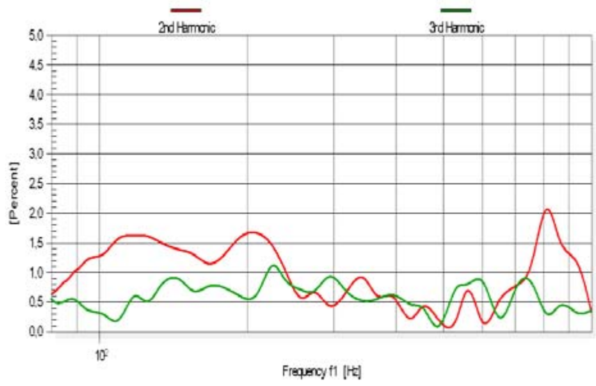

Fig 4. Harmonic distortion of same 15" woofer with demodulating rings. Free air –20V

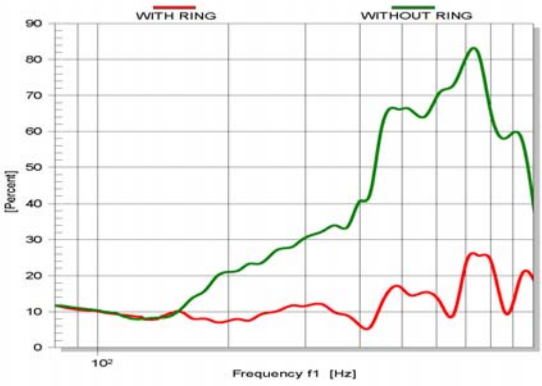

Fig 5. Two Tones Second Order Intermodulation Distortion comparisons on a 15" woofer with demodulating rings (DDR) versus same woofer without DDR. Free air – 20V

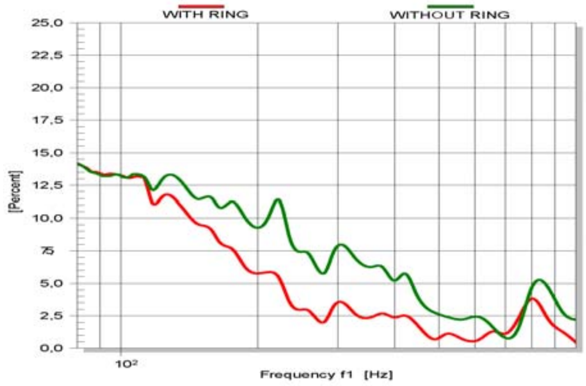

Fig 6. Two Tones Third Order Intermodulation Distortion comparisons on a 15" woofer with demodulating rings (DDR) versus same woofer without DDR. Free air – 20V

EIGHTEEN SOUND
Via dell'Industria 20
42025 Cavriago – Italy
website: http://www.eighteensound.com
e-mail: info@eighteensound.com