Eighteen Sound

Double and Triple Silicone Spider: DSS and TSS

Magneto-dynamic transducers are affected by a wide variety of problems related to the intrinsic distortions they generate.
These distortions are different at small and high amplitudes; the dependency from amplitude is an indication of inherent system nonlinearities, while also spectral components unrelated with the applied stimulus are generated.
These distortions limit the acoustic output of the system, generating audible unmatched results if compared to the originally applied signals, and creating instability that could go toward overloading in high power-driving conditions.

The main non linearity founded in speakers are summarized below:

1) The variation of force factor due to the coil winding entering and leaving the gap during displacement (Bl(x)). This will drive to possible asymmetries on the excursion, with Even harmonic distortion generated and/or Odd harmonic distortion in the output signal due to force factor roll-off character. This drives to Odd harmonic distortion generation. These distortions are related to the input signal.
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), generating 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 changes completely the displacement versus time suspension behaviour. Even these distortions are related to the input signal;

3) The variation of the inductance character due to coil entering and leaving the gap during displacement (Le(x)); this will drive to possible asymmetries if the magnetic circuit is not correctly designed with second harmonic generated, but mostly high intermodulations factors produced.
There is an additional source of distortion due to the change of permeability in the iron of the magnetic path. 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.

Double Silicon Spider technology (**DSS**) works in conjunction with the surround in order to provide linear movement and high excursion capabilities. This all serves as a balanced suspension system for the moving mass, maintaining its control and integrity over the whole transducer working operative range.

A Double Silicon Spider is made by joining two single spiders using a dedicated special silicone layer. It offers enhanced bending mechanical properties when compared to single spider technology.

The stiffness of the suspension system determines the resonance frequency of the speaker along with the mass of the cone, voice coil and air load. Considering the mass as a constant, stiffness depends on instantaneous voice coil position, x. Reversible mechanisms are due to viscoelastic behaviour of the suspension. Non reversible changes occur for example during break in due to creep. Rather then static test, a dynamic measurement cycle shows real life behavior.

DSS has better capacity to retain its shape after long life test cycles. The offset of the speaker can be evaluated in a dynamic test where the excitation level is raised and the DC component of the displacement is measured. After a power test is made, the DC offset is measured again. During the same test the peak displacement is measured for different voltages.

The ability of the DSS to maintain its shape results in lower levels of harmonic distortion and prevents jump-off effects.

Double silicone spider is also able to maintain the same peak excursion limits after break-in or a prolonged conditioning while, for a simple spider design, after a simple break in the maximum displacement raises due to stiffness loosening.

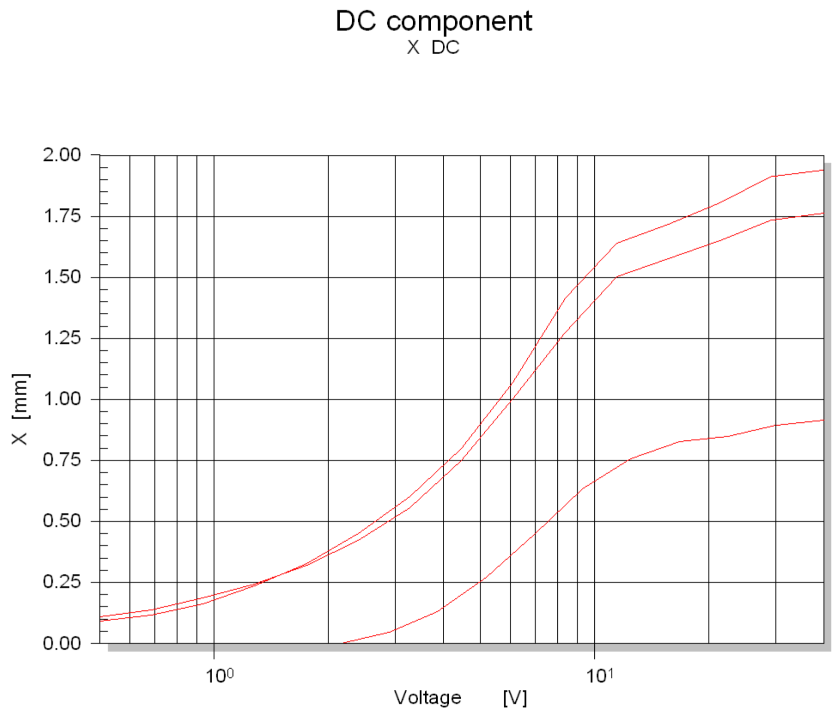

Figure 1: Single spider DC offset measured in a level sweep.
Lower curve is fresh spider. Upper curves are after break-in and 1 hour conditioning.
The difference between the lower curve and break-in is already 100%, resulting in permanent shape deformation.

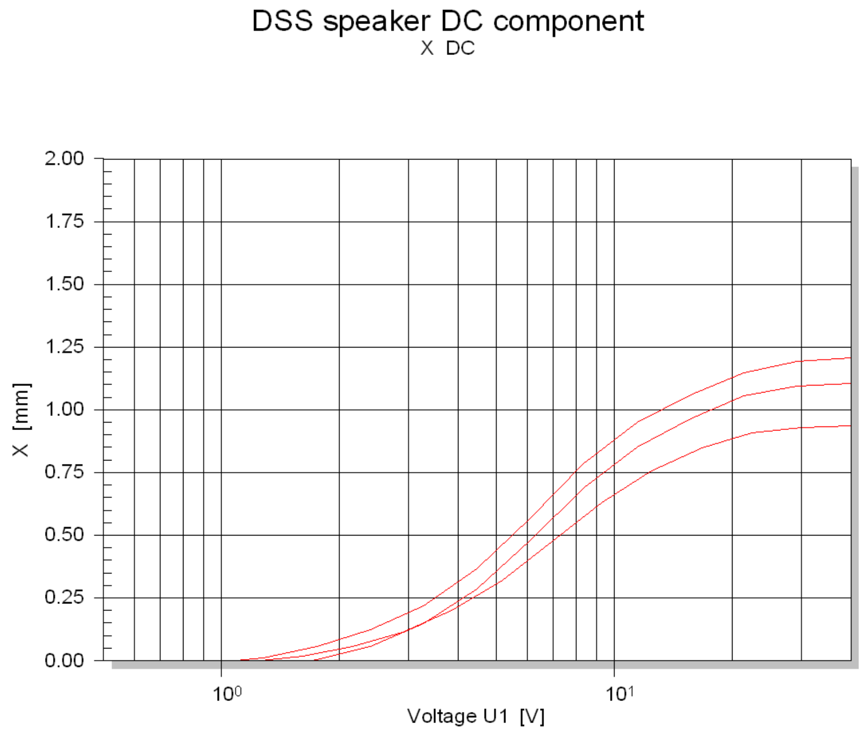

Figure 2: DSS speaker DC offset measured in a level sweep.
Lower curve is fresh spider. Mid curve is made after break-in. Upper curve after 1 hour conditioning.
The difference between all curves is almost constant, resulting in little shape deformation.

Stiffness of suspension Kms (X)

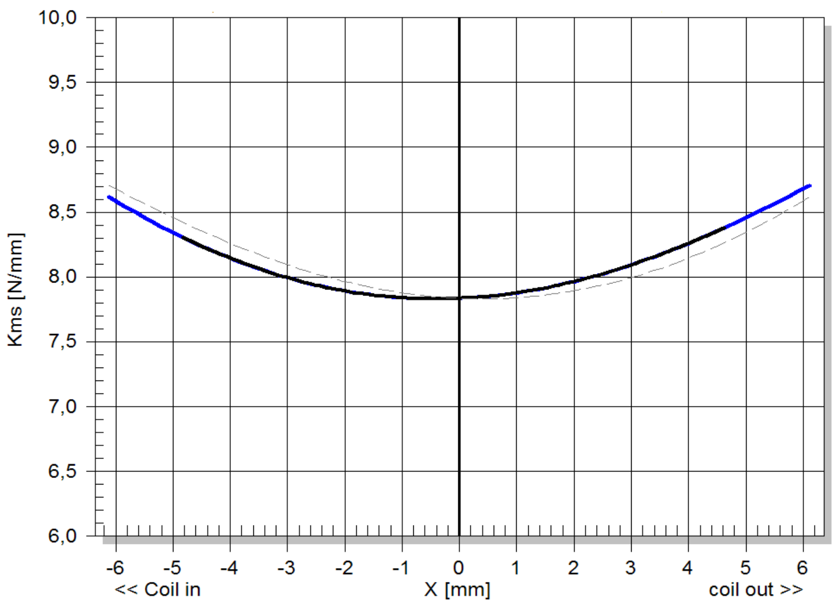

Figure 3: DSS speaker dynamic stiffness - Kms(x) - versus displacement from rest position X.
Stiffness offset and asymmetry versus coil displacement is minimal, resulting in lower harmonic distortion.

From the acoustical side, the speaker hugely benefits from the use of DSS, because of the enormously improved control over excursion.

DSS represents a dedicated answer to the high dynamic of today's pro audio systems where high quality suspensions design is able to withstand the high stress and mechanical fatigue of peak power levels and prolonged transducer use.

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