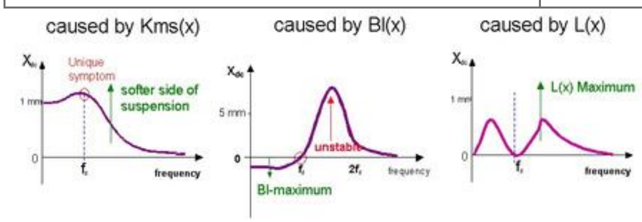
DC DISPLACEMENT – DYNAMIC OFFSET THE VOICE COIL

Characteristics:	KLIPPEL R&D System	KLIPPEL QC System
DC displacement versus frequency	DIS	
DC displacement versus amplitude	DIS	
Asymmetrical probability function pdf	LSI, PWT	
Peak-bottom value	DIS, TRF, LSI, PWT, SPM	MSC



The figure above illustrates the typical frequency of the dc displacement caused by an asymmetrical shape of nonlinear stiffness Kms(x), nonlinear force factor Bl(x) and nonlinear inductance L(x).

Asymmetries in the motor and suspension nonlinearities generate a dc component in the voice coil displacement which can be detected by a laser sensor. The sign of the dc component has a high diagnostic value because it is directly related with the shape of the nonlinearity. For example, an asymmetrical stiffness characteristic generates a dc component which always shifts the coil to the softer side of the suspension. An asymmetrical force factor characteristic may cause a significant dc component for excitation frequencies above resonance in the same order of magnitude as the fundamental. DC displacement generated by a poor suspension system may spoil the performance of an expensive motor structure because a dynamic voice coil offset produces audible intermodulation distortion.

KLIPPEL R&D SYSTEM (development)

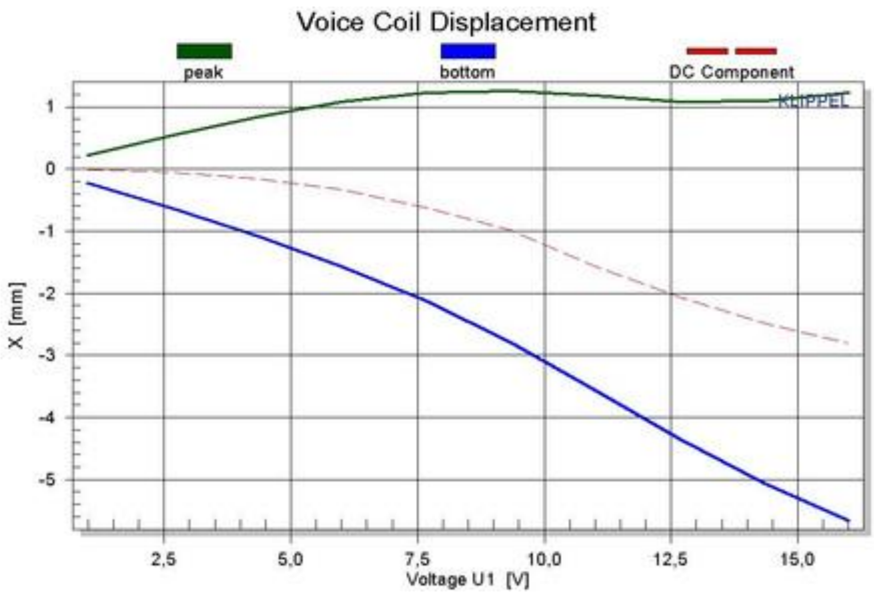
Module	Comment
Transfer Function Module (TRF)	TRF reveals the dc component in the waveform of the displacement and in the Rub & Buzz analysis (instantaneous distortion 3D plot).

Module	Comment
Large Signal Identification (LSI)	LSI predicts the dc displacement generated by a pink noise stimulus by using the nonlinear large signal model and the identified loudspeaker parameters. The predicted value can be compared with the value measured independently by using a laser sensor.
Power Test (PWT)	PWT provides similar features like the LSI but may be used to monitor the dc component of multiple devices under test using ordinary audio signals.
Analyzer Hardware Displacement Meter of the Distortion Analyzer Hardware (DA)	The stand-alone operation mode of the DA measures the peak, bottom, dc component of the displacement using a laser sensor. This is a simple way for assessing the dc component in loudspeakers reproducing any signal.
3D Distortion Module (DIS)	DIS module measures the steady-state response of the dc component versus frequency at different excitation levels.

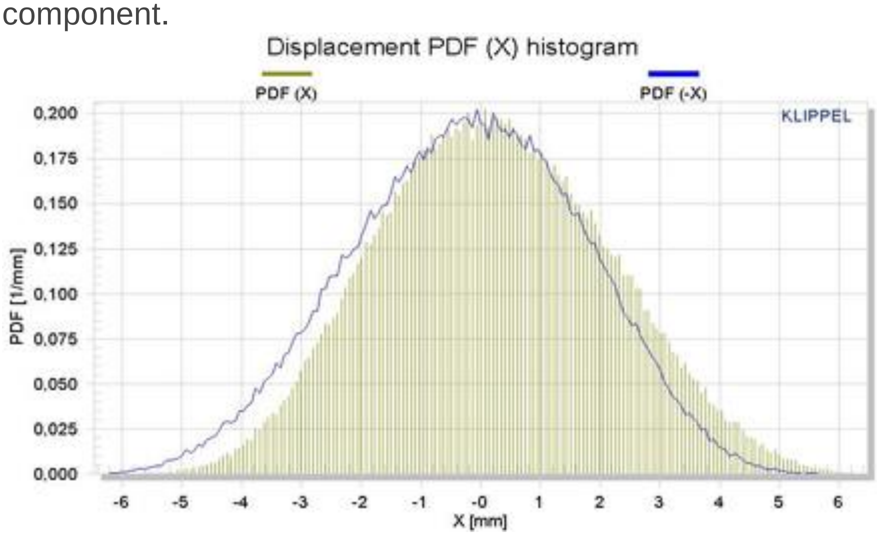
KLIPPEL QC SYSTEM (end-of-line testing)

Module	Comment
MSC (Motor Suspension Check)	MSC calculates the dc component using the large signal model and the identified nonlinear parameters in ultra short time (< 1s).It dispenses with a laser sensor.

Example:



The figure above shows the result of the motor stability check where the dc displacement is measured by a sinusoidal tone above the resonance frequency (1.5 fs). Increasing the terminal voltage, the dc displacement in the example approximately equals the amplitude of the ac component.



The figure above shows the displacement probability density function pdf as measured by the LSI revealing an asymmetrical shape which is obvious by comparing the curve with the blue curve represented by the mirrored pdf. Since the voltage signal has a symmetrical pdf, the dc component shifts the coil to the positive side away from the rest position.