MSPM Pro C11

Micro Suspension Part Measurement

Module of the KLIPPEL ANALYZER SYSTEM (Document Revision 1.6)

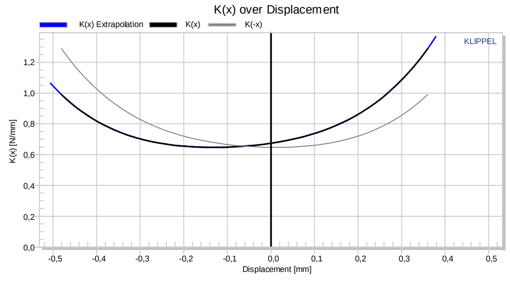
FEATURES

- Measurement of nonlinear stiffness *K*(*x*)
- Small diaphragms (diameter < 7 cm)
- Measurement of bare membranes without attaching a voice coil
- Suspension Parts of:

  micro-speakers, headphones, tweeters, microphones

BENEFITS

- Automatic measurement
- Nondestructive, dynamic method
- Specification of suspension parts
- Optimal driver design in R&D



DESCRIPTION

The *MSPM Pro Micro Suspension Part Measurement* software module and hardware accessory for the KLIPPEL R&D System is designed for the measurement of the large signal stiffness of small suspension parts (micro-speakers, headphones, tweeters, microphones).

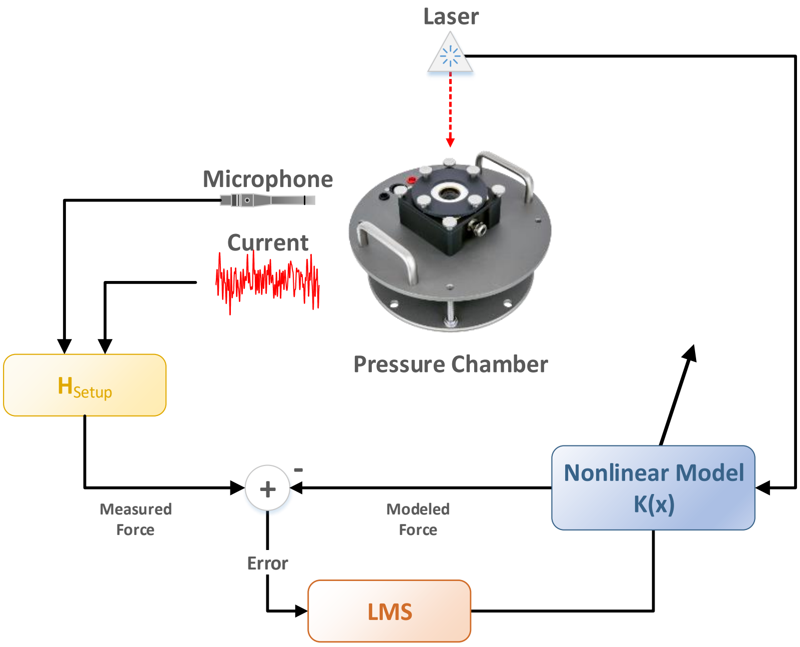
The membrane is excited passively by the sound pressure in a small pressure chamber. The nonlinear behavior of the stiffness is measured by monitoring the distortion in the displacement of the membrane.

Article number	#2500-602

CONTENT

1 Overview

1.1 Principle

Measurement Principle	 The *MSPM Pro Micro Suspension Part Measurement* identifies the nonlinear stiffness characteristic of small membranes. The membrane is glued into a plate, which is mounted in the *MSPM Bench*. During the measurement, the membrane is excited by sound pressure in the small pressure chamber. Sound pressure *p* inside the pressure chamber, current *i* of the driving speaker, as well as the displacement *x* of the membrane is captured during the measurement. Using this information, the nonlinear stiffness behavior can be determined by using a fitting algorithm.

1.2 Results

***K*(*x*) over Displacement**	The nonlinear stiffness of the membrane *K*(*x*) is displayed as a curve. In addition, coefficients describing a regular power series can be exported and used in the *SIM Simulation* or *SIM-AUR Simulation / Auralization* module.

2 Requirements

2.1 Hardware

MSPM Bench (Art. #2500-601)	MSPM Bench comprises a small pressure chamber with a flexible clamping mechanism for micro suspension parts.	
Analyzer	The *Klippel Analyzer 3* or the *Distortion Analyzer* are used as hardware to control the laser head and to perform the measurement.	
Laser Stand	The MSPM Bench is designed to work with one of the following laser positioning devices • 3D Scanner (Scanning Vibrometer System SCN) (Art. #:2510-004) • LST Bench (Art. #: 2500-310) + Translation Stage (Art. #:2300-001) • Pro Driver Stand (Art. #:2211-100) + Translation Stage (Art. #:2300-001)	
Laser Displacement sensor	A high precision laser displacement sensor is required. It is recommended to use: • Keyence LK-H052 Laser sensor (Art. #:2103-200)	
Microphone	A 1/4" microphone is required for sound pressure measurement in the pressure chamber. Recommended Product: • MIC 40PP-S1 (Art. #:2400-007)	
Amplifier	A power amplifier is required for performing the measurement.	
Computer	A personal computer is required for performing the measurement.	

2.2 Software

dB-Lab (>=210.128)	Project Management Software of the KLIPPEL R&D SYSTEM.
LPM-Module	Software Module for multitone measurements with the KLIPPEL Analyzer devices.
MSPM Lite [optional]	It is recommended to first determine the linear mechanical parameters using the *MSPM Lite Micro Suspension Part Measurement* module.

3 Limitations

3.1 Device Under Test

Parameter	Min	Typ	Max	Unit
Dimension	DUT Dimensions can be found in *A12 MSPM Bench*			
Resonance frequency	100		2500	Hz
Cone Breakup Frequency[1]	600			Hz

3.2 Sensors

Laser	Laser limitations can be found in *A2 Laser Displacement Sensor*
Microphone	Microphone limits can be found in *A4 Microphones*

4 Outputs

4.1 Result Curves

K(x) over Displacement	The window shows the identified nonlinear stiffness $K(x)$ of the suspension part.
Fitting Error in Frequency Domain	Diagnostic window; shows the forces F in frequency domain. You can use this plot to check for a good fitting of both linear and nonlinear parameters.
Transfer Function DUT X/F	Diagnostic window; shows the transfer function X/F of the DUT.
Transfer function Measurement Setup F/I	Diagnostic window; shows the transfer function F/I of the Setup.

4.2 Result Parameters

Parameter	Unit	Description
k_1 … k_4	N/mm	Coefficients describing the nonlinear stiffness
$K(x=0)$	N/mm	Mechanical stiffness at rest position
R	kg/s	Mechanical resistance
m	g	Moving mass
E_{lin}	%	Linear error in force relative to stimulus signal F_{Stim}
Model Performance	dB	Performance of the nonlinear model
d_K	%	Ratio of the distortion in measured displacement
E_{Setup}	%	Error in measured transfer function

[1] Negligible partial vibrations below the stated frequency

5 MSPM Bench Specification

5.1 Specification for 1.0 and above

5.1.1 Maximum/Minimum Ratings	Min	Max	Unit
Driver Nominal Impedance	8		Ω
Input Voltage (continuous, <40s)		12	V
Input Voltage (short term, <5s)		19	V
Driver used: 18 Sound 6ND410			

6 References

6.1 Related Modules	MSPM Lite, SPM Pro, SPM Lite
6.2 Manuals	MSPM Manual

Find explanations for symbols at:

http://www.klippel.de/know-how/literature.html

Last updated: April 29, 2021

Designs and specifications are subject to change without notice due to modifications or improvements.