MSPM Pro C11

Micro Suspension Part Measurement

Module of the KLIPPEL ANALYZER SYSTEM (Document Revision 1.5)

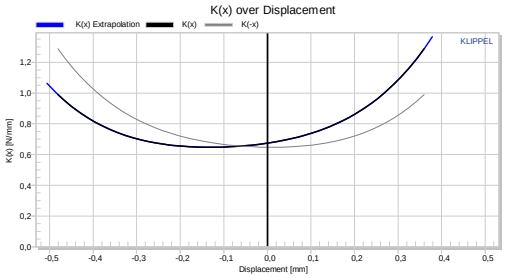
FEATURES

- 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 non-linear behavior of the stiffness is measured by monitoring the distortion in the displacement of the membrane.

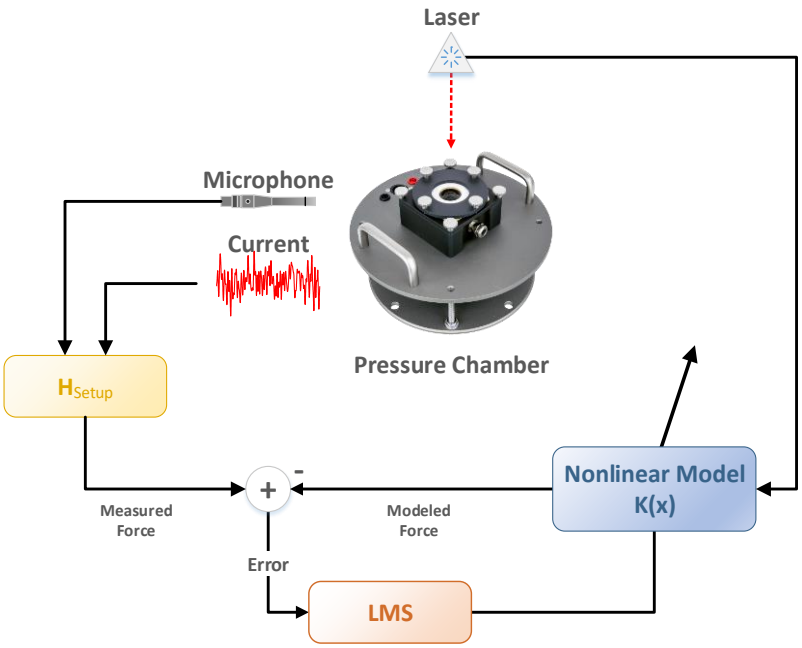
Article number	#2500-602

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.	
dB-Lab (>210.124)	Project Management Software of the KLIPPEL R&D SYSTEM.	
LPM-Module	Software Module for multitone measurements with the KLIPPEL Analyzer devices.	
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)	dB-Lab is the project management software of the KLIPPEL R&D SYSTEM.
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
$k_1 \dots k_4$	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: May 19, 2020
Designs and specifications are subject to change without notice due to modifications or improvements.