MSPM Lite C10

Micro Suspension Part Measurement

Module of the KLIPPEL ANALYZER SYSTEM (Document Revision 1.10, dB-Lab 212)

FEATURES

- Linear parameter measurement for suspension of micro-speakers, headphones, tweeters, microphones
- Resonance Frequency & Q-Factor
- Sound pressure excitation for measurement of bare membrane without attaching a voice coil

BENEFITS

- Parts testing before driver assembly
- Specification of suspension parts
- Optimal driver design in R&D

Name	Value	Unit	Description
f_r	896.4	Hz	Resonance frequency
Q	3.74	-	Quality factor
m	0.051	g	Moving mass
C	1.787	mm/N	Mech. Compliance
K	0.559	N/mm	Stiffness
R	0.026	Kg/s	Mech. resistance

DESCRIPTION

The *MSPM Lite Micro Suspension Part Measurement* software module and hardware accessory for the KLIPPEL R&D System is designed for the measurement of the linear mechanical parameters of small suspension parts (Micro-speakers, headphones, tweeters, microphones).

The membrane is excited passively by the sound pressure in a pressure chamber and the linear parameters: resonance frequency, Q-factor, stiffness, moving mass and mechanical resistance are determined dynamically by a simultaneous measurement of displacement and sound pressure.

Article number	#2500-603

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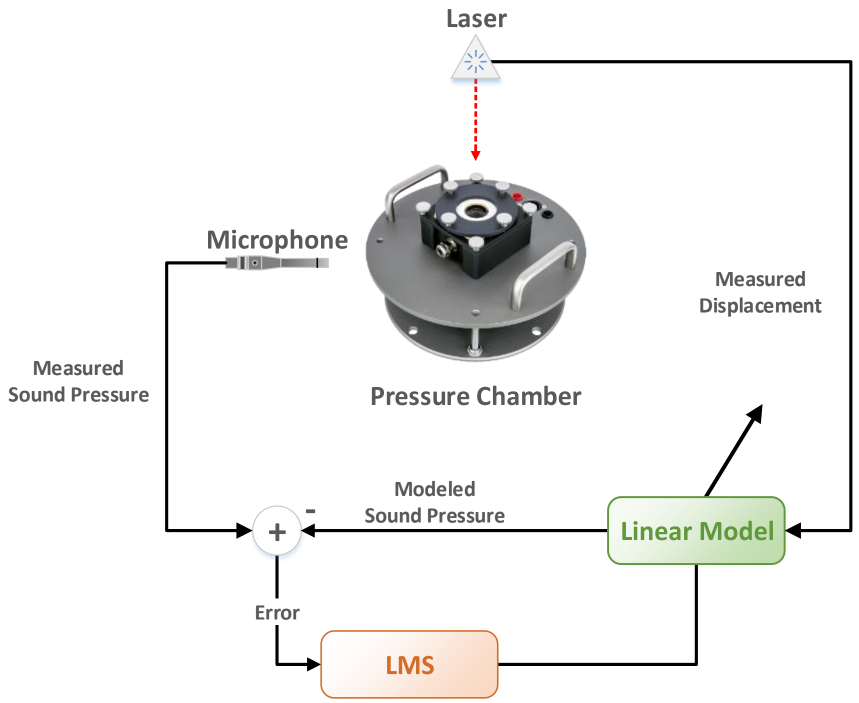
1 Overview

1.1 Principle

Measurement Principle



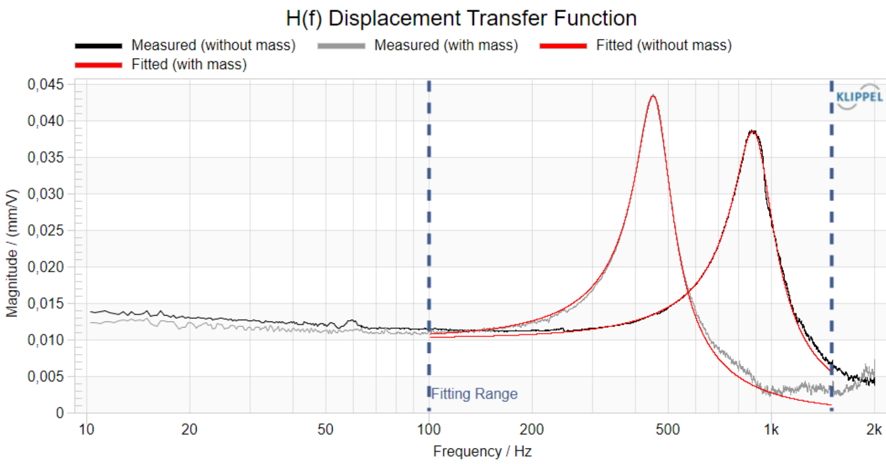
The *MSPM Lite Micro Suspension Part Measurement* identifies the linear mechanical parameters of small membranes. The device under test (DUT) is glued onto a DUT carrier, which is mounted on the *MSPM Bench*.

During the measurement, the membrane is excited by the sound pressure in the small pressure chamber generated by the built-in speaker. The sound pressure *p* inside the pressure chamber as well as displacement *x* of the membrane are captured during the measurement. The resulting transfer function is modeled by a spring mass system, using resonance frequency and quality factor. Using the resonance shift by adding a known mass (*Added Mass Method*), or by entering the known value of the moving mass, the linear parameters may be calculated.

1.2 Results

Resonance Frequency, Quality Factor

The resonance frequency and the quality factor of the clamped membrane can be determined by fitting a mass-spring resonator model based on the measured transfer function between sound pressure and displacement.



Linear Parameters	By either using the *Added Mass Method*, or by importing a known moving mass, the linear mechanical parameters resistance *R*, stiffness *K* and moving mass *m* can be calculated from the resonance frequencies and Q factors.

Name	Value	Unit	Comment
Results			
f_r	896.39	Hz	Resonance frequency
Q	3.74	-	Quality factor
m	0.0176	g	Moving mass
C	1.7872	mm/N	Mechanical compliance
K	0.5595	N/mm	Stiffness
R	0.0265	kg/s	Mechanical resistance

2 Requirements

2.1 Hardware

MSPM Bench (Item #2500-604)	The MSPM Bench comprises a small pressure chamber with a flexible clamping mechanism for micro suspension parts. The built-in driver generates the sound pressure that can be measured by a 1/4-inch microphones via the provided feed-through.	
Laser Stand	The MSPM Bench is designed to work with one of the following laser positioning devices • 3D Scanner (Scanning Vibrometer System SCN) (Item #2510-004) • LST Bench (Item # 2500-310) + Translation Stage (Item #2300-001) • Pro Driver Stand (Item #2211-100) + Translation Stage (Item #2300-001)	
Analyzer	Both the *Klippel Analyzer 3* and the *Distortion Analyzer* are supported to perform MSPM measurements. Both, the *ALS* (internal map) or LSX (for external amp) configuration of the KA3 are suitable.	
Laser Displacement sensor	A high-precision laser displacement sensor is required. It is recommended to use Keyence LK-H052 Laser sensor (Item #2103-200).	
Microphone	A 1/4" microphone is required for sound pressure measurement in the pressure chamber. The recommended microphone is the MIC 40PP-10-S1 (Item # 2400-360).	
Amplifier	A power amplifier is required for performing the measurement. For operation with *KA3*, the internal Amp Card is recommended. For external amplifiers, refer to the Amplifier Requirements of the KLIPEPL Analyzer System.	
Computer	A personal computer is required for performing the measurement. Please refer to the general PC requirements of the KLIPPEL Analyzer System.	

2.2 Software

dB-Lab	The KLIPPEL dB-Lab R&D software from version 210.128 is required to run the MSPM Lite.
TRF Module	The MSPM Lite control and post-processing module is based on meaurements performed with the Transfer Function Measurement (TRF) module.

3 Limitations

3.1 Device Under Test

Parameter	Min	Typ	Max	Unit
Dimension	DUT dimension limits can be found in *A12 MSPM Bench*			
Resonance frequency	100		2500	Hz
Cone break-up 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

Input Curves	The window shows the measured transfer function $H_{X/P}$ with and without mass.

4.2 Result Parameters

Parameter	Unit	Description
f_r	Hz	Resonance frequency of suspension part
Q	-	Quality factor of suspension part
m	g	Moving mass
C	mm/N	Mechanical compliance
K	N/mm	Mechanical stiffness
R	kg/s	Mechanical resistance

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, < 40 s)		12	V
Input voltage (short term, < 5 s)		19	V

Driver used: 18 Sound 6ND410

Find more specification information in *A12 – MSPM Bench*.

[1] Negligible partial vibrations below the stated frequency

6 References

6.1 Related Modules	• MSPM Pro – Micro Suspension Part Measurement Pro • SPM Lite – Suspension Part measurement Lite • QC LST – Linear Suspension Test
6.2 Manuals	• MSPM Manual
6.3 Specifications	• A12 MSPM Bench

Find explanations for symbols at:

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

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KLIPPEL MODULE OVERVIEW FOR MOVING PARTS MEASUREMENT

	SPM Lite	SPM Pro	MSPM Lite	MSPM Pro	QC LST Lite	QC LST Pro
R&D System	✓		✓		✓[5)]	
QC System	-		-		*QC Basic* or *Standard*	
Base Module	TRF		TRF	LPM	-	
Analyzer Hardware	Distortion Analyzer 2 Klippel Analyzer 3 [5)]		Distortion Analyzer 2 Klippel Analyzer 3 [5)]		Klippel Analyzer 3 [5)] QC Production Analyzer	
Test Bench	SPM or LST	SPM	MSPM[6)]		LST, MSPM[6)] or SPM[7)]	
Laser Sensor (Default) (Measurement Range)	IL-030 (+/- 12.5 mm)	LK-H082 (+/- 18 mm)	LK-H052 (+/- 10 mm)		IL-065 (LK-H052[8)]) (+/- 10 mm)	
Laser Sensors (Alternative) (Measurement Range)	LK-H022 LK-H052 LK-H082 LK-H152 LK-G32	LK-H052 (+/- 10 mm) LK-H152 (+/- 40 mm)	LK-H022 (+/- 3 mm) LK-H082 (+/- 18 mm) LK-G32 (+/- 5 mm)		LK-H022 LK-H052 LK-H082 LK-H152 LK-G32	
Microphone	✓	-	✓		Opt.	✓
Linear Parameters f_0, Q, k, c, m, r	✓	- (only k_{eff})	✓ (only effective)		✓ (*m* import, no *r*)	✓ (*m* & *k* relative, no *r*)
Nonlinear Parameters $K(x)$, $C(x)$	-	✓	-	✓	-	
Mass Import	✓	-	✓		✓	
Added Mass	✓	-	✓	-	-	
DUT Ø in mm	30 – 222[1)] (490[2)])	30 – 222[1)]	< 70		30 – 222[1)] (490[2)]) <70[8)]	
Frequency Range in Hz	1 – 100[4)] (200[3)])	1 – 100	100 - 2500		1 – 100[4)] (200[3)]) 100 – 2500[8)]	

1) *Standard Ring Set*
2) *SPM Bench (with custom ring)*
3) *LST Bench*
4) *SPM Bench*
5) *Min. dB-Lab Release 210*
6) *MSPM Bench requires additional equipment for laser positioning (SCN Vibrometer, LST-Bench or Pro-Stand)*
7) *For DUTs with Ø >= 222 mm / <= 490 mm, customized clamping rings required*
8) *MSPM Bench*