Suspension Part Measurement Lite C 7

KLIPPEL Analyzer System (Document Revision 1.8)

FEATURES

- Measure the linear parameter like f_0, Q-factor, stiffness k_0, moving mass m and mechanical resistance R
- Measure spiders, surround, cones, passive radiators [1]
- Easy and fast clamping
- Size from 1 – 8 inch
- Nondestructive, dynamic method

APPLICATION

- Specification of suspension parts and Passive Radiators
- Optimal driver design in R&D
- Production sample testing
- Incoming goods inspection

DESCRIPTION

This software module and hardware accessory for the KLIPPEL R&D System is dedicated to the small signal measurement of suspension parts (spiders, cones, surrounds) and passive radiators (drones). The linear mechanical parameters like resonance frequency f_0, Q-factor, stiffness k_0 and mechanical resistance R are determined dynamically by a simultaneous measurement of displacement and sound pressure.

A fitting algorithm is used to accurately extract the resonance frequency and the Q-factor from the transfer function between sound pressure and displacement. The complete set of linear parameters is calculated by either specifying an absolute moving mass m or using the *Added Mass Method*.

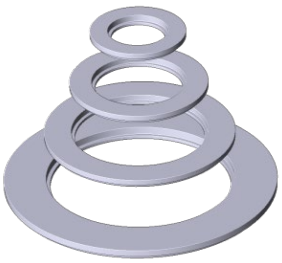
The suspension parts are attached to the measurement bench by using a variable set of clamping parts (rings and cones) that fit any size of circular geometries up to 222 mm diameter.

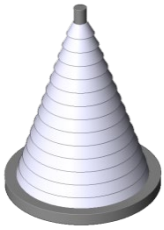
Further information about measuring passive radiators can be found in document [1].

Article Number:	2500-310, 2500-302, 2500-301, 2500-103

CONTENT

1 Accessories for SPM Lite

LST Measurement Bench with external laser boom (Art. #: 2500-310)		The LST Measurement Bench consists of a sealed enclosure with a volume of 26 liters and a 10” driver which excites the device under test (DUT) pneumatically. The laser rack including the laser rod and platform is mounted externally to provide an easy accessibility and adjustability. For easy mounting and measurement the clamping platform is orientated in a horizontal position. The suspension part is attached to the measurement bench using a set of rings for the outer rim as well as inner mounting parts (cone and nuts). The measurement is performed in the small signal domain thus gravity ensures sufficient clamping in most cases. A custom clamping system can be installed by the user to increase measurement accuracy by mounting the device under test vertically. The set contains the required cables to connect the measurement bench to the KLIPPEL Distortion Analyzer.
MIC 40PP-S1 IEPE (Art. #: 2400-007)		The G.R.A.S. 40PP-S1 is the default microphone for SPM Lite application. This cost-efficient microphone with a sensitivity of 10 mV/Pa can be connected directly to the IEPE powered MIC inputs of the *Analyzer Devices*. With default configuration of the microphone inputs this microphone may handle up to 140 dB SPL before clipping occurs.
Ring Set (Art. #: 2500-302)		Multiple sets of rings allow mounting almost all suspension parts with a circular geometry between 2 and app. 9 inch. After measuring the outer diameter and the width of the rim the ring set can easily be identified by using a table and nomenclature. The rings are made of 10 mm aluminum. Subsets of rings (to cover only selected sizes) or special forms (elliptic sizes) may be provided on customer request.

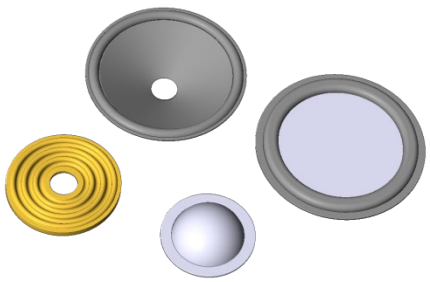
Cone Set (plastic) (Art. #: 2500-301)		The cone is attached to the inner rim of the suspension part, providing a defined moving mass and a reflection surface for the laser sensor. Multiple plastic cones are organized in a set with a simple nomenclature to cover from 14 - 111 mm diameters. Single cones may be provided on customer request.
Software: SPM Lite Software (Art. #: 2500-103)	A special CAL Script to calculate linear parameters of suspension parts	

2 Additional Components required

Klippel Analyzer 3	In order to use the SPM Lite a KA3, the KLIPPEL R&D System (from version 210), is required.  The required card configuration for use with external amplifier is: • Laser Card • XLR Card (optional: asymmetrical output of laser card may be used instead) • Speaker Card (optional, for amplifier gain calibration and verification) In case no external amplifier is used, the following cards are required: • Laser card • Amplifier Card • Speaker Card (optional: test bench may be connected to Amplifier Card directly)
Distortion Analyzer	The Distortion Analyzer 1 or 2 is used as the hardware to control the laser head and to perform the measurement.  In order to use the Distortion Analyzer, an external power amplifier must be used.
Laser Displacement sensor	A displacement laser which is usually available as standard equipment of the KLIPPEL R&D System measures the displacement of suspension at the required precision. • For standalone operation of the SPM Lite the Keyence IL-030 is recommended. • The Keyence LK-H52/ LK-H82 sensor that is usually used with the KLIPPEL R&D System is recommended for SPM Lite and SPM Pro
Microphone	A quarter inch microphone is required for sound pressure measurement within the test bench. As the sound pressure peak level may be high.
Software	The Suspension part measurement uses the following software modules of the KLIPPEL R&D System: • dB-Lab • Transfer Function Module TRF

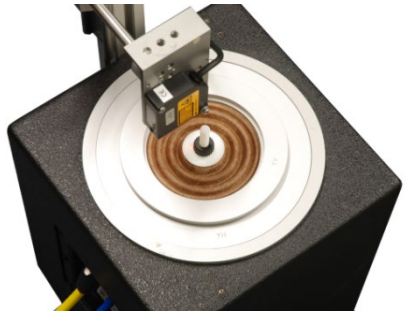
Power Amplifier	A power amplifier is required for performing the measurement.
Computer	A personal computer is required for performing the measurement.

3 Objects

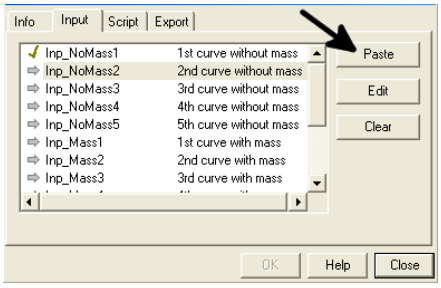


Suspension parts (spiders, suspensions, cone with suspensions) and passive radiators of circular geometries with a diameter up to 222 mm can be measured by using the small clamping set (rings, cones). For particular objects with more complicated curvatures, unusual sizes or extremely small rims special clamping parts can be manufactured on customer's request. KLIPPEL may provide service based on detailed drawings.
Although the suspension is pneumatically excited the used technique can cope with significant air porosity of the suspension.

4 Measurement Procedure



1) Mounting the DUT (Device Under Test)
2) Setting up the correct stimulus settings (voltage, bandwidth)
3) Performing the main TRF measurement(s)
4) Determining the moving mass by using the *Added Mass Method* (recommended option; in this case another TRF measurement with additional mass has to be performed) or by using a scale



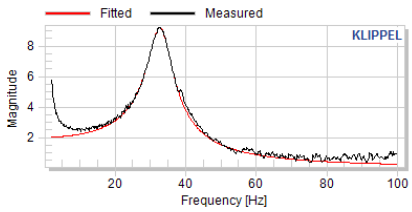
5) Passing the TRF results to a CAL operation
6) Running the CAL operation

5 Results

Result Variables

Name	Value	Description
f_p	39.26 Hz	Resonance Frequency
Q_{MP}	4.513	Quality Factor
M_{MP}	15 g	Moving Mass
C_{MP}	1.095 mm/N	Mechanical Compliance
K_{MP}	.913 N/mm	Stiffness ($1/C_{MP}$)
R_{MP}	.820kg/s	Mechanical Resistance

The calculated linear parameters are shown in a table. Also error and warning messages appear here.

Result Curves		The *Results Curves* show the measured curves and their corresponding fitting curves. A high accordance between the curves implies a high accuracy of the parameter identification.

6 Look up tables for clamping set

LST Cone Set		
Cone number	Cone diameter D_C (mm)	Cone weight (g)
1	11	2.1
2	18	5.2
3	25	9.5
4	32	14.9
5	39	21.3
6	46	28.9
7	53	37.6
8	60	47.3
9	67	58.3
10	74	70.1
11	81	83.1
12	88	97.3
13	95	112.4
14	102	128.6

Part	Mass (g)
Hexagon bolt	7.25
Knurled nut	3.25

Name of the ring	**D_R (mm)**
A1	30
B1	33
C1	36
D1	39
E1	42
F1	45
G1	48
H1	51
A2	54
B2	57
C2	61
D2	65
E2	69
F2	73
G2	77
H2	81
A3	85
B3	89
C3	93
D3	98
E3	103
F3	108
G3	113
H3	118
A4	124
B4	130
C4	136
D4	142
E4	148
F4	154
G4	160
H4	166
A5	173
B5	180
C5	187
D5	194
E5	201
F5	208
G5	215
H5	222

7 References

[1] Application Note 57 – Parameter Measurement of Passive Radiators

Find explanations for symbols at:
http://www.klippel.de/know-how/literature.html
Last updated: February 05, 2019