MTON Multi-Tone Measurement S64

Module of the KLIPPEL ANALYZER SYSTEM (dB-Lab Ver. 212)

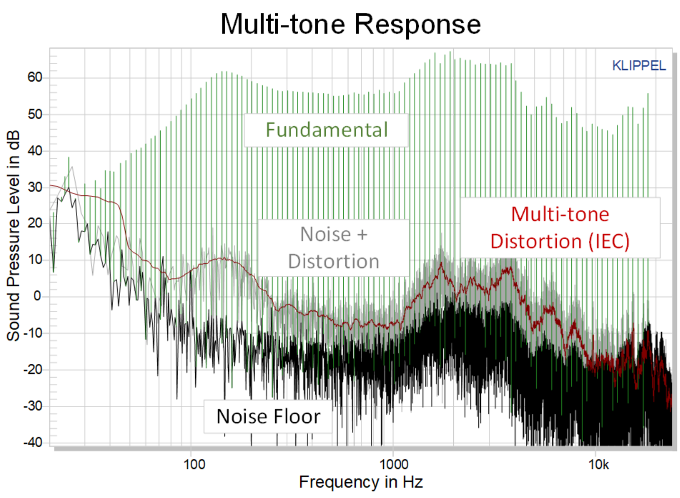
Document Revision 2.0

FEATURES

- Multi-tone fundamental and distortion measurements
- SPL Max and max. voltage according to IEC 60268-21 [1]
- Continuous Max. SPL related to ANSI/CEA-2010-B [2] and ANSI/CEA-2034 [3].
- Thermal compression
- Variable measurement and cooling time durations

BENEFITS

- Measurement of wireless, active and passive speakers
- Get acoustic “Fingerprint”
- Flexibility on stimulus and threshold setup
- Protection limits to avoid the DUT destruction
- Temperature protection



DESCRIPTION

The *MTON Multi-tone Measurement* is a Klippel RnD module which provides a complete measurement of the device under test (DUT) using a multi-tone stimulus. MTON module offers different measurement modes to provide a high flexibility of measurement procedures.

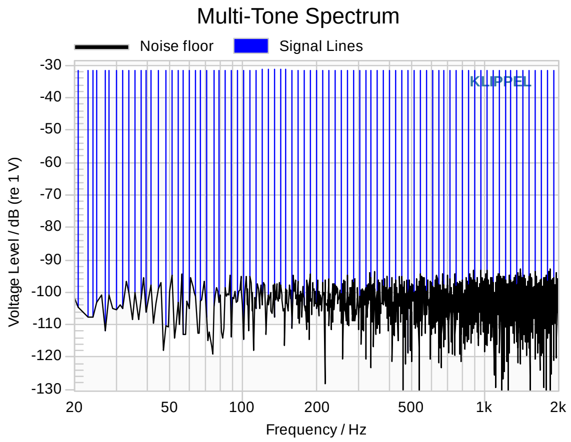
While the *Single Measurement* mode performs a single multi-tone measurement, the *Multiple Measurements* mode offers an automatic test sequence to obtain the operation limits of the DUT related to mechanical and thermal compression as well as multi-tone distortion.

This flexibility in the threshold and stimulus configuration allows the MTON module to pinpoint the SPL_{max} according to IEC 60268-21[1] as well as the continuous max SPL (ANSI/CEA-2010-B [2] and ANSI/CEA-2034 [3]) among other standard measurements.

Article number	1001-114

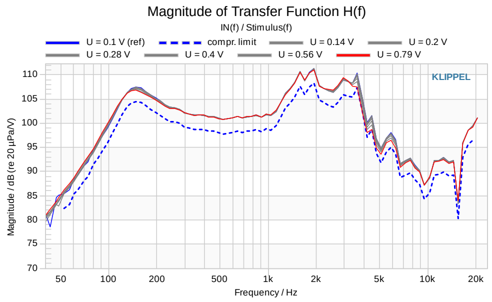
CONTENT

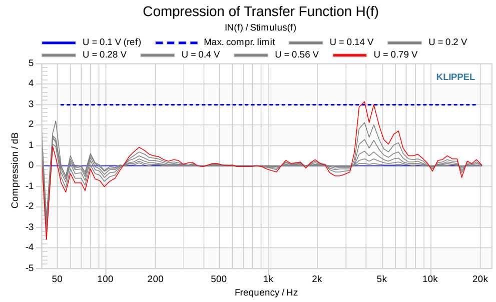
1 Overview

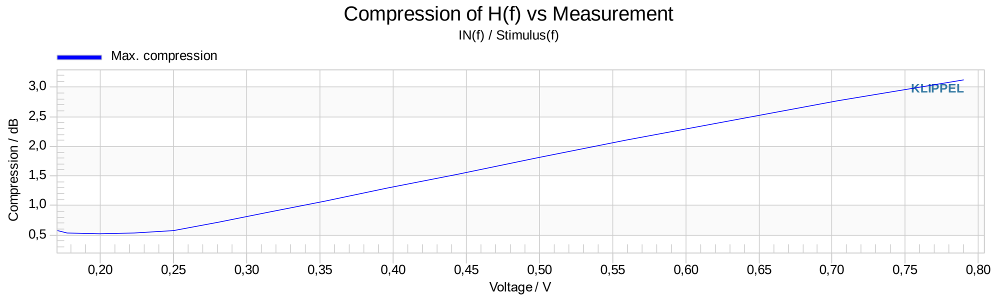
1.1 Principle	
Objective	The main objective of MTON module is to provide a complete and flexible measurement environment using a multi-tone stimulus. Single values as SPL, voltage at DUT terminals and maximum displacement of voice coil, as well as result curves as multi-tone distortion, transfer function and compression are calculated.
Excitation Signal	The stimulus used during the measurement is a sparse multi-tone complex spaced logarithmically on frequency. Frequency range, frequency resolution and stimulus shaping among other parameters may be specified by the user. The use of a sparse multi-tone complex signal to excite the system allows the separation and characterization of distortion, which can be used to define a threshold to avoid the device destruction. Moreover, the thermal compression suffered by the device under test can be calculated, since increase of temperature leads to increasing DC-resistance.  In addition, a dense multi-tone signal similar to white noise is provided by MTON. The available shaping curves offer the stimulus characteristics required for several standards as well as pink and white noise spectrum for both sparse and dense multi-tone signals.

2 Examples

2.1 Compression of transfer function

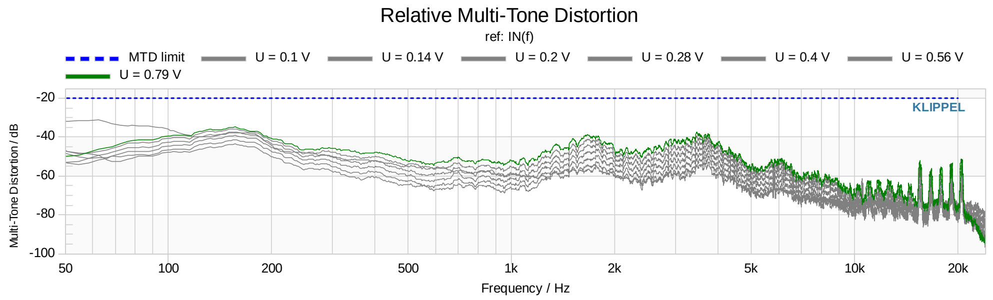


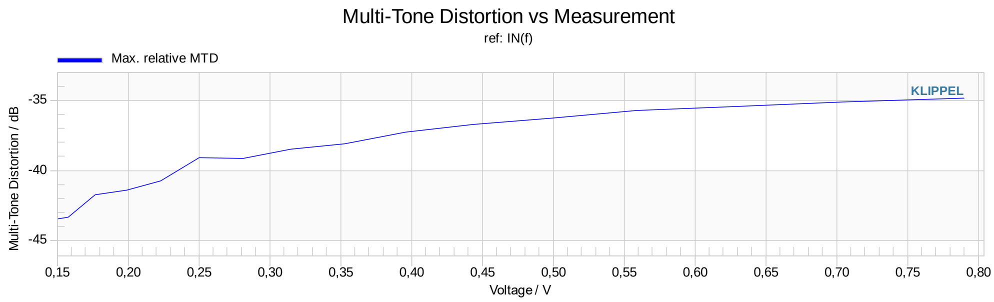




The compression is calculated from the measured transfer functions using the first measurement as reference. Measurement voltage increases automatically until the user defined compression threshold (in the example 3 dB) is reached. The results of last measurement are shown in red color to emphasize the threshold overcoming.

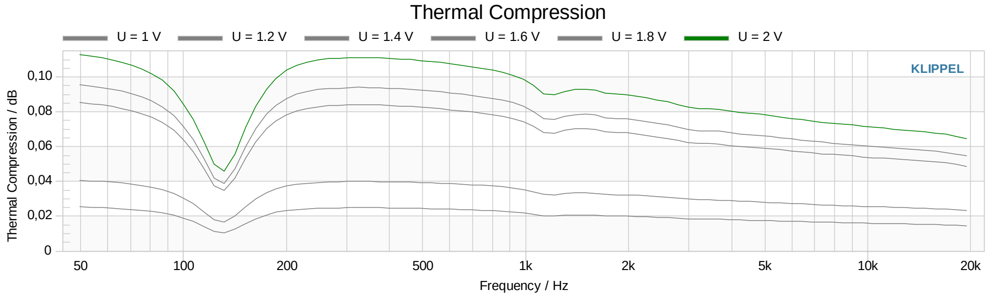
2.2 Multi-tone distortion

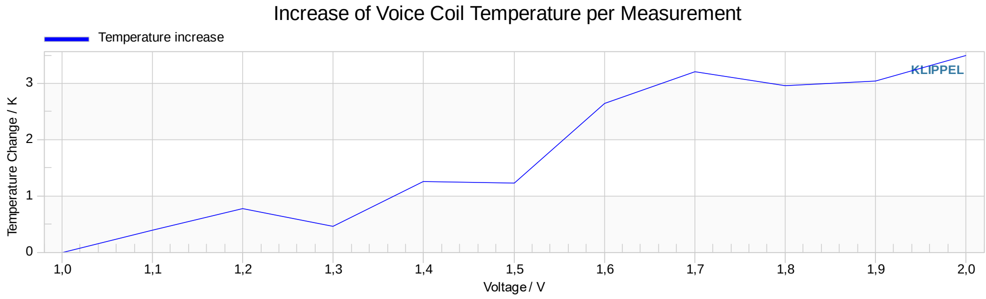




Multi-tone distortion curves are evaluated for the input signal selected by the user. Two different calculation methods can be selected to obtain the multi-tone distortion results: relative to SPL mean and absolute.

2.3 Thermal compression / Temperature increase





Thermal compression can be measured electrically if the Klippel Analyzer (KA3, DA) is connected to the speaker terminals. This measure provides a heating threshold based on the increase of voice coil temperature.

3 Requirements

3.1 Hardware			SPEC
Analyzer		The Distortion Analyzer or the Klippel Analyzer 3 are used as the hardware to perform the measurement.	H1, H3
Microphone	*[optional]* Free field microphone with omnidirectional directivity characteristic over the desired measurement bandwidth.		A4
Amplifier	*[optional]* KA3 Amp-Card or external audio amplifier with a flat frequency response over the desired measurement bandwidth		
Laser Displacement Sensor	*[optional]* A high precision laser displacement sensor may be used to capture the membrane movement.		A2
Computer	A personal computer is required for performing the measurement.		
3.2 Software			
dB-Lab	Project Management Software of the KLIPPEL R&D SYSTEM. Requires at least version 210.820.		

4 Input

Parameter	**Min**	**Typ**	**Max**	**Unit**
Stimulus				
Min Frequency	> 0	20	F max	Hz
Max Frequency	F min	18000	$0.4 \cdot f_{sample}$	
Relative Resolution	1	24	999	Points per octave
Shaping	• 1/3 Octave Bands (R10) • Continuous Shaping Curve • Not Used			
Time	0.02	1	5	s
Preloops	0	1		Stim. repetition
Averaging	1	1	256	Stim. repetition
Pause	0	0		s
Protection				
Max. Compression		3		dB
Multi-Tone Distortion Relative Limit		- 20		dB
Max. Increase of Voice Coil Temperature	> 0	60		K

5 Output

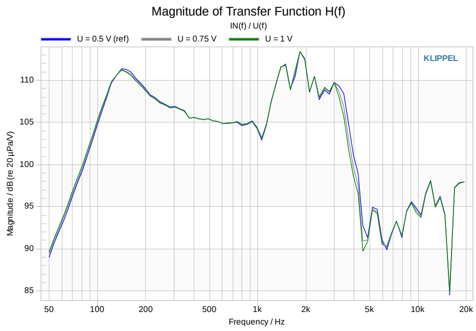
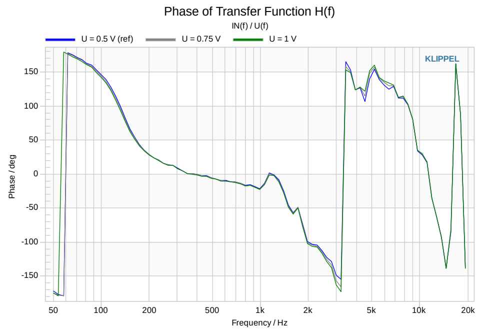
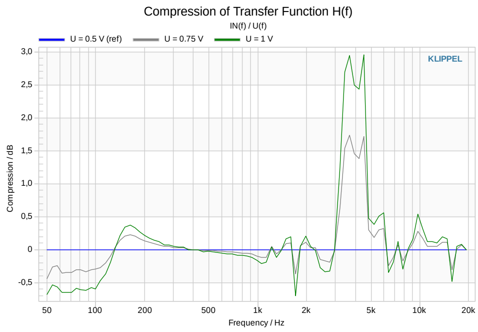
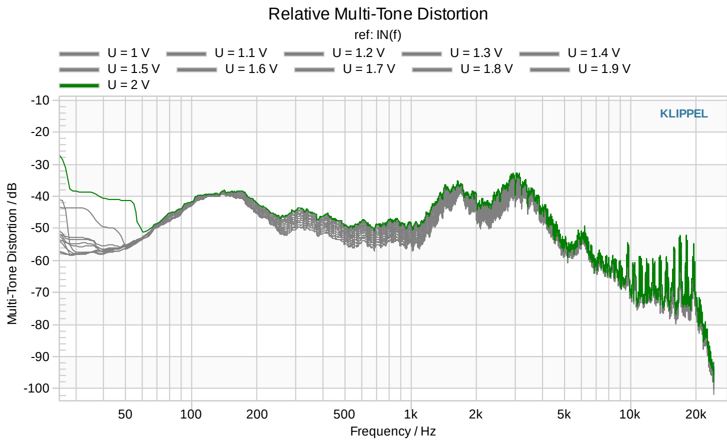
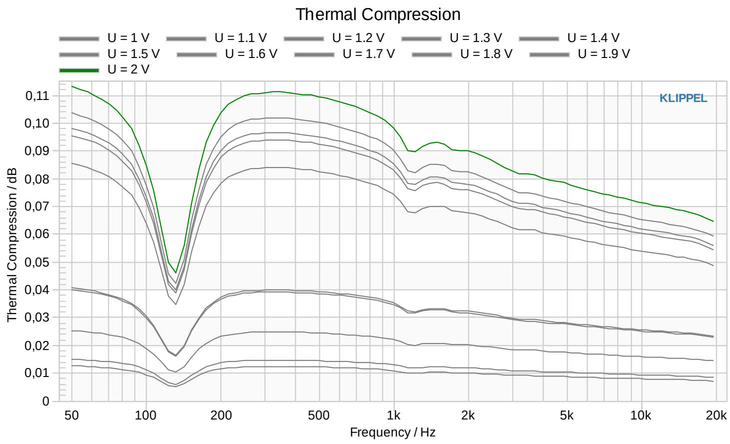
Summary	Shows warnings and errors produced during the process, data collection table of results and stimulus properties.

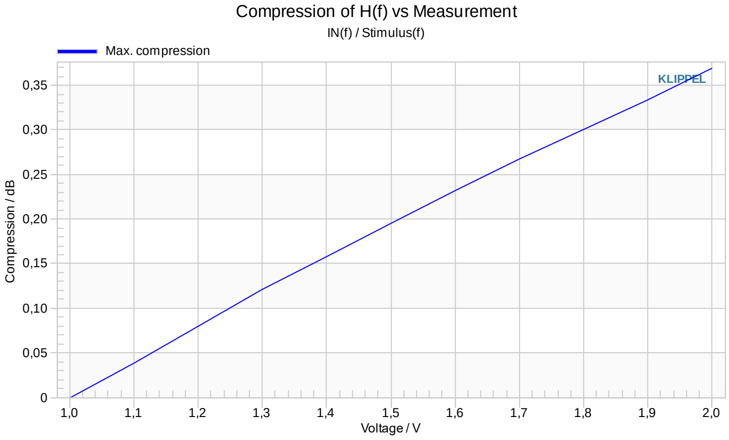
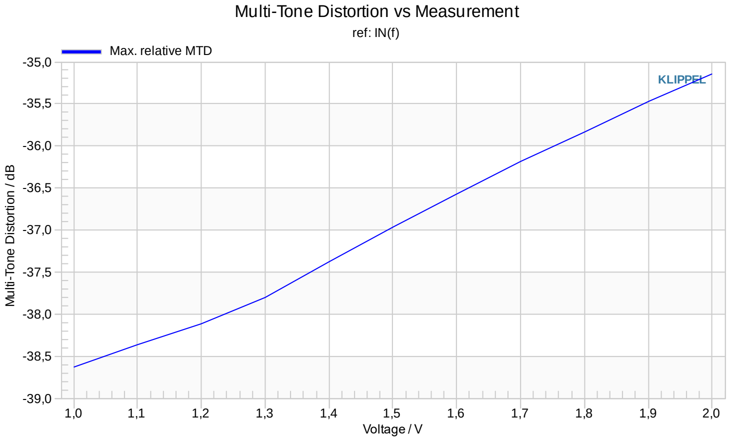
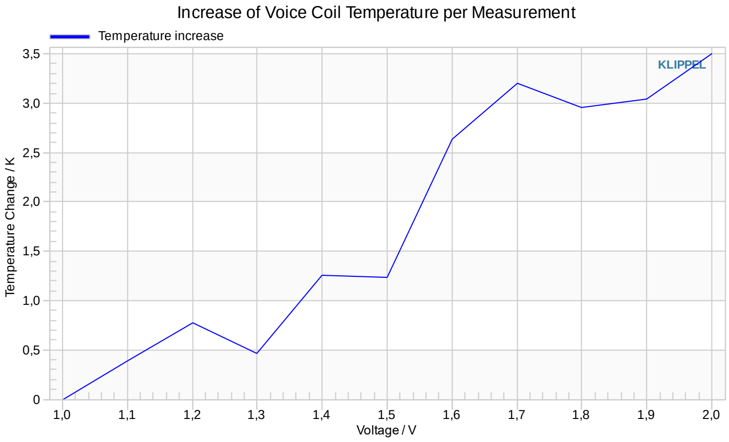
Results of last passed measurement

Parameter	Value	Unit	Description
U_{max}	2	V	Root mean square of stimulus.
SPL_{max}	109.05	dB	Sum level of fundamentals in microphone signal.
$\lvert x \rvert_{peak}$	0.73	mm	Absolute peak displacement.
ΔT	3.5	K	Temperature increase of voice coil.
C_{max}	0.37	dB	Max compression in the frequency range 200 - 1970 Hz.
MTD_{max}	-35.14	dB	Maximum multi-tone distortion of microphone signal relative to mean value.

Stimulus properties

Parameter	Value	Unit	Description
f_{min}	49.87	Hz	Lowest multi-tone frequency line
f_{max}	19401.26	Hz	Highest multi-tone frequency line
$f_{Re\ monit\ 1}$	1.99	Hz	Re monitoring frequency 1st pilot tone
$f_{Re\ monit\ 2}$	2.99	Hz	Re monitoring frequency 2nd pilot tone
t	1	s	Signal duration
K	3.04	-	Kurtosis
C	13.05	dB	Crest factor

H(f) Transfer Function Magnitude and Phase, C(f) Compression	Magnitude and phase of transfer function are displayed if activated. In multiple measurements mode, the compression of the transfer function measurements is calculated using the first measurement as reference. In addition, the compression limit is displayed if protection is activated.   
Multi-Tone Distortion	Graph showing multi-tone distortion curves measured. In addition, the multi-tone distortion curve is displayed if protection is activated. 
TC(f) Thermal Compression	Window showing the thermal compression measured, if resistance monitoring activated. 

Compression vs Measurement	Graph showing the maximum or mean compression of each individual measurement over the measurement voltages if transfer function is activated. 
Multi-Tone Distortion vs Measurement	Graph showing the multi-tone distortion peak of each individual measurement over the measurement voltages if multi-tone distortion calculation is activated. 
ΔT Temperature Increase	Graph showing the voice coil temperature increase of each individual measurement over the measurement voltages if resistance monitoring is activated. 

Sum Level Input

Chart showing the SPL value measured over the measurement voltages if microphone signal is captured.

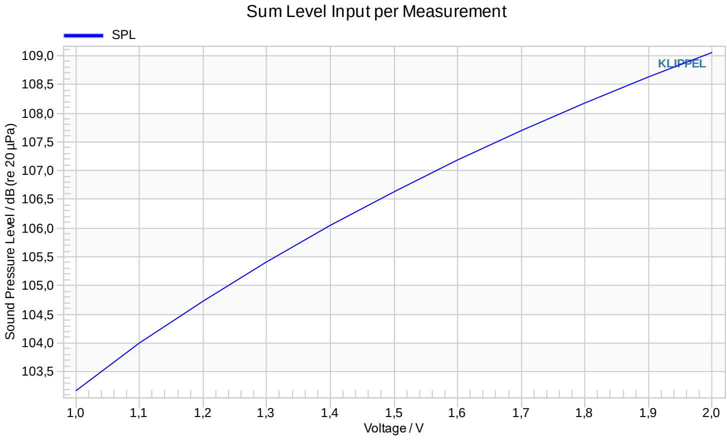


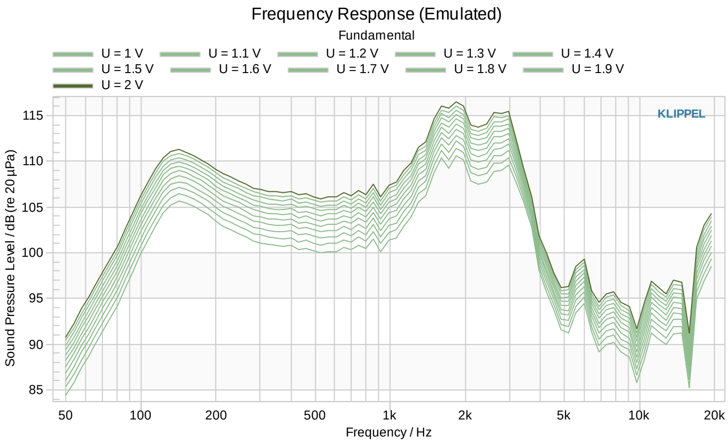
Table Detailed Results

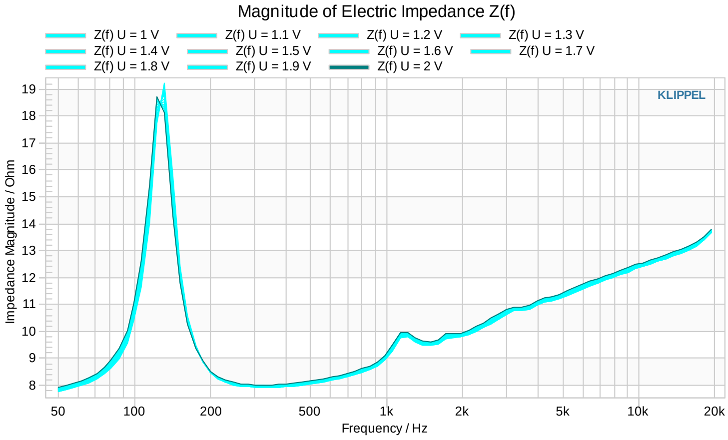
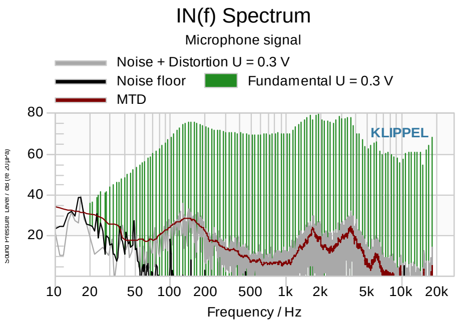
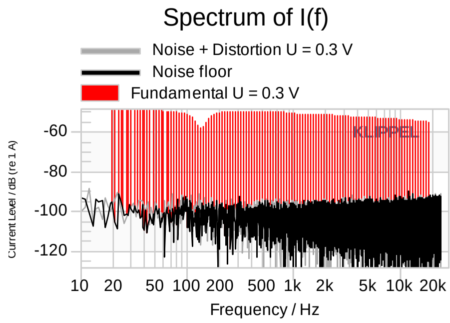
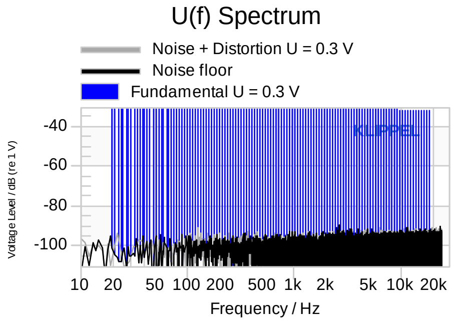
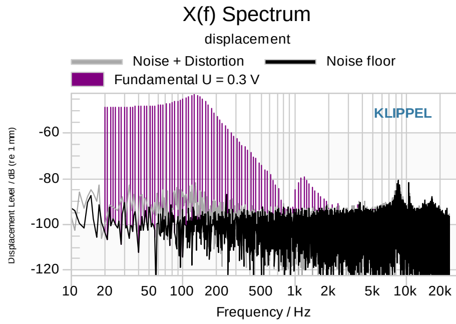
Collect result values of all measurements.

Meas.	U	SPL	$\lvert x \rvert_{peak}$	C_{max}	Abs. MTD_{max}	Rel. MTD_{max}	ΔT
11	2 V	109.05 dB	0.73 mm	0.37 dB	52.7 dB	-35.14 dB	3.5 K
10	1.9 V	108.63 dB	0.69 mm	0.33 dB	51.94 dB	-35.48 dB	3.04 K
9	1.8 V	108.17 dB	0.65 mm	0.3 dB	51.14 dB	-35.83 dB	2.96 K
8	1.7 V	107.69 dB	0.62 mm	0.27 dB	50.3 dB	-36.19 dB	3.21 K
7	1.6 V	107.18 dB	0.58 mm	0.23 dB	49.42 dB	-36.57 dB	2.64 K
6	1.5 V	106.63 dB	0.55 mm	0.2 dB	48.49 dB	-36.96 dB	1.23 K
5	1.4 V	106.05 dB	0.51 mm	0.16 dB	47.49 dB	-37.37 dB	1.25 K
4	1.3 V	105.41 dB	0.47 mm	0.12 dB	46.43 dB	-37.81 dB	0.46 K
3	1.2 V	104.73 dB	0.44 mm	0.08 dB	45.45 dB	-38.12 dB	0.78 K
2	1.1 V	103.99 dB	0.4 mm	0.04 dB	44.46 dB	-38.37 dB	0.39 K
1	1 V	103.17 dB	0.36 mm	0 dB	43.39 dB	-38.64 dB	0 K

Frequency Response (Emulated)

Frequency response emulated from microphone signal is displayed.



Z(f) Impedance Magnitude	Magnitude of electric impedance calculated from voltage and current measurements at terminals. 
IN(f), I(f), U(f), X(f) Spectrum	Measured signals in frequency domain. Only visible if input is activated. In addition, noise + distortion and noise floor of last measurements are displayed.    

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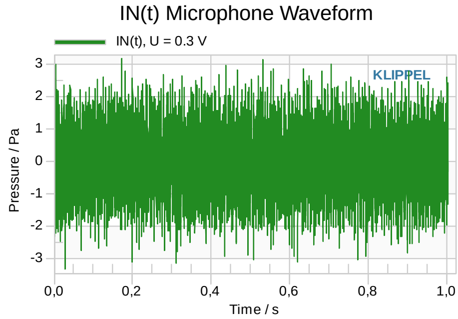
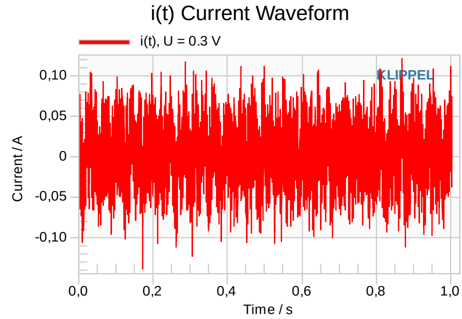
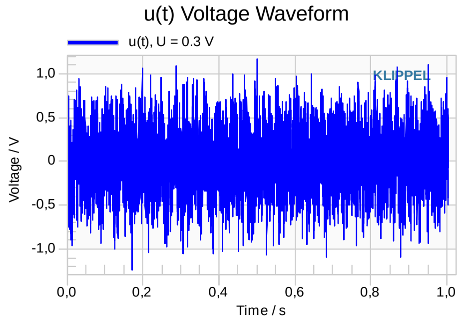
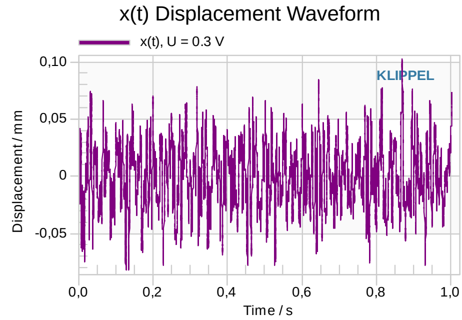
<td>IN(f), I(t), U(t), X(t) Waveform</td>
<td>Measured signals in time domain. Only visible if input is activated.









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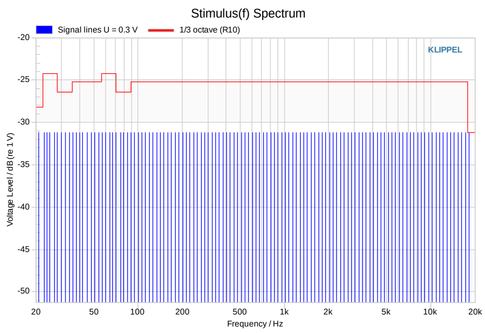
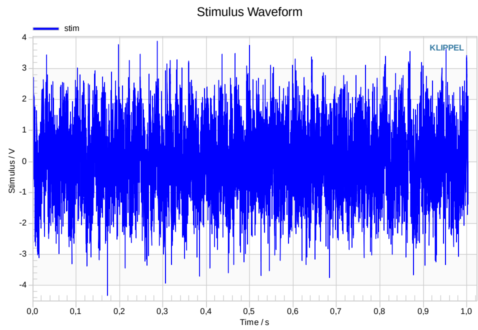
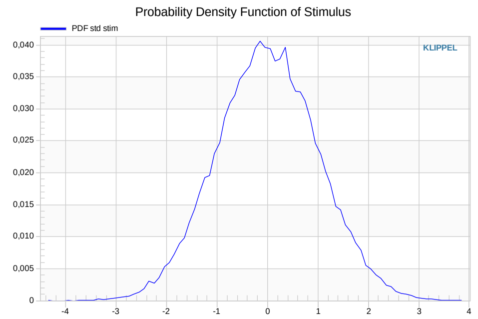
<tr>
<td>Stimulus Spectrum, waveform and PDF</td>
<td>Stimulus spectrum displayed as signal lines and 1/3 octave bands (R10), stimulus in time domain and probability density function of stimulus.







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6 References

6.1 Related Modules	Multi-Tone Distortion Task (MTD) Live Audio Analyzer (LAA) Distortion Measurement (DIS) Transfer function measurement (TRF) Tone Burst Measurement (TBM) In-Situ Room Compensation (ISC)
6.2 Manuals	Multi-Tone Measurement User Manual
6.3 Standards	[1] IEC 60268-21: "Sound system equipment – Part21: Acoustical (output-based) measurements", 2018, International Electrotechnical Commission [2] ANSI/CEA-2010-B: "Standard Method of Measurement for Subwoofers", 2014, Consumer Electronics Association [3] ANSI/CEA-2034: "Standard Method of Measurement for In-Home Loud-speakers", 2013, Consumer Electronics Association
6.4 Publications	A. Taylor, "Mastering Wireless Multi-Tone Testing" W. Klippel: Physical and Perceptual Evaluation of Electric Guitar Loudspeakers Voishvillo, et. al. , "Graphing, Interpretation, and Comparison of Results of Loud-speaker Nonlinear Distortion Measurements," J. Audio Eng. Society 52, No. 4 pp. 332-357 (Apr. 2004)
6.5 Application Notes	AN16 Multi-tone Distortion Measurement AN46 Test Enclosure for QC

Find explanations for symbols at:

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

Last updated: 2020-06-10