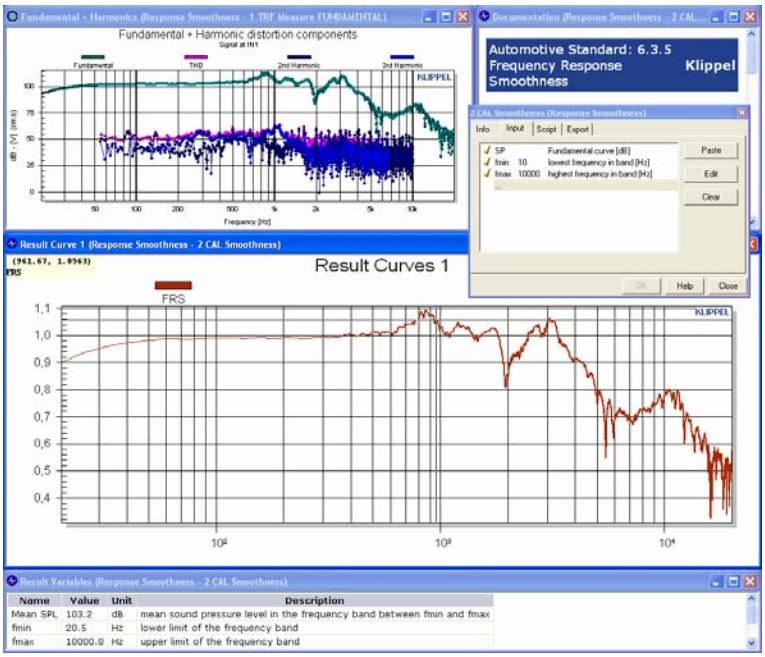
Frequency Response Smoothness **AN 40**

Application Note to the KLIPPEL R&D SYSTEM

The frequency response smoothness describes the variation in the amplitude response of a loudspeaker by normalizing the measured response to the mean sound pressure level is a stated frequency band.

This Application Note is a step by step introduction for a fast calculation of the Frequency Response Smoothness with the appropriate Klippel Template.



CONTENTS:

Definition

Mean sound pressure level

$$p_r = \sqrt{\sum_{i=1}^{n} \frac{p_i^2}{n}}$$

$$\overline{L_p} = 20 \log \frac{p_r}{20\,\mu\text{Pa}}\,\text{dB}$$

The calculation of the mean sound pressure level is defined according to IEC standard 60258-5 in paragraph 20.6 [1] as the Root Mean Square values of equal logarithmical frequency bands. (p_i is the sound pressure in a definite 1/k octave band)

The mean sound pressure level will be calculated afterwards from the mean sound pressure.

Frequency Response Smoothness

$$d_{FRS}(f) = \frac{L_p(f)}{\overline{L_p}}$$

The frequency response smoothness is defined as the frequency response (L_p) referred to the mean sound pressure level $\overline{L_p}$ in a stated frequency band.

KLIPPEL

Klippel GmbH
Mendelssohnallee 30
01309 Dresden, Germany

www.klippel.de
info@klippel.de

TEL: +49-351-251 35 35
FAX: +49-351-251 34 31

Requirements

Start Up

To measure and calculate the Effective Frequency Range the following equipment is required:

- Install the RnD Analysis Software on your computer
- Create a new object and select the *Response Smoothness* to start the analysis
- Enter the sensitivity of the microphone in property page *Input* for the *TRF Measure FUNDAMENTAL* or use a pistonphone to calibrate the microphone.

Procedure

TRF Measurement

Motivation: We start with a simple sinusoidal sweep measurement to gain the Transfer Function of the Loudspeaker.

How to do it: Adjust the measurement microphone normal to the driver as preferred and select the *TRF Measure FUNDAMENTAL* operation. In *Properties* → *Stimulus* set F_{min} to a lower and F_{max} to a higher value than the boundary frequencies of the required working range and modify the voltage if necessary.

Run the measurement.

Select the curve "*Fundamental*" from the window *Fundamental + Harmonic distortion components* and copy it to the clipboard.

Motivation: The frequency response smoothness can easily be calculated by the *CAL Smoothness* operation.

How to do it: Select *SP* in *Properties* → *Input* and paste the Fundamental curve from Clipboard.

Enter your frequency bounds fmin and fmax which determines the averaging band as preferred. Usually they should correspond with the bounds of the required working range of the loudspeaker.

Results

After running the script the result curve window will appear showing the frequency response smoothness according to the standard is absolute value which allows you to evaluate the balance characteristic. At a mean SPL of 100dB a smoothness curve between 0.94 and 1.03 corresponds with variation of the SPL curve by 6dB.

The window *Result Variables* displays the Mean SPL according to IEC 20.6 in the frequency band between **fmin** and **fmax**. These bounds usually resemble your entered parameters, but might deviate if they exceeded the bounds of the fundamental curve.

More Information

Standard

[1] IEC Standard 60268 Sound System Equipment – Part 5 Loudspeakers, 20.6 Mean sound-pressure level in a stated frequency band

KLIPPEL
Klippel GmbH
Mendelssohnallee 30
01309 Dresden, Germany
www.klippel.de
info@klippel.de
TEL: +49-351-251 35 35
FAX: +49-351-251 34 31