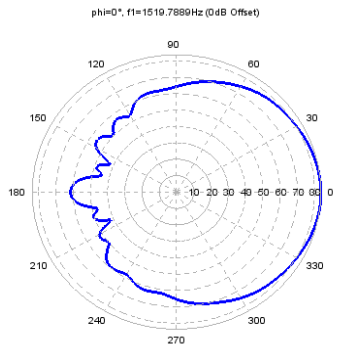
Polar Far-Field Measurements (POL) S41

Software of the KLIPPEL R&D and QC SYSTEM (Document Revision 1.7)

FEATURES

- Automated measurements
- One / two turntable applications
- Generate Polar / Balloon data
- CEA 2034 Spinorama
- Open export interface
- Fast measurement
- Interface to various turntable hardware
- Microphone Multiplexing



DESCRIPTION

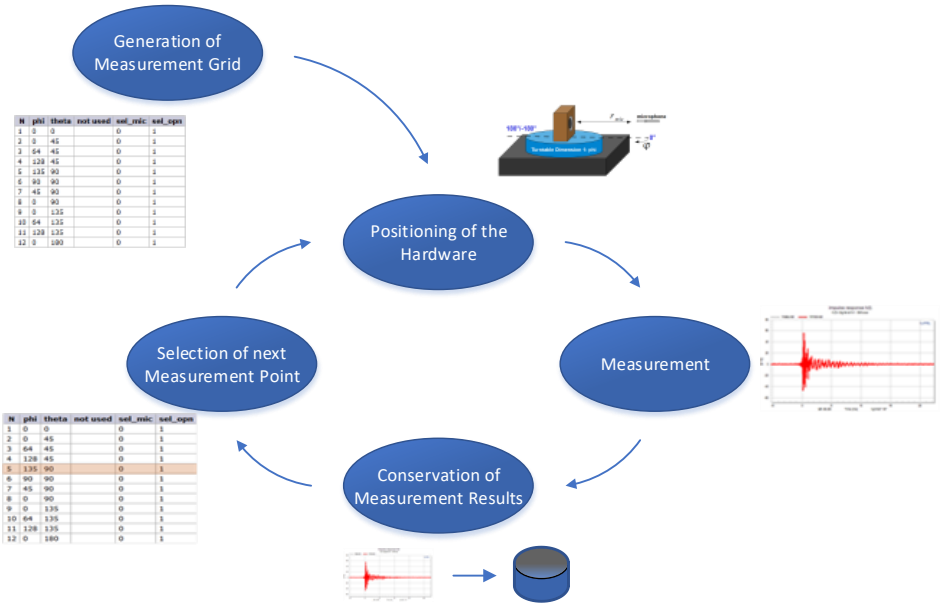
The POL Module offers a fully automated measurement process of polar measurement applications. Classic measurements like directivity characteristic of sound sources and microphones can be realized, as well as the directivity measurement of other parameters (e.g. distortion components). Interfacing to industry standard turntables the POL Module offers a flexible solution for standard measurements. Measurement results are stored in a Klippel database, or exported to an open, VACS compatible data format.

Article number	1001-103

CONTENT

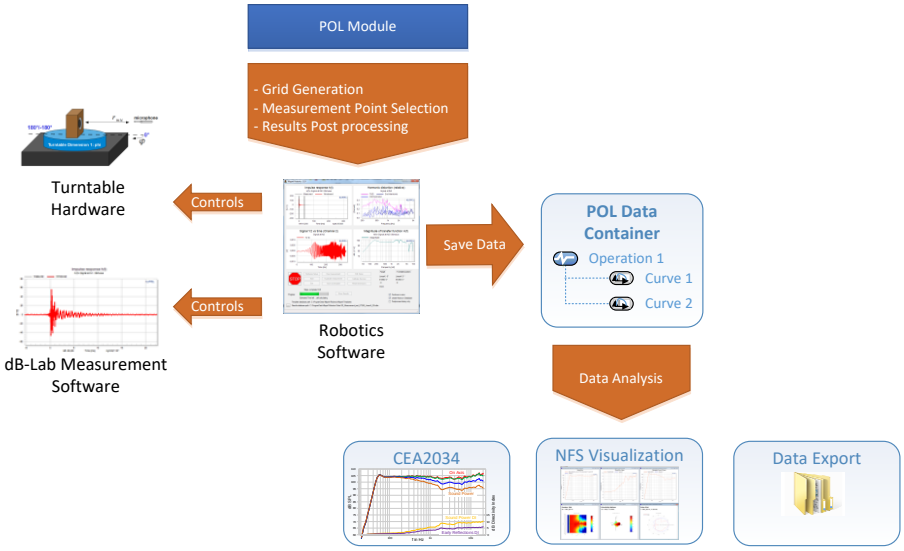
1 Principle

Measurement Process



The POL Module follows the basic principle of a Process master, controlling the positioning hardware as well as the acoustic measurement system.
After a measurement grid is generated according to the setup parameters, the measurement cycle is started. It automatically positions the hardware, starts the measurement and selects the next measurement coordinates after the results are processed and stored.

Software Structure



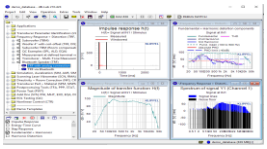
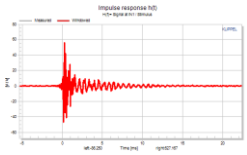
The POL module is a script to control the Robotics Software. It generates the measurement grid and defines which measurements are operated at each point. Once a measurement is done, the POL module defines the post processing, applied to this data.

2 Components of POL Module

2.1 POL Module

Robotics Software	Basis Software for Control of Turntables and Measurement Software	
POL Software	Measurement Script for conducting polar measurement.	

2.2 Additional Components required

			Spec#
dB-Lab (>210)		Project Management Software of the KLIPPEL R&D SYSTEM	F1
Klippel Analyzer DA2 or KA3		The Klippel Analyzer 3 (KA3) and Distortion Analyzer 2 (DA2) are the hardware platforms for the measurement modules performing the generation, acquisition and digital signal processing in real time	H1
Microphone		IEPE or Phantom powered Microphones are supported	A4
TRF – Module		The Transfer function (TRF) is a dedicated PC software module for measurement of the transfer behaviour of a loudspeaker.	S7
Turntable		Different turntables are supported, to be used as actuator. Recommended Devices are: • LinearX LT360EX • Outline ET250-3D • Head Acoustics HRT I • Klippel Scanner turntable • Klippel Axis Control	-
Multiplexer (optional)		Instead of rotating the loudspeaker, directivity can be measured automatically using a microphone array in combination with a multiplexer.	A8

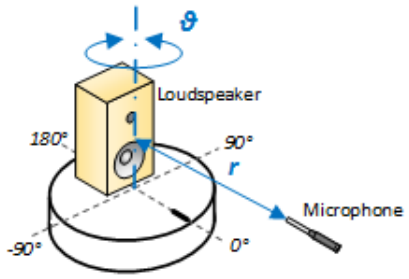
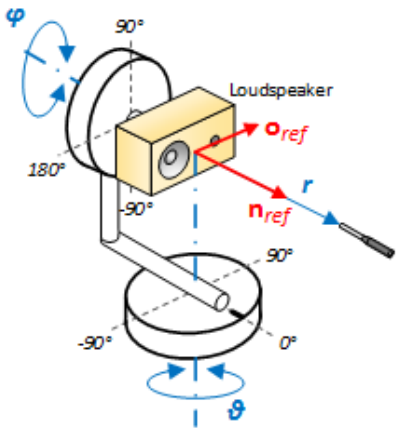
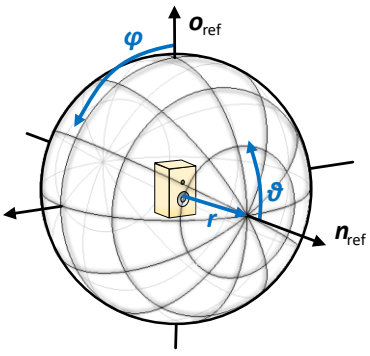
3 Details

3.1 Supported Hardware

In general, hardware supported by the Klippel Robotics Software is supported by the POL Module. However, some hardware is more or less useful due to various restrictions.
Please read specification of the specific turntable for detailed hardware requirements.

Klippel SCN Hardware	The Klippel Scanner hardware is supported. As it consists of one turntable and two linear actuators, it is only useful for polar measurements with one turntable.
Klippel Axis Control Kit	The Klippel Axis Control Kit is a modular set consisting of Motor, Controller and all auxiliary devices for an easy setup and operation of any custom build turntable solution.
LinearX LT360	Due to the serial connection the interface between PC and Turntable is robust and easy to install. A USB-Serial converter is needed, if your PC does not offer a serial port.
Head Acoustics HRT I	The HRT I turntable is connected with the PC via a serial connection.
Outline ET250-3D	The ET250-3D turntable offers a network interface. This opens appealing option to cover long distances between Measurement and controlling PC.

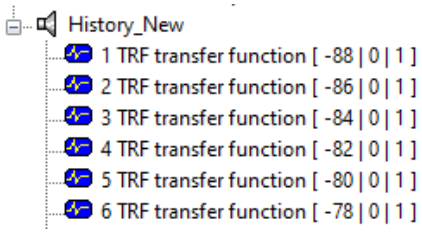
3.2 Grid options

1D – Polar Grid		The basic application is the one-dimensional polar Measurement. It requires no more than the min/max angle and the resolution. From this information the Array of measurement points is generated.
2D – Balloon Grid		For two dimensional measurements, the program expects the turntables positioned as shown in the picture. A horizontal turntable is positions the theta angle. Mounted on top, a second turntable positions the phi angle. A polar Coordinate system pointing its pole to the reference axis of the system is recommended 

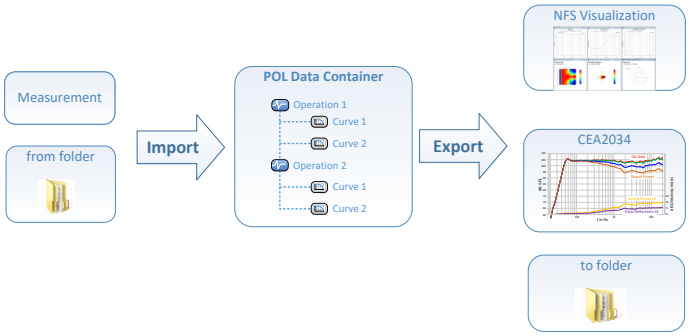
4 Results

4.1 Measurement Database

The measurement result of each point can be stored in the database. Each operation can be identified by the point number and the measurement coordinates.
This provides a detailed investigation of all measurement data, after a measurement is finished.
Also data can be extracted or reprocessed from the measurement databases.



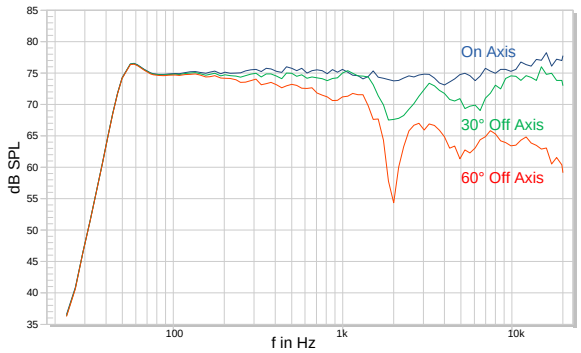
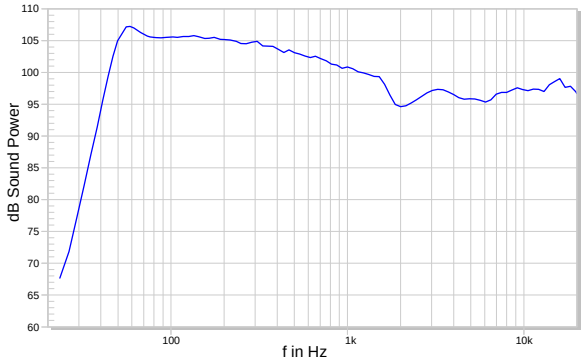
4.2 Data Container

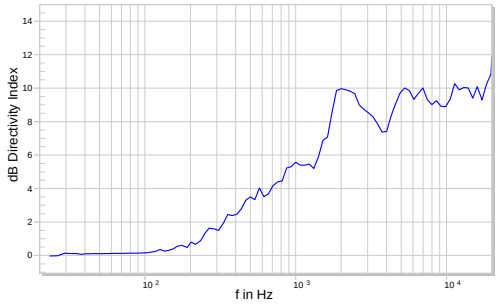


After finishing the measurement all data is stored in a data container in database. This container provides an open export interface for further analysis of the results.
For Example:

- Analysis with Visualization Software
- Generation of CEA2034 - Spinorama
- Export to external Software (VACS)

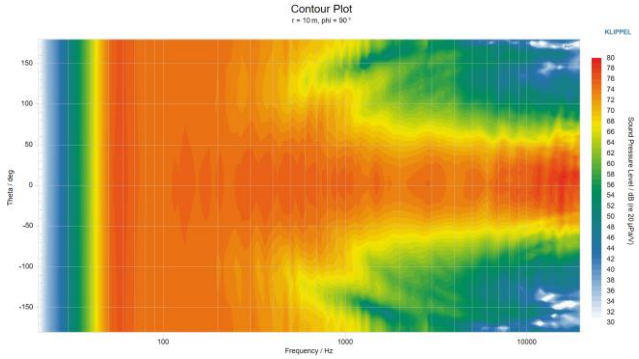
4.3 Visualization

SPL RESPONSE	Frequency behavior of all measured points (e.g. On-Axis) can be analyzed in the SPL Response window. 
SOUND POWER	By integrating the squared sound pressure over the radiated surface the total sound power output of the device is calculated. 
DIRECTIVITY INDEX	The directivity index shows the relation of the On-Axis response compared to the sound power output. For example, an omnidirectional source has directivity index of 0.

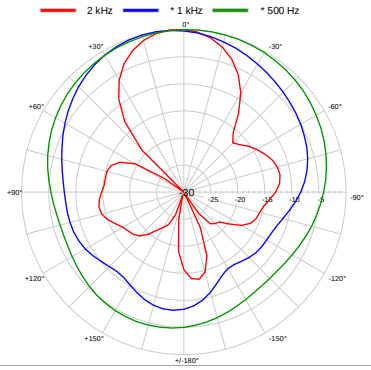


CONTOUR PLOT

The plot provides a directivity analysis over the whole frequency band. It shows very clear how the directivity changes over frequency and at which Frequency the first side lobes appear.

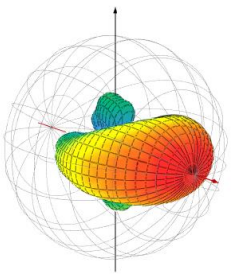


POLAR PLOT



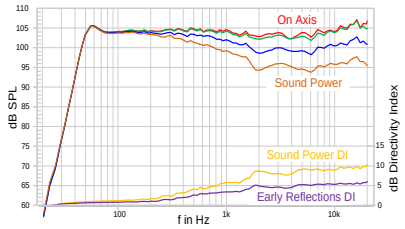
The polar plot visualized the radiation behavior over the polar angle theta for a single frequency.

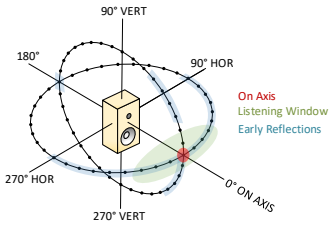
DIRECTIVITY BALLOON



Performing a 2 dimensional polar measurement the 3D radiation characteristic over both angles theta and phi is visualized by the balloon plot.

4.4 CEA2034 – Characteristics

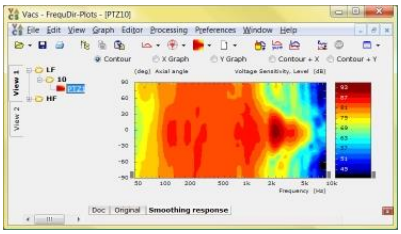




This module calculates the outputs curves in the standard reporting format, specified by the CEA 2034 standard. [3]

4.5 Output Interface (VACS)

To view the measured data as a polar plot, the interface to external programs is provided.
Output data for VACS is generated in the same disk location as the database.
For each point, an export file is generated, exporting frequency data and relevant header information for the specific measurement point. This data is easily imported into VACS or similar programs, to visualize the data.
Please see further information about VACS at [2]



VACS data format example:

```
Param_Coord_x1=1;
Param_Coord_x2=0;
Param_Coord_x3=0;
Param_Coord_Type='Spherical';
Scaling_Phase_t= .0027083;
Data_Format='LeveldB_Phase';
Data_Domain='Frequency';
Data_LevelType='SoundPressure';
Data_AbscUnit='Hz';
Data_BaseUnit='';
Curve=[
199.218750 99.751595 0.000000
210.937500 99.952965 0.000000
222.656250 99.845772 0.000000
...
4980.468750 58.437752 0.000000
4992.187500 55.589455 0.000000
];
```

5 References

[1]. Fourier Acoustics: Sound Radiation and Nearfield Acoustical Holography, Earl G. Williams

[2]. VACS - Visualizing Acoustics Software http://www.randteam.de/VACS/Index.html

[3]. CEA-2034: *Standard Method of Measurement for In-Home Loudspeakers*, 2013 Consumer Electronics Association

Find explanations for symbols at:
http://www.klippel.de/know-how/literature.html
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