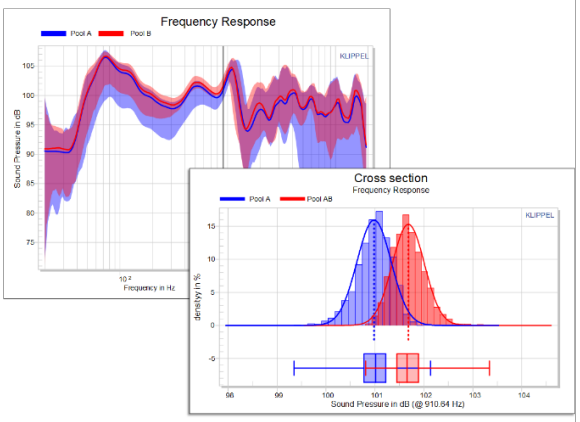
STAT Statistics S48

Module of the KLIPPEL ANALYZER SYSTEM (QC Ver. 7, dB-Lab Ver. 212)

Document Revision 2.3

FEATURES

- Statistics for Klippel RnD and QC data
- Visualization of variances
- Cross section view of curve data
- Pool-based test object organization
- Manual or automatic assignment to pools
- Limit calculation + export
- Optional: Automatic Defect Classification ADC (not yet available)



BENEFITS

- Visualize curve and scalar data statistics
- Compare individual test objects
- Compare batch differences or design choices
- Define limits intuitively by point-and-click
- Sort test objects in pools by limit-thresholds
- Identify the needle in the haystack
- Create regular statistic reports
- Find and identify golden units

DESCRIPTION

The statistics module (STAT) reads Klippel curve and scalar results and displays the data statistics in charts and tables. Test objects are organized in pools to visualize the statistics of all measures depending their grouping. Pool may be assigned manually, semi-automatically (by limit thresholds) or automatically (optional plugin ADC).

The measure data of all active pools is displayed in a common chart for direct comparison. The visualization may be normalized to a reference in order to show the absolute or relative variation.

Limits may be calculated by definition (e.g. 6 dB shift definition) or interactively via point & click. The feedback loop to Klippel QC is closed through exporting the limits in a compatible format.

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1 Overview

1.1 Introduction

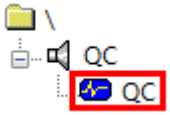
The STAT module is a sophisticated statistics tool dedicated to measurement data of the KLIPPEL Analyzer System. All curve and single value data may be processed for statistical analysis.

The measurement data of several test objects is assumed to be alike, with respect to active measures, measurement conditions and data organization.

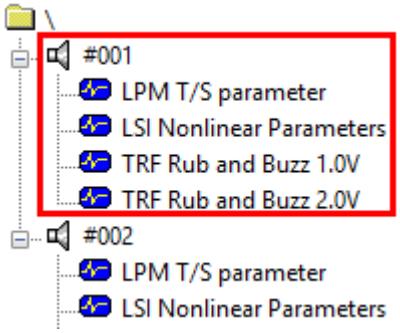
In the statistic the test objects are organized in pools (e.g. “good”, “bad”, “borderline”). The measures of the test objects are strictly connected to the test objects – when a test object is assigned to a pool, all measures of this test object are displayed in the style of the pool.

The definition what a “test object” is depends on the data organization. A test object may be one of the followings:

- A single operation in a KLIPPEL database



- A driver object in a KLIPPEL database



- A complete KLIPPEL database

1.2 Principle

The measurement data is extracted from Klippel databases and imported to the STAT operation. This extraction requires *db extract* version 3.

The setup of the extraction and the statistical calculations are all defined and stored in the STAT operation.

2 Requirements

2.1 License

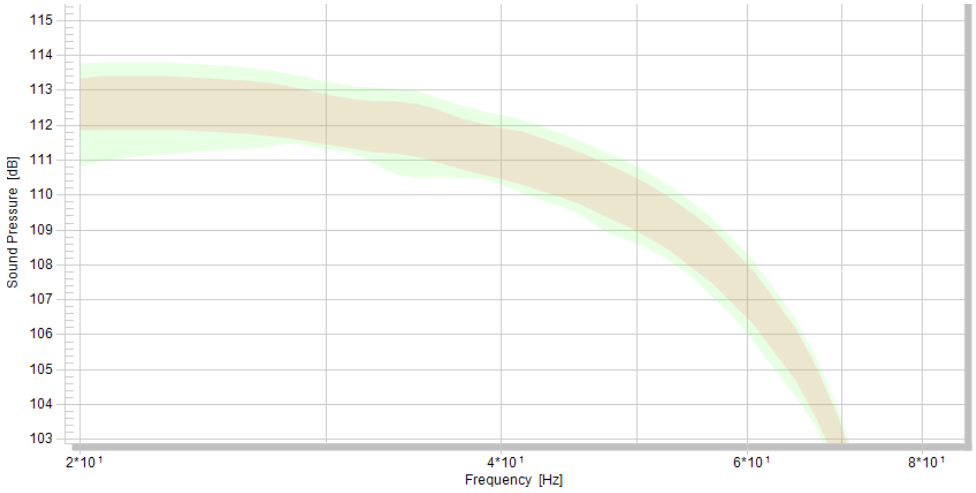
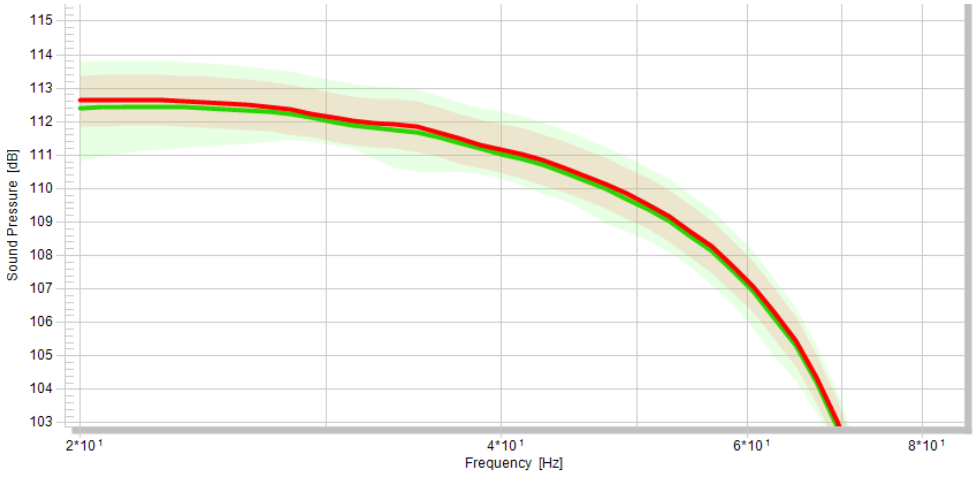
License Device	A Klippel license dongle or *Klippel Analyzer 3* is required to issue the license for the *STAT*.

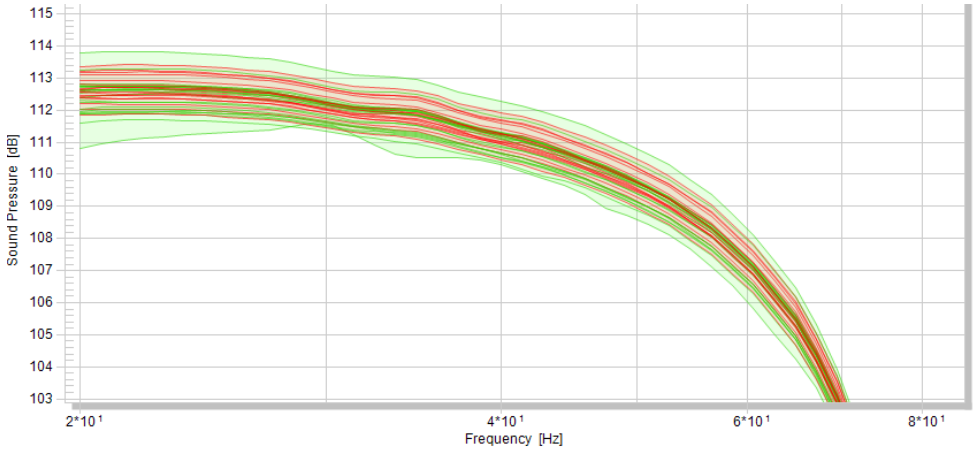
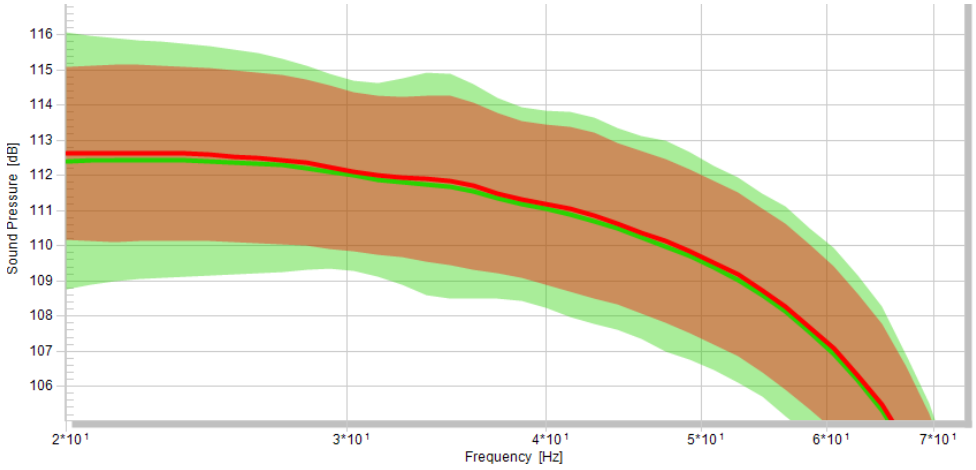
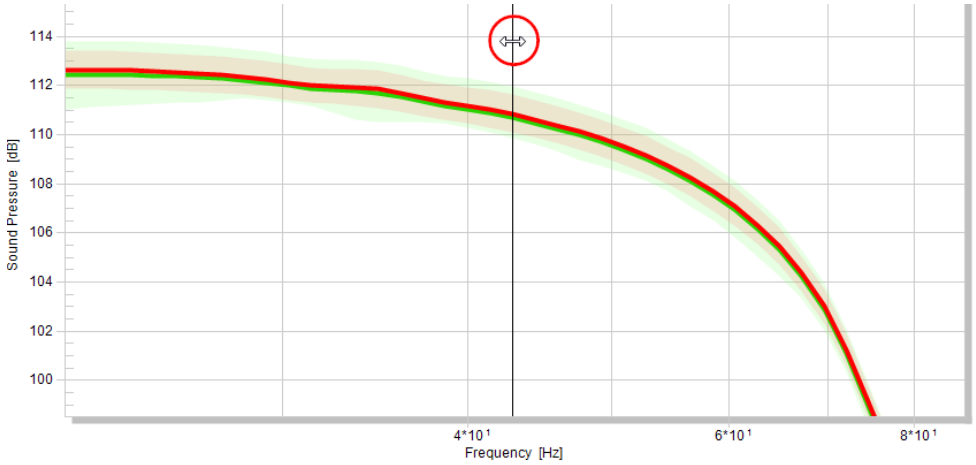
2.2 Software

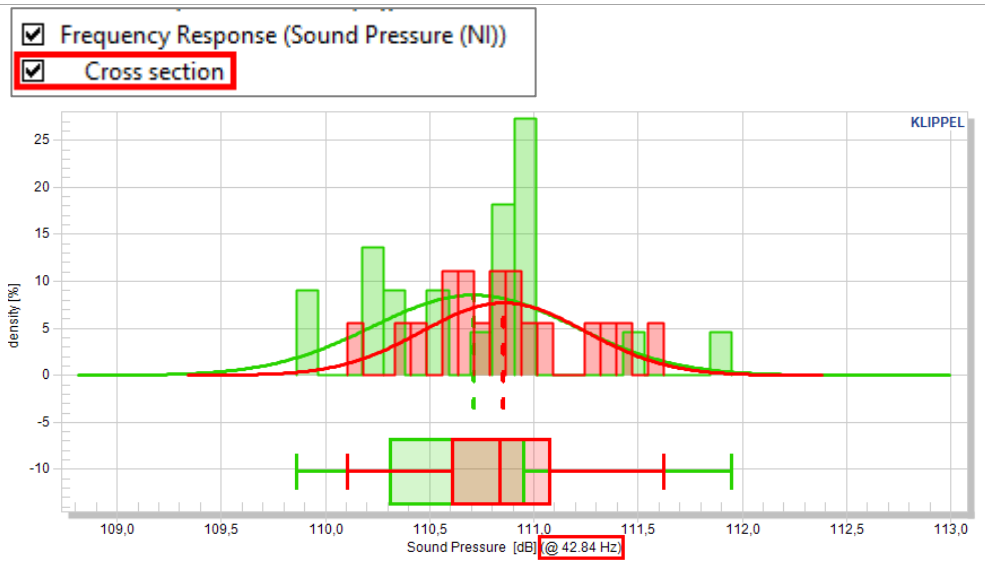
	• Klippel RnD v210 or Klippel QC v6 • Klippel *db extract* v3.x

3 Statistical Results

3.1 Curve Measures

Minimum Maximum	The minimum and maximum of the measurement data is displayed for every pool. If both, maximum and minimum are active, the area between is displayed to illustrate the actual spread of each pool. 
Mean	The mean curve represents the average curve of each pool for each measure. The calculation is performed independent of the measure's unit (e.g. dB, Ohm), hence the mean represents the "optical" mean, not necessarily the physical mean – for example: the mean calculated from frequency responses dB does not represent the physical average level, but the average curve in the dB scale. 

Base Data	The curves of the measurement data for all test objects can be visualized with this option. This enables the user to identify a test object (e.g. serial number) by clicking on a curve. It is not recommended to enable this feature if more than approximately 200 curves are displayed. The limit depends the system performance and the number of data points of each curve. 
Standard Deviation	This option displays the factorized standard deviation (e.g. 6σ) around the mean curve.  The factor may vary over the abscissa. This feature assumes a normal distribution of the measurement data.
Cross Section	This feature activates a movable cursor in the chart. At the cursor's position, the cross section of the data is displayed in an additional chart. This cross section chart features all functionalities of a single value result. 

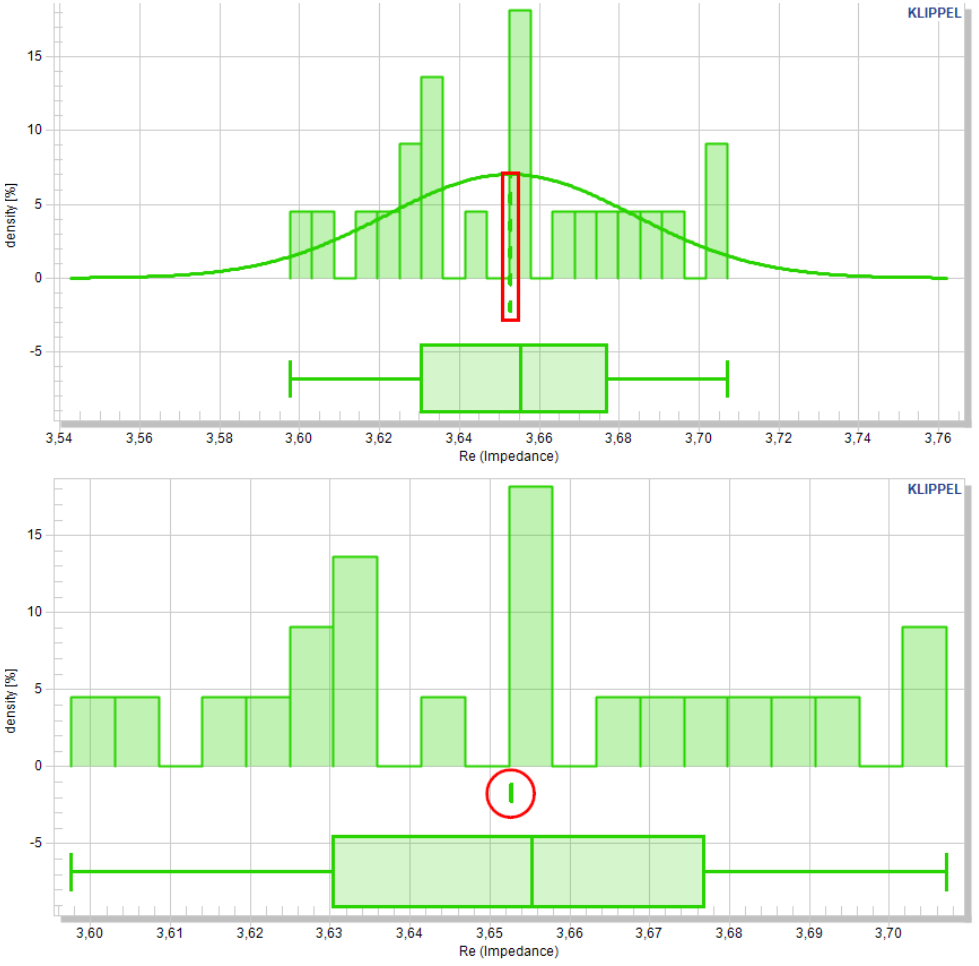


Since the cross section can be seen as a single value, all features reserved for single value data apply for the cross section.

3.2 Single Value Results

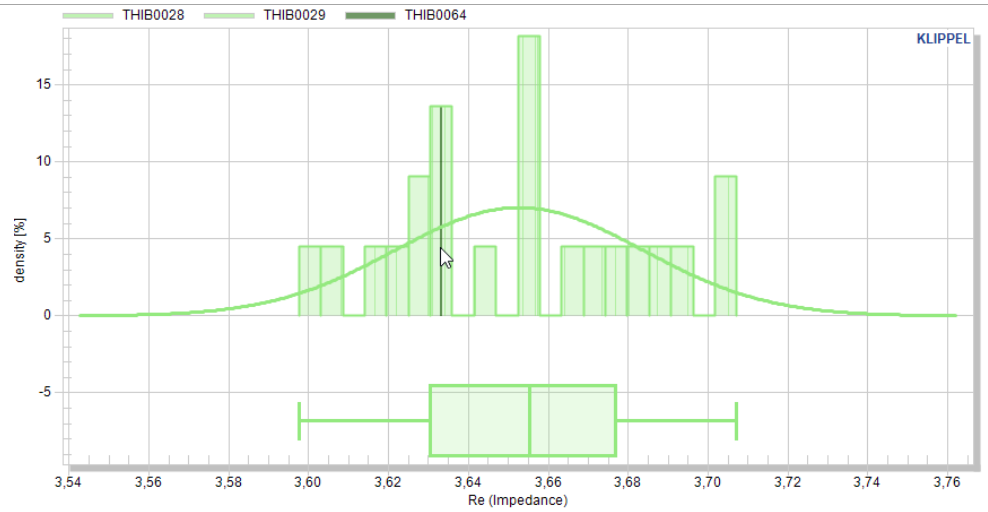
Mean

The mean value of the measurement data. If the normal distribution is active, the mean value is illustrated up to the top of the normal distribution. Otherwise it is shown below the zero axis.



Base Data

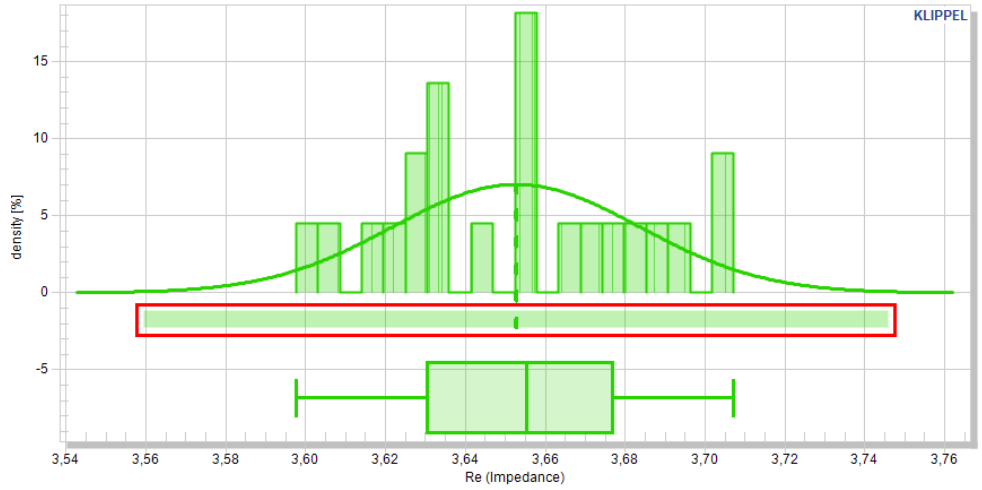
This option displays the individual measurement data of all test objects to provide point & click identification of the serial number.



If the histogram is active, the height of the individual data corresponds with the histogram bar. If the histogram is not active but the normal distribution is active, the height corresponds to the maximum of the normal distribution curve. If the normal distribution is also deactivated, the height corresponds to 100% or 1.

Standard Deviation

The factorized standard deviation may be displayed.



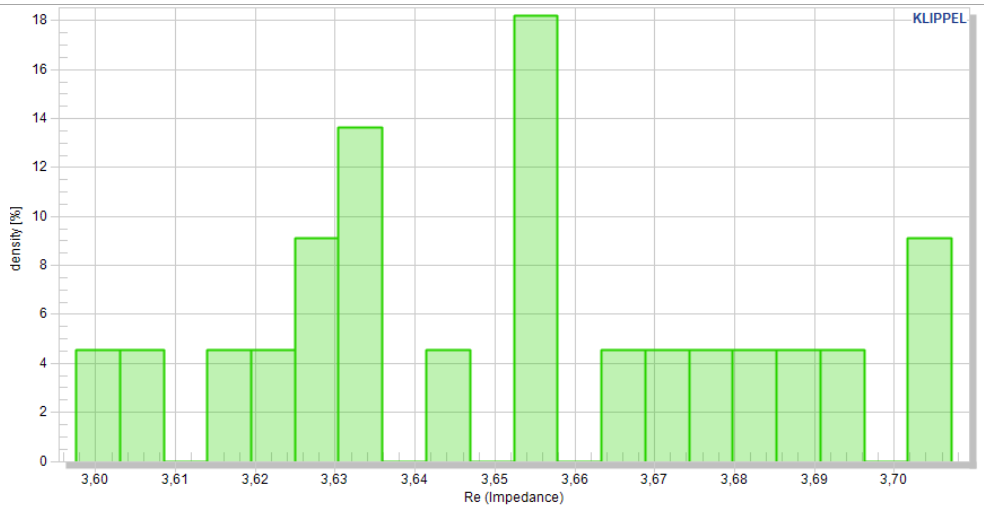
This feature assumes a normal distribution of the measurement data.

Histogram

The bar representation of the histogram can be activated with this option. The type may either be

- “absolute count” (the height of a bar represents the number of test objects in a bar) or
- “density” (the height of the bars is displayed relatively to the actual number of test objects in a pool).

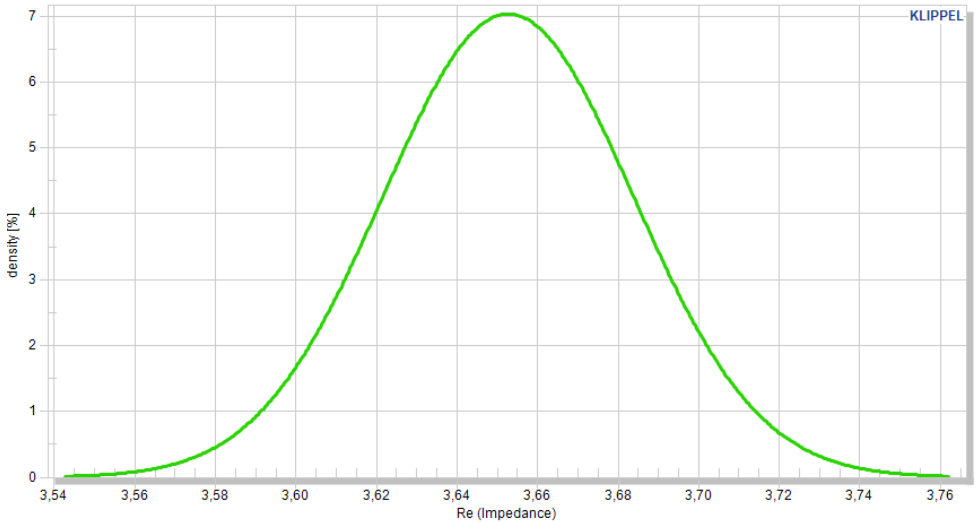
Comparing distribution plots of different pools with different number of test objects might require displaying the density type.



The number if bars is always 20.

Normal Distribution

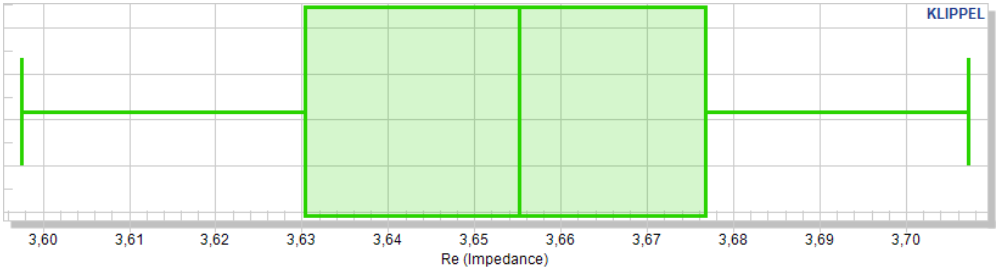
This option displays the fitted normal distribution curve of each pool. The area below the curve equals the area of the histogram curve.



This feature assumes a normal distribution of the measurement data.

Boxplot

This feature activates the boxplot which illustrates the measurement data split into quartiles.

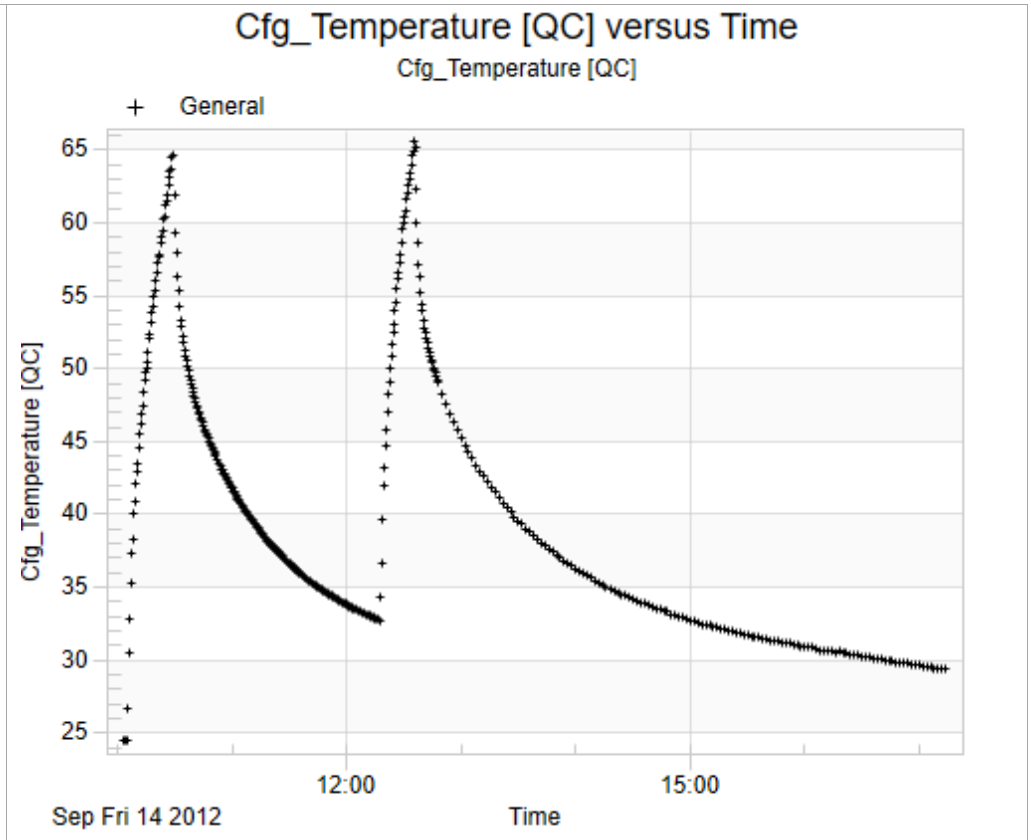


Dependency Plot

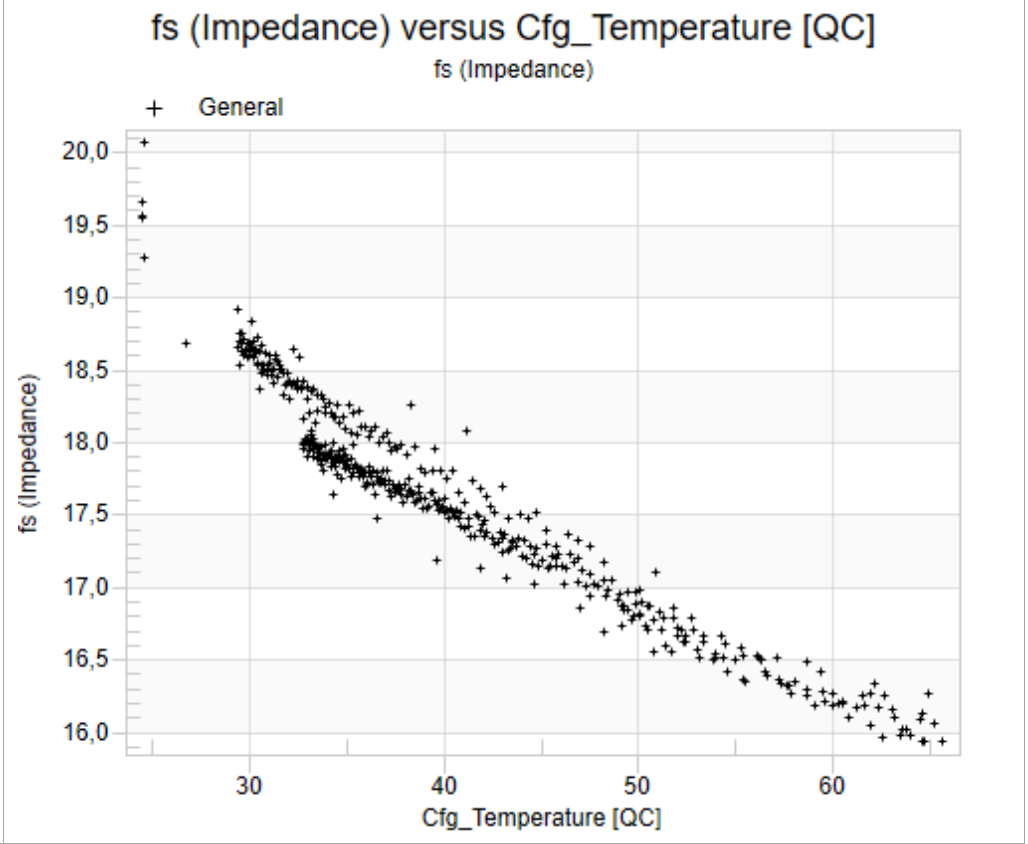
The dependency plot displays the single value results (or a cross section) of statistical objects versus another single value result. The dependency plot reveals if there is a dependence of one single value result to another.

Examples:

Temperature versus time



Resonance frequency versus temperature



3.3 Other Result Windows

Pool Assignment	This window shows all pools with their color, their name and the serial number of the assigned test objects. The pools can be renamed, given a different color, hidden or deleted. If a pool is deleted, all test objects are assigned to the *General* pool. 
Measure Overview Table	This table shows the overview of the measures and their pools. **Pool** | **Coil Offset (Motor + Suspension)** | **fs (Impedance)** | **Re (Impedance)** | **Impedance (Impedance)** general | $\bar{x}$: - Min: - Max: - σ: - N: 0 | $\bar{x}$: - Min: - Max: - σ: - N: 0 | $\bar{x}$: - Min: - Max: - σ: - N: 0 | N: 0 Pool A | $\bar{x}$: 0.263657 Min: - 0.199856 Max: 0.883667 σ: 0.321618 N: 22 | $\bar{x}$: 126.039 Min: 96.7033 Max: 527.068 σ: 89.971 N: 22 | $\bar{x}$: 3.65267 Min: 3.59753 Max: 3.70719 σ: 0.0311027 N: 22 | N: 22 For single values (and cross sections) the mean value ($\bar{x}$), minimum (Min), maximum (Max) and standard deviation (σ) are calculated. The number of test objects (N) with data is displayed for curve and single value measures.
Yield Statistics	This table lists all active measures and the number or passed and failed test objects per pool. The passed number is expressed as percentage. | | **Frequency Response (Sound Pressure (PNI))** | | **General** | 89.58 % pass (43 of 48) 10.42 % fail (5 of 48) 0.00 % void (0 of 48) | The overall yield is not yet calculated but will be in a future release.
Golden Unit Ranking	This table lists the first test objects that fit best to a reference (e.g. mean of the reference pool). | **Global Distance** | **SN** | **Pool** | ☑ **fs (Impedance)** | ☑ **Frequency Response (Sound Pressure (PNI))** | | 1.22 % | Mass_10 | Good | 0.43 % | 2.01 % | | 1.76 % | Mass_03 | Good | 0.06 % | 3.46 % | | 1.92 % | Mass_01 | Good | 0.18 % | 3.67 % | | 1.93 % | Mass_02 | Good | 0.24 % | 3.62 % | | 2.23 % | Mass_09 | Good | 0.18 % | 4.28 % | | 2.66 % | Mass_08 | Good | 0.80 % | 4.51 % | Measures may be excluded from the calculation of the global rank.

4 Limitations

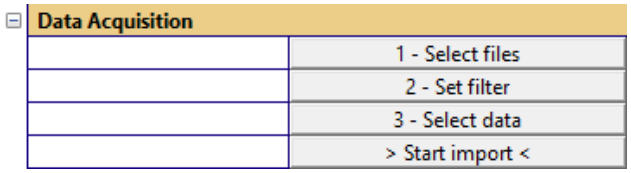
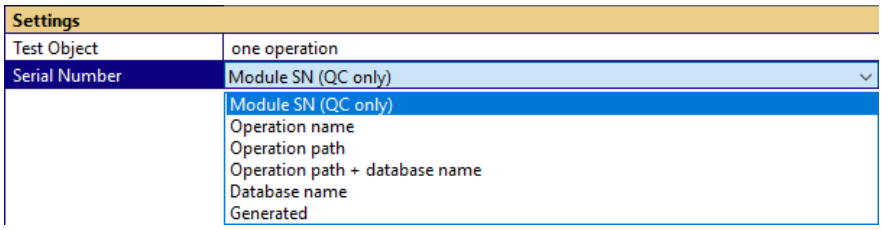
4.1 Limit Calculation

Limit Types	For each measure it is possible to select the limit types: • None (no limits) • Min+Max (minimum and maximum limit) • Max (only maximum limit)

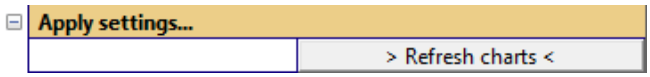
Calculation Mode	The following modes are available to generate the limits: • Shift mask a shift is defined and applied to the mean curve • Sigma factor mask a factor for the standard deviation is applied to the mean curve • Absolute limits the limits are defined without further calculatio • Factor mask (mul) – only available for data not in dB or % a factor is applied to the mean curve Each calculation mode provides entry masks to input the limit definition. If the limit mode is not “None”, the limit definition can also be entered graphically by using the CTRL (minimum limit) or SHIFT (maximum limit) with the left mouse button (LMB). The data points are automatically filled into the definition matrix.
Jitter	If jitter (horizontal widening) is active, the curve before the jitter is applied is also displayed to identify the impact of the jittering.

5 Parameters

5.1 Source Data

Data Acquisition	The buttons call *db extract* to select/define • input database files, • filtering options • result selection and All settings are stored in the STAT operation. No separate file is needed. 
Settings	The parameters define the entity of a test object (please refer to section Introduction) and how the serial number is defined. 

5.2 Processing

Apply settings…	**Refresh charts** Triggers a chart update. The button is frozen, if no update is required. 
Select measure	Defines the measure for which the following settings, statistics definitions and limit setup are changed.  The list of measures depends on the definition of the test object.
Settings	Defines general settings for a measure:

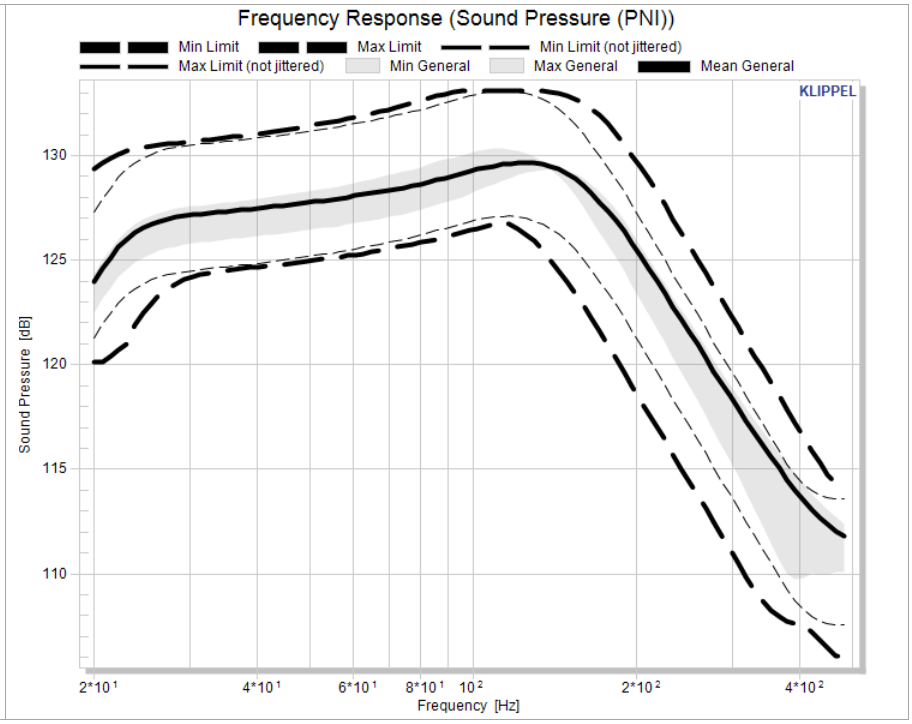
<table>
<tr><td></td><td>

Activation/deactivation of a measure
Normalization (referring the data to a reference), for measures not in dB or % a relative normalization is available (display of deviation in percent)
Definition of reference pool – the reference pool is used for normalization and limit calculation
Resolution reduction

<table>
<tr><th colspan="2">Settings</th></tr>
<tr><td>Activate</td><td>☑</td></tr>
<tr><td>Normalize</td><td>☐</td></tr>
<tr><td>Reference pool</td><td>general</td></tr>
<tr><td>Reduce resolution</td><td></td></tr>
</table>
</td></tr>
<tr><td>Statistics</td><td>The category defines statistical settings. The content is depending on the data type (curve data with/without cross section, single value data).
<table>
<tr><th colspan="2">Statistics</th></tr>
<tr><td>Mean</td><td>☑</td></tr>
<tr><td>Base Data</td><td>☐</td></tr>
<tr><td>Standard Deviation</td><td>☐</td></tr>
<tr><td>Histogram</td><td>☑</td></tr>
<tr><td>• Type</td><td>Density</td></tr>
<tr><td>Normal Distribution</td><td>☑</td></tr>
<tr><td>Boxplot</td><td>☑</td></tr>
<tr><td>☑ Plot Feature Versus</td><td>Time</td></tr>
</table>
</td></tr>
<tr><td>Limit Calculations</td><td>The limit calculation is activated and defined in this category.
<table>
<tr><th colspan="2">Limit calculation</th></tr>
<tr><td>Limits ...</td><td>Min + Max</td></tr>
<tr><td>Calculation mode</td><td>Absolute limit</td></tr>
<tr><td>Absolute min limit</td><td></td></tr>
<tr><td>Absolute max limit</td><td></td></tr>
<tr><td>Jitter</td><td></td></tr>
</table>
The limits may be entered manually in the text input or entered graphically by clicking in the charts.
Available limit calculation modes:

absolute
shift mask
factor mask (only for linear measures, e.g. impedance)
statistical mask

The jitter option spreads the limits horizontally. If a jitter is defined, the influence of the jitter is visualized by separate curves:</td></tr>
</table>



Find explanations for symbols at:

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

Last updated: May 26, 2021