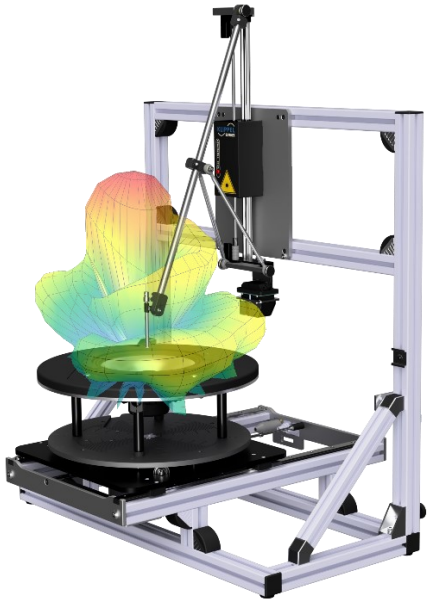
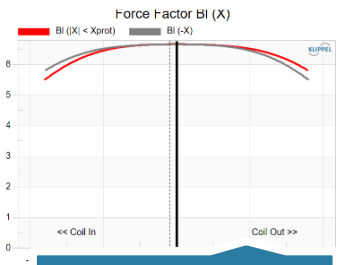
What's New in KLIPPEL ANALYZER SYSTEM
dB-Lab 212 – QC 7

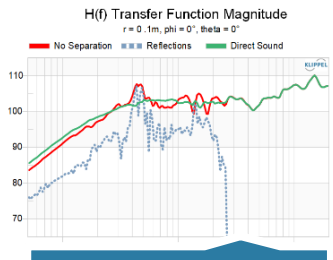
Document Revision 3



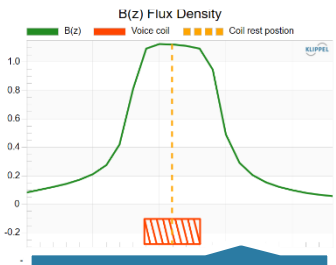
COMPACT ALL-IN-ONE SOLUTION FOR



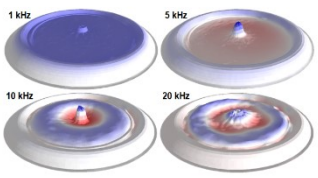
Electical Testing



Acoustical Testing



Magnetic Testing



Mechanical Testing

Overview

Minor Update dB-Lab 212.240 / QC 7.2 (March 2022)

Updates in R&D dB-Lab 212

- **Time Frequency Analysis (TFA):**
  - Complete revision of user interface, graphical appearance, processing and feature scope
  - Processing:
    - Simple setup mode for most common tasks
    - Flexible reduction of time resolution for wavelet and filter bank analysis (peak, rms)
    - Dedicated processing mode for impulse responses (waterfall etc.)
    - Compatibility with QC 3DL –Spectrogram 3D Limits module
  - Player and auralization functionality added:
    - Playback of imported wave files (Windows default audio device)
    - Change of playback rate (slow down)
    - Frequency (bandpass) and time filter to cut sections of interest
    - Intuitive cursor control and dedicated playback control window
    - Export of filtered wave file
  - Import:
    - Import impulse responses from wave files
    - Import of long wave files supported
    - Generic import of all waveform data generated by modules of the KLIPPEL Analyzer System
    - Easy clipboard import
  - Reworked display settings and graphical appearance
  - New operation and report templates, new examples

- **Large Signal Identification (LSI3):**
  - Enlargement headroom increased
    - Headroom is limited by amplifier and not by internal processing any more
    - Level of U_{small} is not critical any more

QC 7.2 Update

- **QC Stand-alone Software version**:
  - No Klippel hardware (KA3, PA) required
  - Minimal test setup using sound card and microphone for acoustic testing
  - Comprehensive tests of active systems (personal / smart devices, Bluetooth®)
  - Any impedance-related modules (IMP, SPL-IMP, MSC, BAC) support 3rd party data acquisition hardware (e.g., power amplifier with voltage / current sensing)
    - Calibration of voltage and current measurement provided
    - Calibration of Amplifier gain supported.
    - Dante® and other audio streaming protocols supported

- **3D Spectrogram Limits (3DL):** **Full release**
  - Integrated ambient noise detection and PNI – Production Noise Immunity (replace all mode only)
  - Limit calibration added
  - New operation and test templates
  - Compatibility with TFA - Time Frequency Analysis

- New Add-On "Adjust Limits"
  - Allows adjustment of frequency response limits by operators
  - Password protection available
  - Flexible, iterative adjustment of limits with full traceability

- Separated serial numbers for passed and failed verdicts
- New frequency response option: full signal versus windowed response (fundamental response only)
- **External Synchronization (SYN):**
  - Show delays between measurements in open loop scenarios
  - Allow Wave Export (store sensor signals) in open loop import mode

- **Post-Processing Task (PPT):**
  - New processing mode: Analysis of single curve input
  - New results including limit calculation and verdicts:
    - Band Values: Calculation of max, min, rms or mean value of user defined bands of a measured curve
    - Band Values - X Axis value: search of x-axis position where max or min band values are located

- **IO & Prompt Task (IO Task):**
  - Supports manual input of data or queries including limits and verdicts

- **Spectrum Analysis (SAN):**
  - Now supports input signal sharing (e.g., for multi-channel testing)

Main Features Explained

The KLIPPEL Analyzer System has received a first minor software update for version 212 in 2022 providing various new features for both R&D and QC applications. The update is free of charge for all users running dB-Lab 212 or QC7.

The **Time Frequency Analysis (TFA)** module has faced a major revision and feature update. As a dedicated post-processing tool for the analysis of waveforms in time and frequency domain it can import any signal or impulse response generated by the KLIPPEL Analyzer System or imported from wave file. In addition to the spectrogram analysis options based on STFT, wavelet transform or auditory filter banks with superior time resolution, this powerful post-processing tool now provides an interactive band-pass filter and playback function for subjective distortion analysis and diagnostics. Replacing the PLAY module, the TFA can now load very long wave files in order to obtain signal characteristics and pick a time range for detailed analysis. Overall performance and usability and graphical appearance were improved.

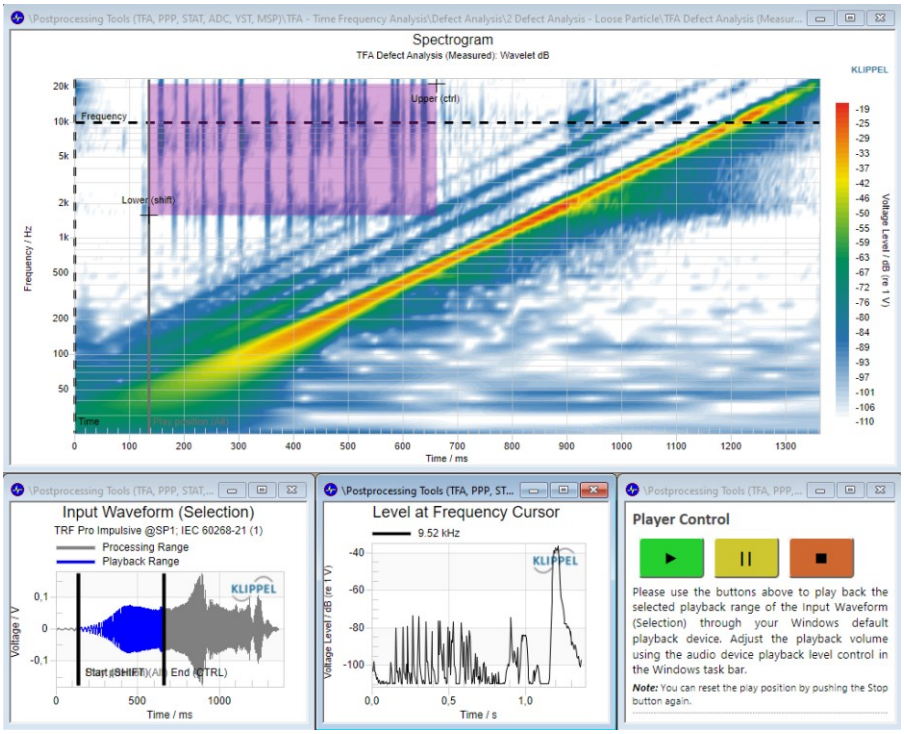


Figure 1: TFA wavelet transform of chirp response and filtered playback feature; playback time and frequency range is adjusted using the cursors in the spectrogram plot.

Now officially released, the **QC 3D Spectrogram Limits (3DL)** is an offspring of the TFA, dedicated to the particular requirements of QC testing. This add-on for the chirp-based **Sound Pressure Task (SPL)** of the KLIPPEL QC software uses the auditory filter bank shared with the TFA to generate a time-frequency plot of the measured DUT's response. The 3DL applies automatically generated "3D Limits" to the spectrogram based on golden reference DUTs to reveal the signature of irregular distortion and abnormal sound caused by loudspeaker defects (Rub&Buzz, loose particles, …). Any exceedance of the limit threshold is highlighted clearly in the dedicated result plots. As an addition to the well-established "Rub&Buzz" measurement in time domain (impulsive distortion, IEC 60268-21) providing best sensitivity for even tiniest loose particles, the 3DL provides new benefits such as detecting abnormal behavior anywhere in the spectrum, identifying external (uncorrelated) disturbance, detailed defect root cause analysis as well simplified Rub&Buzz filter setting. 3DL now also supports **ambient noise detection** feature and **Production Noise Immunity (PNI)** add-on.

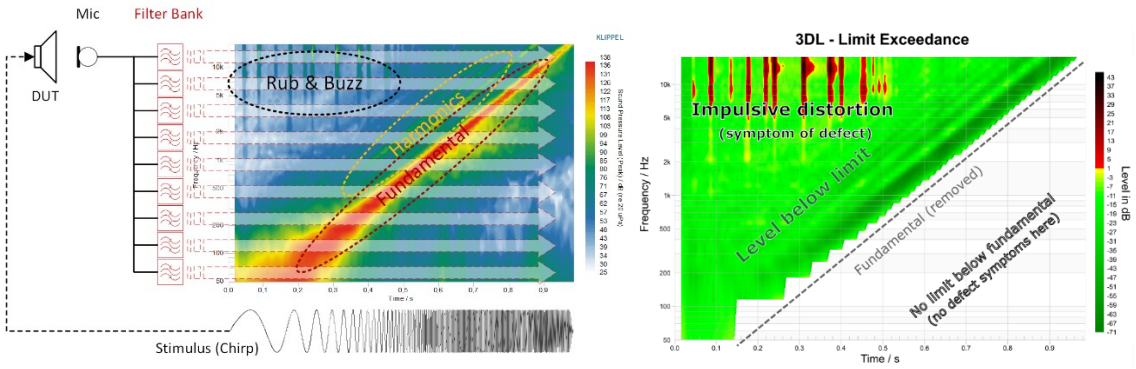


Figure 2: Schematic of filter bank analysis (left); detected loose particle failure in spectrogram 3D limit surface; limit area is defined by harmonic order of chirp signal (right)

The **QC Stand-alone Software** version is dedicated to all test scenarios where the KLIPPEL Analyzer Hardware is not required or cannot be applied. Together with the **External Synchronization (SYN)** add-on it is highly suitable for any closed or open loop test scenario using 3rd party hardware (e.g., audio interface) or wave-file-based analysis. It only requires PC, laptop or tablet running Windows® and a KLIPPEL USB license dongle.

In addition to output-based audio testing according to IEC 60268-21, the QC Stand-alone now also supports all tasks and features of the QC software that are based on voltage and current measurement such as **Impedance (IMP)** for T/S parameter testing and **Motor + Suspension Check (MSC)** for patented nonlinear parameter testing (e.g., voice coil offset). This allows creating powerful and yet price-efficient test setups using smart amplifiers with built-in voltage and current sensing such as *Powersoft Mezzo* series that are capable of streaming sensor signals via *DANTE* network for professional quality control in cost-sensitive applications (such as rental companies, service stations and many more).

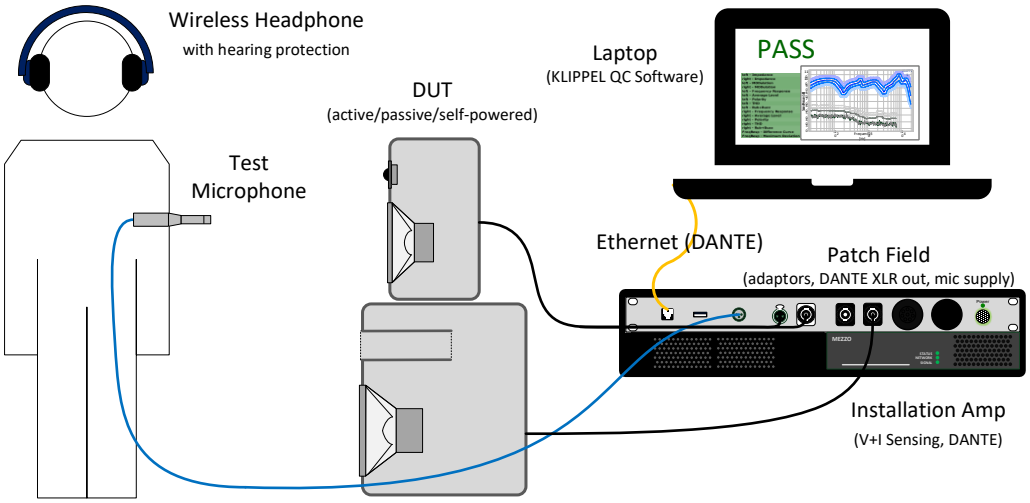


Figure 3: Mobile quality control test setup for rental companies based on QC Stand-alone Software and smart amplifier with DANTE interface

Minor Update dB-Lab 212.116 / QC 7.1 (November 2021)

Updates in R&D dB-Lab 212

- Near Field Scanning Software **(applied to Carousel (NFS) and Workbench hardware):**
  - Asynchronous testing for half space measurement (e.g., Bluetooth®)
  - Half space Scanning of compact devices. Enables smaller grids and increased measurement precision for very small DUTs
  - Visualization: new normalization options (to listening point) for Contour plot and Beam width
  - Listening Zones: Smoothing, Iso Frequencies, Distance Scaling (1/r), Voltage Scaling
- Multi-Tone Measurement (MTON)**: Update**
  - Full compatibility with QC MTD Task
  - Multi-tone distortion calculation: energy ratio of distortion in bands to fundamental
  - Single value result and limit: total multi-tone distortion to fundamental ratio
  - New charts: Multi-Tone Response, Total MD Ratio vs Step
  - Limits now available in single measurement mode
  - Probability density function and higher moments of measured signals
  - Complex room correction curve applied to microphone waveform and transfer function
- Linear Parameter Measurement (LPM) & Large Signal Identification (LSI):
  - Support of amplifiers with steep high-pass filter slope below pass band (e.g., Class D, DSP processed amplifiers with HP <= 24 dB/oct. @ 10 Hz)
- 3D Distortion Measurement (DIS):
  - Revision of graphical display and chart configuration
- SCN Vibration Scanning Software:
  - New Lasers supported: LK-H022 (all scan modes), LK-H082 (flat scan only)
  - Upper Frequency Limit increased: Scans with KA3 are supported up to 66 kHz
  - Geometry Export: Units included and new 2D *.dxf export formats
- Poly2SCN **(Converter from Polytec Scan Data to Klippel Software):**
  - New visualization and remeshing of Polytec measurement grid
  - Geometry Detection: Supports rectangular and asymmetrical grids
  - Detects non-scanned areas within the measured grid (e.g., to isolate vibrating enclosure from driving speakers).

QC 7.1 Update

- Multi-Tone Distortion Task (MTD)**: Major Revision**
  - Full compatibility with MTON module of R&D system
  - Transfer function and emulated frequency response added in addition to fundamental
  - Level result added (AC RMS response level)
  - Multi-tone distortion calculation: energy ratio of distortion in bands to fundamental
  - Single value result and limit: total multi-tone distortion to fundamental ratio
  - New test templates with MTD for passive and self-powered audio systems
  - Settings and limit import added
- Calibration:
  - Microphone Calibration of microphones using wave files
  - Calibration process can now be automated (QC Automation)
- Sound Pressure (SPL) & Sound Pressure and Impedance (SPL+IMP):
  - Frequency bands of band levels can now be defined independently (overlap allowed)
- Preconditioning: sweep generator settings harmonized with SPL task (Level and Speed Profile added)

Major Update dB-Lab 212 / QC7 (July 2021)

New KLIPPEL Software Module

SCN Nearfield Add-On (SCN-NF): Acoustic testing using holographic identification technique

- Add-On for KLIPPEL SCN Scanning Vibrometer
- Acoustic measurement of transducers and small devices in half-space (baffle)
- Comprehensive near/ far field radiation data
- Directional characteristics and sound power
- Direct Sound Separation, suppression of room reflections and modes
- No anechoic room required
- Compact hardware setup

Multi-Tone Distortion Measurement (MTON): Full release

- New: Flexible multi-tone stimuli with user definable crest factor
- Fundamental and distortion measurements
- SPL Max and max. voltage according to IEC 60268-21
- Continuous Max. SPL related to ANSI/CEA-2010-B and ANSI/CEA-2034
- New: Compression vs. frequency
- Customizable cycling and stepping
- Protection limits to avoid damage of test objects
- Testing transducers, active and passive speakers
- Compensating frequency jitter induced by digital audio devices or transmission

Linear Simulation (LSIM): Full release

- Linear signal modeling from digital input to acoustical output
- Lumped parameters modeling
- Analyzing electrical, mechanical, acoustical state spectra and transfer behavior
- Automatic equalization to target alignments
- Small signal performance considering properties of typical program material
- Efficiency and voltage sensitivity versus frequency
- Calculates parameters from geometrical input
- New: Post-filter simulating room response
- New: Phase and group delay

Rocking Mode Analysis (RMA): Full release

- Solve Rub&Buzz problems caused by rocking modes
- Improve speaker balance for safe operation at high output levels
- Find the dominant root cause for rocking
- Assess imbalances in mass, stiffness or force factor and locate them
- All important results on a single page
- New: Improved user assistance with prioritized instructions
- New: Traffic-light coded severity grading for rocking level

Updates in Existing KLIPPEL Products

dB-Lab:

- New sensor management, unified for R&D and QC
- Improved chart graphics, performance and interactions
- Measurement protocol holds hardware configuration, timeline and errors
- New operation icons, warnings, errors
- Separate signal configurations for each device
- User defined chart annotations
- Report Generator: new report templates for all modules, new style
- Manual Sweep for R&D: Simple, intuitive sine generator with fundamental and distortion analysis, optionally operated by 3D-mouse

End-of-Line testing software QC 7:

- New software remote control interface
  - Automation API replaces IO-Monitor API (still supported)
  - Automate QC testing (measurement control, SN input, GPIO, result access,)
  - Supports flexible integration with your favorite programming or scripting language (e.g., Python)
- New sensor management
  - Sensor setup simplified and unified with R&D applications
  - Dedicated configuration for KLIPPEL Analyzer 3, Production Analyzer, 3rd party audio interface and wave file import – no more confusion
  - Tasks support various sensor types (result units, dB level references)
- Multi-channel test capabilities expanded
  - 3rd party audio interface (sound card) - support up to 15 I/O channels
  - Wave file analysis - up to 128 channels (e.g., for smart speaker testing)
  - Dedicated channel-based routing options
- New template for power amplifier testing
  - Stereo amp check with dummy load resistor
  - Voltage/current frequency response, distortion
  - Quick power test with large signal multi-tone
- External Synchronization (SYN):
  - Multi-channel open loop analysis improved - analyze multiple wave files in one test sequence
  - Terminology and handling of sequence *Execution Modes* for closed and open loop testing improved – better integration in automated sequences
- Time-frequency analysis of chirp response (3DL): Absolute limit option added
- Acoustic test tasks (SPL, SPL-IMP):
  - New limit alignment option *Absolute (normalized)* for floating limits - fixed tolerance for normalized frequency response → test frequency response shape independent of level/sensitivity (e.g., powered speakers, uncalibrated device test)
  - Harmonize handling of phase and polarity and removing cross-dependencies (delay correction)
- Electric test tasks (IMP, TSX):
  - Now also supports *Signal Sharing* with other IMP tasks – test two devices/speaker channels with only one measurement

Statistics (STAT):

- Dependency analysis plots for single values reveal correlation and dependency versus time, sample or other measure (e.g., temperature)

Near Field Measurement Software (NFS):

- Improved Postprocessing: ISO frequencies, smoothing, distance scaling
- New 3D graphics integrated into dB-Lab
- Better interactive analysis
- Near Field Visualization of spatial sound pressure distribution
- Overlay of multiple polar plots vs frequency

Time-Frequency Analysis (TFA):

- Signal Statistics: mean, rms, peak, bottom, kurtosis, crest factor
- Probability density function of wave form
- Energy-time curve of impulse responses

Vibration Scanner Software (SCN):

- Automatic Laser Calibration for KA3
- Direct Step Motor Control available from dB-Lab

Updates for KLIPPEL Hardware

SCN Multi-Scanning Workbench:

- SCN vibration scanner hardware includes now add-on for half-space (baffle) acoustic testing

Compatibility

Klippel R&D Software is compatible with data measured in dB-Lab 206 and higher

Klippel QC7 Software supports any data measured with QC4 and higher

Main Features Explained

The Klippel Software received a major update in early summer 2021. The main software platform *dB-Lab* 212 for both, *QC 7* and *R&D*, now provides a shared sensor management. The ***Klippel Multi-Scanning Workbench*** is now fully released bringing the near field holographic sound field scanning technology that provides directivity, sound power and room correction to a much smaller form factor. For comprehensive measurement of distortion using multi-tone stimuli, the MTON module is now released. Simulation tools are complemented by a new linear simulation module LSIM, dedicated to speaker and enclosure design.

Klippel QC software has been upgraded with a new automation control interface and multi-channel support for any Windows or ASIO audio interface, as well as wave-file based open loop testing. It includes more flexible options for testing and synchronization and for smart or stand-alone audio devices. Many small but useful tools and updates in existing modules round up this new major release. Read about, get your update, and explore or start with a free trial version.

General New Features in dB-Lab

dB-Lab is the platform software for the Klippel Analyzer System. It is used to setup, operate, analyze and post-process measurements or simulations. In the new software version, all four aspects of the frame have been updated. For **setup,** the sensor handling for any supported hardware or wave files was reworked and is now unified for R&D and QC. Sensors are either calibrated and stored in new sensor files or selected from a pool of commonly used sensors. The routing setup of the hardware is streamlined and more flexible when using multiple test hardware devices. Available sensors can be assigned to any signal path.

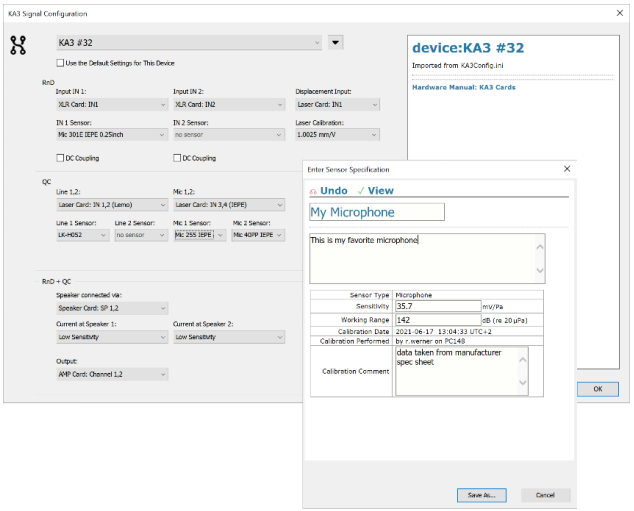


Figure 4: Signal Configuration dialog for KLIPPEL Analyzer 3 and new microphone form.

When **operating** a measurement, new operation icons indicate if problems may have occurred during the measurement. Errors and warnings are clearly marked and, in most cases, directly linked to the manual. This allows for quick identification of problematic procedures and shortens your workflow. A new measurement protocol window lists meta and progress information of the measurement including a time line, hardware configuration, and errors and warnings. **Analyzing** results has been made easier by improved graphics, harmonized terminology, better customization, and annotations within the graph for illustration of interesting details. The graphics export to many formats has been extended and includes annotations and user customizations. For **post processing**, all results can be exported directly to pdf reports based on new report templates and for the most common applications. The *Manual Sweep* live scope function as known from the QC framework is now also freely available for R&D and allows simple analysis of sinusoidal stimuli. This function can be smoothly operated by a handy 3D mouse.

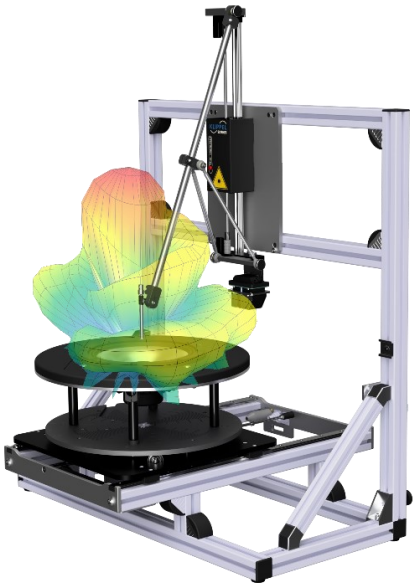


Figure 5: Woofer mounted on the SCN scanning workbench using new near field add-on (SCN-NF).

Comprehensive Scanning Solutions

A gap has been filled for **acoustic spatial measurements** using a smaller form factor than the well-known, large Near-Field Scanning System (NFS). Based on the popular vibration scanner hardware (SCN), the automated acoustic scanning and the full spatial characteristics of sound sources by holography is now available. A hardware add-on (SCN-NF) extends existing vibration scanners to a multi-scanning workbench for other useful sensors such as microphone, probes, and magnetic sensors. The main application is acoustic scanning in normal rooms. Thus, no anechoic room is required for accurate acoustic measurements. Typical devices under test are transducers and small audio devices (mobiles, smart speaker).

Advanced holographic analysis suppresses room reflections as well as modes. Based on far less points then required for a conventional directivity measurement on a fine acoustic grid in greater distance, a near field measurement reveals an analytical description of the source and therefore can provide spatial data at any distance outside the scanning surface and at any resolution. Important output results include directional characteristics such as balloon plots, directivity plots, sound power and many more. Whereas the large Near-Field Scanner allows full and half space measurements, the ***Multi-Scanning Workbench*** is focused on half space configuration (using a baffle).

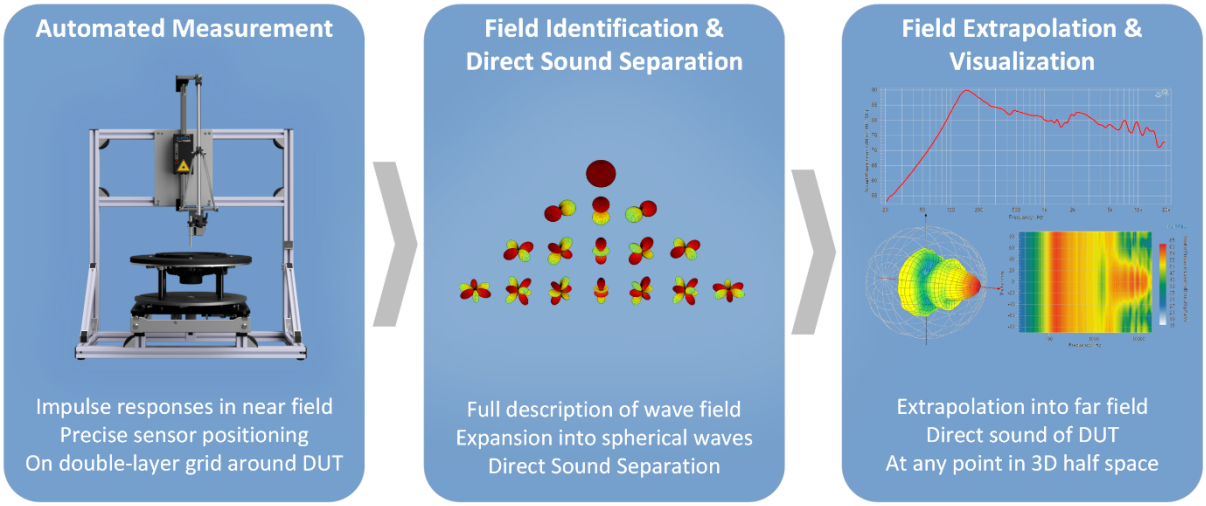


Figure 6: Principle and results of the holographic measurement principle.

The typical test time starts from as low as 5 minutes when assuming rotational symmetry. A full scan without any symmetry assumptions takes about 1 hour. The ***Multi-Scanning Workbench*** (formerly SCN hardware) now comes as complete hardware platform for vibration and sound pressure (or other domain) scans. Two separate software packages are available for mechanical and acoustical analysis. Please check the website for more information and an explanation video.

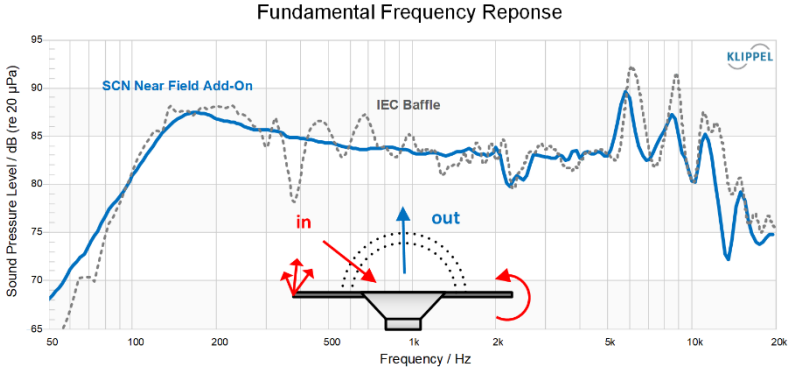


Figure 7: Comparison of a transducer frequency response measured in a traditional IEC baffle vs SCN Near Field add-on (SCN-NF).

The **vibration scanning** software now supports an automated laser calibration and verification. To position sensors at any location, a simple positioning frontend for the individual axis has been added. Based on vibration data, rocking modes can be detected reliably and the root cause of rocking can be identified. The Rocking Analysis Module (RMA) is released now and has received substantial improvements to guide the user effortlessly from measurement to analysis. A clear indication is given if the device under test has a critical rocking behavior which may result in reduced output audible distortion (Rub&Buzz) and early failure (field rejects). The actual scanning time for a rocking analysis takes usually less than 10 minutes. This allows testing multiple devices of one batch to isolate systematic behavior from random effects.

The graphical output and user interface of the NFS near field scanner **visualization software** was completely reworked and is now natively integrated in dB-Lab. Distance scaling is now available from the scanning surface to far field. The license structure was also simplified. Refer to the current price list.

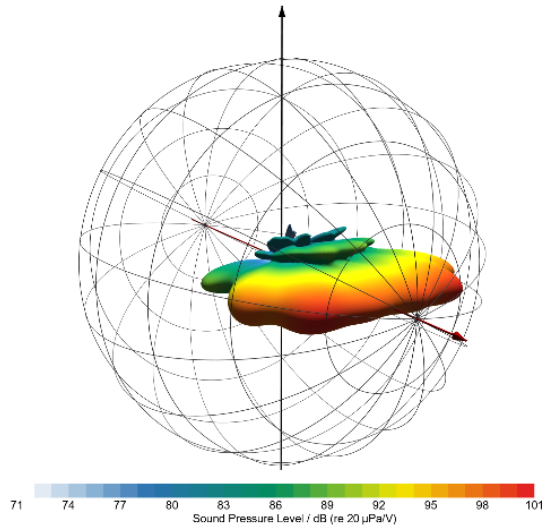


Figure 8: Balloon plot generated with the new NFS visualization in dB-Lab.

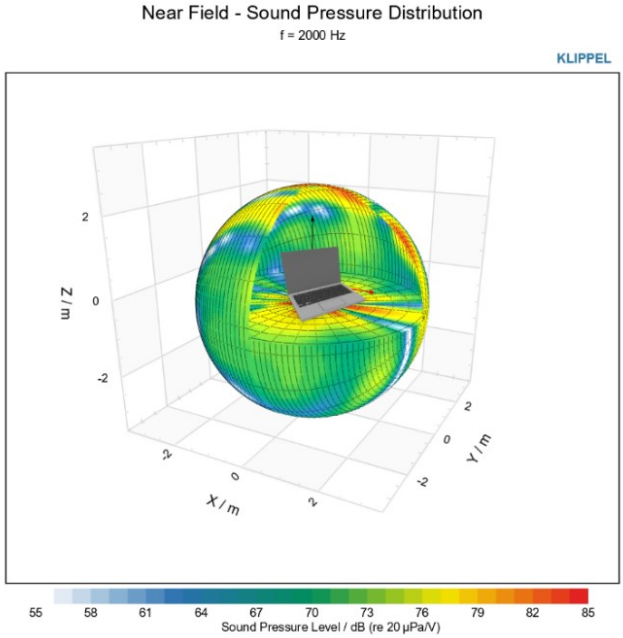


Figure 9: Visualization of the near field SPL distribution of a laptop scanned with NFS.

Distortion Analysis

MTON, the **multi tone-based analysis** module is now released. Multi-tone stimuli are quite useful test signals due to their music-like properties with the advantage of direct distortion measurement at the non-excited spectral bins. Therefore, multi-tone distortion provides a much more realistic picture than a pure sine tone measurement and the corresponding harmonic distortion analysis. MTON has a new option to specify the crest factor (impulsiveness - ratio of peak and rms value of the stimulus) which is important for high power tests and for accurate imitation of real-world music material. Stepping and cycling tests allow automatic thermal and non-linear compression measurements.

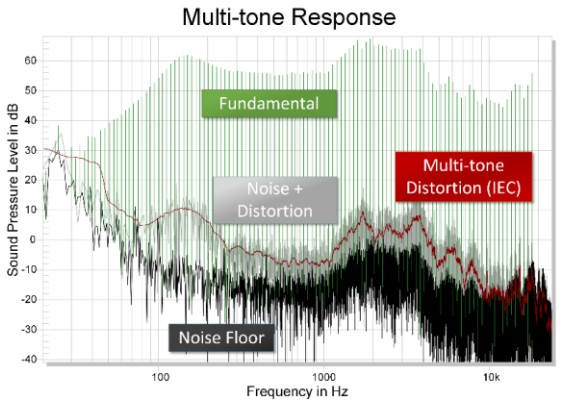


Figure 10: Main result plot of the MTON module.

To protect the device under test, several limits can be defined to avoid damaging when increasing test levels automatically. For transducer or passive systems, electrical, mechanical and acoustical signals can be analyzed and conclusions can be drawn for distortion generating mechanisms. MTON supports testing of any active audio systems with wireless connection (e.g., Bluetooth®) and compensates for potential frequency jitter.

The Sound Pressure Analysis (SPL) in QC software is extended by an add-on for time-frequency analysis. This three-dimensional surface plot (spectrogram) reveals the signature of distortion and abnormal sound, and can now be checked against user-defined **3D-limits** (3DL) relative to a reference or as an absolute limit.

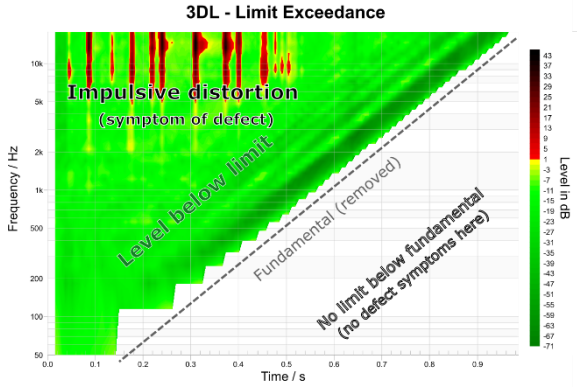


Figure 11: Detected loose particle failure of 3D spectrogram limit surface; limit area defined by harmonic order of chirp.

Simulation

The well-known non-linear simulation modules SIM and SIM-AUR received a corresponding tool for linear simulation (LSIM). In contrast to many available tools, the LSIM targets the overall design for green speakers (efficient, light weight, small). Maximum peak voltage, voltage sensitivity and efficiency for a given program material can be tuned easily to application requirements. Automatic EQ-tuning is available and with just one click, the effects on peak displacement and spectral properties of the response are predicted. A full set of all relevant states is analyzed and the corresponding transfer behavior is plotted.

LSIM is optimized to work with the Klippel Controlled Sound (KCS) solution. A simple user interface, interactive networks and enclosure configuration, as well as geometry-based parameter input, help considerably when starting to work with the module.

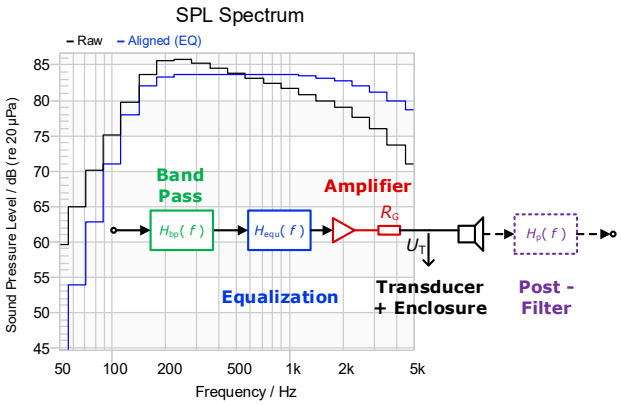


Figure 12: Comparison of simulated SPL spectrum of raw loudspeaker vs aligned response using LSIM.

End of Line Testing

A wider range of applications can now be tested with Klippel QC software. Complex test scenarios can be implemented and controlled using the new **Automation API** software interface. This API is the successor of the long existing IO-Monitor interface, which is still supported. It can be integrated easily in popular script languages such as *Python*. The above-mentioned sensor management routine is available for Klippel analyzers, soundcard-based interfaces, digital audio devices and wave file analysis. Sensor files can be shared with R&D software and result charts are correspondingly scaled and labeled.

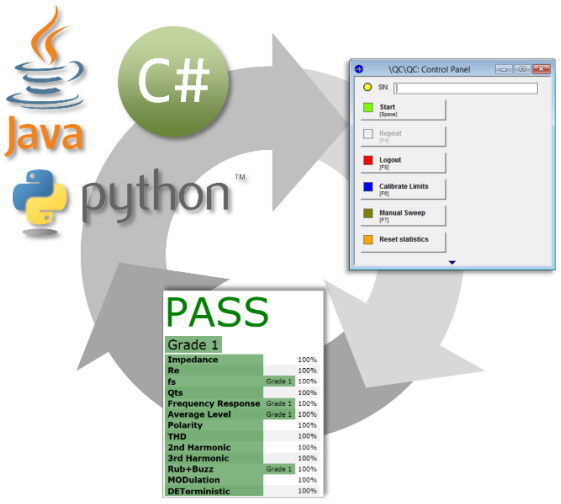


Figure 13: Flexible Automation API integration for QC software remote control.

Especially for directivity-controlled devices (beam forming, speaker and microphone arrays) multi-channel capabilities are expanded. For any non-Klippel front-end, up to 15 channels are supported as well as 128 channels for wave file processing. Using

the input signal sharing feature, one measurement can capture many signals that are automatically distributed to multiple analysis tasks. This considerably reduces test and setup time.

Open loop testing was improved to analyze multiple wave files in one test sequence, as well as better support for mixed configurations of Klippel hardware and external audio devices. Typical examples are testing sound emitting devices and microphones without audio streaming access using wave file stimuli and responses.

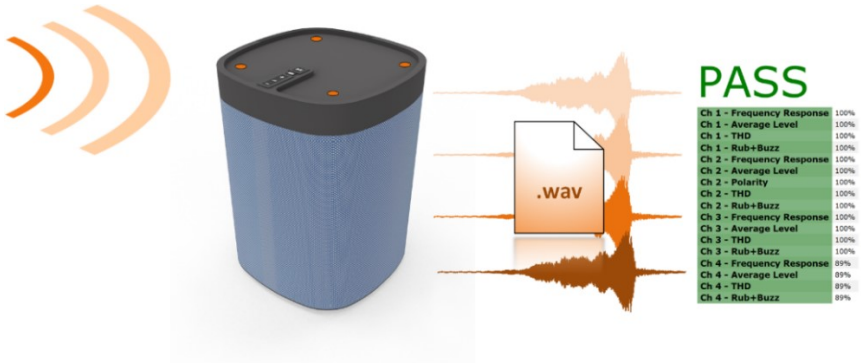


Figure 14: Wave file-based testing a smart speaker's four microphone responses using KLIPPEL QC.

Tools

A huge number of small features and bug fixes are included in dB-Lab 212 and QC7. For a complete list check the *history.txt* file available at the welcome page in dB-Lab. Two features shall be mentioned here:

The Time-Frequency Analysis (TFA) tool (a twin of QC-3DL module) is improved with additional diagnostics of the imported wave file. A comprehensive signal analysis (mean, rms, peak, bottom, kurtosis, crest factor) is now available and the probability density function of the amplitude distribution is plotted.

The new energy-time plot is especially useful when analyzing impulse responses.

A statistical analysis of almost any KLIPPEL result can be done by the Statistics (STAT) module, in particular for QC results. It can now map single value results or curve data at a certain frequency or abscissa versus time, sample, or other results. The latter reveals mutual dependencies of results which are useful for understanding and optimizing production processes. However, STAT can also analyze results from R&D software modules.

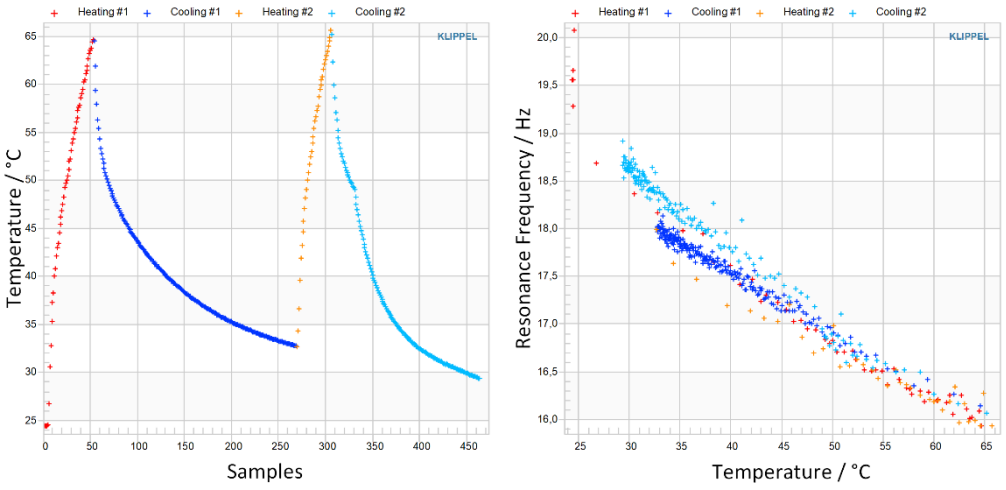


Figure 15 Dependency plots generated with STAT module (left: ambient temperature vs. time/samples; right: resonance frequency of a subwoofer vs. ambient temperature)