

KLIPPEL® QC SYSTEM

100%

END-OF-LINE

TESTING

PASS

Frequency Response

Average Level

Polarity

THD

2nd Harmonic

3rd Harmonic

Rub+Buzz

Impedance

Re

Le

QI-box

fs

Qts

Qms

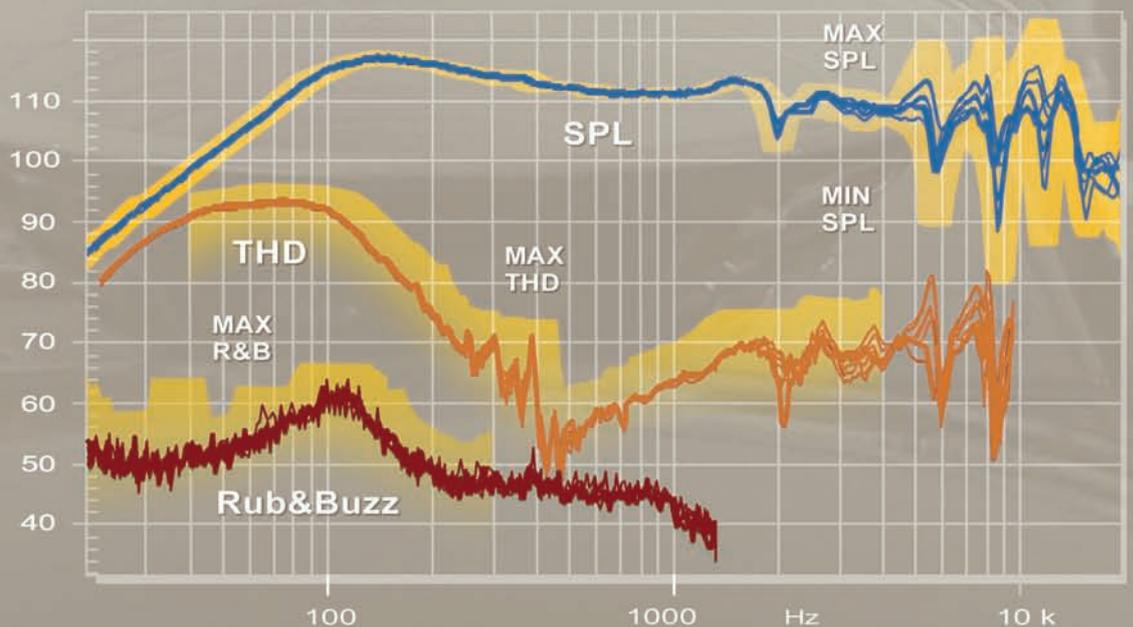
Qes

Box Leak

Voice Coil Offset

Stiffness Asymmetry

XBI



What KLIPPEL QC Offers for End-of-line Testing:

KLIPPEL instruments, the recognized standard in R&D loudspeaker analysis, developed a new generation of diagnostics tools dedicated to Quality Control.

• fast as a flash

4

high speed measurement at physical limits
alternating testing – one instrument works for two

• comprehensive testing

5

transducer, electronics and multi-channel systems
small and large signal performance (T/S parameters, X_{MAX})

• more sensitive than human hearing

6

time domain analysis for rub & buzz, loose particles and other impulsive distortion
detection and localization of air leakage noise

• robust in a production environment

7

reliable detection of noise corruption
noise immunity by auto-repeat and merging of valid data

• minimal rejection rate

8

on-line diagnostics of loudspeaker defects
motor and suspension check (coil offset in mm)

• as simple as possible

9

start-up tool for organizing test and templates
tools for automatic setting of limits

• flexible data export and post-processing

10

report generator + extraction tool for creating text-files
matching tool for selecting paired speakers

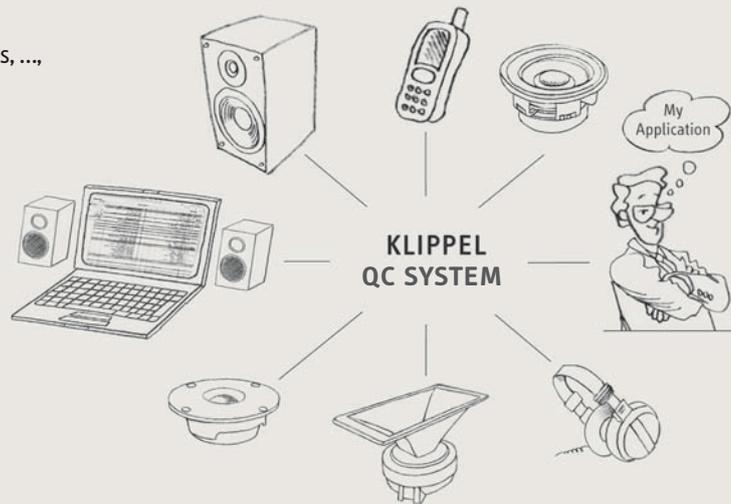
• ready for process automation

11

integration via hardware pins and software IO monitor
remote configuration of multiple lines via local or global network

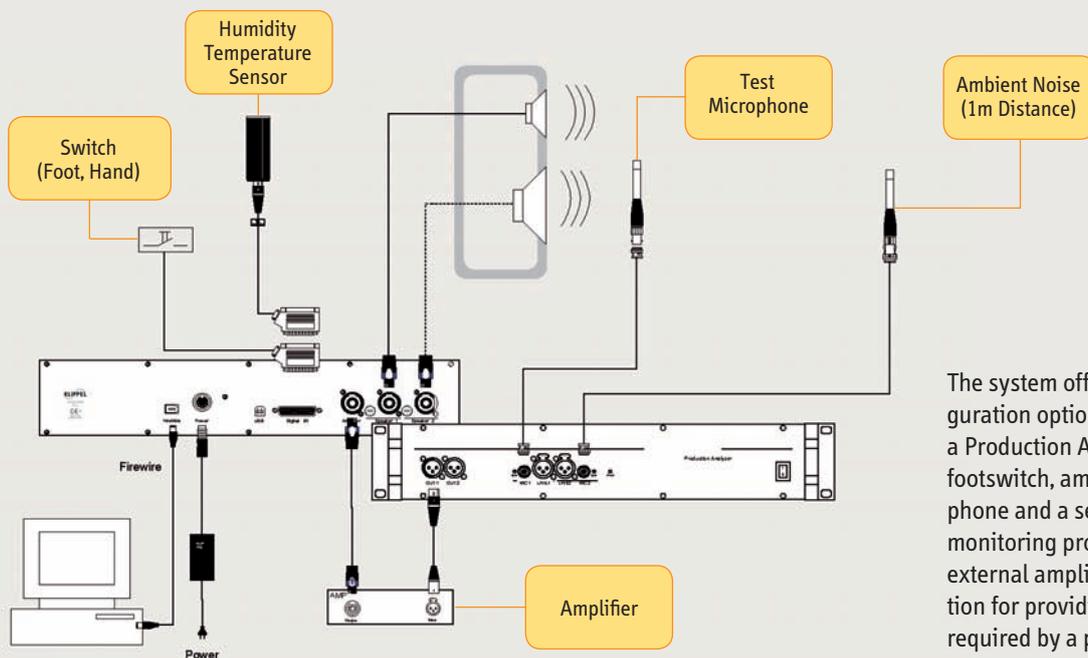
Applicable to Wide Range of Products

- Any kind of transducer (moving coil, electro-static, piezo, balance armature)
- Drivers mounted in sealed or vented enclosures, horns, ..., car bodies
- Audio electronics (amplifiers, DSP)
- Single to multi-channel loudspeaker system
- System with digital and acoustical delay (MP3 player)
- Passive, active systems with analogue and digital interface (USB)
- 0.5 Ω up to 20 k Ω impedance: (automotive, 100 V PA speaker)
- 1 mW to 1 kW power (telecommunication, professional application)
- 1 mA to 60 A current (microphone, shakers)
- 5 Hz ... 90 kHz frequency range (subwoofer, high-end tweeter)



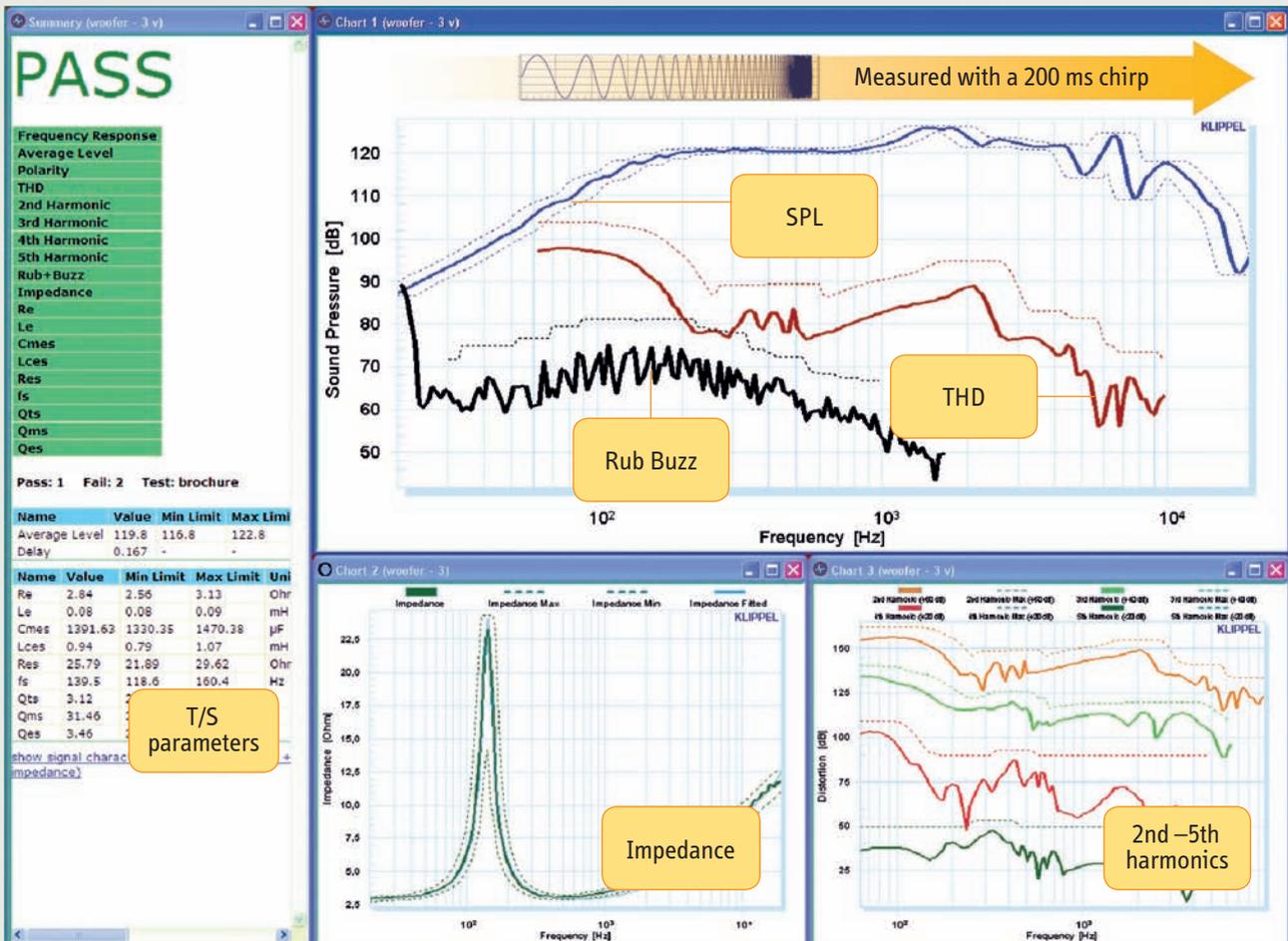
Solid Hardware for End-of-line Testing

- 100 dB SNR
- 4 inputs (2 XLR line + 2 BNC) selectable by routing
- Preamplifiers controlled in 1 dB steps to ensure maximal SNR
- ICP Power for microphone, accelerometers and others
- 2 Speaker terminals to measure tweeter and woofer simultaneously
- Galvanically decoupled current sensor up to 60 Amps
- Voltage sensor up to 300 V
- Sensor for temperature and humidity for climate monitoring
- General purpose digital input and output pins (GPIO)

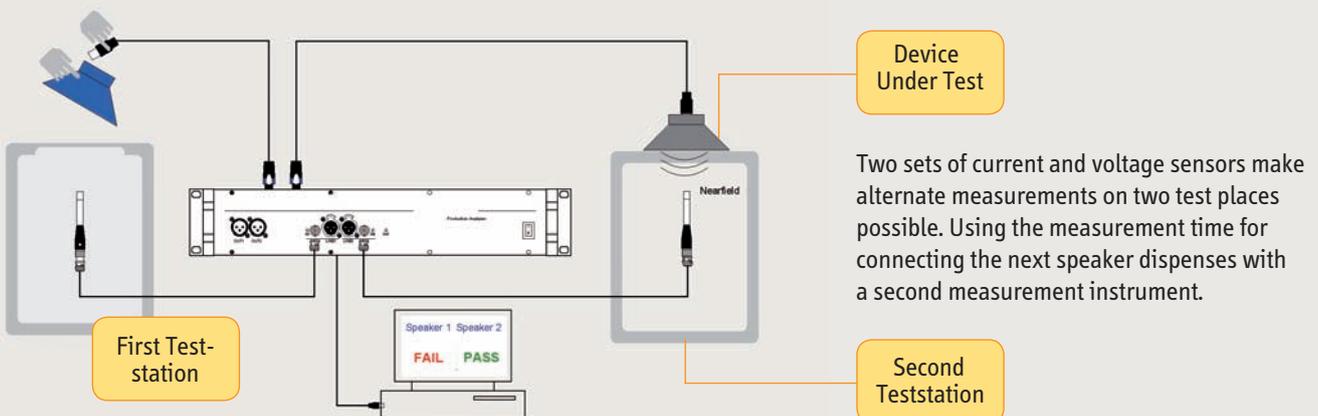


The system offers multiple configuration options. Here we show a Production Analyzer, computer, footswitch, amplifier, test microphone and a second microphone for monitoring production noise. The external amplifier is a flexible solution for providing the performance required by a particular application.

Measurements at the physical limits require optimal test stimuli to excite the device under test (DUT) at the particular frequencies where defects produce reliable symptoms. Chirps with variable sweep speed profile are optimally adjusted to the transient behaviour of the loudspeaker. Such a stimulus sounds like the crack of a whip, starting slowly at low frequencies but having 10 times higher sweep speed at high frequencies as shown in the waveform below. A 200 ms stimulus is sufficient for comprehensive measurement of a 5 inch woofer.

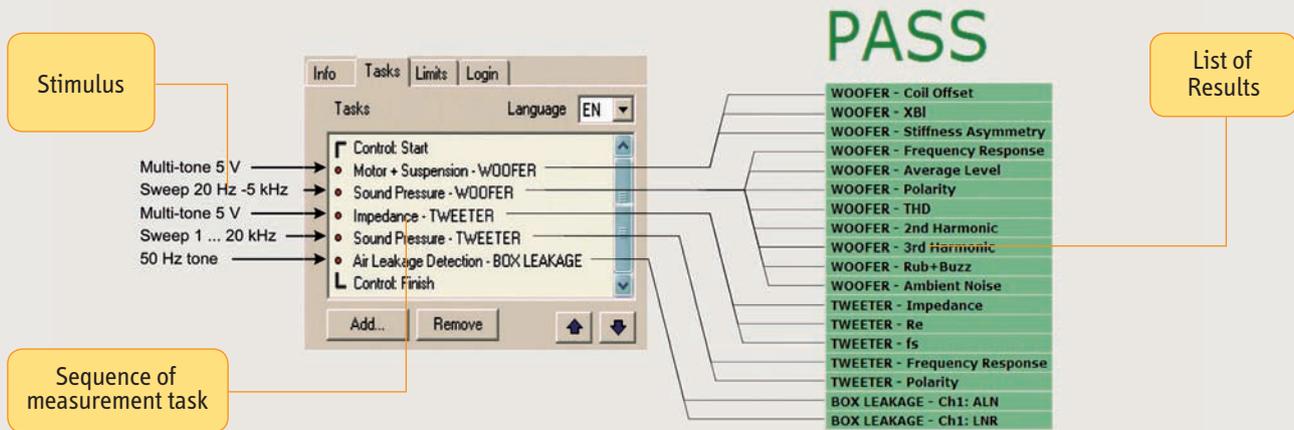


Powerful signal analysis mainly performed in parallel to the running measurements, reduces post processing time. Multiple measurement tasks overlap, processing the last response while the next stimulus is being rendered. New analysis techniques exploit the transient response when there is no time for getting into steady-state.



Comprehensive Testing

The KLIPPEL QC system provides flexibility and high performance for comprehensive testing of transducers, systems and electronics such as amplifiers, mixing consoles and other multi-channel audio devices with analogue or digital input (USB). Multiplexers for selecting microphones, inputs and outputs can be controlled by the GPIO pins at the rear side of the Production Analyzer.



Linear Measurements

- Magnitude and phase of frequency response
- Gating of the impulse response
- Polarity by phase measurement at selected frequency
- Crosstalk between two channels
- Sensitivity in specified frequency range
- Variety of test signals (sine sweep, stepped sine, two-tone, multi-tone, wave file)
- Sweep amplitude profile to ensure optimal SNR
- Sweep with speed profile - higher resolution at critical frequencies

Distortion Measurements

- Harmonic and intermodulation versus amplitude and frequency stepped and continuous
- Absolute and relative harmonic distortion (percent or dB)
- Individual distortion components 2nd – 5th order, THD
- Multi-tone distortion to reveal harmonics and intermodulation components
- Harmonic distortion with variable sweep profile
- Transient distortion analysis superior to steady state measurement
- Incoherence while reproducing music, speech and noise stimulus synchronous with spectral analysis

Parameter Measurement

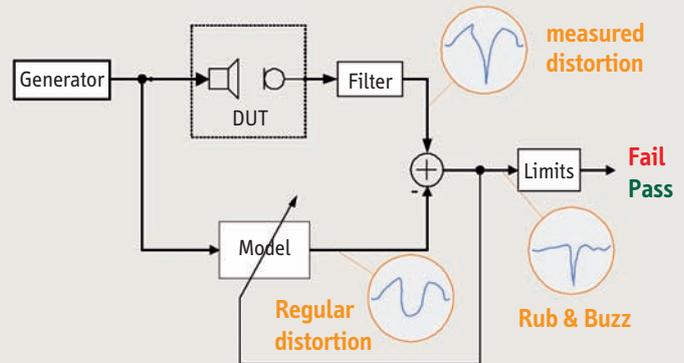
- Thiele/Small parameters by added mass technique
- R_e , f_s , Bl , M_{ms} , Q_{ts} , Q_{es} , Q_{ms} , R_{ms} , V_{as} , K_{ms}
- Port resonance f_b , and loss factor Q_b of a vented-box system
- Maximal peak displacement (X_{max})
- Voice coil offset in mm
- Stiffness asymmetry in %

More Sensitive Than Human Hearing

Rub and Buzz

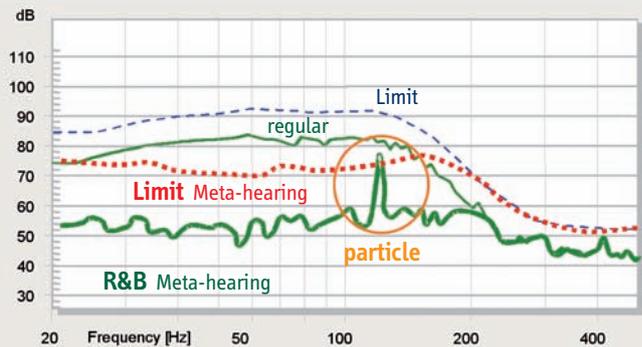
A unique tracking filter in the Standard QC system exploits phase and amplitude information of higher order harmonics in the time domain and detects the impulsive distortion generated by rubbing coils or buzzing parts.

The optional Meta-Hearing-Technology provides additional sensitivity for rub & buzz. An adaptive model measures the loudspeaker nonlinearities and synthesizes the regular distortion as produced by good units. The active compensation of the regular distortion in the measured signal reveals the symptoms of loudspeaker defects more clearly even if they are not audible and completely masked by regular distortion.



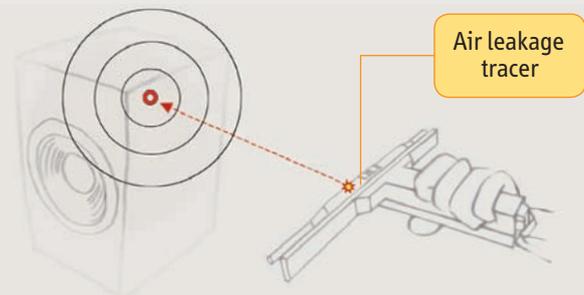
Loose Particles

For example a loose particle produces an inaudible click at 120 Hz which is completely masked by the regular distortion generated by motor and suspension non-linearity. Those defects can be detected by Meta-Hearing before becoming audible in the final application



Air Leakage and Turbulent Noise

Klippel QC system detects noise from air leakage in sealed and vented enclosures and turbulences at dust cap, spider, ports, and orifices. This fast technique (0.5 s) outperforms a human tester while separating ambient noise and other rub and buzz (mechanical) distortions. The AIR LEAKAGE TRACER is a handy tool to find the position of the leakage source during a manual inspection.

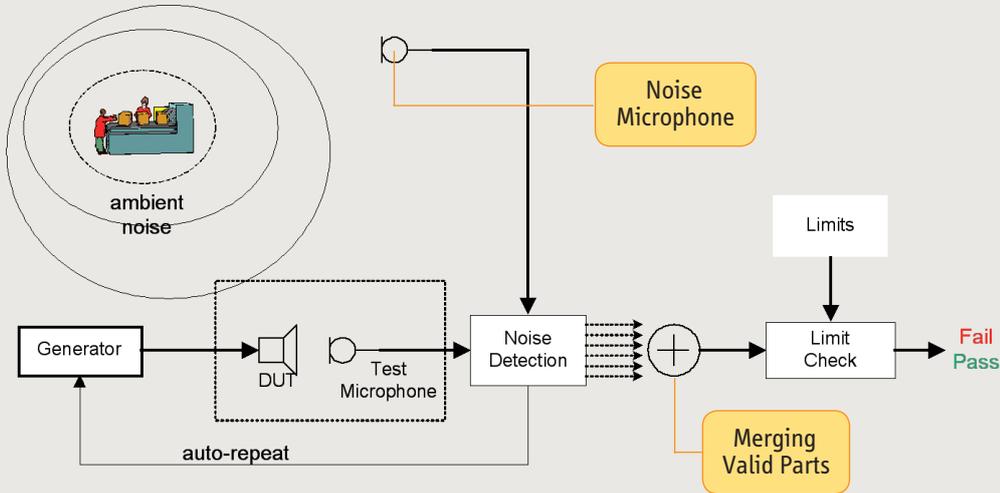


Loose Electrical Connections

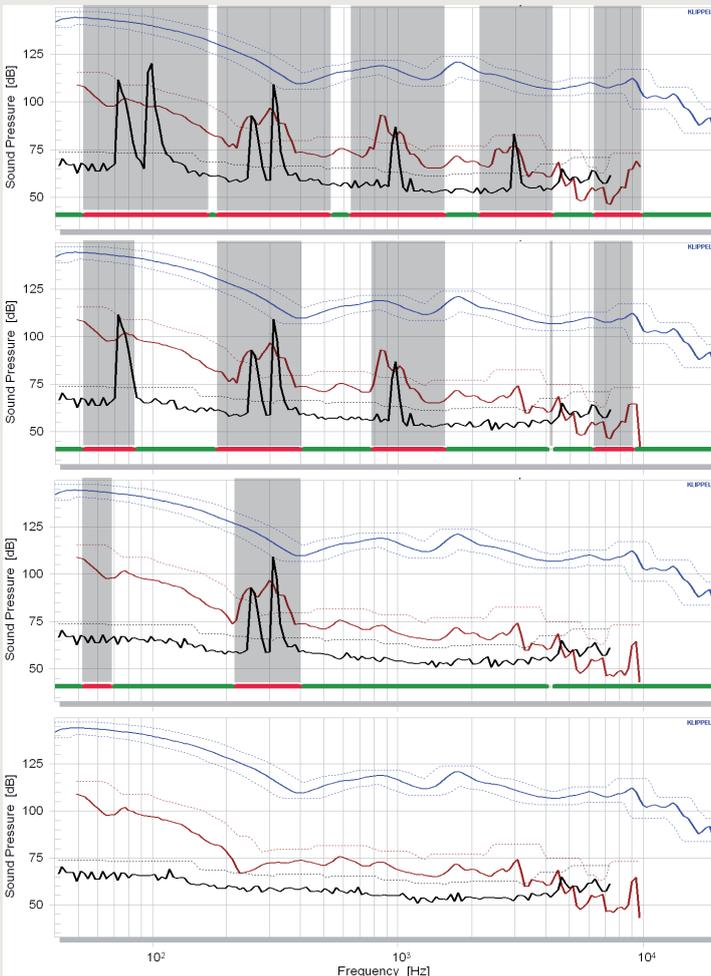
Defective contacts and drop outs in the digital audio stream generate impulsive distortions which can be detected by a transient analysis in the time domain.

Robust in a Production Environment

Ambient Noise Immunity



Ambient noise from production environment is monitored by a second far field microphone. Corrupted measurements are repeated automatically and valid parts from each measurement are stored and merged together, ultimately providing valid results. This ensures full production noise immunity even if each single measurement is corrupted.



28% valid

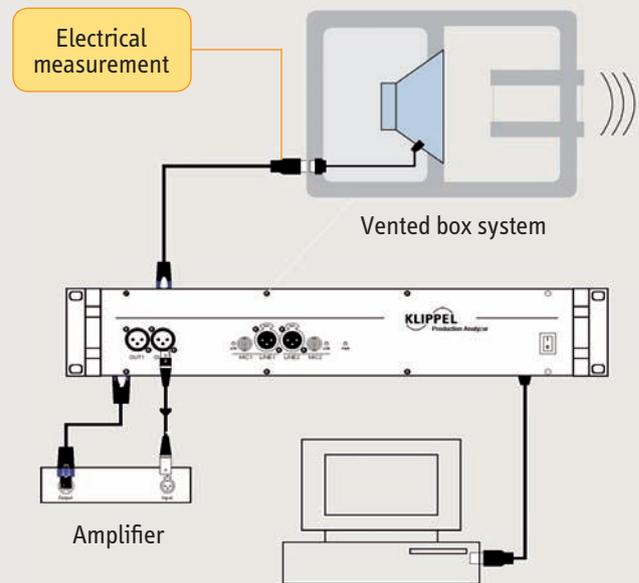
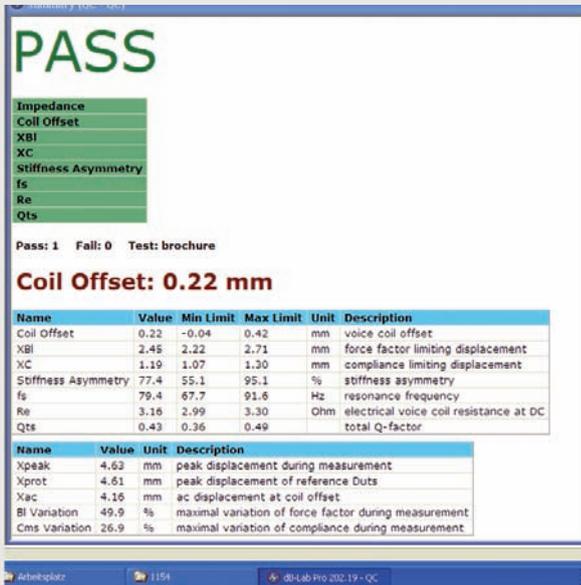
62% accumulated

85% accumulated

100% valid

PASS

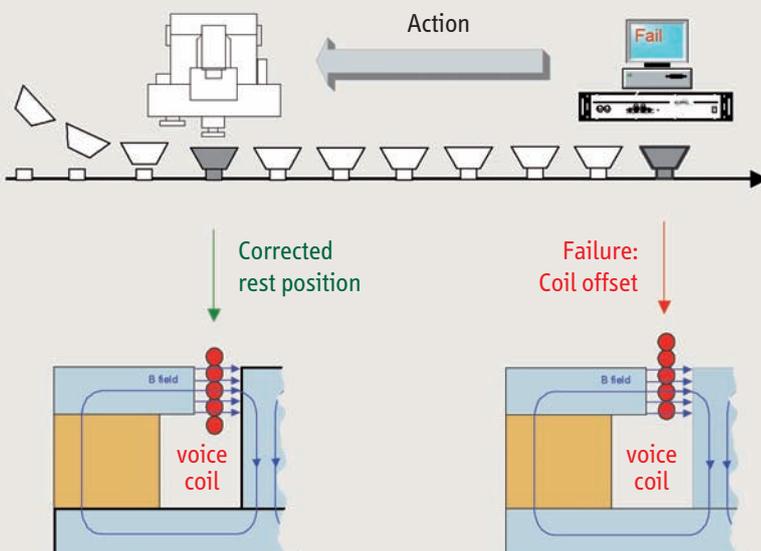
Motor and Suspension Check



Thiele/Small and nonlinear loudspeaker parameters are measured in the small and large signal domain. The driver operated in free air, in sealed or vented enclosures. No microphones or mechanical sensors (lasers) are required. All information is derived from electrical input current making the measurement immune from ambient noise. The following parameters are measured within a second or less:

- Voice coil offset in mm
- Stiffness asymmetry in %
- Maximal peak displacement (X_{max})
- Displacement X_{BI} limited by force factor
- Displacement X_C limited by compliance
- Port resonance f_b , loss factor Q_b

On-Line Diagnostics



KLIPPEL QC integrates advanced loudspeaker diagnostics into end-of-line testing. This simplifies the interpretation of the results and shows the cause of the defect. This is not only the basis for repairing units but also for discovering trends in parameter variations and in adjusting the manufacturing process in time to reduce the rejection rate and assure high and consistent quality.

If a new batch of spiders causes a variation in the rest position of the coil, the offset in mm can be measured as soon as the first defective driver arrives at the KLIPPEL QC. This information is used to adjust the rest position of the coil and to compensate for the varying properties of the suspension part. There is no longer a need to ship drivers with a coil offset.

As Simple as Possible

Getting Started

Different access levels are provided for operator and QC engineer. The operator sees only the control elements he needs in the language he understands. Therefore, the complexity is reduced to ensure shorter training times. One instruction sheet guides the QC engineer and operator in the start-up phase.

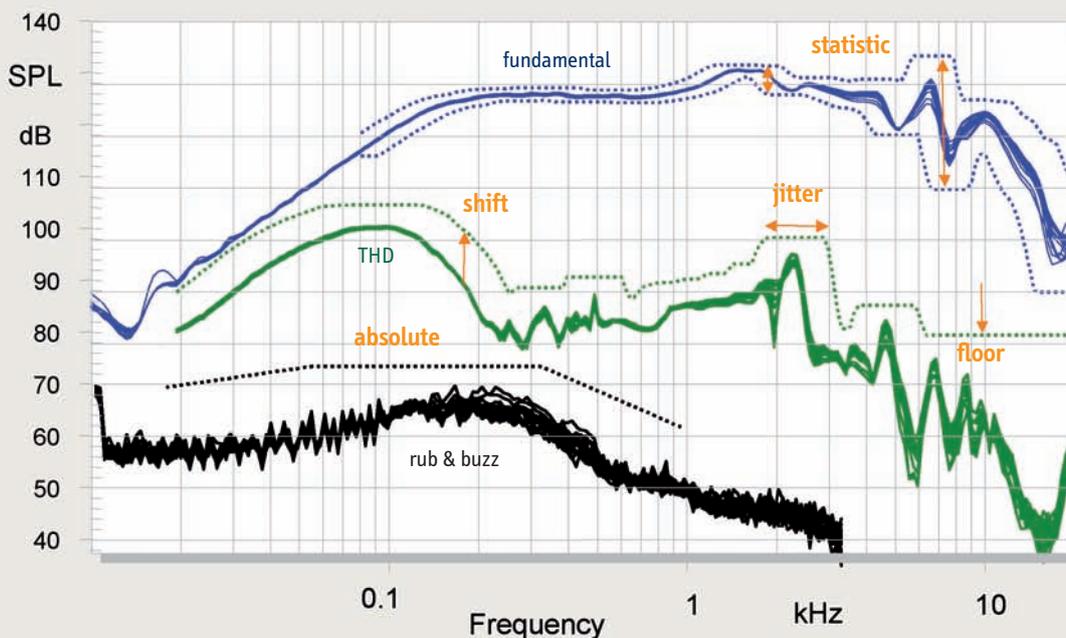
- Intuitive, customizable user interface
- Predefined task with optimal stimulus
- QC Toolbox – no programming required for normal task
- Multiple tasks can be combined to a measurement sequence
- Closely related to Klippel R&D tools
- Auto-detection of new DUT connected to the hardware
- Multi language support
- Manual and start-up guide in Chinese and English
- Bar Code Reader supported



The QC start tool with template management simplifies the setup selection for each device under test and organization of the measurement results. Loudspeaker type and serial number can be read by barcode interface.

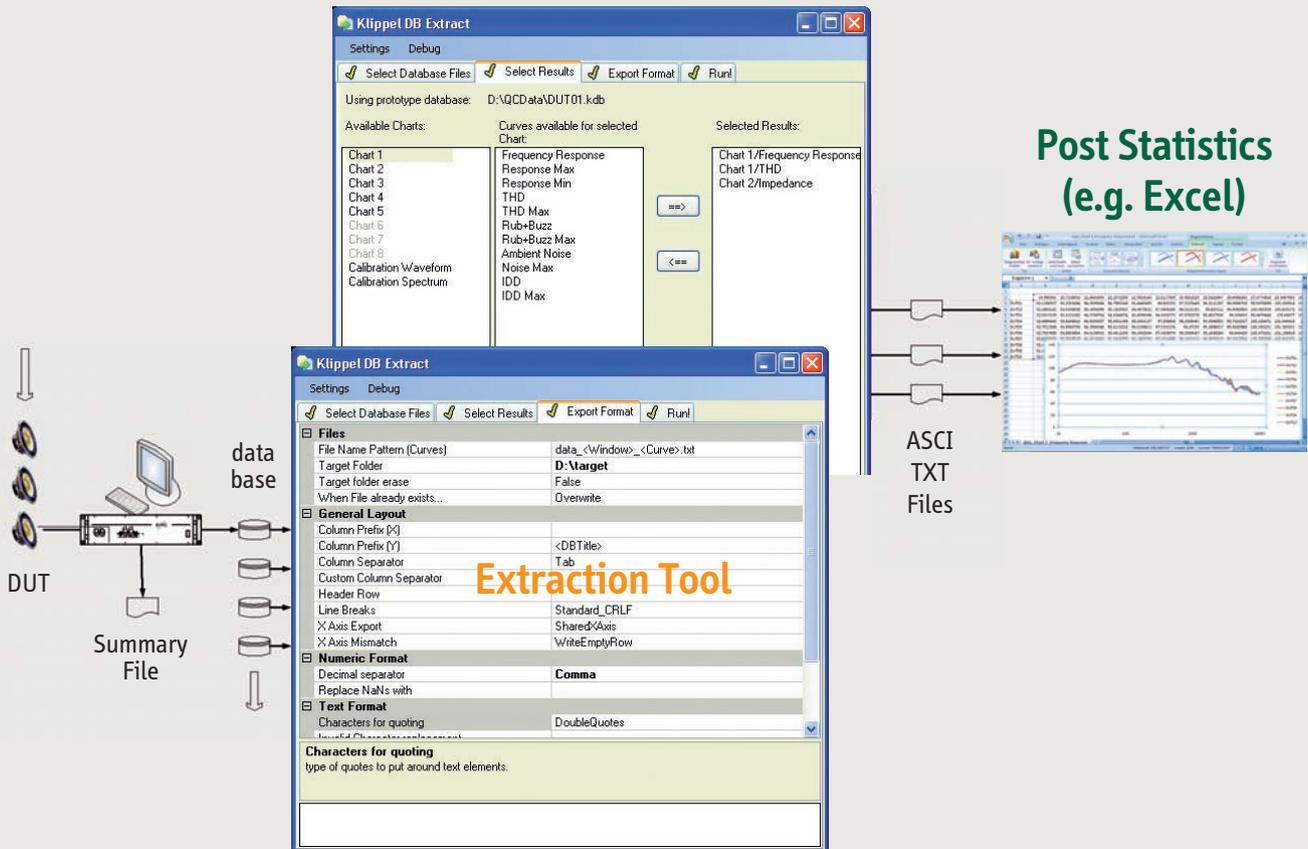
Smart limit setting

Klippel provides powerful tools for setting limits manually or automatically based on random samples and statistical calculations. This data can also be used to find „Golden reference units“ with parameters close to average values. Limits can be adjusted with such golden units if the ambient temperature or other conditions change.

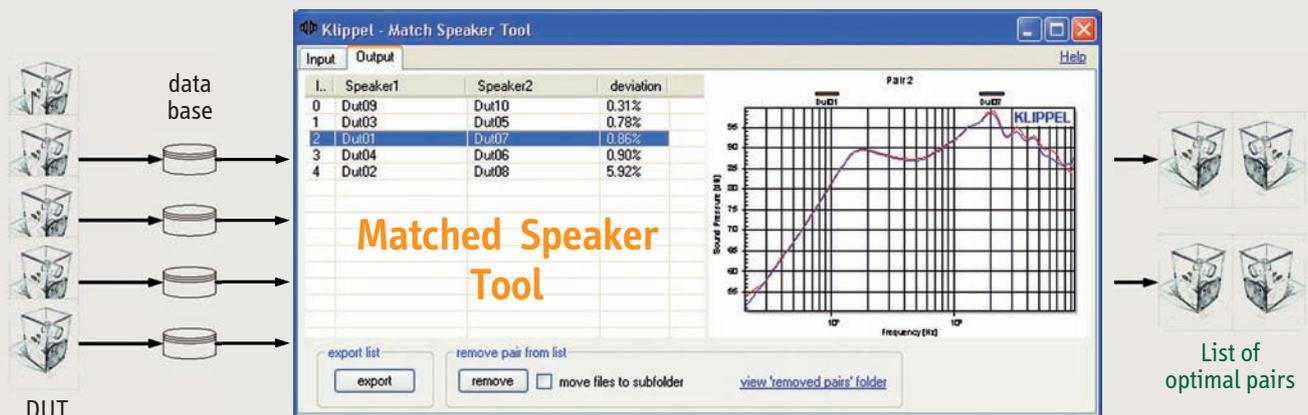


Limit curves can be automatically derived from measurements. This is accomplished by exploiting the standard variations, adding meaningful tolerances by applying jitter, shifting the average curve, inserting a floor and other algorithms.

Flexible Data Export and Post-Processing



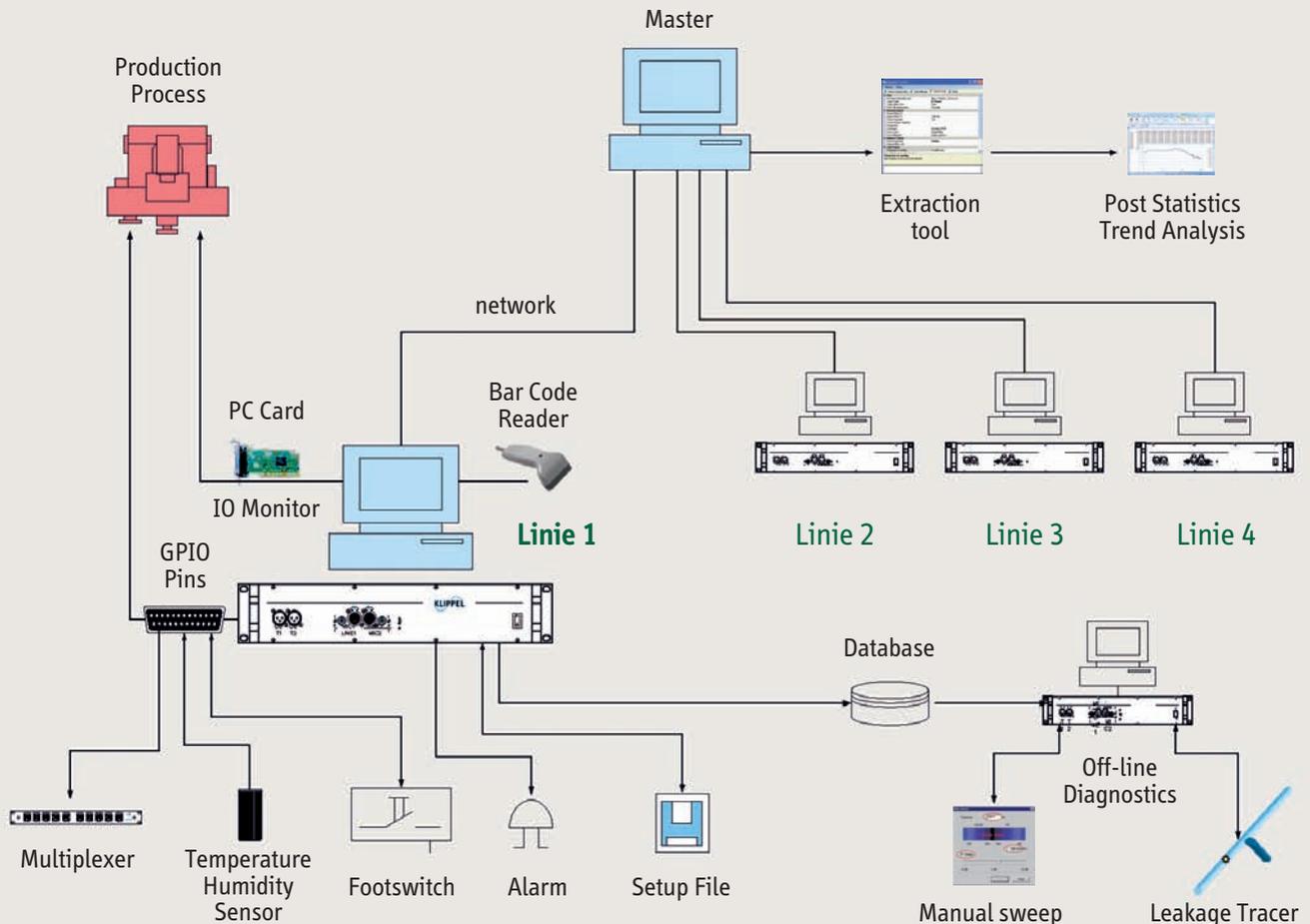
The measurement system produces an ASCII summary file (verdicts, single value parameter) in an easily readable text format. High speed export is realized by writing all results into a binary database. The extraction tool provides access to all data and allows the flexibility to generate a text file in a desired format. Output in different format can be generated for process control, long-term statistics, diagnostics and customer reports.



Match Speaker Tool selects optimal pairs of speakers from the databases which have similar properties.

Ready for Process Automation

The QC system seamlessly integrates with the manufacturing process by using GPIO pins. A software IO monitor supports integration into user software using dll interface (VB.Net, C#, C++, Java, etc.). Simple scripting language SCILAB (similar to MATLAB®) allows fine tuning of test algorithms, limit checks and user interfaces. The combination of access control and script encryption protects setups against unauthorized modifications.



The test setups can be remotely configured via local or global network. Multiple lines can be synchronized from any QC work station.

Everything out of One Hand

To complete the QC system we provide the following accessories:

- Microphone with ICP power supply up to 165 dB peak
- Power amplifier for QC application
- Artificial mouth
- Artificial ear
- Multiplexer for speaker, microphone and XLR inputs
- Temperature and humidity sensor
- Footswitch
- Speaker, amplifier and microphone cables

Application Guide

Test	Drive Units Components	System passive, active	Electronics
Amplitude frequency response	X	X	X
Frequency response	X	X	X
Sensitivity	X	X	
Mean level in frequency band	X	X	X
Polarity	X	X	X
Impulse response	X	X	X
Time delay	X	X	X
Crosstalk		X	X
Noise floor		X	X
Input/Output compression	X	X	X
THD+noise	X	X	X
2nd-5th order harmonics	X	X	X
Intermodulation	X	X	X
Multi-tone distortion	X	X	X
Incoherence	X	X	X
Rub & buzz detection	X	X	
Loose particle detection	X	X	
Loose connection & drop outs	X	X	X
Air leakage noise detection	X	X	
Localization of air leakage	X	X	
Electrical impedance	X	X	X
T/S and nonlinear parameters	X		
Resonance frequency f_s	X		
Loss factors Q_{ts} , Q_{es} , Q_{ms}	X		
Force factor Bl	X		
Moving mass M_{ms}	X		
DC Resistance R_e	X		
Voice coil offset	X		
Suspension asymmetry	X		
Peak displacement X_{max}	X		
Port resonance frequency and loss factor		X	
Limits calculated automatically	X	X	X
Golden reference units	X	X	X
Pass/Fail statistics	X	X	X
Process indices C_{pk} , P_{pk}	X	X	X
Matching devices to pairs	X	X	X

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