QC – Air Leak Stethoscope (ALS) S30

Module of the KLIPPEL Analyzer System (QC Version 6, dB-Lab 210)

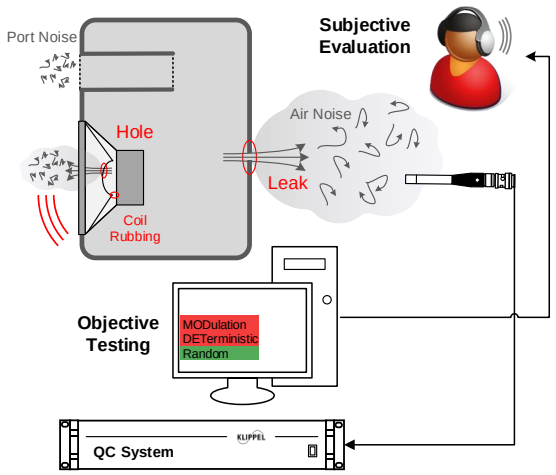
Document Revision 1.4

FEATURES

- Detection and localization of air leaks and other defects
- Auralization of defect symptoms
- Processing kernel from Air Leak Detection (ALD)
- Interactive operation
- No reference unit required

BENEFITS

- Diagnostics of defective units
- Ear protection
- Subjective and objective evaluation of defects
- Root cause analysis
- Operator training



DESCRIPTION

The Air Leak Stethoscope is a powerful off-line diagnostics tool dedicated to detecting and localizing air leaks and other audible defects in audio systems of any kind and size. A hand-held “stethoscope” microphone is used to trace the place of origin of defect noise and distortion. Special signal processing is applied to assess and classify air noise and defect distortion. Additionally, the isolated distortion signal is played back via headphones for subjective evaluation and ear protection.

The ALS is the interactive counterpart to the Air Leak Detection (ALD) end-of-line test task sharing the same signal processing kernel and result parameters.

Article number	4000-243

CONTENT

1 Overview

1.1 Principle

The ALS is designed for interactive defect detection and localization in loudspeakers and audio systems. In order to stimulate air leakage noise and mechanical defects, the device under test (DUT) is excited with low frequency tone ensuring high excursion and high pressure in the enclosed air volumes (e.g. cabinet, dust cap).

The acoustical response is recorded with a hand-held microphone which is moved around the DUT by the operator. Signal processing is applied to extract distortion components which are used to calculate dedicated single value measures (*MODulation, DETerminstic, Random*). A colour bar display indicates the distortion level in an intuitive way relative to the acoustical background noise floor which is measured separately. No actual testing limits based on reference units are required.

Additionally, the isolated distortion signal may be played back via the host PC's audio interface for subjective evaluation. Using insulated headphones, the operator's ears are protected while providing a listening sensitivity which is beyond the human hearing.

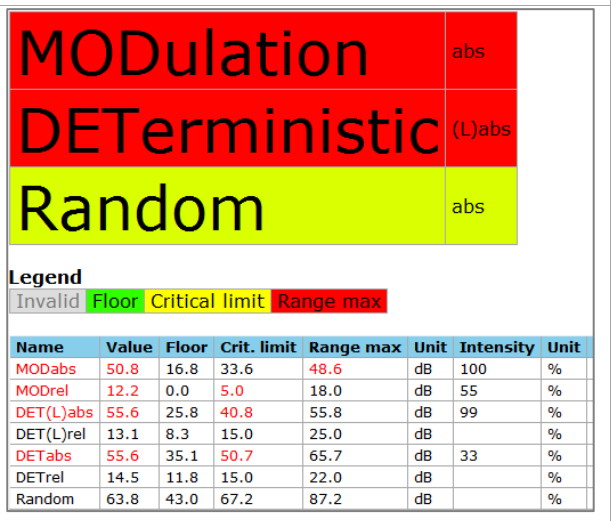
Please find more background information on the signal processing and definition of measures in the specification *S18 – Air Leak Detection (ALD)*.

1.2 Results

Measures

The ALS provides the same result data as the *Air Leak Detection* module:

- **MODulation** (modulated noise)
  - MODabs (absolute)
  - MODrel (relative)
- **DETerministic** (deterministic distortion)
  - DETabs (absolute)
  - DETrel (relative)
  - DET(L)abs (absolute)
  - DET(L)rel (relative)
- **Random** (sporadic distortion)



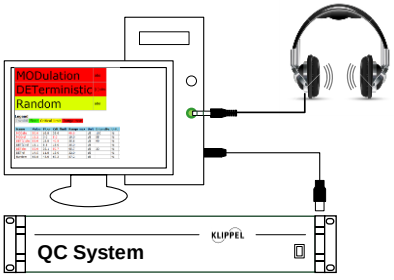
Name	Value	Floor	Crit. limit	Range max	Unit	Intensity	Unit
MODabs	50.8	16.8	33.6	48.6	dB	100	%
MODrel	12.2	0.0	5.0	18.0	dB	55	%
DET(L)abs	55.6	25.8	40.8	55.8	dB	99	%
DET(L)rel	13.1	8.3	15.0	25.0	dB		%
DETabs	55.6	35.1	50.7	65.7	dB	33	%
DETrel	14.5	11.8	15.0	22.0	dB		%
Random	63.8	43.0	67.2	87.2	dB		%

The distortion levels of these measures are provided in the result table. However, the main display is a colour bar diagram which displays the distortion levels qualitatively for easy interpretation.

Auralization & Wave Export

In order to evaluate defect distortion, the ALS suppress the actual test tone and low order harmonics in the sound pressure response. The residual signal can be exported to a WAVE file or immediately played back to the standard audio device of the host PC. This makes it possible to auralize defect symptoms with enhanced sensitivity while protecting the ears of harmful sound pressure levels.

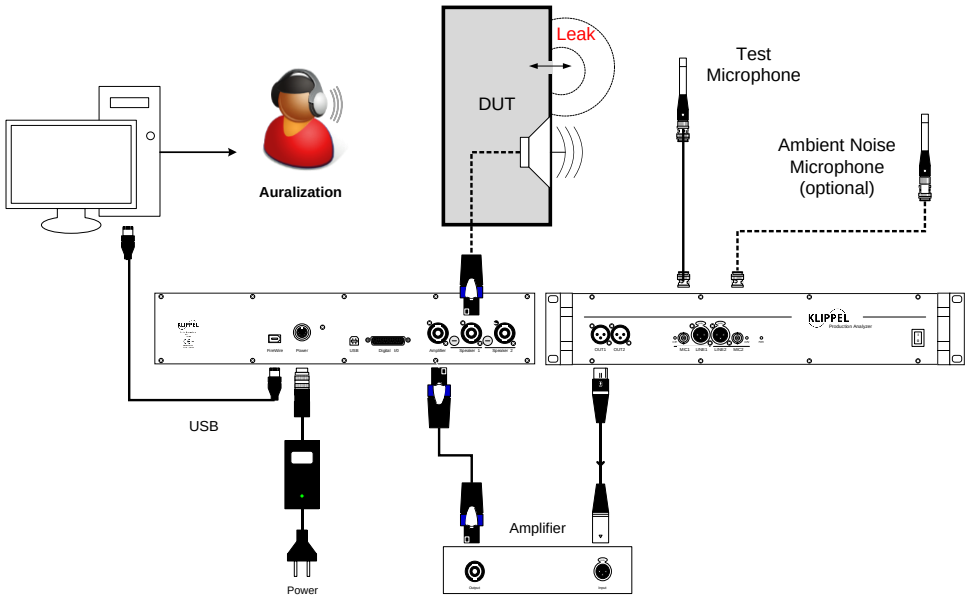
Using this feature, the ALS can be operated in order to localize defects without using the PC monitor.



2 Requirements

2.1 Hardware

Scheme (Passive DUT)



The schematic shown above illustrates the typical hardware setup for passive audio system diagnostics with ALS.

Components

- Measurement hardware
  - KLIPPEL Production Analyzer or
  - Klippel Analyzer 3 (e.g. KA3 QC configuration) or
  - 3rd party audio interface (for active systems)
- PC with sound card for auralization
- Test microphone (“stethoscope”)
- Optional: ambient noise microphone
- Power amplifier or KA3 with Amplifier or QC Card (required for passive systems)
- Optional: headphones (for auralization)
- USB license dongle

For more information about hardware requirements please refer to *C3 QC Set*.

2.2 Software

QC Framework

- KLIPPEL QC Standard software
- *Air Leak Stethoscope* license

No additional setup is required

R&D Framework

- KLIPPEL dB-Lab Release 210 or higher
- QC in R&D license (free)
- *Air Leak Stethoscope* license

No additional setup is required

Note: KLIPPEL Analyzer 3 (KA3) hardware is required to operate the MSC in the RnD software framework.

2.3 Acoustics

Environment	The ALS does not have any specific acoustical requirements. Anechoic or insulated rooms may improve performance due to lower background noise.
Ambient Noise	Sporadic disturbances are usually not critical for the ALS off-line application because the measurement is performed repeatedly. However, the steady noise floor should be as slow as possible. However, using an additional ambient noise microphone, corrupted measurements can be identified and the results invalidated. Please refer to *S18 – Air Leak Detection (ALD)* for more information.

3 Parameters and Results

3.1 Setup Parameters (Selection)

Parameter	Symbol	Min	Typ	Max	Unit
STIMULUS					
Time – measurement time (incl. pre-loop)	t_{test}	0.45	0.45	0.97	s
Frequency – test tone frequency	f_{test}	4	50	1000	Hz
Voltage (rms) – stimulus voltage	$\tilde{V}_{\text{stim}}$	0	1	200	V

3.2 Measurement Results

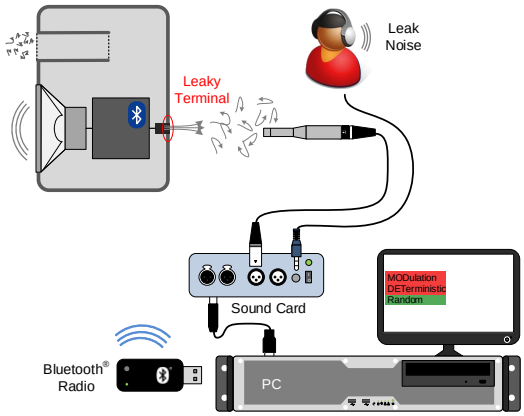
Measured Name	Symbol	Unit
Modulated distortion (absolute)	MOD_{abs}	dB
Modulated distortion (relative)	MOD_{rel}	dB
Deterministic leak distortion (absolute)	$DET(L)_{\text{abs}}$	dB
Deterministic leak distortion (deterministic)	$DET(L)_{\text{rel}}$	dB
Deterministic distortion (absolute)	DET_{abs}	dB
Deterministic distortion (relative)	DET_{rel}	dB
Random Distortion	*Random*	dB

4 Examples

4.1 Production Offline Diagnostics of Multimedia Speakers

During the end-of-line test of multimedia speakers, all DUTs are tested for *Rub & Buzz* defects and air leakage using the KLIPPEL QC Standard with *ALD*.

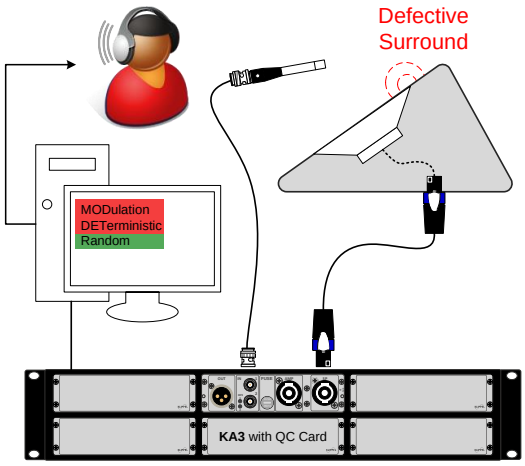
Failed units are transferred to an off-line diagnostics station which is equipped with the ALS in order to localize the defect root cause. For digital speakers, the test signal may be played back directly via Bluetooth® or USB connection and the microphone signal can be recorded through a professional audio interface that also provides the audio diagnostic signal to the operator's headphone.



4.2 Inspection of Professional Speaker

The incoming goods inspection in a rental company for professional audio products (PA speakers, stage monitors…) is crucial to identify damage due to ageing or misuse.

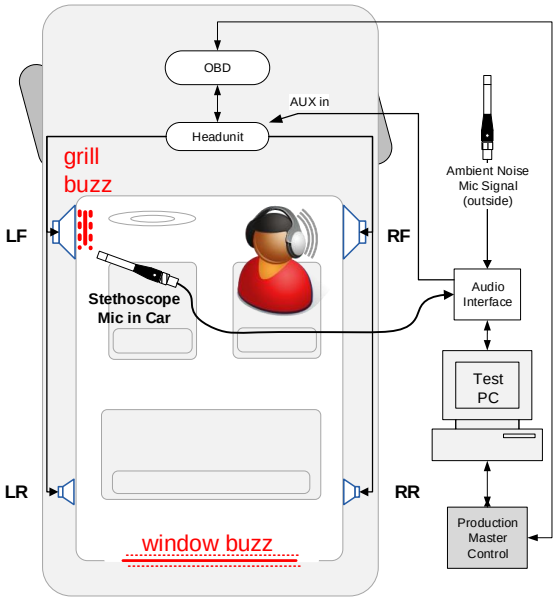
The ALS is a powerful tool to identify and localize such defects easily. Using noise insulated headphones the operator can test the equipment at critical playback levels with maximal sensitivity while protecting the ears.



4.3 Localization of Parasitic Vibration in Car Interior

After assembling the audio system in car manufacturing, a short acoustical end-of-line test is performed focussing on mounting defects and parasitic vibration (speaker induced buzzing).

In case the test failed, the ALS is used to quickly localize the problem in the car interior for immediate repair.



5 References

5.1 Related Modules	• S18 Air Leak Detection (ALD) • S56 Live Audio Analyzer (LAA) • Difference-Auralization (DIF-AUR)
5.2 Manuals	• Manual Air Leak Stethoscope • Manual Air Leak Detection
5.3 Publications	W.Klippel, R.Werner; “Measurement of Turbulent Air Noise Distortion in Loudspeaker Systems”, J. Audio Eng. Soc., Vol. 59, No. 7/8, 2011 July/August

6 Patents

Germany	102009033614
USA	12/819,455
China	201010228820.8

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