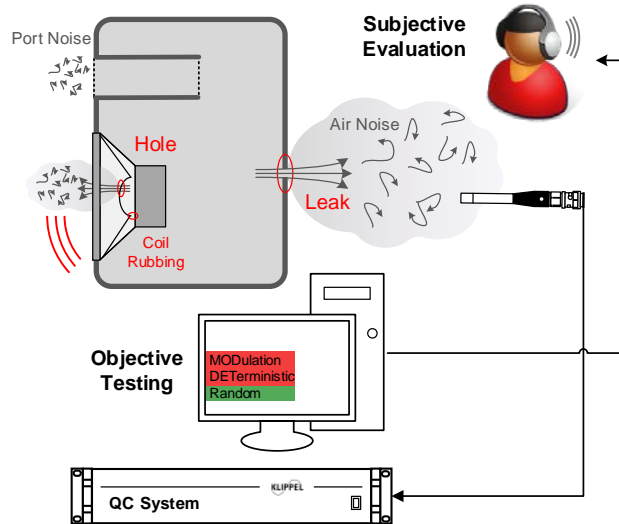


## FEATURES

- Detection and localization of air leaks and other defects
- Auralization of defect symptoms
- Processing kernel from Air Leak Detection (ALS)
- Interactive operation
- No reference DUT 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) on-line testing module sharing the same signal processing kernel and distortion measures.

Article number

4000-243

## CONTENT

1	Overview .....	2
2	Requirements .....	3
3	Parameters and Results.....	4
4	Examples .....	4
5	References.....	6
6	Patents .....	6

# 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, DETerministic, 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.

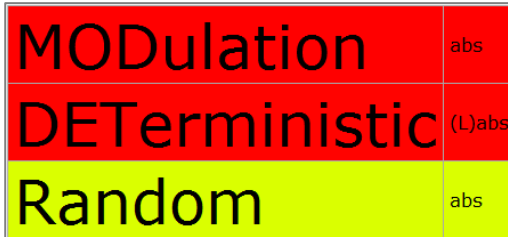
Please find more background information on the signal processing and definition of measures in the specification *S18 – Air Leak Detection (ALD)*.

## 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)



#### Legend

Invalid Floor Critical limit Range max

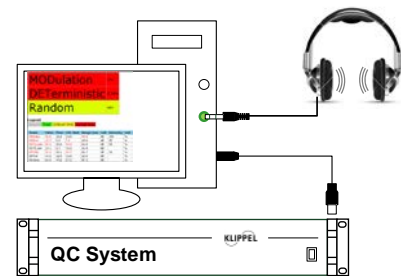
Name	Value	Floor	Crit. limit	Range max	Unit	Intensity	Unit
MODabs	50.8	16.8	33.6	48.6	dB	100	%
MODrel	12.2	0.0	5.0	18.0	dB	55	%
DET(L)abs	55.6	25.8	40.8	55.8	dB	99	%
DET(L)rel	13.1	8.3	15.0	25.0	dB		%
DETabs	55.6	35.1	50.7	65.7	dB	33	%
DETrel	14.5	11.8	15.0	22.0	dB		%
Random	63.8	43.0	67.2	87.2	dB		%

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

<h3>2.1 Hardware</h3>	
<p>Scheme (Passive DUT)</p>	
<p>Components</p>	<ul style="list-style-type: none"> <li>• KLIPPEL Production Analyzer</li> <li>• PC with audio interface (sound card)</li> <li>• Test microphone (“stethoscope”)</li> <li>• Optional: ambient noise microphone</li> <li>• Power amplifier (for passive systems only)</li> <li>• Optional: headphones (for auralization)</li> </ul> <p>For more information about hardware requirements please refer to <i>C3 QC Set</i>.</p>
<h3>2.2 Software</h3>	
	<ul style="list-style-type: none"> <li>• KLIPPEL QC Standard System</li> <li>• <i>Air Leak Stethoscope</i> license</li> </ul>
<h3>2.3 Acoustics</h3>	
<p>Environment</p>	<p>The ALS does not have any specific acoustical requirements. Anechoic or insulated rooms may improve performance due to lower background noise.</p>
<p>Ambient Noise</p>	<p>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 low as possible.</p> <p>However, using an additional ambient noise microphone, corrupted measurements can be identified and the results invalidated. Please refer to <i>S18 – Air Leak Detection (ALD)</i> for more information.</p>

### 3 Parameters and Results

#### 3.1 Setup Parameters (Selection)

Parameter	Symbol	Min	Typ	Max	Unit
<b>STIMULUS</b>					
Time – Measurement time (incl. preloop)	$t$	0.45	0.45	0.97	s
Frequency – Test tone frequency	$f_{test}$	4	50	1000	Hz
Voltage (rms) – stimulus voltage	$\tilde{U}_{stim}$	0	1	200	V

#### 3.2 Measurement Results

Measured Name	Symbol	Unit
Modulated distortion (absolute)	MOD <sub>abs</sub>	dB
Modulated distortion (relative)	MOD <sub>rel</sub>	dB
Deterministic leak distortion (absolute)	DET(L) <sub>abs</sub>	dB
Deterministic leak distortion (deterministic)	DET(L) <sub>rel</sub>	dB
Deterministic distortion (absolute)	DET <sub>abs</sub>	dB
Deterministic distortion (relative)	DET <sub>rel</sub>	dB
Random Distortion	Random	dB

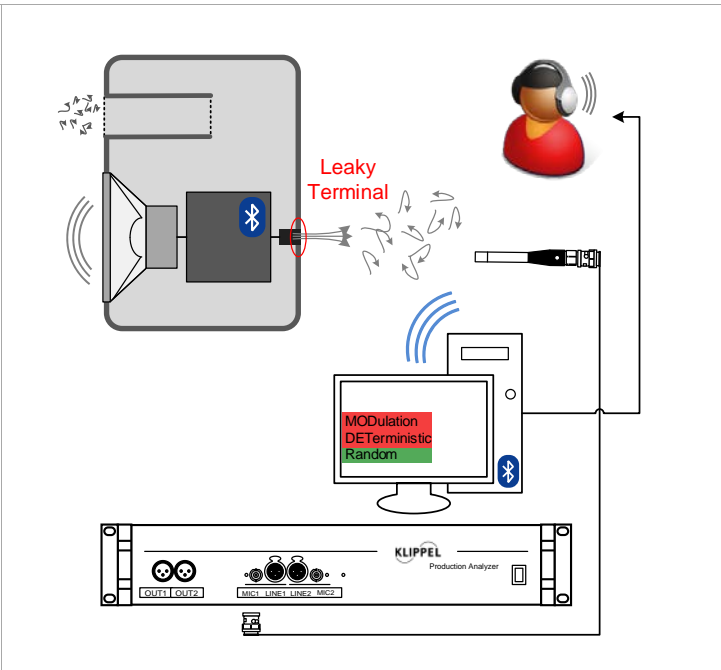
### 4 Examples

#### 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 System (e.g. *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. The test signal may be played back directly via Bluetooth or USB connection.

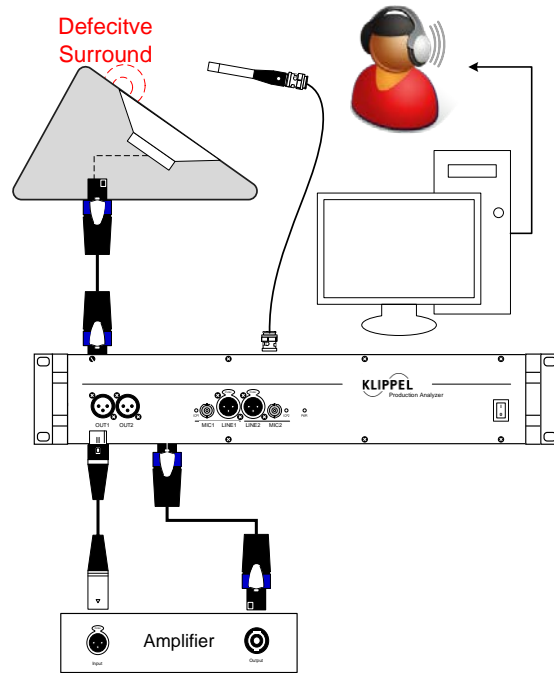
The example shown here shows a speaker with leaky input terminal due to faulty mounting.



**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.

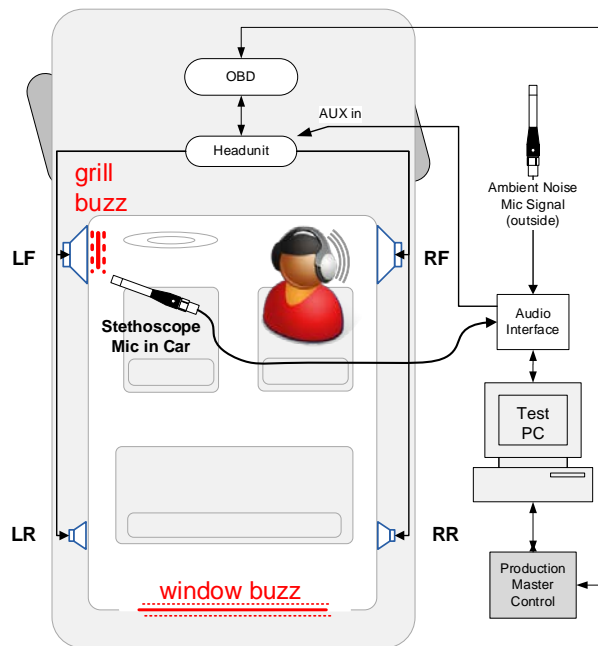
The ALS is a powerful tool to identify and localize such defects easily. Using noise insulated headphones the operator can test the equipment at critical playback levels with maximal sensitivity while protecting the ears.



**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

<b>5.1 Related Modules</b>	<ul style="list-style-type: none"> <li>• C3 QC Set</li> <li>• S18 Air Leak Detection (ALD)</li> <li>• S22 DIF-AUR Difference Auralization</li> </ul>
<b>5.2 Manuals</b>	<ul style="list-style-type: none"> <li>• Manual Air Leak Stethoscope</li> <li>• Manual Air Leak Detection</li> </ul>
<b>5.3 Publications</b>	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

<b>Germany</b>	102009033614
<b>USA</b>	12/819,455
<b>China</b>	201010228820.8

Find explanations for symbols at:

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

Last updated: March 29, 2017

