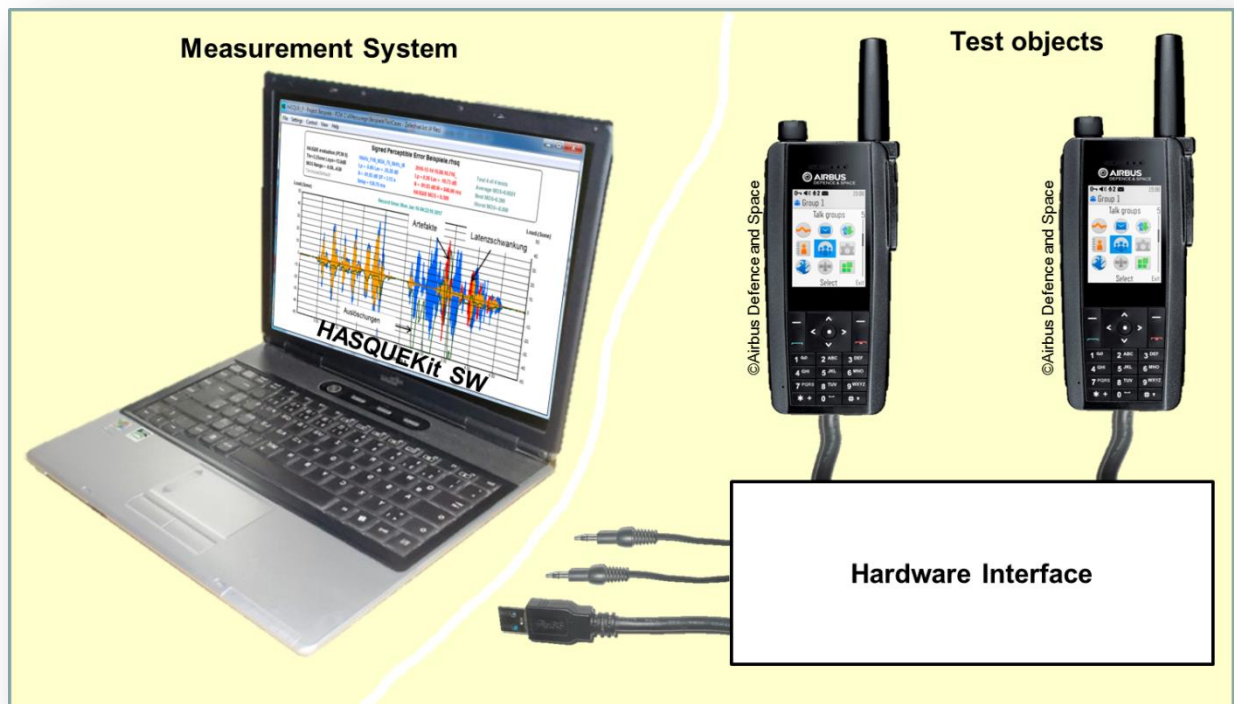


HASQUEKit -Adaptable Measurement System-



Quality evaluation of audio and
telecommunication systems for individual
hardware solutions

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Intended use:

General

This **HASQUEKit** is as a clean software solution providing measurement- and test functions for the quality evaluation of audio and telecommunication systems for real time hardware systems and so for post processes PCM recordings. This HASQUEKit can be adapted with the aid of programmable signal interfaces to various hardware solutions and is suitable for the implementation in research, development and manufacturing environments.

System independent plausible evaluation of audio systems

Measurement principles, which are designed for a certain system as e.g. a speech codecs, drop out for evaluation of any other system as e.g. noise reduction, echo cancellation, bandwidth extension or any broad band systems, due to typical limitation of such systems. The HASQUE principle is well adapted to the natural properties of the human hearing system, carries out listening test simulation, operates without band limitations, takes signal and background noise into account and thus is suitable for hearing adequate quality evaluation of all audio systems.

System independent quality enhancement

The optimum quality of an audio system is only achievable with optimal parameterization. HASQUE operates without limitations and thus is suitable to find the optimal parameterizations of an audio system.

Precise Real time measurements

Due to the robust measurement principle and the automatic level adaptation to the unknown hardware interfaces reproducible real time evaluation with high precision (typ. 1%) is possible.

Error recognition (Error tracer)

Self-defined errors can be detected with one view from innumerable test cases with the aid of a programmable error recognizer making detailed examinations in time and frequency domain possible.

Offline quality evaluation

Offline quality evaluation of post processed signals offers the opportunity to make still unknown errors and error causes visible making automatic analysis and quality enhancement with latest means possible without the need of expensive test drives.

HASQUE measurement systems are used by the „Bundesanstalt für den Digitalfunk der Behörden und Organisationen mit Sicherheitsaufgaben“ (BDBOS) for certification of digital radio devices and control centres.

More details about HASQUE are available in: [HASQUE](#)

Real Time measurement system for audio hardware devices

Quality evaluation of hardware devices needs suitable interfaces between measurement system and the hardware under test.

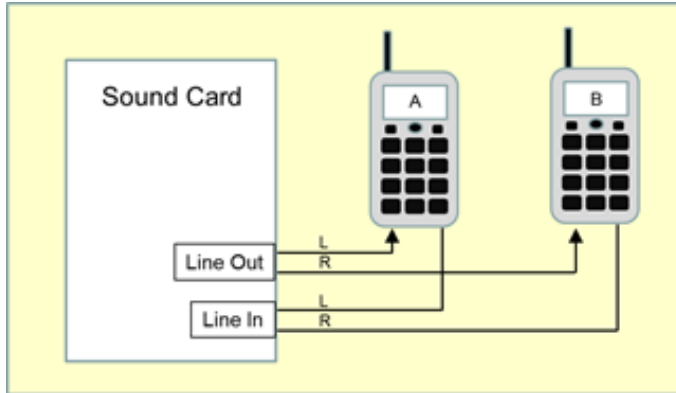


Figure 1: Line as analog measurement interface

This HASQUEKit is adaptable to different hardware configurations by programmable selection and settings to a suitable sound card (audio device).

The simplest solution is to apply the onboard sound card of a PC or a Laptop, whereas software and hardware operate as independent self-acting measurement system.

The hardware interfaces of onboard sound cards are usually 3.5 mm jacks providing stereophonic signal interface mostly named

“line in” or “line out” respectively.

Selection of sound cards

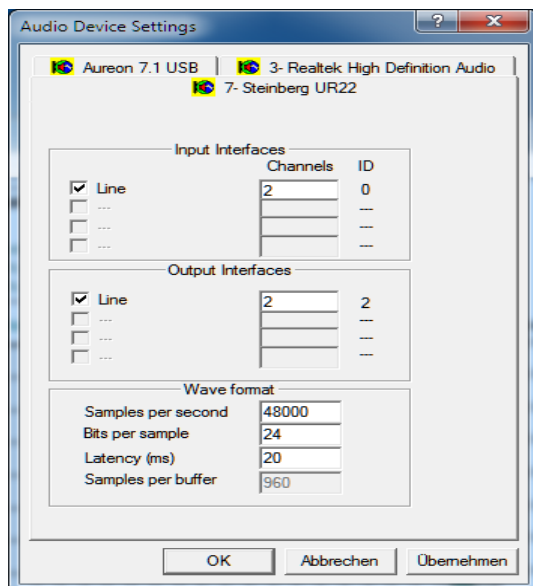


Figure 2: Selection of the sound card

Quality evaluation of audio hardware is possible with the aid of onboard or USB sound cards respectively.

The HASQUEkit is designed for two bi directional audio channels and hence is suitable for the application of most available sound cards.

The HASQUEkit checks the availability of sound cards and makes the selection and parameterization for the desired quality measurement with the aid of programmable property pages possible.

The application of high quality sound cards with high sampling rate and high resolution makes measurements with high precision possible.

Programmable control interface

Some measurement tasks might require application dependent control switches as for instance the PTT control of radio devices or the switch of the signal path into a loop for reference measurements.

Switches for these tasks must be offset- and ground free programmable switches in order to make a distortion free control possible. Hence the use of a USB relays card is made possible with the HASQUEKit.

The HASQUEKit provides a function which checks the presence of a connected USB relay card and controls in case of available relay card up to four relays according to the programmable measurement tasks during real time tests. Hence PTT key functions can be simulated or the signal path can be switched for reference tests if desired.

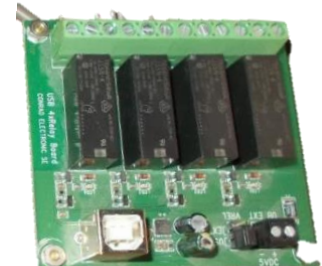


Figure 3: USB Relay card

HASQUE Kit-Hardware

The hardware structure in figure 4 makes demanding measurement tasks of two independent channels with high quality 24 Bit converters possible.

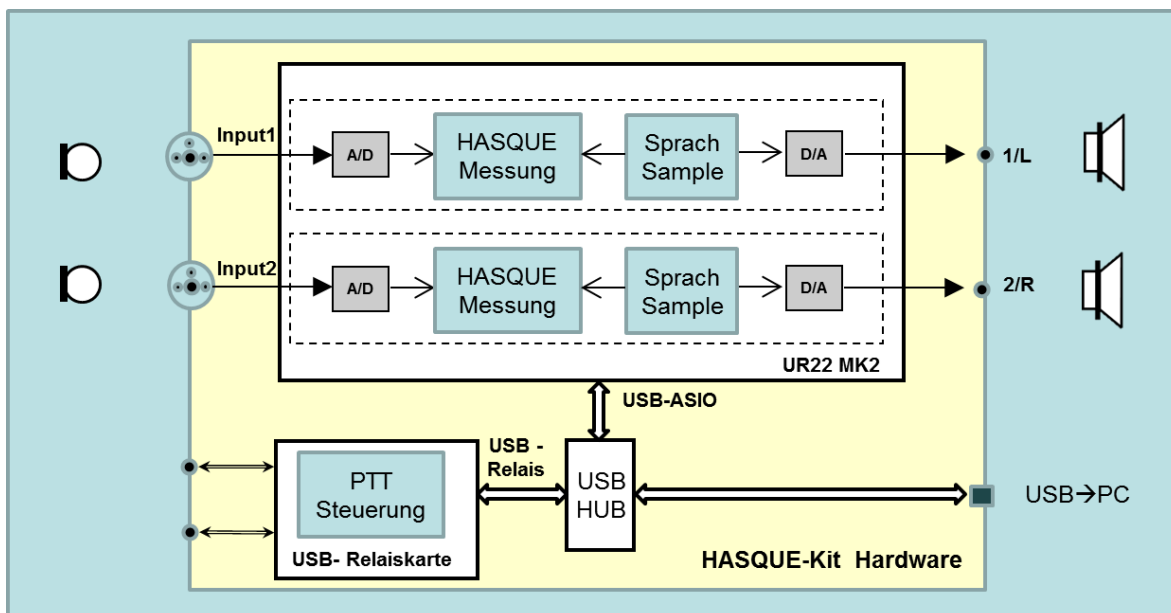


Figure 4: Recommended hardware structure

The PTT control and the audio streaming of the radio devices under test are both USB controlled. For this purpose the connection between PC and USB is spitted over an USB Hub.

Hardware settings as sample rate, PTT status or the buffer size for the ASIO interface are programmable and are saved in an initialization file to the PC.

The signal inputs Input1 and Input2 are fitted with kombi sockets XLR/6.3mm jack sockets and are adjustable separate input gain and switchable microphone phantom power.

Signal outputs as 1/L and 2/R are fitted with 6.3mm jack sockets. The output levels are adjustable with a common gain control.

The relay card has programmable switches which are used for PTT control of the radio devices under test. The HASQUE-Kit software provides simple commands to make reliable flow control including PTT response times possible over the USB interface. The relay contacts are available with luster contacts in the board of the relay card.

Software Features of the Real-time packet:

- Hardware test programs
 - Quick function test
 - Automatic level adaptation
- Task editor real time measurement control
TIP-programming
- Zero delay calibration
- Signal delay (Latency) measurement and compensation
- Automatic PCM file recording (8, 16, 24, 48 kHz) *.wav
- File list creation
- Individual and prepared listening test settings
- Test signals for tests and evaluation:
 - Bartlett burst
 - Sinusoid
 - White noise
 - Butterfly sinusoid and noise
 - Sweep
 - Impulse
 - User defined reference filesWindows PCM (wav), Intel, 8, 16, 24, 48 kHz, 16 Bit, mono

Offline evaluation of PCM recordings

Offline evaluation offers in addition to the listening test simulation of post processed recordings numerous measurement functions for error tracing and error analysis of audio and telecommunication systems and thus is even so suitable for quality enhancements of the systems under test.

Offline measurements are carried out with windows conform PCM signals (*.wav files). It is possible to carry out single and series measurements. The sample rate of the measurement system is adapted to the

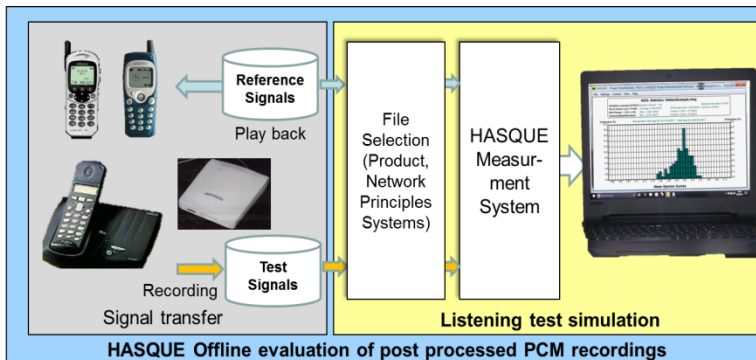


Figure 5: Offline measurement system

sample rate indicated in the header of the audio files. Statistics about quality measures, latency and speech interrupts are computed in conjunction with series measurements.

Series measurements are carried out with file lists, which can be created with the aid of a special editor for easy composition of different test cases. An import

function for compressed RST-files extracts the belonging reference and test cases, creates the corresponding file list and releases the selections for evaluation.

The entire functions of the offline measurement system as well the following indicated measurement results and representations are part of the real time measurement system.

Software Features of the Offline packet:

- Offline evaluation
 - File selection: File list generator for the collection of PCM test cases to be evaluated, single file selection, RST file conversion into PCM file lists
 - Programmable time and gain alignments
 - Individual and prepared listening test settings
 - Play back of PCM selections (GUI controlled)
 - Zooming, shifting and scaling
 - Sample rate adaptation
 - Picture generator based on EMF vector graphics
- Representations
 - MOS results summary about all tests of a test series
 - MOS statistic distribution curve, percentile, standard deviation, variance, thresholds
 - Delay results summary about all tests of a test series
 - Delay results statistic distribution curve, percentile, standard deviation, variance, thresholds
 - Speech interrupt results summary about all tests of a test series
 - Speech interrupt statistic distribution curve, percentile, standard deviation, variance, thresholds

- Individual error results about all tests (error classification and error tracer)
- Time domain separate representation of reference and test signal
- Time domain representation of reference and test signal - single, separate, merged
- Frequency domain representations of reference and test signals
- Signed and unsigned perceptible error
- Correlations between test and reference files
- Individual error (error classification and error tracer)
- Results
 - EMF file including the picture about the statistics of the results
 - HASQUE Riff Result file for easy access to the applied test cases
 - Text (ANSI) including lists about measurement results of each single test
- Online help books

Technical Data:

Specifications of the HASQUE software:

Sample rate	adaptive to the applied reference files
¹ Bandwidth	programmable
Latency accuracy	typ. 0.1 ms
Maximal delay	1 sec
² MOS range	programmable
³ Threshold of acceptance	programmable
Max. Input level	0 dBFS
Max. Output level	0 dBFS
² System level	programmable
Level control	-20 dB ... +6 dB, step size 0.1 dB
¹ PCM Format	Windows PCM (wav), Intel, 8kHz, 16 Bit, mono
Results (Picture)	Enhanced Meta Files (EMF)
Results (Text)	ANSI
Results (HASQUE)	RIFF, RHSQ Files

Computer:

Operating System	Windows 7 ... 10
Processor	AMD A4-4000 APU with Radeon (tm) HD Graph. 3000MHz, 1 Core, 2 logical processors.
Memory (RAM)	> 2 GB

USB Interface:

Specifications	USB 2.0
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¹ Conditions are adapted to any sample rate of the reference files automatically for offline evaluation.
Real time evaluation supports 8, 16, 24 and 48 kHz samples

² The MOS scale can be adapted to individual requirements

³ Listening test conditions can be adapted to individual requirements

The following technical data depend on the selected and connected hardware and indicated an example for a typical standard sound card.

Converter:

Sample rate	48 000 Hz
Bits per Sample	24
Format	Windows PCM (wav)

Measurement input:

Analog Interface 3.5 mm jack stereo

Bandwidth	20 Hz - 23000 Hz at 48 kHz sampling rate
Max. Input Level	1,2 dBu
Input Impedance	10 k Ω

Measurement output:

Analog Interface 3.5 mm jack stereo

Bandwidth	20 Hz - 23000 Hz at 48 kHz sampling rate
Max. Output Level	1,2 dBu
Output Impedance	150 Ω
SNR	typ. 90 dB
THD (1kHz)	typ. 0.1 %

Literature:

1. Sound acoustics: [HASQUE](#)