HEAD acoustics

DATA SHEET

Code 60025

HQS-Ac2Ac

HEAD acoustics Quality Standard, Acoustic-to-Acoustic Measurements

OVERVIEW

HQS-Ac2Ac

Code 60025

HEAD acoustics Quality Standard, Acoustic-to-Acoustic Measurements

HQS-Ac2Ac is a quality standard developed by HEAD acoustics for testing arbitrary voice communication systems. HQS-Ac2Ac treats the transmission path between two endpoints as a "black box", allowing general testing and optimization of communication quality. It can be used e.g. where access to the transmission path is difficult or not possible, but also to quickly assess the end-to-end quality of a system as a whole.

HQS-Ac2Ac supports all frequency bands common for voice communication – narrowband to fullband, covers symmetrical (e.g. headset-to-headset) as well as asymmetric (e.g. headset-to-hands-free) paths. In addition to basic performance metrics such as gain, frequency response and distortion, HQS-Ac2Ac also applies advanced metrics such as echo, double-talk, communication quality in the presence of background noise and more. HQS-Ac2Ac applies several internationally acknowledged speech quality assessment metrics (e.g. 3QUEST, ABLE) for comprehensive analysis of real-life speech transmission quality.

KEY FEATURES

Comprehensive automated test suite

Universally applicable to any speech transmission path independent of connection type, system topology etc.

Supports symmetric (e.g. hands-free ↔ hands-free) and asymmetric (e.g. headset ↔ hands-free) systems

Tests in all common frequency bands (narrowband to fullband)

Provides comprehensive test results with a high focus on real-life performance

APPLICATIONS

Measurements of arbitrary paths, systems and devices for speech transmission with limited accessibility to the transmission path, e.g. due to:

- (Inaccessible) encryption, e.g. in closed communication networks
  - Police
  - Military
  - Rescue services
- Custom/proprietary codecs or protocols
  - Voice-over-IP systems
- Fixed installment systems/devices
  - Building intercom systems
  - Emergency intercoms, e.g. in elevators

Measurements of arbitrary paths, systems and devices to test end-to-end speech transmission quality in a system as a whole

DETAILS

The ideal test case for assessment of voice communication quality is a singular device, e.g. a smartphone, in a fully accessible test environment. All crucial elements for communication can be replaced by measurement and simulation hard-/software for a comprehensive analysis. However, there are communication systems in which speech quality plays a major role, but accessing the transmission path is not possible. For such systems, HEAD acoustics developed HQS-Ac2Ac. The HEAD Quality Standard treats the transmission path between two devices as a "black box" and evaluates only the acoustic in- and outputs of the path.

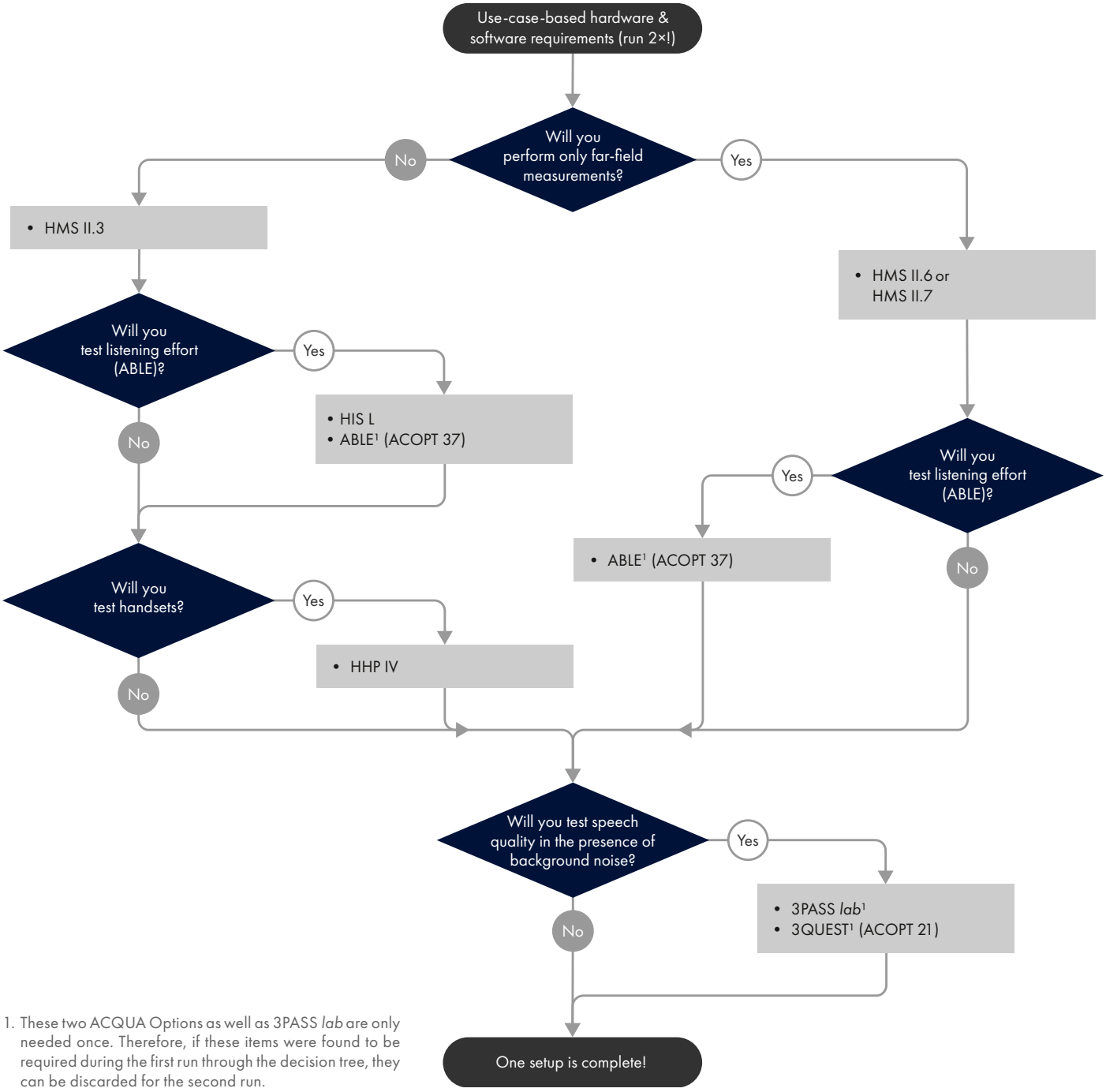
Inaccessible Transmission Path

For a significant number of scenarios in which voice communication quality plays a key role, accessibility to the transmission path is either severely limited or even impossible. For example, many VoIP terminal devices and conferencing systems use proprietary codecs and protocols, preventing the option of simulating a reference client for the device under test (DUT). Dedicated systems for special purposes (communication networks for police, military, rescue services etc.) may use inaccessible encryption. Other systems are hard-wired (door/building intercom systems, emergency intercoms etc.) and therefore prevent relocation to a measurement environment for performing measurements.

For systems with limited or no access to the transmission path, HEAD acoustics developed HQS-Ac2Ac. The HEAD Quality Standard treats the transmission path between two devices as a "black box" and evaluates only the acoustic in- and outputs of the path. HQS-Ac2Ac therefore is ideally suited for any test case without electrical access to the transmission path as well as for systems which cannot be measured by conventional means for any reason.

USE-CASE-BASED REQUIREMENTS

The hardware and software requirements for HQS-Ac2Ac vary per specific device type and application scenario. The below decision tree must be completed two times - once for the 'near end', once for the 'far end' - to determine the required hardware and software. The hardware and software items listed on pages six and seven as 'General Requirements' are necessary independent of use case.



1. These two ACQUA Options as well as 3PASS *lab* are only needed once. Therefore, if these items were found to be required during the first run through the decision tree, they can be discarded for the second run.

Product Codes

3PASS *lab*[1]	Code 6990		HIS L	Code 1701
3QUEST[1] (ACOPT 21)	Code 6844		HMS II.3	Code 1703
ABLE[1] (ACOPT 37)	Code 6869		HMS II.6	Code 1706
HHP IV	Code 1406		HMS II.7	Code 1707

Due to the solely acoustic black box-approach, testing with Ac2Ac is completely independent of any type of connection (wired, short/long range wireless etc.), (custom) codec, encryption, handshake procedures and so on, which usually prevents testing or requires special hardware and software.

The System as a Whole

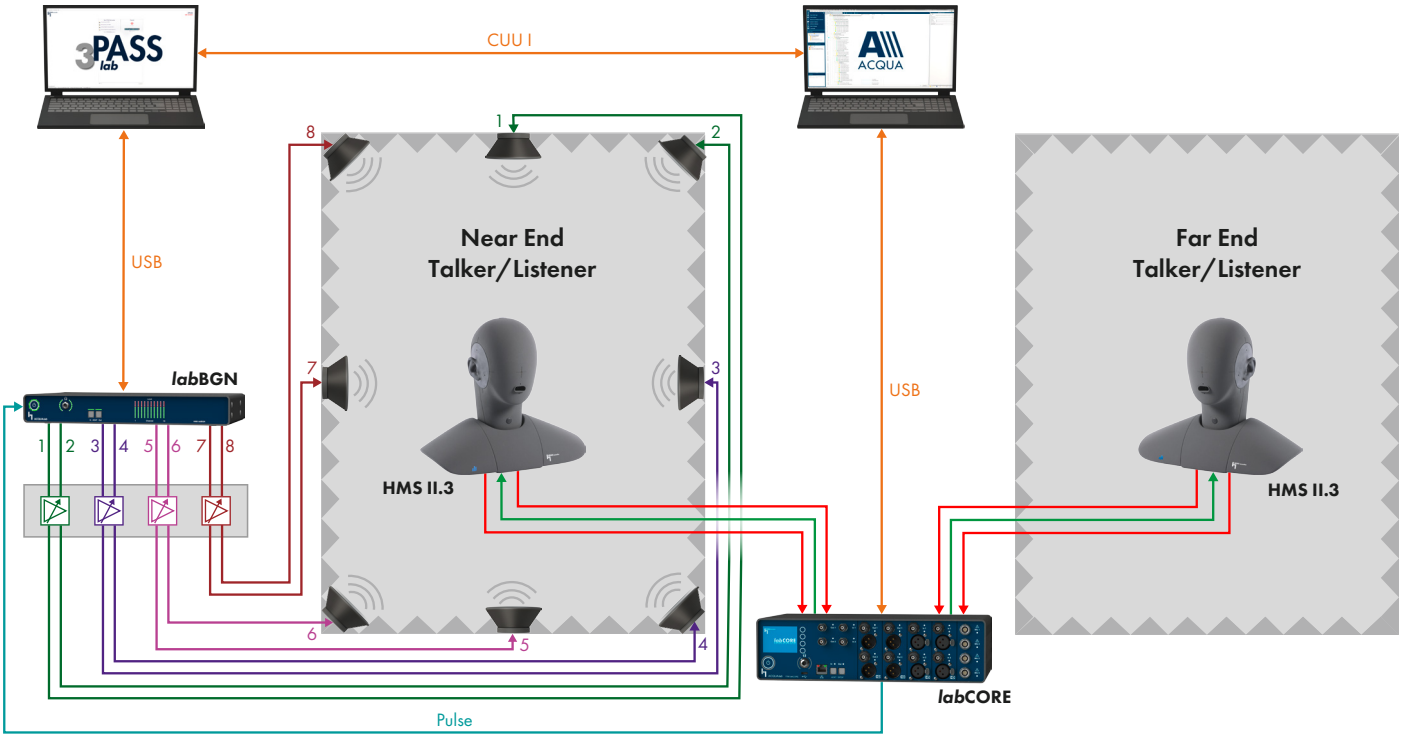
Even if the transmission path can be accessed, testing the system end-to-end can be interesting. Any system comprises a large number of elements which can impair transmissions. Even if all singular components in a transmission chain have been optimized for good performance, issues may appear when they are chained together to form a whole system. There may for example be disregarded or unaccessible singular elements introducing impairments, there may be unforeseen interactions between elements, and so on. Therefore, testing the system as a whole with HQS-Ac2Ac is beneficial to quickly assess the general performance including all components, accessible or not.

SCOPE OF DELIVERY

HQS-Ac2Ac
- Revision 01
- delivered as ACQUA Database Backup

V2C File
- License File for ACQUA Dongle

Revision History
- PDF File



A generic setup for Measurements with HQS-Ac2Ac. At each end of the transmission path, a HMS simulates the DUT's user. Both are situated in an acoustically separated anechoic environment. They are connected to one common labCORE hardware platform, binaurally as well as with their artificial mouth. Both support far-from-the-ear as well as close-to-the-ear DUTs, therefore the system under test may be of arbitrary symmetrical or unsymmetrical configuration. Background noise is simulated at the near end by 3PASS lab. This setup would support any test contained in the HQS-Ac2Ac database, any frequency range (narrowband to fullband), any possible type of closed voice communication system and any type of terminal devices. Only for handsets, the handset positioner HHP IV would be required for each respective end.

Acoustic End-to-End Measurements

One of the major challenges when evaluating only the acoustic in- and output of voice communication is to separate desired from undesired signals. The lack of access to the transmission path prevents extraction of raw signals as well as measuring in- or output in user-defined states.

An important factor in in-depth analysis of speech quality is the unavoidable near-end acoustic leakage (sidetone mouth-to-ear). To tackle this issue, HQS-Ac2Ac applies 'Time-synchronous Noise Compensation' (TNC). This process includes performing dedicated measurements and removing acoustic leakage from the signal to be analyzed as far as the acoustic situation allows. This enables HQS-Ac2Ac to perform conclusive echo and double-talk tests that would otherwise be impossible.

In order to gather usable measurement data, both ends of the transmission path have to be located in acoustically separated environments to avoid crosstalk. Both locations generally require their own HMS to simulate the user at either end. On the other hand, not having any electrical access to the transmission path waives the need for hard- or software to simulate a reference client or a wireless network. Additionally, the measurement procedure with HQS-Ac2Ac is relatively straightforward and test results are very close to real-life user experience.

The illustration on page five shows a "universal" setup for HQS-Ac2Ac as an example. Despite needing two acoustically separate rooms and having two HMS, only one *lab*CORE unit is required. Also, background noise simulation is needed only for the near end, thus one 3PASS *lab* suffices for HQS-Ac2Ac.

Limitations

Because of the purely "external" look on the transmission path, not all signals can be directly measured or reconstructed based on measurements. For example, effects happening in the send-

GENERAL REQUIREMENTS

Please use the flow chart on page five to determine the hardware and software required for your individual use case. Please note that you have run through the flow chart **two** times, once for the 'Near End' and once for the 'Far End' of your test case(s).

The items listed below are generally required independent of use case(s).

Hardware

*lab*CORE (Code 7700)
› Modular multi-channel hardware platform

*core*BUS (Code 7710)
› I/O bus mainboard

*core*OUT-Amp2 (Code 7720)
› Power amplifier board, for sending direction

*core*IN-Mic4 (Code 7730)[2]
› Microphone input board, for receiving direction

*core*BEQ (Code 7740)
› *lab*CORE binaural equalization, incl. filter set for one artificial head (delivered with *lab*CORE)

*core*BEQ-Add (Code 7741)
› *lab*CORE binaural equalization, additional set of filters for one artificial head (*core*BEQ required)

Software

One of the following HEAD acoustics Software:

ACQUA (Code 6810)
› Advanced Communication Quality Analysis Software, Full-license Version (Version 5.0.100 or newer)

ACQUA Compact (Code 6860)
› (Version 5.0.100 or newer)

ACOPT 09 (Code 6819)
› Option SLVM P.56

Continued on next page

2. HMS II.7 requires *core*IN-ICP4 instead of *core*IN-Mic4.

or receive path are mixed together and cannot be separated from each other. Other measurement results have a "natural" limit in informative value. For example, the signal-to-noise ratio (SNR) between the useful signal (echo) and disturbing signal (sidetone) is small when nothing but acoustic measurement results are available. Channel noise naturally is random, it cannot be subtracted from the result to improve SNR. As a result, testing based on this data can elaborate whether the transmission path works flawlessly, but not necessarily differentiate between a good DUT and a very good DUT.

GENERAL REQUIREMENTS

ACOPT 29 (Code 6856)

› Option EQUEST - Echo Quality Evaluation of Speech in Telecommunication

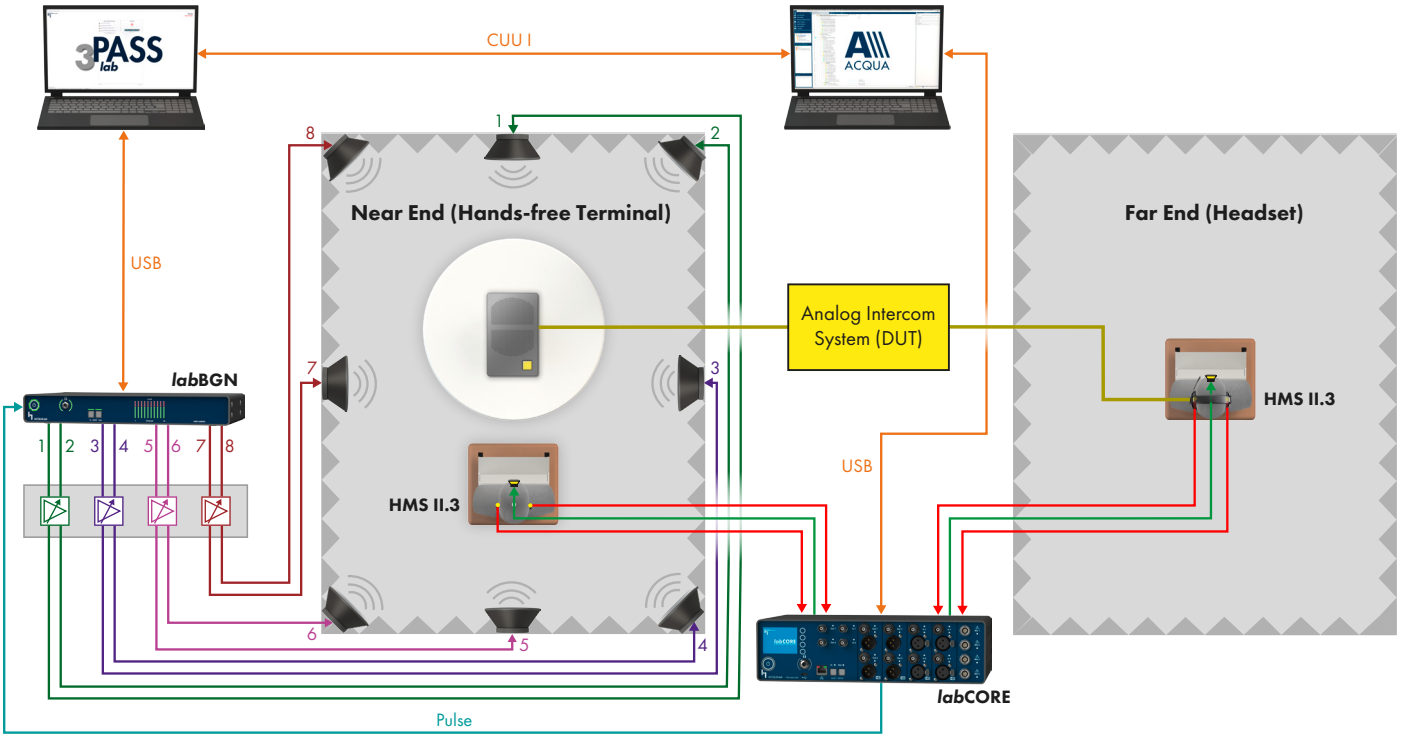
IN PRACTICE

APPLICATION EXAMPLES

Measurement of an Analog Intercom System with HQS-Ac2Ac

This exemplary test scenario depicts testing an analog intercom system with HQS-Ac2Ac. The terminal devices of the system are a hands-free intercom unit at the near end and a headset at the far end.

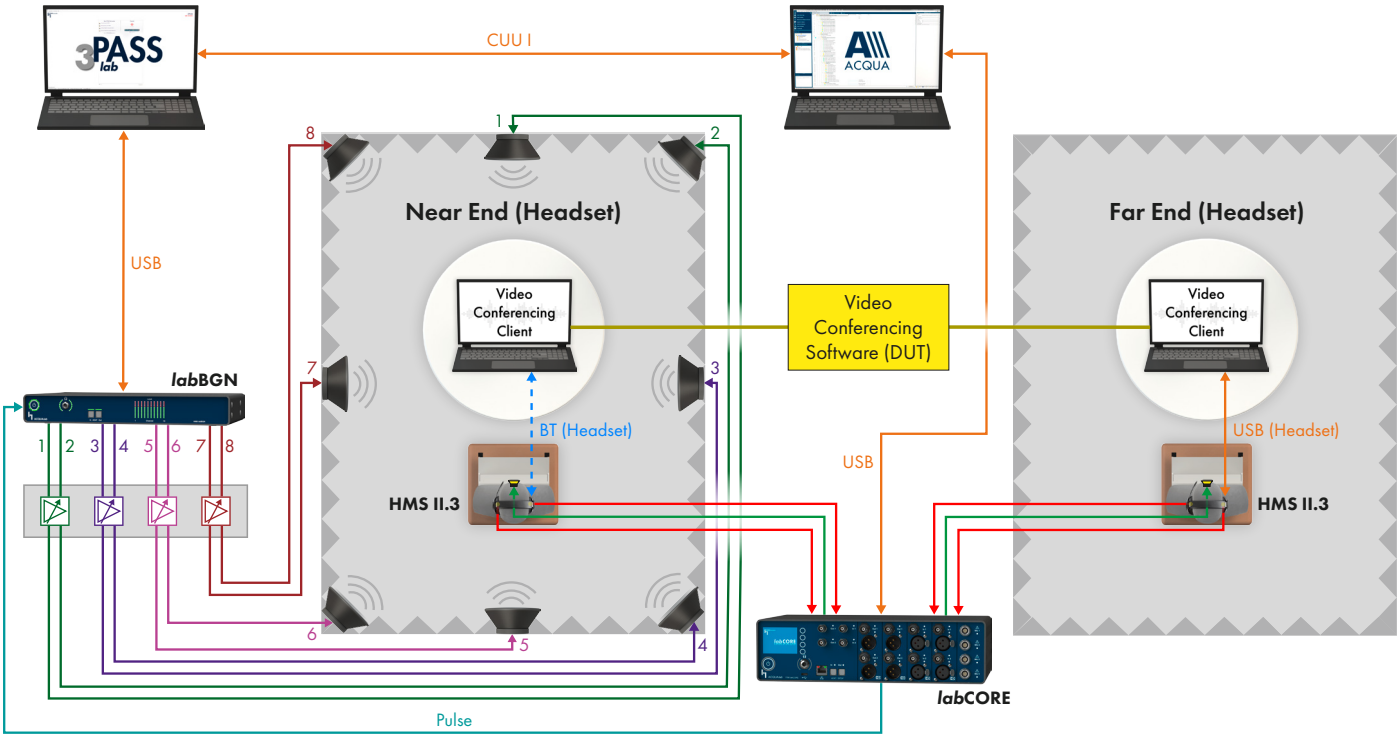
Users at each end are simulated by one HMS II.3 per room. Both are connected to *lab*CORE via *core*OUT-Amp2 and *core*IN-Mic4. Speech quality in the presence of background noise at the near end (3QUEST) is tested with 3PASS *flex*. For full repeatability of measurements, background noise playback is synchronized by *lab*CORE through a pulse connection to the hardware platform *lab*BGN. ACQUA operates in conjunction with *lab*CORE to generate, receive and analyze signals.



Measurement of a Video Conferencing System with HQS-Ac2Ac

This exemplary test scenario depicts testing an IP-based video conferencing system with HQS-Ac2Ac. The terminal devices of the system are headsets at both ends, connecting to their respective client PC via Bluetooth® at the near end and USB at the far end. However, neither these types of connection, nor the connectivity of the PCs to a local network and the Internet, are relevant for HQS-Ac2Ac as it solely examines the acoustic in- and outputs of the headsets.

Users at each end are simulated by one HMS II.3 per room. Both are connected to *lab*CORE via *core*OUT-Amp2 and *core*IN-Mic4. Speech quality in the presence of background noise at the near end (3QUEST) is tested with 3PASS *flex*. For full repeatability of measurements, background noise playback is synchronized by *lab*CORE through a pulse connection to the hardware platform *lab*BGN. ACQUA operates in conjunction with *lab*CORE to generate, receive and analyze signals.



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