



Code 6995

3PASS
flex

HEAD acoustics 3-Dimensional Playback of Acoustic Sound Scenarios

OVERVIEW

3PASS *flex*

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HEAD acoustics 3-Dimensional Playback of
Acoustic Sound Scenarios

3PASS *flex* is an advanced background noise simulation system capable of recording and playing back real-life background noise scenarios in test rooms and vehicle cabins. Key strength of 3PASS *flex* is its adaptability regarding placement and number of recording microphones and loudspeakers for playback.

3PASS *flex* is particularly suitable for multi-point noise simulation (MPNS) as required for testing multi-microphone hands-free systems in vehicles. As such, 3PASS *flex* complies with recommendations ITU-T P.1100 (Annex F) / P.1110 (Annex F) / P.1120 (Annex F), and P.1140 (Annex B).

KEY FEATURES

Compliance with ETSI TS 103 224

Automated digital system equalization

Flexible microphone and loudspeaker arrangements

Binaural equalization with artificial head according to 3GPP TS 26.132 and ETSI TS 103 224

Remote control of 3PASS *flex* playback by ACQUA/ VoCAS via TCP/IP, REST, or adapter cable

APPLICATIONS

Sound field reproduction for device testing at one position in space according to ETSI TS 103 224

Testing multi-microphone systems in the presence of background noise:

- › In-car hands-free systems
- › In-car communication (ICC)
- › Voice-controlled devices
- › Conferencing systems
- › Smart speakers
- › Internet of Things (IoT) devices
- › Home automation systems
- › Active noise cancellation (ANC) headphones / headsets / hearing aids
- › Handsets

Sound field reproduction at multiple locations in space (MPNS) for testing according to:

- › ITU-T P.1100 Annex F
- › ITU-T P.1110 Annex F
- › ITU-T P.1120 Annex F
- › ITU-T P.1140 Annex B

DETAILS

A growing number of devices and applications in cars, homes, and offices applies multi-microphone solutions to pick up human voice. Reliable testing in realistic conditions of such systems requires an advanced multi-point (background) noise simulation (MPNS) for customized microphone and loudspeaker arrangements. 3PASS *flex* addresses this purpose. It supports all necessary steps – recording background noise scenarios, automatic digital equalization of the playback system, and affecting the measurement with synchronized background noise playback.

DESCRIPTION

General

3PASS *flex* reproduces previously recorded background noise scenarios including their essential spatial characteristics. It is applicable for development and assessment of complex background noise reduction algorithms. Thus, it helps assessing the performance of in-vehicle hands-free systems, hands-free communication devices such as smart speakers or conferencing devices, or headsets under real life conditions.

3PASS *flex* enables automated digital system equalization via flexible arranged microphones, the MSA I / MSA II microphone surround arrays, or via a binaural HATS (e.g., HMS II.3). Flexible microphone arrangements are feasible by using the SQadriga III frontend with IEPE/ICP microphones and optionally BHS II for binaural recordings. The microphones of MSA I / MSA II are fixed by default. Nevertheless, they are detachable and can be positioned individually by means of a BNC cable. Furthermore, 3PASS *flex* supports binaural equalization with an artificial head according to 3GPP TS 26.132 and ETSI TS 103 224. The arrangement of the loudspeakers depends on the measurement location and the position of the device under test. Due to the flexible arrangement of the microphones, the loudspeaker arrangement is also not determined.

Application Setups

3PASS *flex* has no limitations regarding the composition of its applications apart from the number of used microphones and loudspeakers. The maximum number of applicable microphones is ten calibration microphones plus six informational microphones. The allocation to each microphone category is freely customizable during the equalization. According to the maximum number of calibration microphones, the maximum number of applicable loudspeakers is ten.

3PASS *flex* provides one setup for different applications. The application usually depends on the device under test. The number of microphones, loudspeakers, as well as their connection types are customizable.

Equalization

There are different equalization procedures due to different microphone arrangements for application setups:

- › Equalization with flexible setup
- › Equalization with MSA I / MSA II
- › Equalization with binaural artificial head

3PASS *flex* runs the appropriate equalization according to the applied setup. Most steps of the equalization procedures are similar but differ in detail. In general, all equalizations require level adjustments for the loudspeakers in the setup. Then, 3PASS *flex* records sweeps from each loudspeaker with the applied microphones. For binaural equalization according to 3GPP TS 26.132, there are additional microphone settings for *labCORE*. Finally, 3PASS *flex* runs calculations for the equalization by using the recorded signal data from the sweeps.

Remote Control

3PASS *flex* provides an interface for remote operation by other HEAD acoustics software (ACQUA, VoCAS). There are multiple ways for controlling 3PASS *flex* remotely:

- › TCP/IP
 - » 3PASS *flex* and ACQUA/VoCAS run on the same computer or on computers in the same network.
- › REST
 - » 3PASS *flex* and ACQUA/VoCAS run on the same computer or on computers in the same network.
- › HAE Remote
 - » 3PASS *flex* and ACQUA/VoCAS run on different computers which are interconnected by an adapter cable (CUU I).

OPTIONS

Hardware

CUU I (Code 6085)

- › Adapter USB <> USB for Remote control HAE

CSO I.0 (Code 9822)

- › Loudspeaker cable set for 3PASS (4 speaker connections)

HSW II.1 (Code 2952)

- › HEAD Subwoofer for 3PASS (incl. KMT DC 3 Power Amplifier)

HSW II.1-V1 (Code 2952-V1)

- › HEAD Subwoofer for 3PASS (incl. LD Systems XS700 Power Amplifier)

HSW II.1-V2 (Code 2952-V2)

- › HEAD Subwoofer for 3PASS (incl. QSC GX3 Power Amplifier)

GENERAL REQUIREMENTS

Hardware

Hardware Platform

labBGN (Code 6486)

- › ACQUA/*lab* 16-channel background noise hardware platform

Recording Equipment

3PASS *flex* does not require a fixed microphone arrangement. Nevertheless, recordings with appropriate arrays are feasible.

Flexible Microphone Arrangement

SQuadriga III (Code 3324)

- › Handheld 8-channel frontend

SQ3 TP 05 (Code 3324-05)

- › SQuadriga III Tool Pack Controller Mode

CLL X.xx (Code 3780-xx)

- › LEMO 8-pin male <> LEMO 8-pin male, connection cable between input module and controller, xx meters

Microphone Array

One of the following microphone arrays:

MSA I (Code 6487)

- › 8-channel microphone surround array, asymmetrical, for 3PASS system equalization and recordings

MSA II (Code 6487.2)

- › 8-channel microphone surround array, symmetrical, for 3PASS system equalization and recordings

Binaural Equalization acc. to ETSI TS 103 224

labCORE (Code 7700)

- › Modular multi-channel hardware platform

One of the following Head Measurement Systems:

HMS II.3

- › HMS II.3 (Code 1703)
 - » Head Measurement System, basic version with right ear simulator, 3.3 pinna, and artificial mouth

Continued on next page

RC X.1 (Code 9850)

- › Remote Control (SQadriga III) for starting and stopping of recording, USB

RC X.2 (Code 9851)

- › Wireless handheld transmitter (SQadriga III)

Software

3PASS *reverb* (Code 6996)

- › Option for 3PASS: Simulation of reverberation scenarios

UG 3PASS *flex* > 3PASS *lab* (Code 6994)

- › Upgrade 3PASS *flex* > 3PASS *lab*

UG HAE-BGN > 3PASS *lab* (Code 6991-V1)

- › Upgrade HAE-BGN > 3PASS *flex*, as of HAE-BGN version 2.1

UG HAE-car > 3PASS *flex* (Code 6992)

- › Upgrade HAE-car > 3PASS *flex*, as of HAE-car version 2.1

SCOPE OF DELIVERY

- › Setup DVD 3PASS *flex*
- › Dongle (USB)

GENERAL REQUIREMENTS

- › HIS L (Code 1701)
 - » Head Impedance Simulator, left
- HMS II.3 LN
- › HMS II.3 LN (Code 1703.1)
 - » Head Measurement System, low-noise version with right ear simulator, 3.3 pinna, and artificial mouth
- › HIS L (Code 1701)
 - » Head Impedance Simulator, left
- HMS II.3 LN HEC
- › HMS II.3 LN HEC (Code 1703.2)
 - » Head Measurement System, low-noise version with right human-like ear canal simulator and artificial mouth
- › HIS L (Code 1701)
 - » Head Impedance Simulator, left
- HMS II.3 ViBRIDGE
- › HMS II.3 ViBRIDGE (Code 1703.3)
 - » Head Measurement System, low-noise, with human-like ViBRIDGE (bone conduction simulation) ear simulators (left and right) and artificial mouth

Playback Equipment

The number of loudspeakers, power amplifiers, and cables depends on the applied 3PASS *flex* setup. HEAD acoustics provides a selection of appropriate third party loudspeakers and power amplifiers for 3PASS *flex* configurations.

System Requirements

Computer

- › Multi-core processor
- › 8 GB RAM (recommended: 16 GB RAM)
- › 40 GB free disk space

Operating system (one of the listed)

- › Windows 11 x64
 - » Pro, Enterprise, Education; version 21H2 or newer; languages: US, Western European
- › Windows 10 x64
 - » Pro, Enterprise, Education; version 1809 or newer; languages: US, Western European

IN PRACTICE

APPLICATION EXAMPLES

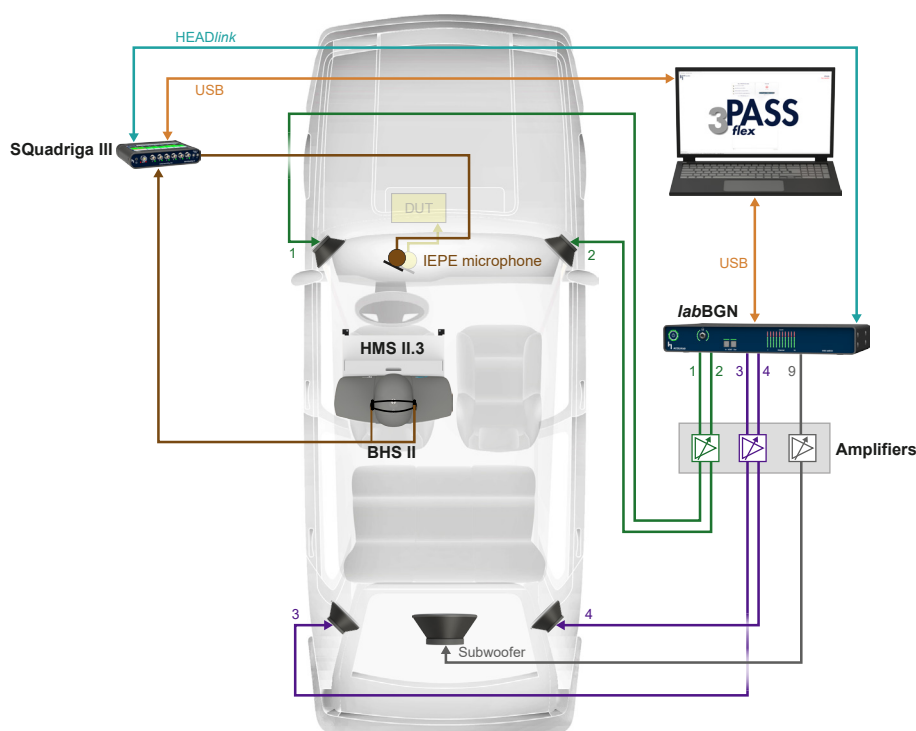
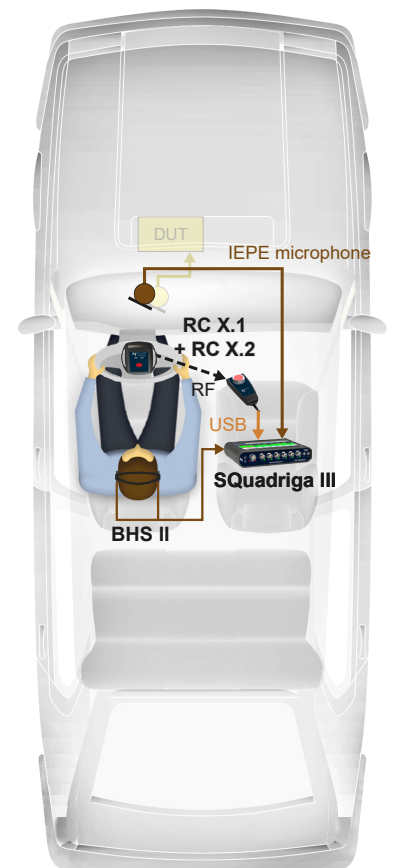
3PASS flex in Car

Recording

The IEPE/ICP microphone connects to SQadriga III. The driver wears BHS II which also connects to SQadriga III. RC X.1 connects to SQadriga III via USB while it is paired with RC X.2. RC X.2 is attached to the steering wheel. When the car reaches the target speed in the desired driving conditions, the driver initiates the recording via RC X.2.

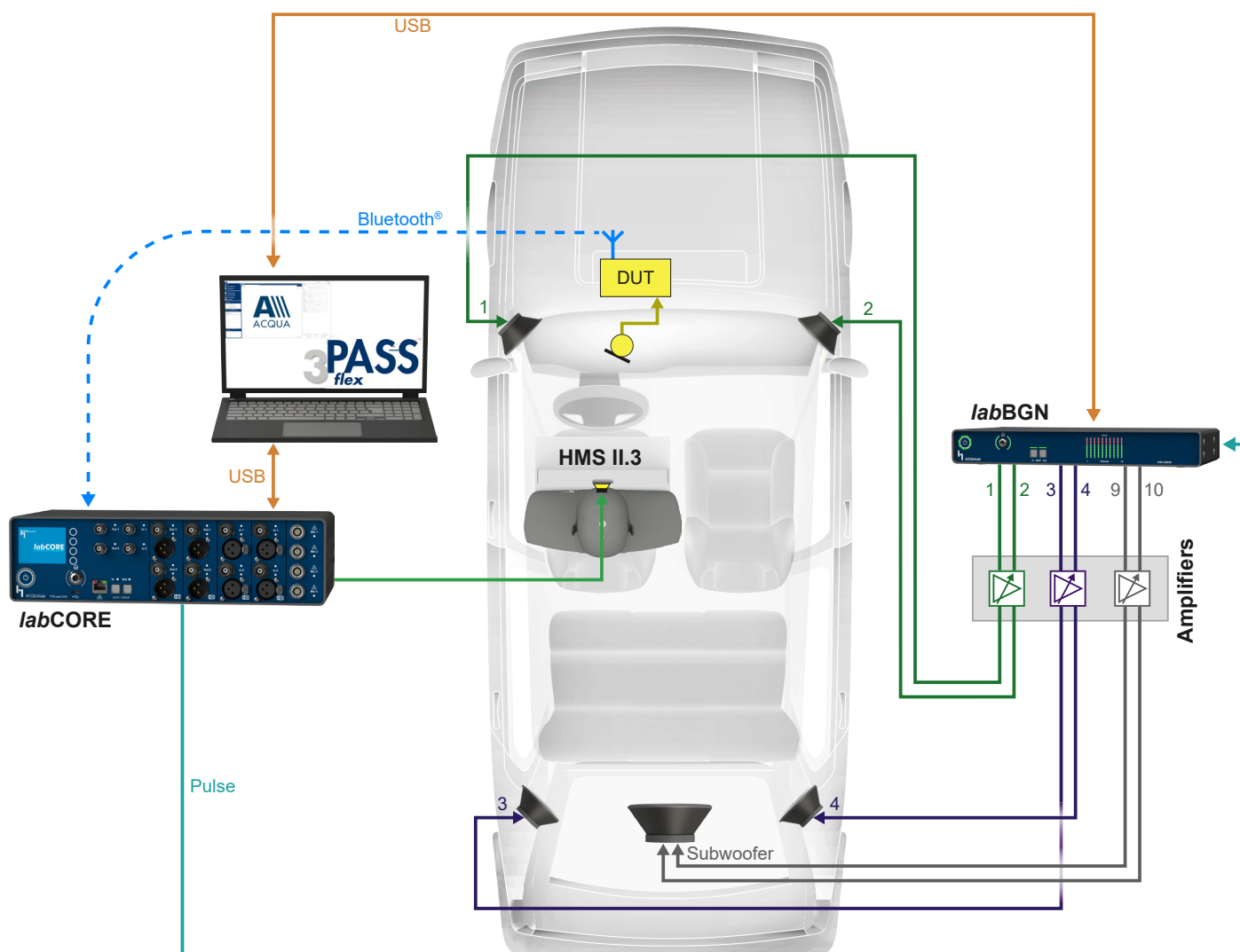
Equalization

SQadriga III connects to the IEPE/ICP microphone and BHS II for distributing the signals via labBGN to 3PASS flex. HMS II.3 replaces the human driver. There is a loudspeaker setup with two loudspeakers on the instrument panel and two loudspeakers on the backrest. A subwoofer is positioned in the trunk. The equalization requires level adjustments of the loudspeakers as well as playback and recording of sine sweeps from each loudspeaker. This data is used for the calculation of the equalization.



Measurement

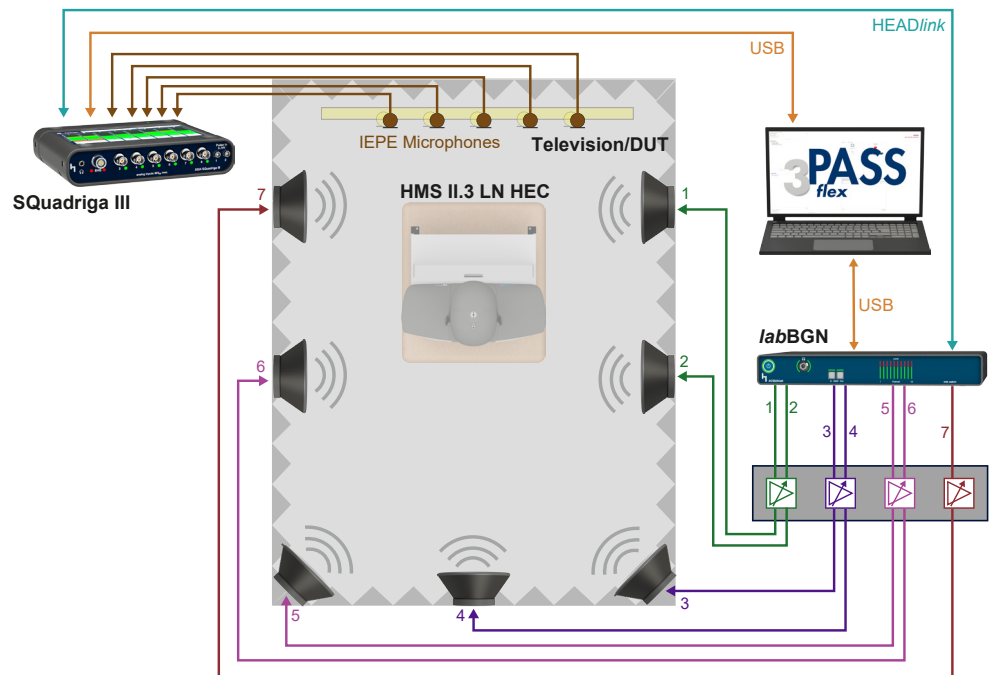
3PASS *flex* plays back background noise via *labBGN* and the loudspeakers. Simultaneously, ACQUA sends a speech signal via *labCORE* to the mouth loudspeaker of HMS II.3 for playback. The microphone of the device under test picks up both, the speech signal and the background noise. This degraded signal is transmitted via Bluetooth® to *labCORE* and further to ACQUA for analysis.



3PASS flex Application with Microphone Array of Television

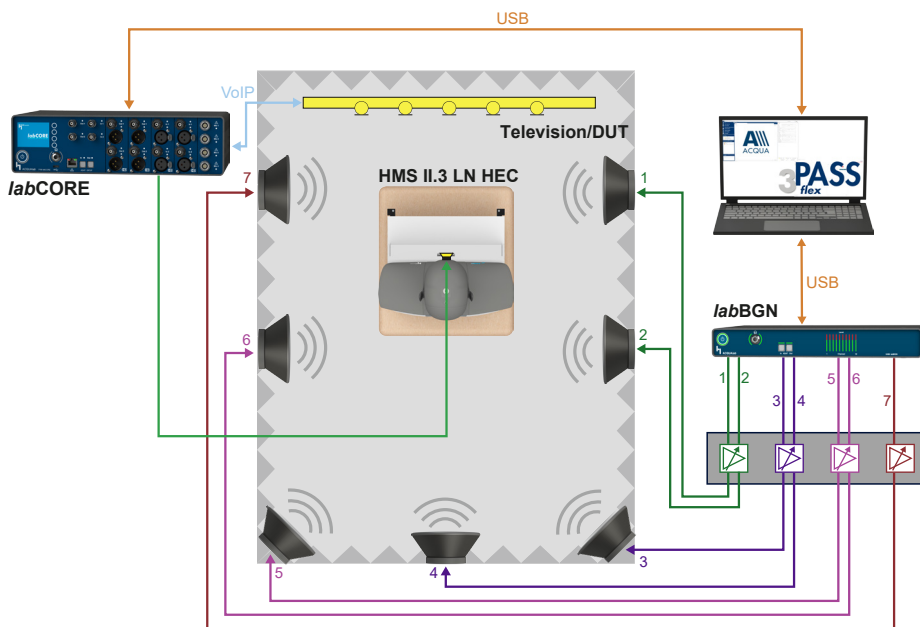
Equalization

Five IEPE/ICP microphones are connected to SQuadriga III. The number of loudspeakers and their position in relation to the DUT is customized. The equalization requires level adjustments of the loudspeakers as well as playback and recording of sine sweeps from each loudspeaker. This data is applied for the calculation of the equalization.



Measurement: Television

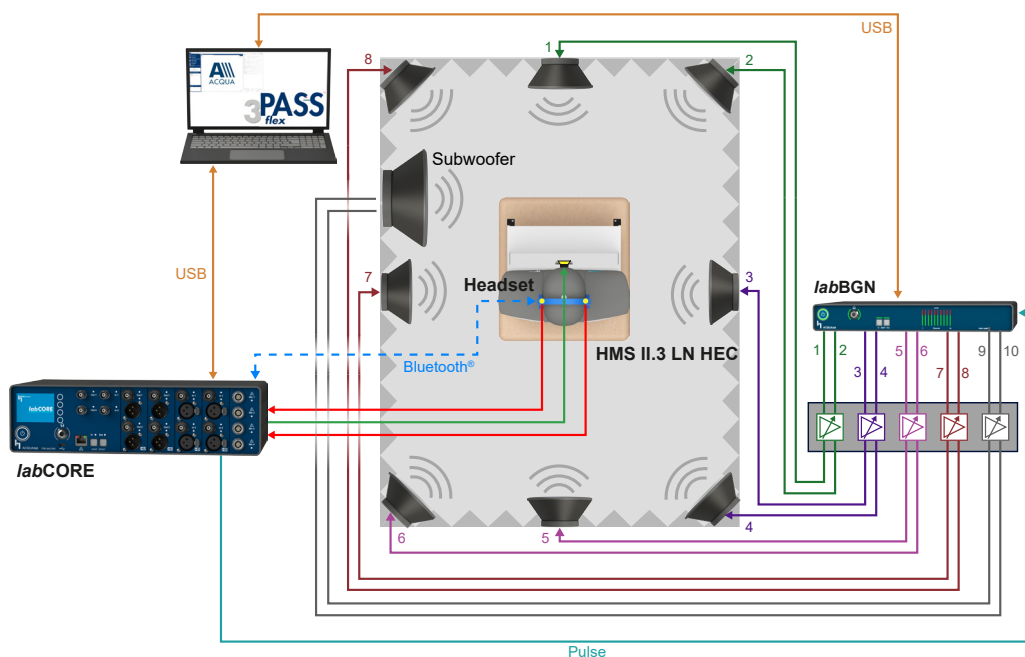
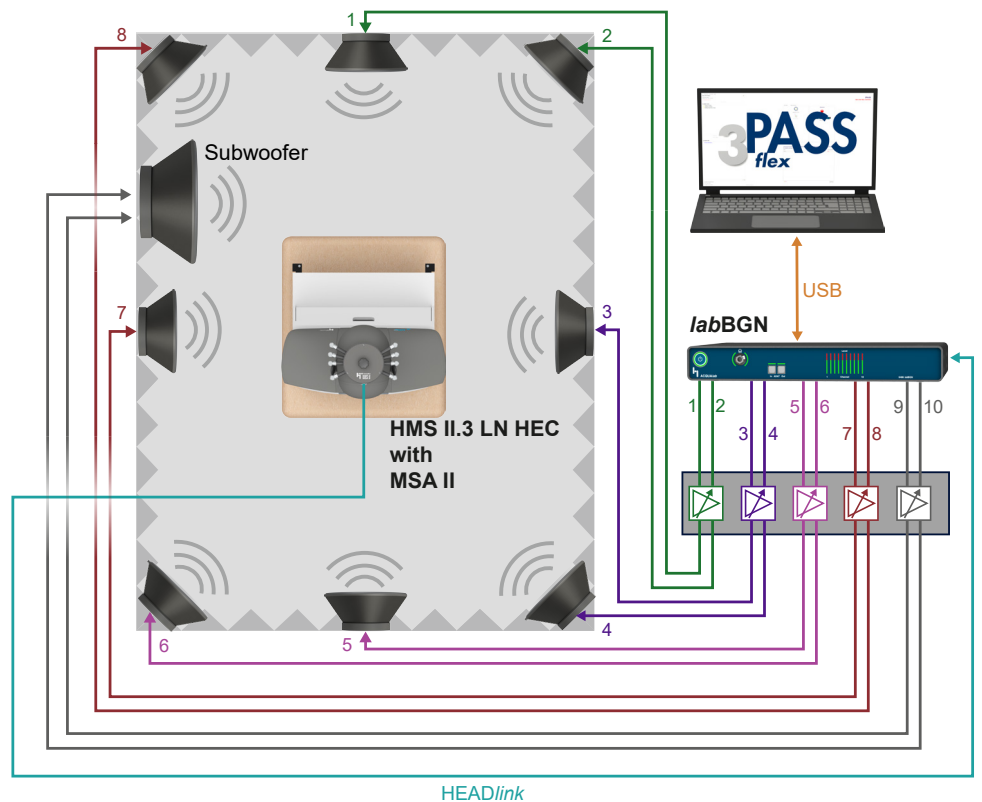
3PASS flex plays back background noise via labBGN and the loudspeakers. Simultaneously, ACQUA sends a speech signal via labCORE to the mouth loudspeaker of HMS II.3 LN HEC for playback. The microphones of the device under test pick up both, the speech signal and the background noise. This degraded signal is transmitted to labCORE and further to ACQUA for analysis.



3PASS flex Binaural Application with Equalization via MSA II

Equalization with MSA II

MSA II is mounted on HMS II.3 LN HEC in the measurement room for recording. It connects to *labBGN* via *HEADlink*. *3PASS flex* runs on a computer which connects to *labBGN*. *labBGN* connects via power amplifiers to the loudspeakers in the measurement room. There are eight loudspeakers and a subwoofer with a very low cut-off frequency. The equalization proceeds as described in ETSI TS 103 224.



Measurement: Binaural ANC Headset

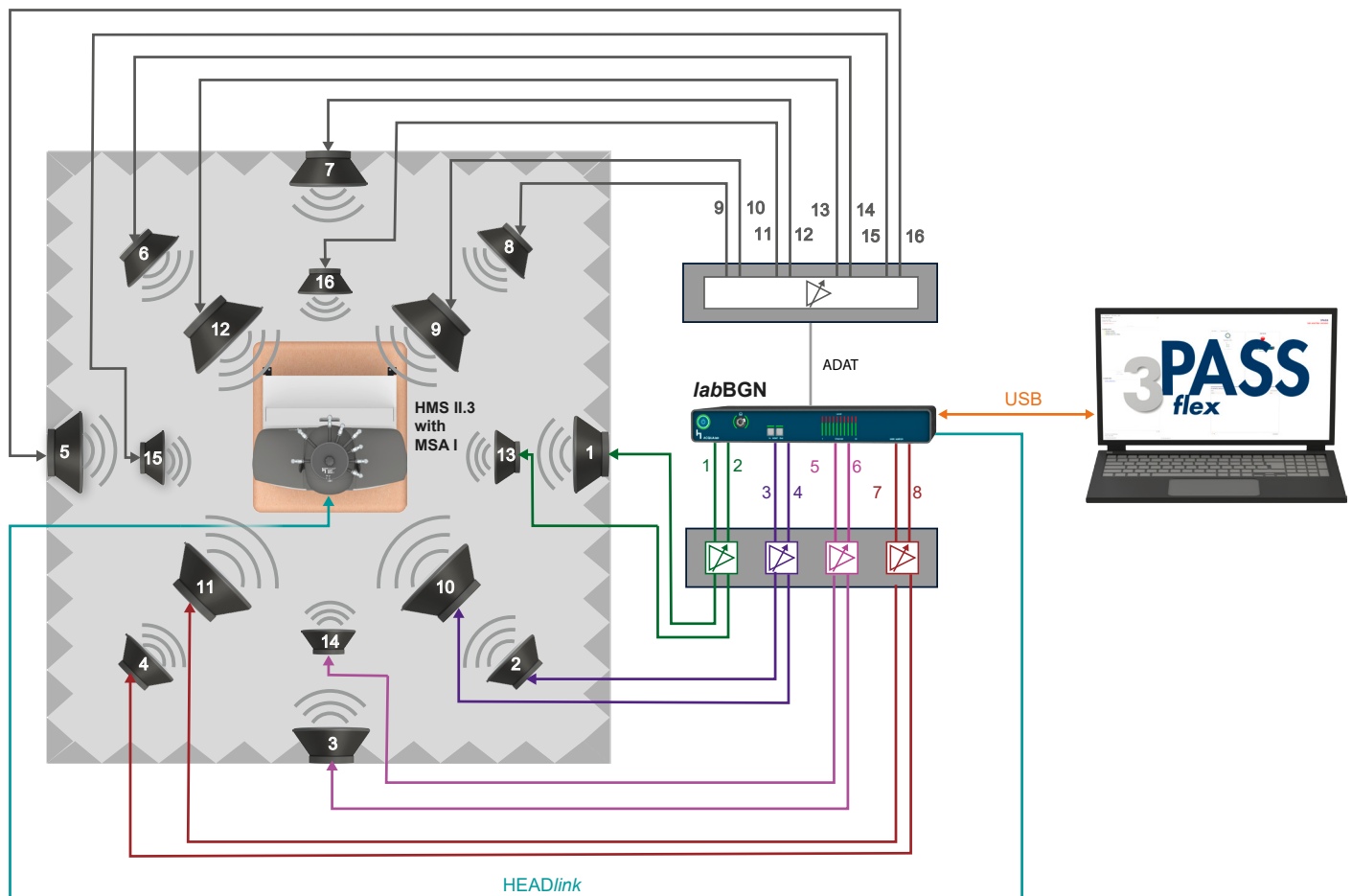
HMS II.3 LN HEC is positioned in the measurement room wearing the headset. The headset exchanges audio data with *labCORE* via Bluetooth. *labCORE* transmits audio signals to HMS II.3 LN HEC and the headset for playback and receives audio signals from HMS II.3 LN HEC and the headset for recording. ACQUA generates the signals for playback and records signals for analysis. *3PASS flex* plays back background noises and ACQUA assesses speech signal processing of the headset.

Configuration Example: Handset Setup (Spatial Audio Testing)

Step 1: Equalization

MSA I is mounted on HMS II.3 in the measurement cabin for recording. It is connected to *labBGN* via *HEADlink*. Equalization is performed in accordance with the procedure specified in ETSI TS 103 224. *3PASS flex* runs on a computer that is connected to *labBGN*. *labBGN* forwards eight analog signals via power amplifiers to eight loudspeakers in the measurement cabin. It also forwards eight digital signals via the ADAT interface to eight additional loudspeakers. The 16 loudspeakers are arranged spherically around the HATS on four levels in accordance with ETSI TS 103 224. The four levels are visualized by the varying sizes of the loudspeakers.

The loudspeakers are distributed across the four levels as follows: loudspeakers 9–12 on the top level; 1, 3, 5, and 7 slightly above the ear level; 2, 4, 6, and 8 slightly below the ear level; and 13–16 on the bottom level.



The white numbering of the loudspeakers on the loudspeakers themselves in this figure is according to the numbering of the loudspeakers in Figure 5b of ETSI TS 103 224 V1.7.1 (2025-11).

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