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DATA SHEET

3PASS *flex* (Code 6995)

3-dimensional Playback of Acoustic Sound Scenarios

Exemplary custom microphone arrangement for 3PASS *flex* application in a car

Overview

3PASS *flex* is an advanced background noise simulation system capable of recording and playback of real-life background noise scenarios in test rooms and vehicle cabins. Key strength of 3PASS *flex* is adaptability regarding quantity and placement of microphones and loudspeakers, making it applicable for a wide range of test cases.

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 the ITU-T standards P.1100 / P.1110 / P.1120 (Annex F), P.1140 (Annex B) and ETSI standard TS 103 224.

Key Features

- Widely configurable, adaptive background noise simulation system
- Up to 10 (+6) microphones and 10 loudspeakers in flexible positions
- Automated, wizard-guided digital system equalization
- Recording and equalization with MSA I, MSA II or custom ICP microphone arrangement matched to application

Applications

- 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
- Sound field reproduction for device testing at multiple locations in space (MPNS) according to:
  - ITU-T P.1100
  - ITU-T P.1110
  - ITU-T P.1120 Annex F
  - ITU-T P.1140 Annex B
  - ETSI TS 103 224

Description

A growing number of devices and applications in cars, homes and offices uses multi-microphone solutions to pick up human voice. Reliable testing of such systems requires an equally advanced multi-point (background) noise simulation (MPNS) with individually tailored microphone and loudspeaker arrangements. 3PASS *flex* is ideally suited for this purpose. It supports all necessary steps – recording background noise scenarios, automatic digital equalizing of the playback system and assisting the measurement process through perfectly timed (triggered) playback.

For recording and automatic equalization, 3PASS *flex* supports up to ten freely positionable calibration microphones (plus six informational microphones). For most mobile applications, these will be ICP microphones connected to the battery-powered standalone recording system SQuadriga III. In head-related acoustic scenarios, the HEAD acoustics microphone surround arrays MSA I (asymmetric, optimized for handsets) and MSA II (symmetrical, optimized for binaural applications) are ideally suited. With MSA I and MSA II, recording and equalization can also be performed with the background noise hardware platform *lab*BGN in conjunction with the 3PASS *flex* PC.

Playback of the recorded noise is achieved via an equally flexible loudspeaker arrangement of up to ten loudspeakers. For adequate playback quality at all microphone positions, the amount of loudspeakers should be at least equal to the amount of calibration microphones. If limited available space requires compact loudspeakers, a subwoofer can be part of the playback setup.

Like previous generation HEAD acoustics background noise simulation systems, 3PASS *flex* builds on the hardware platform *lab*BGN. Thus, users of HAE-BGN and HAE-car with *lab*BGN can easily upgrade to 3PASS *flex* without requiring a new hardware platform.

General requirements

Software

- Microsoft® Windows® 7 Professional, Windows® 8/8.1 Pro or Windows® 10 Pro (English or German version, including all current service packs).

Hardware

- **PC** with multi-core processor, 1.6 GHz or faster, 4 GB RAM, 40 GB free disk space, 3 USB Ports
- ***lab*BGN (Code 6486)**, ACQUA*lab* (8+2)-Channel Background Noise Hardware Platform

Background noise hardware platform *lab*BGN

- **Power amplifier(s)**, total quantity of available channels depends on application
- **Loudspeakers**, total quantity depends on application
- One of the following **microphone arrays**:
  - **MSA I (Code 6487.1)**, 8 channel microphone surround array, Asymmetrical, according to ETSI TS 103 224

  or
  - **MSA II (Code 6487.2)**, 8 channel microphone surround array, Symmetrical, according to ETSI TS 103 224

  or
  - **Custom ICP microphone setup**

Options

- **SQuadriga III (Code 3324)**, Mobile recording & playback system (requires ICP microphones, not included) together with
  - **HEADlink cable CLL X.xx (Code 3780-xx)**, exact type depends on required length
  - **Controller Mode package SQ3 TP 05 (Code 3324-05)**
- **3PASS *reverb* (Code 6996)**, Simulation of reverberation scenarios
- **CUU I (Code 6085)**, Adapter USB <> USB for Remote Control 3PASS (Connection ACQUA/VoCAS PC <> 3PASS PC)

Delivery items

- **3PASS *flex* (Code 6995)**, HEAD acoustics 3-dimensional Playback of Acoustic Sound Scenarios – Flex Version
  - **Setup DVD** 3PASS *flex*
  - **Dongle** (USB)

Symmetrical 8-microphone surround array MSA II on HMS II.3 for binaural applications

Mobile recording & playback system SQuadriga III

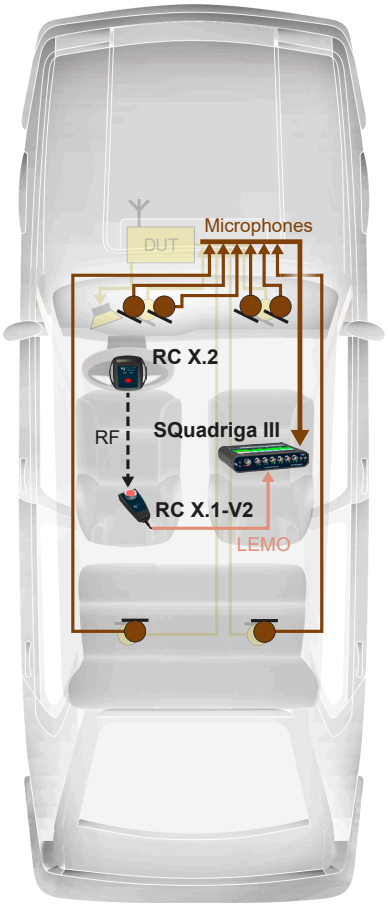
3PASS flex – configuration examples

The following two examples demonstrate typical applications of 3PASS *flex* and the workflow leading to an operational system. The first example shows the use of background noise simulation in a vehicle, the second example an implementation in a test room. Each example is divided into three main steps:

1. Recording of background noise
2. Adding and equalizing the loudspeaker arrangement for background noise playback
3. Adding measurement equipment to perform measurements in the presence of background noise

All illustrations show exemplary configurations based on a real-life application of 3PASS *flex*. All steps build on each other, thus both examples are internally consistent in terms of the selected equipment and its arrangement. However, for other use cases the equipment and its configuration may differ.

Example 1: In-vehicle hands-free communication



Step 1 – Recording

In this example, the hands-free communication system of a vehicle is to be tested in the presence of background noise. The system contains two beamforming microphones for front passengers and two omnidirectional microphones for rear passengers. To record background noise, six ICP microphones are positioned close to the vehicle's inbuilt microphones – one for each omnidirectional DUT microphone and two for each beamforming DUT microphone (to reflect their directional capabilities in the recording).

Background noise can also be recorded with the inbuilt DUT microphones. However, many integrated systems do not allow outside access without significant modification. Modern cars with an on-board A²B® audio bus system change this – they are accessible through *lab*CORE with the *core*A2B hardware extension.

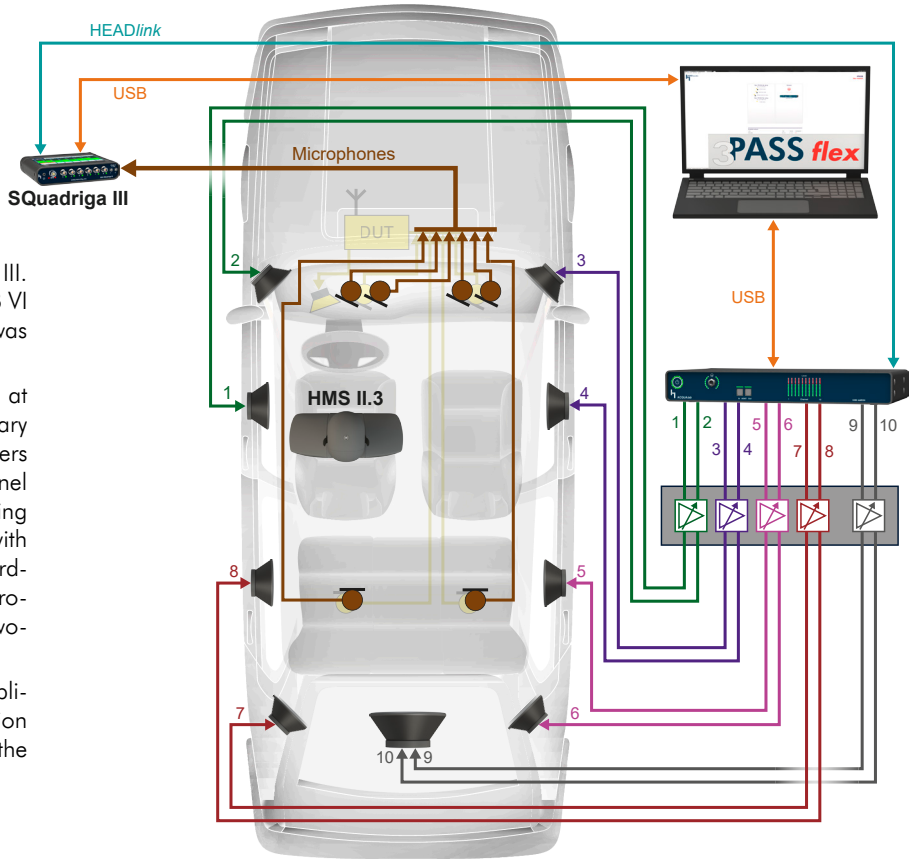
SQuadriga III serves as a self-contained mobile recording system. To ensure traffic safety, SQuadriga III is operated through a combination of the optional remote controls RC X.1-V2 (wired) and RC X.2 (wireless). RC X.2 attaches to the steering wheel, allowing safe operation of SQuadriga III on the move.

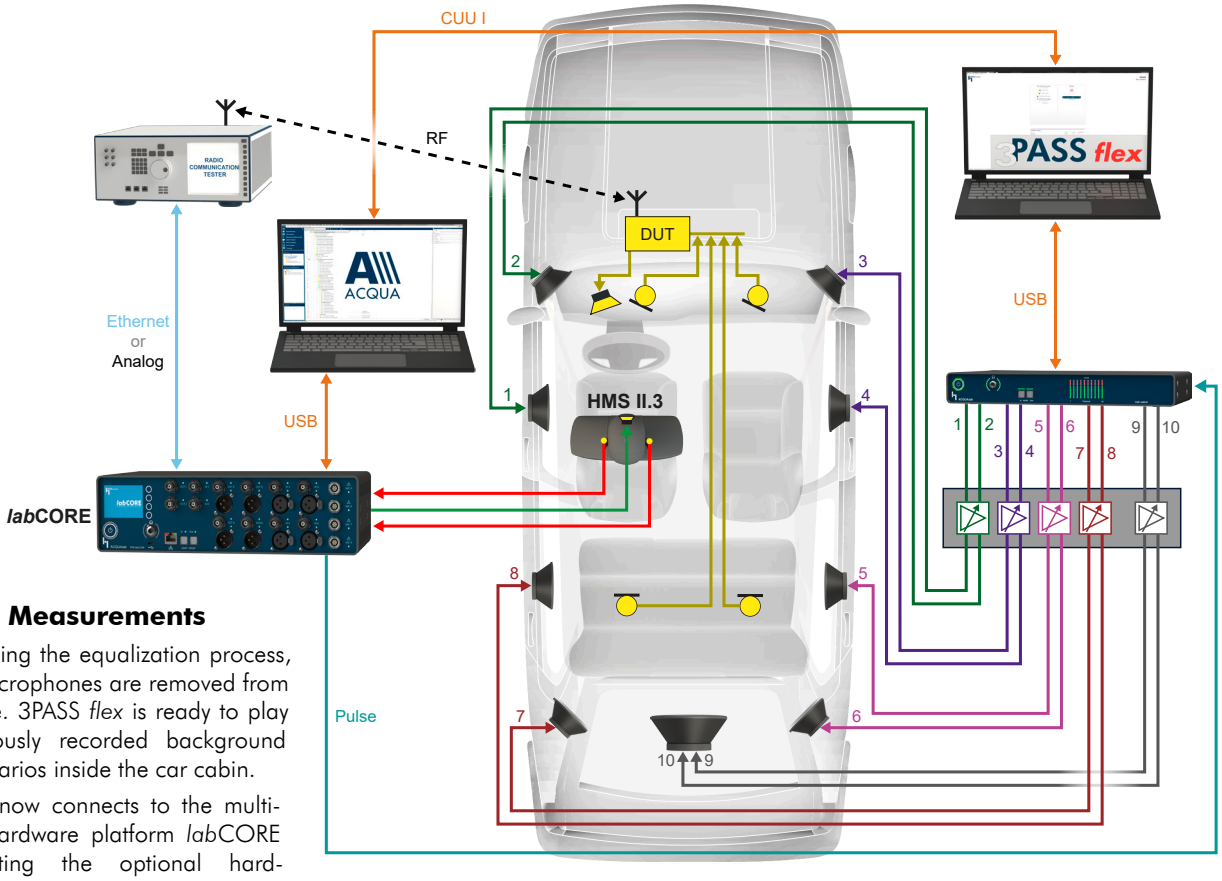
Step 2 – Equalization

For accurate playback of the background noise recorded in step 1, the playback system must be equalized before measurements can be performed. The equalization process is performed with the same microphone setup used for recording, again connecting to SQuadriga III. HMS II.3 mounted on its torso box HTB VI acoustically emulates the driver who was present during the recordings.

To achieve sufficient playback quality at all microphone positions, this exemplary configuration uses eight loudspeakers in the car cabin and a two-channel subwoofer in the trunk. The resulting ten playback channels are supplied with signals by the background noise hardware platform *lab*BGN and ten appropriate amplifier channels, e.g. five two-channel amplifiers.

A computer running the 3PASS *flex* application software handles the equalization procedure by guiding the user through the automated equalization process.





Step 3 – Measurements

After finishing the equalization process, the ICP microphones are removed from the vehicle. 3PASS *flex* is ready to play the previously recorded background noise scenarios inside the car cabin.

HMS II.3 now connects to the multichannel hardware platform *lab*CORE (incorporating the optional hardware extensions *core*OUT-Amp2 and *core*IN-Mic4) to talk and listen to the in-car hands-free communication system. A radio communication tester simulates a cellular network to connect to the vehicle's head unit.

Playback of background noise is synchronized to measurement runs through a triggered connection ('Pulse') between *lab*CORE and *lab*BGN. Synchronization of measurements with background noise ensures perfect repeatability of any test run. The computer running ACQUA acts as the control center of the setup, conducting the tests and gathering results.

Example 2: Smart speaker testing

Step 1 – Recording

In this example, a voice-controlled smart speaker is to be tested in the presence of background noise. The speaker uses a multi-microphone array distributed around its top side.

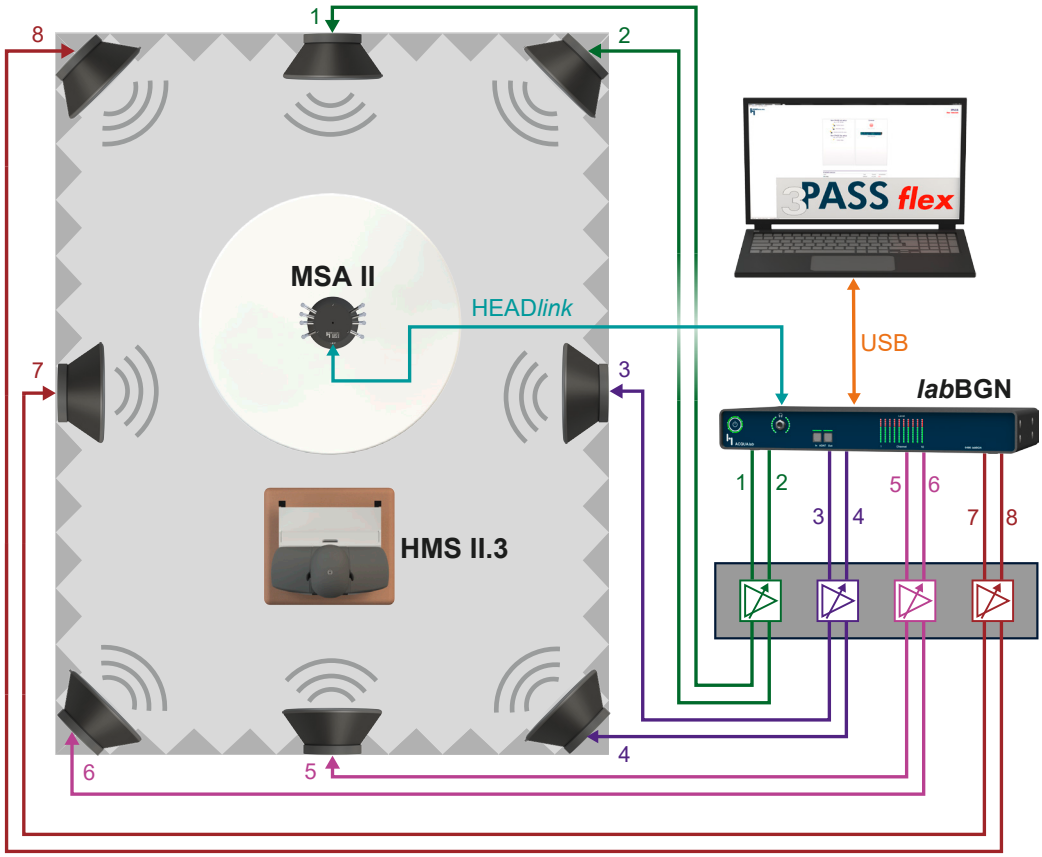
To reproduce its microphone layout and position, the 8-channel microphone surround array MSA II is mounted on the optional stand base SB MSA and placed on the table of a living room. The nearby table surface reflects sound and therefore must be factored in. As MSA II uses HEAD*link* to connect to the recording equipment in this stationary use case, *lab*BGN and the 3PASS *flex*-PC are used for recording.

MSA I or a custom microphone setup can also be viable options. However, MSA II is closest to this speaker's microphone arrangement and thus most convenient.

Step 2 – Equalization

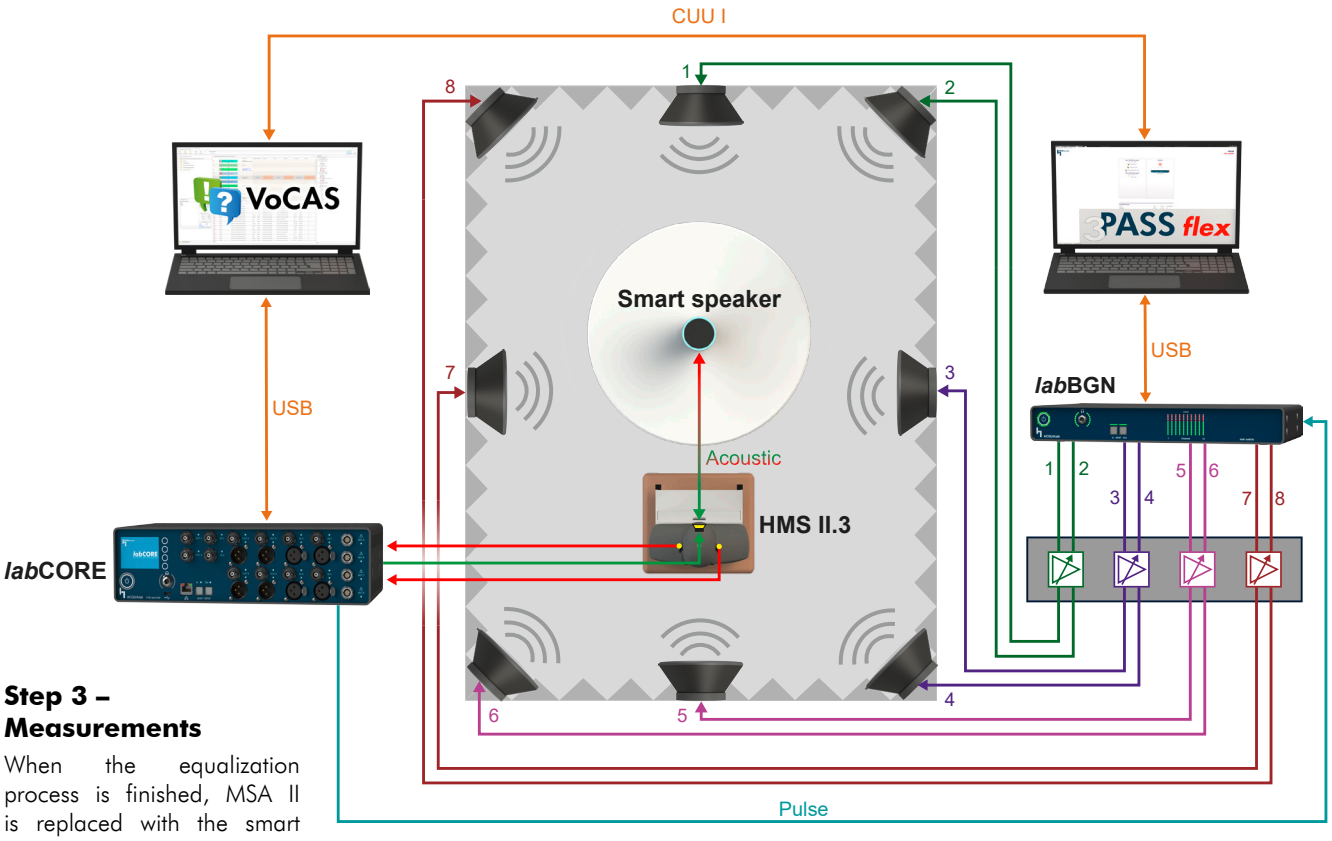
In contrast to an in-vehicle application, measurements and thus also equalization are performed in a different environment – in this case a semi-anechoic room.

MSA II is mounted on SB MSA and placed on a table to recreate the previous microphone arrangement and its acoustic vicinity. For measurements, MSA II will later be replaced by the smart speaker under test. As the measurement scenario will also involve a talker to communicate with the DUT, HMS II.3 is factored in during equalization. It is placed on the supplied Torso Box HTB VI to recreate the acoustic impediment of a standing person in the sound field. In this example, HMS is located right in front of loudspeaker no. 5 and therefore will significantly influence the equalization result.



Again, MSA II connects directly to *lab*BGN via HEAD*link*. The computer running 3PASS *flex* handles the equalization procedure by guiding the user through the automated equalization process.

The test cabin is equipped with eight loudspeakers large enough to make an additional subwoofer redundant, thus only occupying channels 1-8 of *lab*BGN and an appropriate arrangement of amplifiers.



Step 3 – Measurements

When the equalization process is finished, MSA II is replaced with the smart speaker under test. HMS II.3 is now connected to *lab*CORE in sending and receiving direction (incorporating the optional hardware extensions *core*OUT-Amp2 and *core*IN-Mic4). Supplied with signals and controlled by a computer running the voice control analysis system VoCAS, HMS II.3 becomes a talker communicating with the smart speaker.

For measurements, background noise is synchronized between *lab*CORE and *lab*BGN through the triggered 'Pulse' connection to ensure perfectly timed playback and thus full test run repeatability.

If desired, VoCAS and 3PASS *flex* can run together on one computer. However, separating both systems on individual computers might be beneficial for user convenience (physical accessibility), required processing power and disk storage space as well as smooth overall system operation.