HEAD acoustics

DATA SHEET

Code 6798

P.1110

Measurement Standard ITU-T P.1110, Wideband Car Hands-free Terminals

OVERVIEW

P.1110

Code 6798

Measurement Standard ITU-T P.1110, Wideband Car Hands-free Terminals

Achieving a reasonable speech quality with hands-free telephony in vehicles is a challenging task due to the difficult acoustic environment. For ensuring good communication quality, ITU-T published Recommendation ITU-T P.1110 for tests and requirements for wideband hands-free communication in vehicles. The test methods focus on main criteria for speech quality such as frequency response & loudness rating in single talk situations, echo performance and level variation in single & double talk situations as well as quality of background noise transmission. HEAD acoustics implemented all test cases from the recommendation in the ACQUA standard P.1110.

The ACQUA standard P.1110 applies to manufacturers and suppliers of the automotive industry to qualify and optimize their built-in / aftermarket hands-free systems and devices for compliance with Recommendation ITU-T P.1110.

KEY FEATURES

Automated ACQUA standard to assess wideband speech quality of hands-free in communication systems and devices in vehicles

Supports testing of built-in & aftermarket hands-free systems, wired & wireless headsets used in vehicles

State-of-the-art measurement methods for analysis of speech quality

Supports A²B® for recording & digital insertion of background noise

APPLICATIONS

Automated speech quality analysis of wideband car hands-free terminals according to Recommendation ITU-T P.1110

Experimental development & optimization of vehicle hands-free terminals with objective evaluation of sound quality

Optimizing positioning of hands-free microphones & loudspeakers in vehicles

DETAILS

Hands-free telephony in vehicles faces a number of acoustic peculiarities – a low signal-to-noise ratio, echo, double-talk, impairments in RF transmission and more. Therefore, achieving a good communication quality is a challenge. The International Telecommunications Union (ITU) publishes Recommendation ITU-T P.1110 including tests and requirements for speech quality of wideband hands-free communication in vehicles.

Recommendation ITU-T P.1110 provides test methods for factors elementary to communication quality such as loudness rating, transfer function, idle channel noise in send and receive direction, suppression of out-of-band signals, echo attenuation and minimum activation levels. It contains tests for built-in hands-free systems, aftermarket hands-free car kits, wired & wireless headsets in vehicles[1].

DESCRIPTION

Advanced quality aspects

Recommendation ITU-T P.1110 takes advanced aspects for communication quality into account. An artificial head simulates the user of the hands-free terminal in the vehicle cabin. Vehicle-specific conditions are taken into account by measuring the hands-free terminal at its original mounting location. For retrofit systems, a vehicle cabin with typical acoustic characteristics is used.

Another important element in comprehensive testing is realistic background noise during measurements. Accurate source material for the vehicle under test is its individual driving noise on the road. The recommendation specifies different driving speeds and ventilation settings to cover typical real-life driving situations. For applying recordings in a laboratory environment, a background noise simulation system is set up in the cabin and equalized for accurate playback. An exception are vehicles with an accessible A²B® bus system because they allow digital insertion of recorded background noise during measurements in real time.

Based on this very close-to-reality situation, Recommendation ITU-T P.1110 specifies numerous different tests and test signals to capture a comprehensive analysis of system performance. Primary focus is on conversation parameters such as double talk performance and quality in presence of background noise. Some of the measurements are based on current standards for third generation mobile phones such as 3GPP (3rd Generation Partnership Project), others on the results of auditory tests. Test signals include real speech (according to ITU-T P.501), composite source signals (CSS) as well as activation sequences, special noise sequences and speech sequences. For simulation of double-talk, there are dedicated speech signals. Measurements of echo attenuation performance are tested with AM / FM modulated sine signals.

Implementation

HEAD acoustics implemented tests and requirements of Recommendation ITU-T P.1110 in the ACQUA standard P.1110. In combination with the hardware and software, the ACQUA standard allows automated analysis and empiric optimization of complete systems, subsystems and components for hands-free wideband communication in vehicles.

The chapter IN PRACTICE contains three exemplary configurations. They have three main elements: *lab*CORE, ACQUA and a suitable HATS[2,3]. Background noise simulation is performed with 3PASS *flex*. Vehicles equipped with A²B® allow recording background noise with the vehicle's integrated microphones. During measurements, the recorded signal is inserted digitally, thus 3PASS *flex* is not required in this use case. *lab*CORE has to be equipped with the optional hardware extension *core*A2B to access the A²B® bus. For measurements of echo attenuation performance, the motorized rotating reflector HRR I can vary the acoustic echo path.

OPTIONS

Hardware

HRR I (Code 6597)
- HEAD acoustics Rotating Reflector

Software

ACOPT 16 (Code 6836)
- Option PESQ

ACOPT 20 (Code 6843)
- Option Quality Pie

RELEASE NOTES

Database revision and specification version		
Database revision	**Based on specification**	**ACQUA version**
Revision 4, Service pack 3	Recommendation ITU-T P.1110 (01/2019)	at least 4.2.200

GENERAL REQUIREMENTS

Hardware

In addition to the following requirements, further components are required. They are determined based on use case with the flow chart on page 5.

*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

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

Software

ACQUA (Code 6810)
- Advanced Communication Quality Analysis Software, Full-license Version

ACOPT 10 (Code 6820)
- Option TOSQA

ACOPT 17 (Code 6839)
- Option Relative Approach

ACOPT 21 (Code 6844)
- Option 3QUEST - 3fold Quality Evaluation of Speech in Telecommunication (Narrowband/ Wideband)

ACOPT 32 (Code 6859)
- Option Speech-based Double Talk Analysis

SCOPE OF DELIVERY

P.1110 (Code 6798)
- delivered as ACQUA database backup

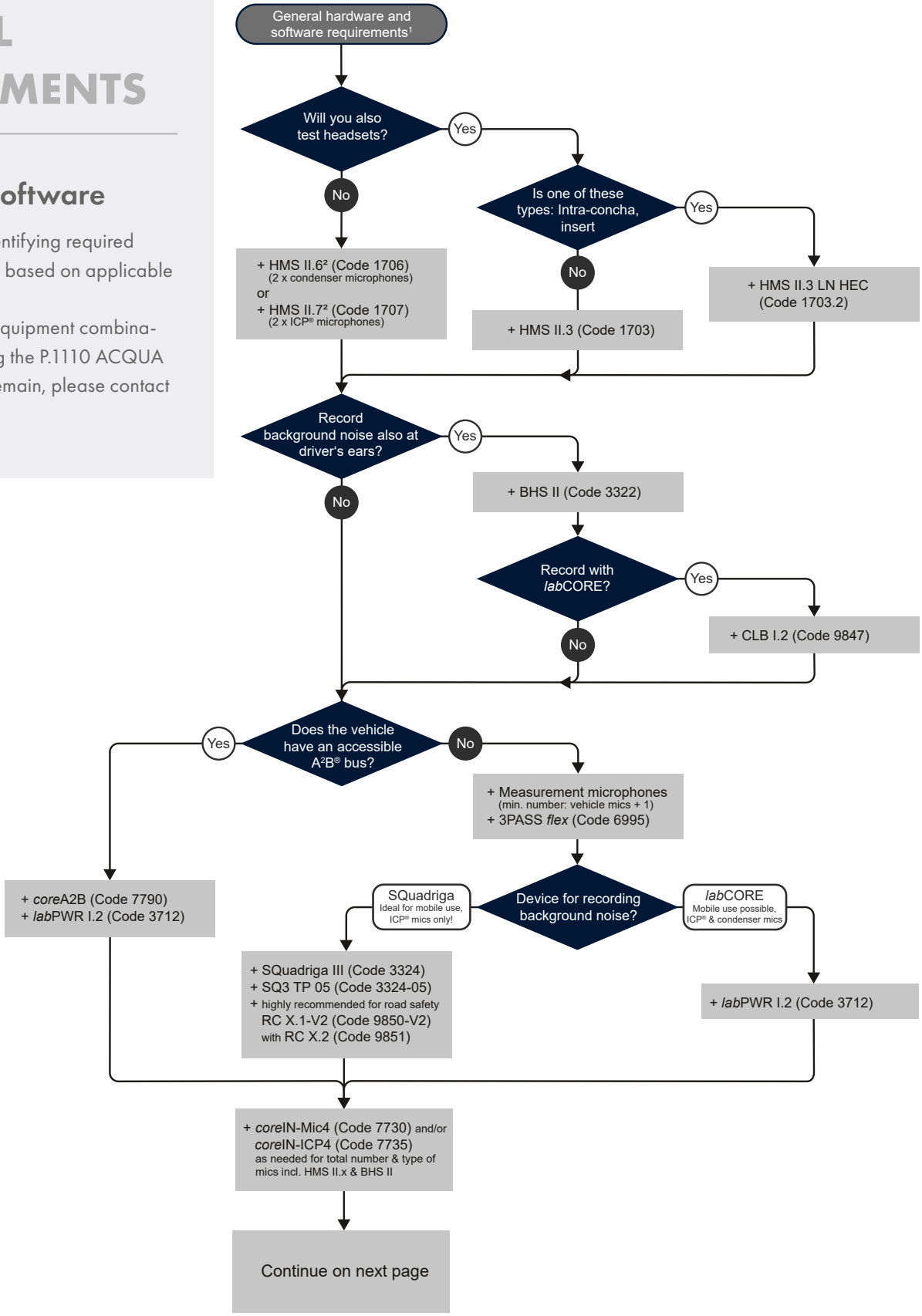
V2C File
- License file for ACQUA dongle

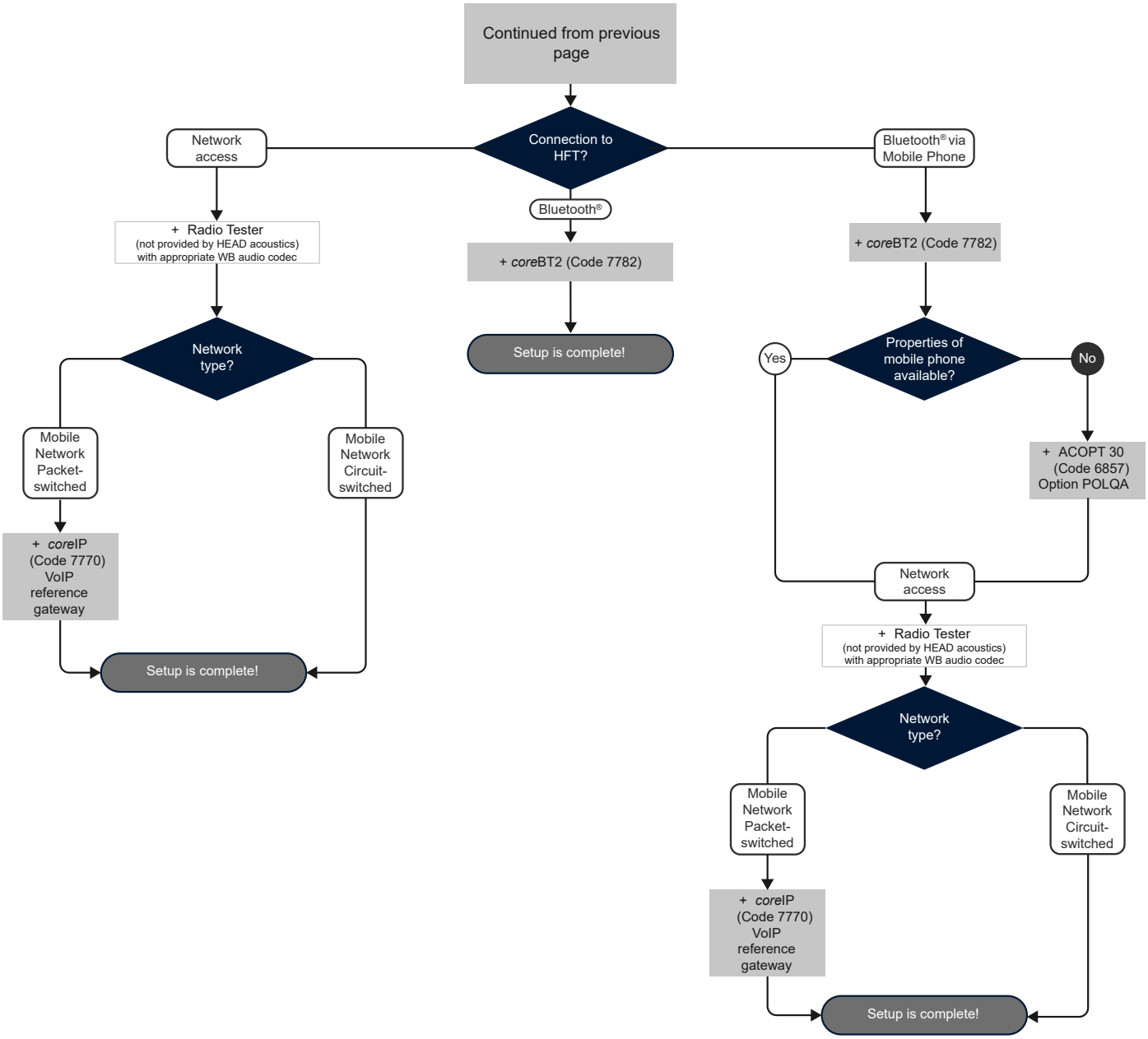
Revision history
- PDF file

GENERAL REQUIREMENTS

Hardware & Software

The flow chart helps identifying required hardware and software based on applicable use cases.
There is a multitude of equipment combinations viable for applying the P.1110 ACQUA standard. If questions remain, please contact HEAD acoustics.




Continued from previous page
Connection to HFT?
Network access
Bluetooth® via Mobile Phone
Bluetooth®
+ Radio Tester
(not provided by HEAD acoustics)
with appropriate WB audio codec
+ coreBT2 (Code 7782)
+ coreBT2 (Code 7782)
Setup is complete!
Network type?
Properties of mobile phone available?
Yes
No
Mobile Network Packet-switched
Mobile Network Circuit-switched
+ ACOPT 30
(Code 6857)
Option POLQA
+ coreIP
(Code 7770)
VoIP
reference
gateway
Network access
+ Radio Tester
(not provided by HEAD acoustics)
with appropriate WB audio codec
Network type?
Mobile Network Packet-switched
Mobile Network Circuit-switched
+ coreIP
(Code 7770)
VoIP
reference
gateway
Setup is complete!
Setup is complete!

IN PRACTICE

APPLICATION EXAMPLES

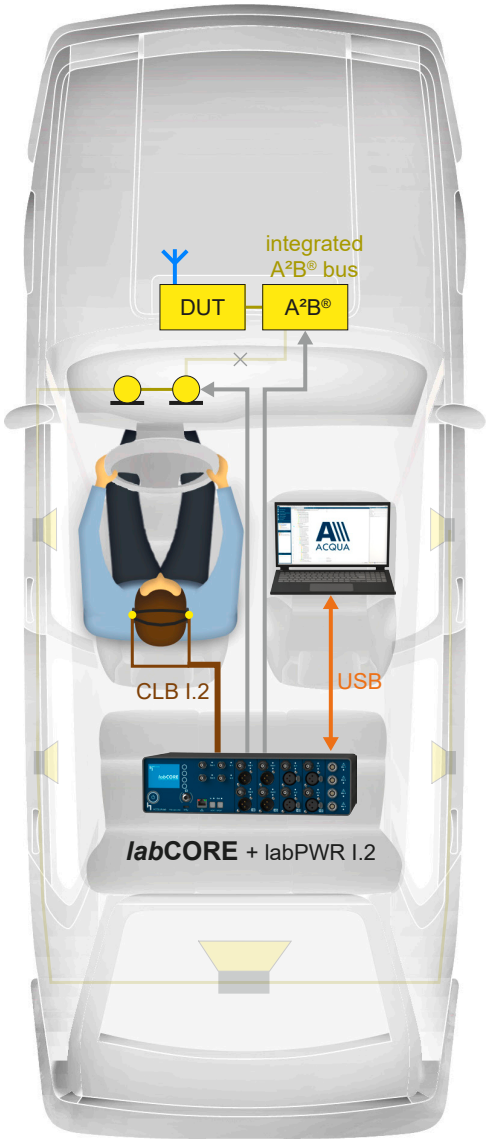
The following examples demonstrate typical measurement configurations of the ACQUA standard P.1110 with associated hardware. The examples include a vehicle with an Analog Devices A²B® bus system and two conventionally wired hands-free systems, a basic system with only one microphone and a more complex system with multiple microphones.

The conventional measurement procedure usually requires three steps:

1. Recording of background noise during driving
2. Adding and equalizing the loudspeaker arrangement for background noise playback (can be omitted for A²B®)
3. Perform measurements in the presence of background noise

Step 2 can be omitted for vehicles with an accessible A²B® bus system. The A²B® bus allows digital insertion of background noise during measurements. Therefore, an audible background noise playback and the associated simulation system are not required.

The illustrations on the following pages show exemplary configurations based on real-life applications of P.1110. All steps build on each other, thus the examples are internally consistent in terms of the selected equipment and its arrangement. For other use cases, equipment and its configuration may vary.



Configuration Example 1: Hands-Free System using A²B®

Step 1 of 2: Recording

The first step for testing hands-free communication systems according to Recommendation ITU-T P.1110 is recording real driving noises. In case a vehicle distributes audio signals – including the hands-free communication system – through an A²B® bus system, the procedure is convenient.

*lab*CORE accesses the A²B® bus via its extension board *core*A2B. Running in proxy mode, *lab*CORE enters the A²B® bus between the master and the first slave node to gain full access to all bus signals. For this mobile application, the HEAD*lab* Power Box *lab*PWR I.2 powers *lab*CORE.

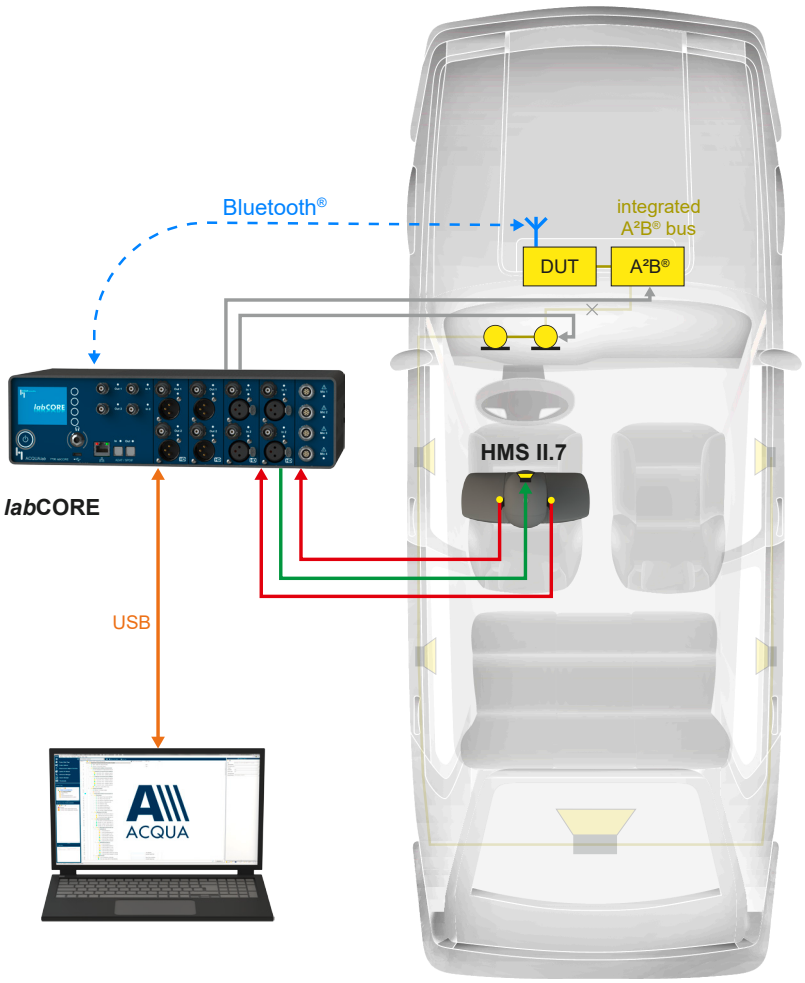
*lab*CORE receives the audio signal from the hands-free system's integrated microphones and passes them on to a laptop running ACQUA. In parallel, the vehicle's driver records binaurally with the headset BHS II.

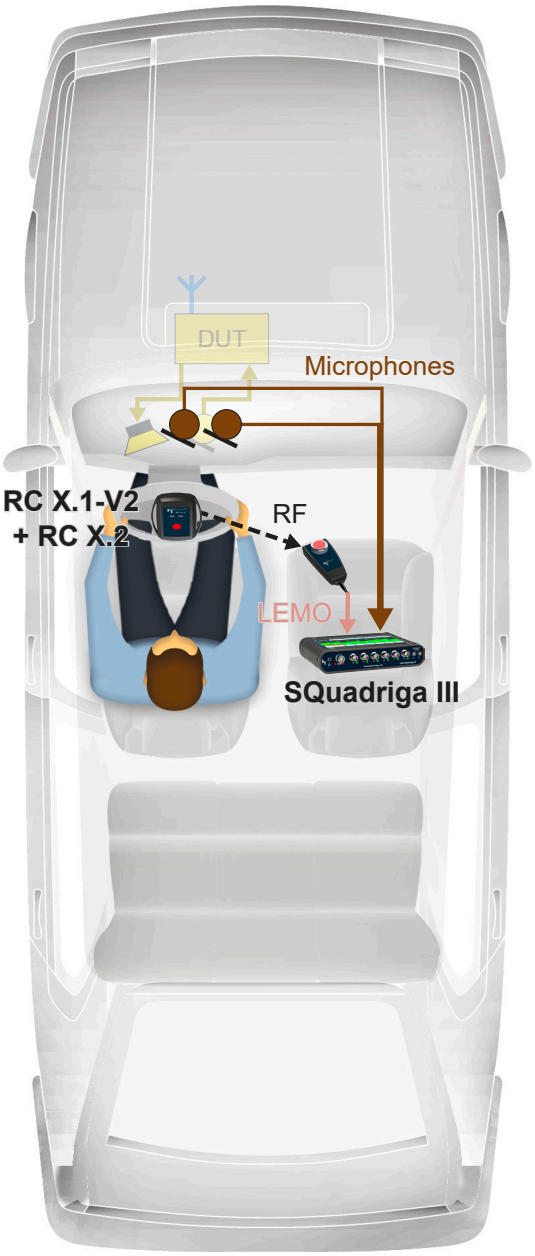
Step 2 of 2: Measurements

The configuration for measurements is stationary and also convenient for vehicles with an A²B® bus system. A background noise simulation system is not required.

Direct access to the A²B® bus via *lab*CORE allows to insert previously recorded background noises signals digitally in real time during measurements. Therefore, audible playback in the vehicle cabin and equalization of the system are not necessary.

*lab*CORE and the laptop running ACQUA shall be placed outside of the car for easier operation. HMS II.7[2,3] simulates a driver conducting a phone call via the hands-free system of the vehicle.





Configuration Example 2: Basic Hands-Free System

Step 1 of 3: Recording

The first step for testing hands-free communication systems according to Recommendation ITU-T P.1110 is recording real driving noises.

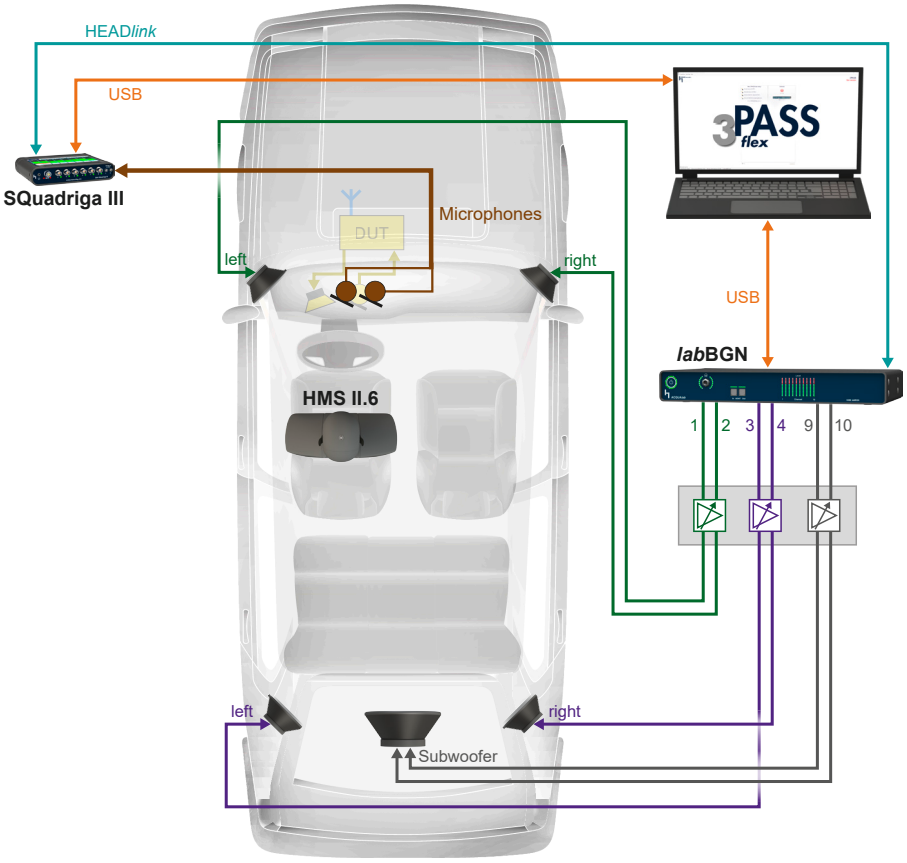
In this scenario, a basic hands-free system with one microphone is the device under test. Driving noise is recorded with two measurement microphones which are positioned next to the integrated microphone. The microphones connect to the mobile hardware platform SQuadriga III.

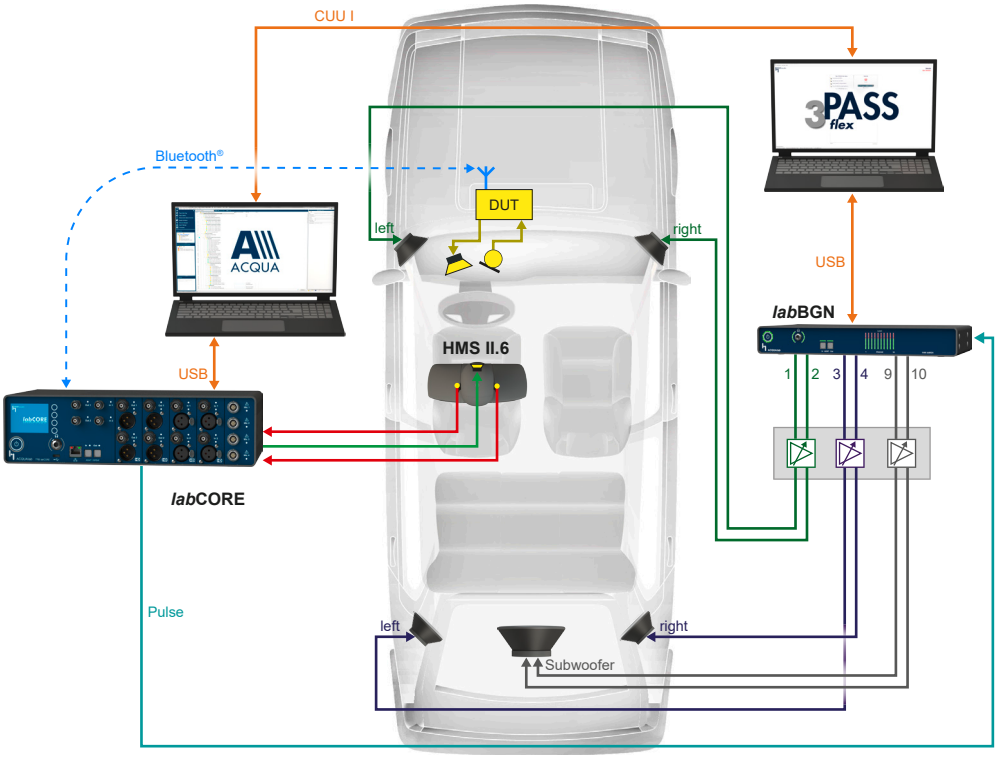
SQuadriga III records and stores the signals from the microphones. The recording is started conveniently by RF signals from the remote control RX X.1-V2. The remote control is fixed to the steering wheel to allow operation of SQuadriga III without diverting the driver from traffic.

Step 2 of 3: Equalization

After the mobile recording session, the configuration changes to stationary. Four loudspeakers and a subwoofer are set up in the vehicle for background noise playback with a suitable system, in this case 3PASS *flex*.

HMS II.6[2,3] replaces the driver – not yet interconnected, just as a physical stand-in for the driver. It recreates the acoustic situation that was present during the recording. The equalization of 3PASS *flex* includes SQuadriga III and the two ICP® microphones from the recording configuration.





Step 3 of 3: Measurements

Once 3PASS *flex* is equalized, HMS II.6[2,3] connects to *lab*CORE for operation of artificial ear and artificial mouth. A second PC runs ACQUA and connects to *lab*CORE. ACQUA controls *lab*CORE, provides and analyses incoming signals. *lab*CORE distributes the signals via its interfaces. The playback of background noises is synchronized with playback from HMS II.6[2,3].

The hands-free system of this vehicle uses Bluetooth for communication. *lab*CORE connects directly to the DUT via *core*BT2.

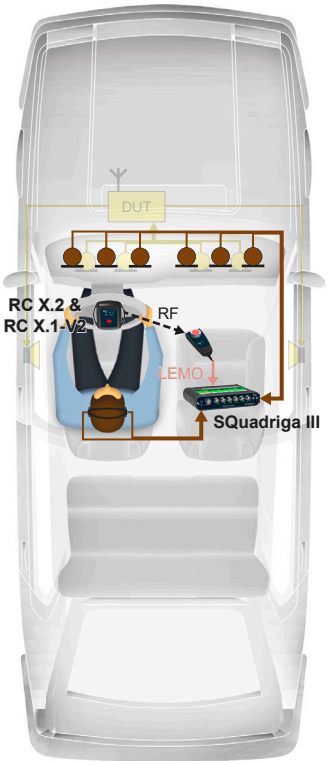
Configuration Example 3: Advanced Hands-Free System

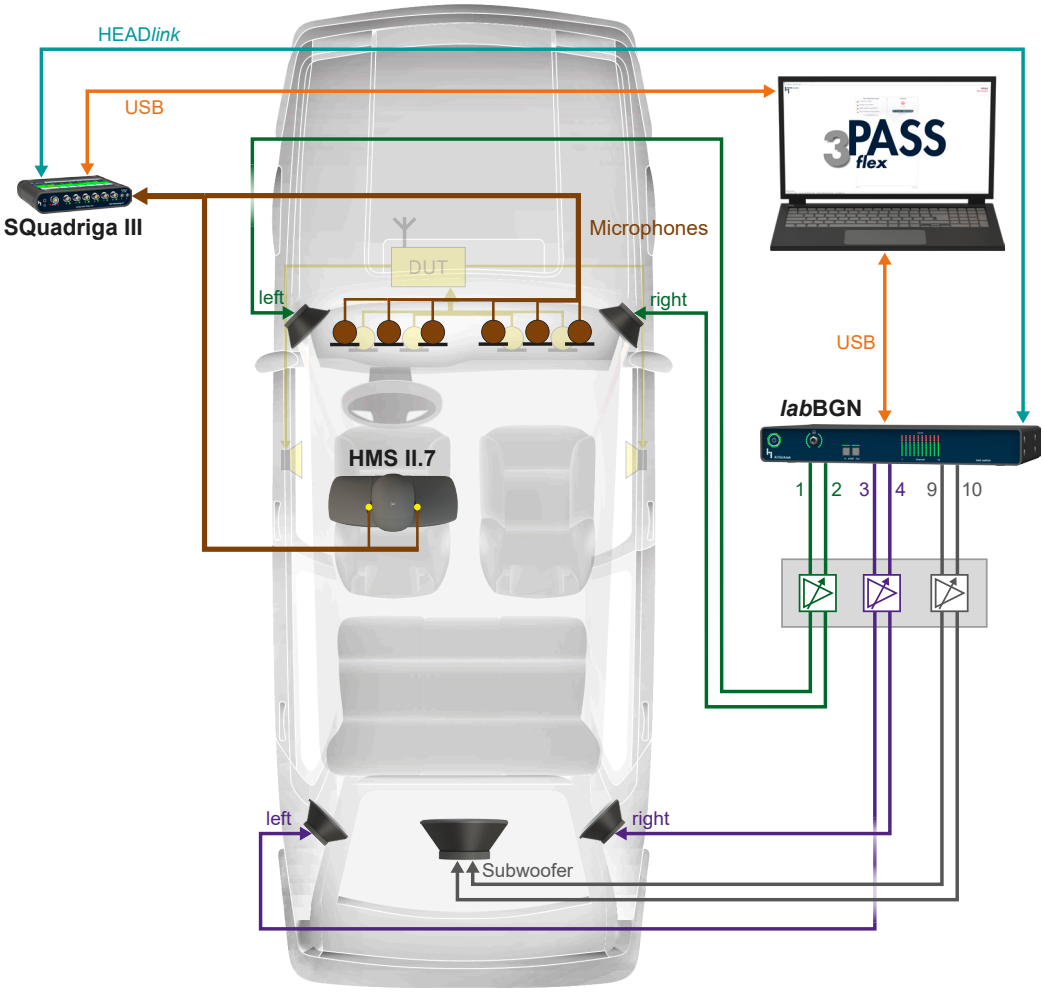
Step 1 of 3: Recording

A sophisticated hands-free system with beamforming microphones for driver and front passenger is the device under test. There is a large amount of microphones to reflect the system's complexity.

Driving noises are recorded with a total of eight measurement microphones. Six ICP® microphones are positioned next to the vehicle's four integrated microphones and the headset BHS II for recording at the driver's ears.

Recording is performed with the mobile hardware platform SQuadriga III. The recording is started conveniently by RF signals from the remote control RX X.1-V2.. The remote control is fixed to the steering wheel to allow operation of SQuadriga III without diverting the driver from traffic.





Step 2 of 3: Equalization

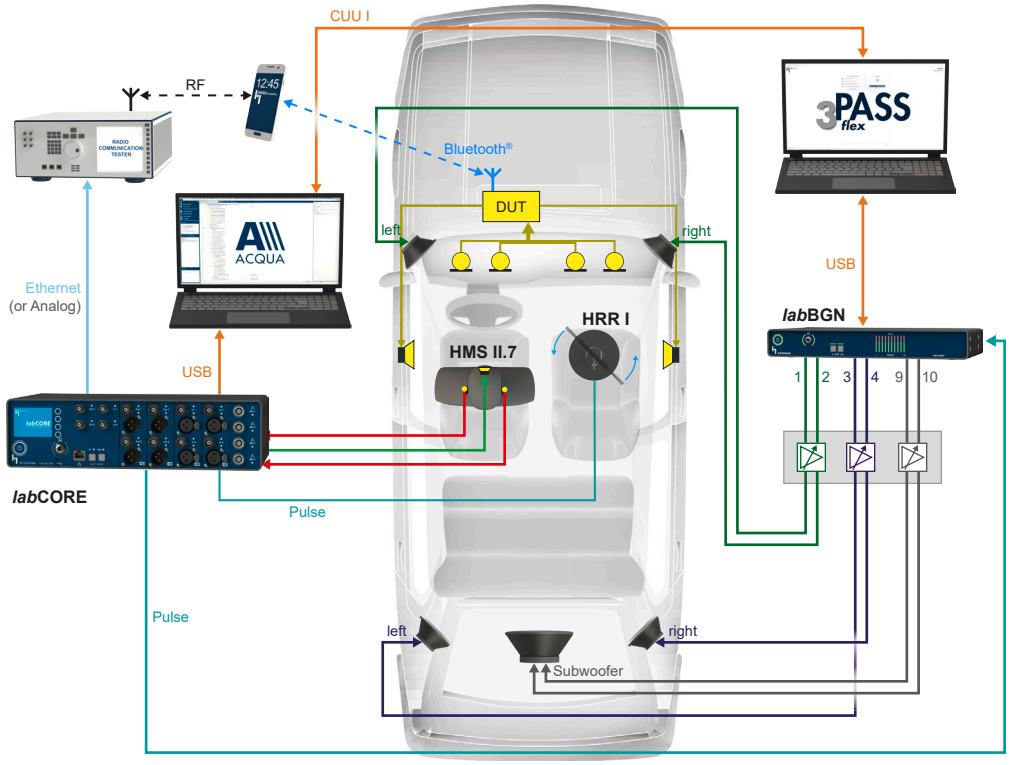
After the mobile recording session, the configuration changes to stationary. Four loudspeakers and a subwoofer are set up in the vehicle for background noise playback with 3PASS *flex*.

HMS II.7[2,3] replaces the driver as a physical stand-in during equalization of the system. The free-field ears of HMS II.7[2,3] replace the headset BHS II that the driver wore during the recording. The equalization of 3PASS *flex* includes SQuadriga III and the six ICP® microphones from the recording configuration.

Step 3 of 3: Measurements

Once 3PASS *flex* is equalized, HMS II.7[2,3] connects to *lab*CORE for operation of artificial ear and artificial mouth. A second PC runs ACQUA and connects to *lab*CORE. ACQUA controls *lab*CORE, provides and analyses incoming signals. *lab*CORE distributes the signals via its interfaces. The playback of background noises is synchronized with playback from HMS II.7[2,3]. HRR I varies the acoustic echo path during measurements for assessing echo attenuation.

The hands-free system of this vehicle applies Bluetooth for communication. The Bluetooth connection is established to a mobile phone. The phone connects to the simulated mobile network of a radio tester that is connected to *lab*CORE.



1. Testing of headset hands-free terminals as well as testing legacy hardware and software (e.g. MFE platforms, SQuadriga II, HAE-car) is rare and therefore mentioned only peripherally in this data sheet. In case of questions about such test cases or products, please contact your HEAD acoustics sales representative for further information.
2. This standard requires an artificial head according to ITU-T P.58. When equalized, HMS II.6 & HMS II.7 can be treated as P.58-compliant for far-field measurement purposes.
3. If available, respective HMS systems and HMS accessories of the previous generation can be used alternatively.

HEAD acoustics

Contact Information

Ebertstrasse 30a
52134 Herzogenrath, Germany
Phone: +49 (0) 2407 577-0
E-Mail: sales@head-acoustics.com
Website: www.head-acoustics.com