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Data Sheet

P.1150 (Code 60058)

Recommendation ITU-T P.1150, In-Car Communication Audio Specification

Overview

Upholding a conversation between driver and passenger(s) in a moving car is stressful and can distract from traffic. In-car-communication (ICC) systems aim to make conversation in cars easier. However, to be useful these systems need to overcome acoustic and additional technical challenges.

The tests defined in Recommendation ITU-T P.1150 aim to ensure a base level of functionality and quality of ICC systems. They focus on main priorities like system stability, listening effort, signal-to-noise ratio and talker localization accuracy. HEAD acoustics implemented these tests in the automated test suite P.1150 for ACQUA.

The test suite P.1150 can be used by manufacturers and suppliers of the automotive industry to qualify and optimize ICC systems and components.

Description

The cabin of a moving car is filled with a diverse mix of noise generated by the engine, tires, wind and mechanical vibrations. They mix with welcome sounds, e.g. the radio. To be intelligible in a conversation, the vehicle's occupants need to outperform the combination of noise and sound by speaking up. At best, the required effort is annoying. At worst, it becomes outright dangerous when distracting the attention – often including the driver's view – away from the road.

In-car-communication (ICC) systems aim to make conversation in vehicles easier by picking up a talker's voice with microphones and playing it back to the listener(s) through loudspeakers. Real-time recording and playback at every seating position requires additional communication equipment that adds technical hurdles like speech quality issues and system delay to the acoustic challenges.

If an ICC system fails to address all of these points, it can become an additional annoyance. At worst, it brings extra confusion and thus adds to the risks it was supposed to resolve. Only when it aids conversation in a reasonably natural way, it serves its purpose.

Beginning of 2020, the International Telecommunications Union (ITU) has issued Recommendation ITU-T P.1150. It defines appropriate test methods for ICC systems to ensure a basic level of functionality and quality. Testing focuses on key requirements towards the system like stability (no acoustic feedback), speech intelligibility and speech quality.

As the seating positions of conversational partners in a vehicle have a significant impact, ITU-T P.1150 takes this into account. The Recommendation defines a set of conversational paths mandatory to be tested as well as an additional set of optional paths.

In combination with additional HEAD acoustics equipment and software, the test suite P.1150 allows automated analysis and empiric optimization of complete systems, subsystems and components for in-car-communication. Another important element in ICC system testing is background noise simulation. This can be achieved with 3PASS *flex* in any vehicle. Vehicles equipped with A²B® bus systems alternatively allow to record background noise for later digital insertion into the ICC system via the bus and thus without 3PASS *flex*. Access to the A²B® bus is possible by equipping *lab*CORE with the optional hardware extension *core*A2B.

Key Features

- Automated test suite to test In-Car-Communication (ICC) systems and devices
- Uses numerous advanced software options (ACOPTs) for analysis of speech quality
- Supports the A²B® bus for recording and digital insertion of background noise

Applications

- Automated speech quality analysis of In-Car-Communication (ICC) systems and devices according to Recommendation ITU-T P.1150
- Experimental development and optimization of In-Car-Communication (ICC) systems and devices
- Optimizing positioning of hands-free microphones and loudspeakers in vehicles

Overview of database revisions and specification versions

Database Revision	Based on Specification Version	Min. ACQUA Version
Rev. 01, Service Pack 1	ITU-T P.1150 01/2020	≥ 4.2.200

Seating Position (Zone) Definitions

When testing ICC systems, it is vital to define seating positions (zones) for left- and right-hand drive vehicles. To avoid confusion and mix-ups, there are some simple rules valid for all vehicle types and left / right-hand drive variants:

- The driver is always zone 1
- The front passenger is always zone 2
- The rear passenger behind the driver is always zone 3
  - → Zone 4 is always in the middle of the 1st passenger row
  - → Zone 5 is always behind the front passenger
- If a vehicle has a third row of seats (= 2nd passenger row), they are numbered with 6, 7, 8 in equal order to the second row
  - → Zone 6 is always behind pos. 3

P.1150 defines mandatory tests covering the paths for which a conversation is particularly difficult:

- 1 → 3 and 1 → 5

In vehicles with two passenger rows (hinted in gray), two more mandatory paths are added:

- 1 → 6 and 1 → 8

Measurements in P.1150
Acoustic stability (Larsen-Effect)
Reinforcement delay
Self-hearing delay[1]
Speech intelligibility[1]
Listening effort
Talker localization accuracy[1]
Adaptive reinforcement[1]
Signal to noise ratio
Speech quality[1]
Double talk attenuation
Media interaction - Alert[1]
Media interaction - Music[1]
Media interaction - Voice[1]
Background noise transmission

General requirements

Software

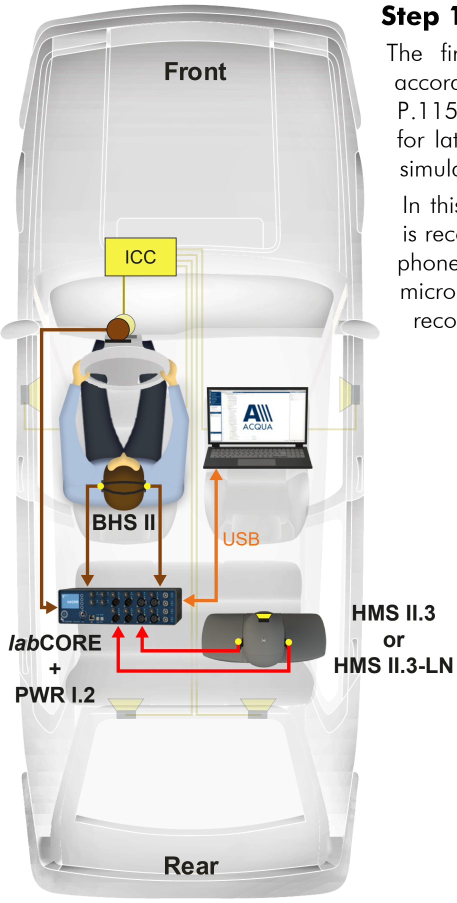
- **ACQUA (Code 6810 etc.)**, Advanced Communication Analysis System
- **ACOPT 09 (Code 6819)**, SLVM P.56
- **ACOPT 26 (Code 6853)**, Room acoustics
- **ACOPT 34 (Code 6865)[1]**, Speech Intelligibility Index according to ANSI S3.5-1997
- **ACOPT 37 (Code 6869)**, ABLE - Assessment of Binaural Listening Effort according to ETSI TS 103 558

Hardware[2]

- Two of the following **HEAD Measurement Systems[3]**:
  - **HMS II.3 (Code 1703)**, HEAD Measurement System, basic version with right ear simulator, 3.3 pinna & artificial mouth **with**
  - **HIS L (Code 1701)**, HEAD Impedance Simulator, left, for HMS II.3/4/5, version 2021

  or

  - **HMS II.3-LN (Code 1703.1)**, HEAD Measurement System, low-noise version with right ear simulator, 3.3 pinna & artificial mouth (based on IEC 60318-4, low-noise, high dynamics) **with**
  - **HIS L-LN (Code 1701.1)**, HEAD Impedance Simulator, left, low-noise version, for HMS II.3/4/5, version 2021
- ***lab*CORE (Code 7700)**, Modular multi-channel hardware platform **with**
  - ***core*BUS (Code 7710)**, *lab*CORE I/O bus mainboard
  - ***core*OUT-Amp2 (Code 7720)**, Power amplifier board (2 channels)
  - ***core*IN-Mic4 (Code 7730)**, Microphone input board
  - ***core*BEQ (Code 7740)**, *lab*CORE binaural equalization software extension
  - ***core*BEQ-Add (Code 7741)**, *lab*CORE binaural equalization software extension, additional set of filters for one artificial head (*core*BEQ required)
  - ***core*IN-A2 (Code 7760)[4]**, *lab*CORE analog balanced / unbalanced input board
- ***lab*PWR I.2 (Code 3712)**, Power box for HEAD*lab* systems (up to 100 W) (used with *lab*CORE in this application)
- **BHS II (Code 3322)**, Binaural headset for SQuadriga II, III or SQobold (used with *lab*CORE in this application)
- **CLB I.2 (Code 9847)**, Adapter for connecting BHS II to ICP inputs



Step 1 – Recording[6]

The first step for testing ICC systems according to Recommendation ITU-T P.1150 is recording real driving noise for later playback via background noise simulation.

In this ideal configuration, driving noise is recorded with (a) measurement microphone(s) positioned near the inbuilt ICC microphone(s). The driver of the car records binaurally at zone 1 with BHS II.

During the recording sessions, special attention must be dedicated to road safety.

HMS II.3(-LN) records driving noise binaurally at zone 5. A *lab*CORE powered by *lab*PWR I.2 receives all signals to pass them on to a laptop running ACQUA.

Via the optional adapter CLB I.2, BHS II is connected to labCORE equipped with the ICP® input board coreIN-ICP4.

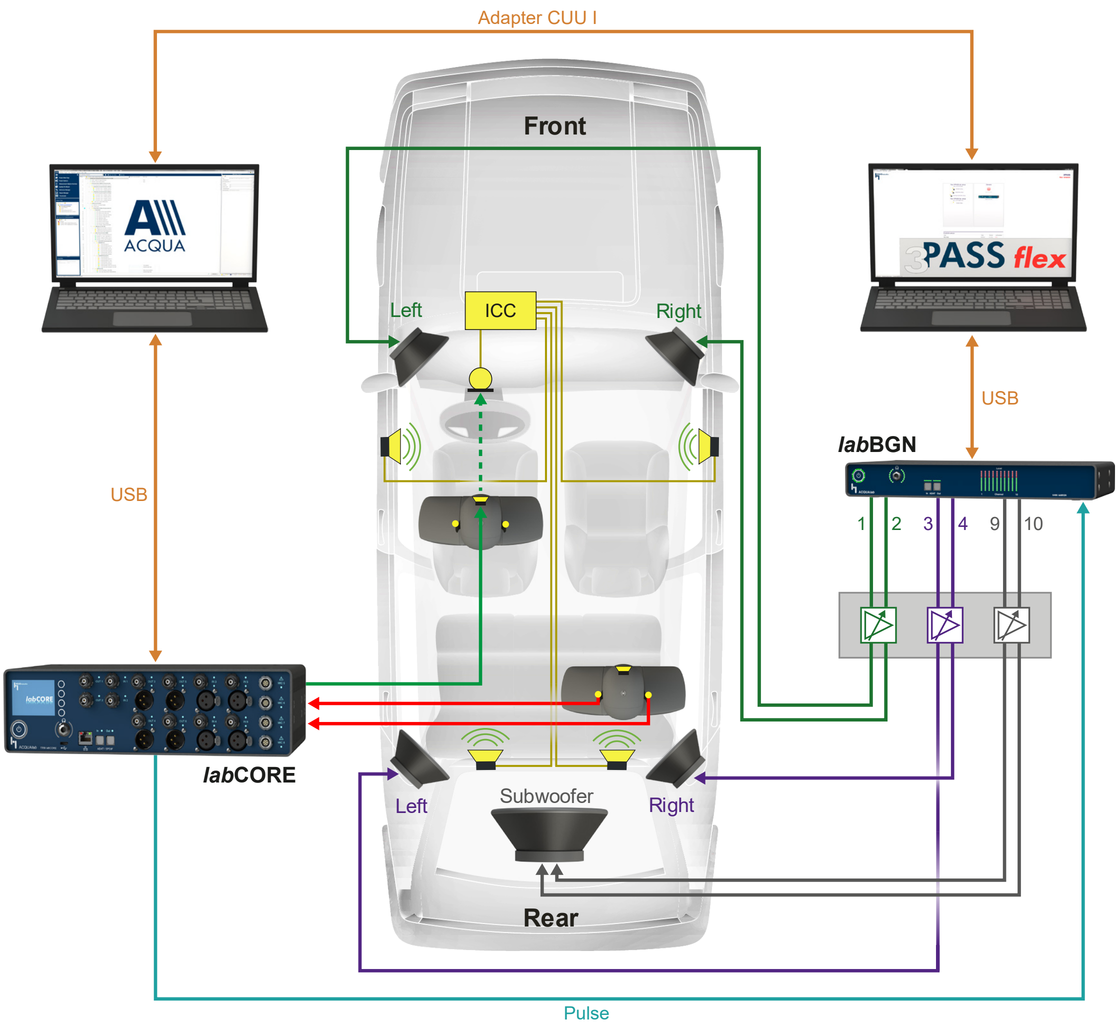
Step 2 – Simulation & measurements

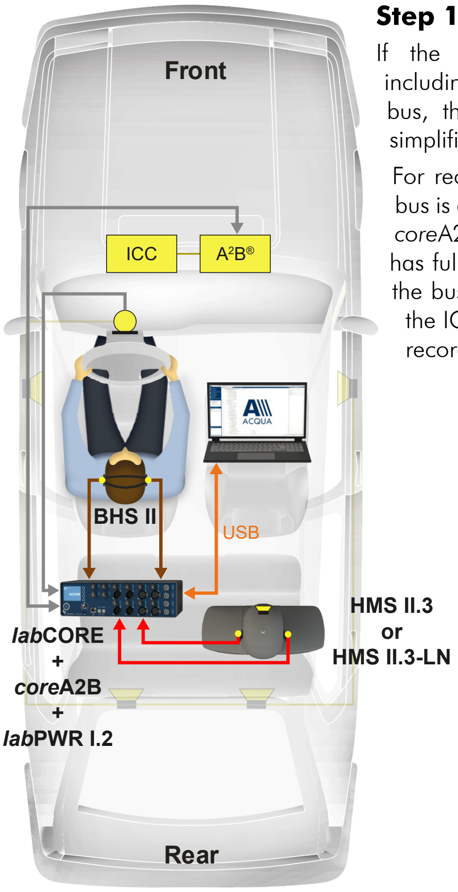
In this step, the previously recorded driving noise is played back by 3PASS *flex* and *lab*BGN. A sufficient number of amplifier channels power at least four loudspeakers and one subwoofer placed in the vehicle.

As the car is stationary in this lab situation, *lab*CORE and the laptop running ACQUA can be placed outside of the car for easier operation.

Two HMS II.3(-LN) at the zones 1 and 5 simulate the car occupants having a conversation via the ICC system of the vehicle.

The setup requires two distinct multi-point equalizations: one with the ICC system's microphone(s) and the HMS at zone 1 and the other with the same ICC system's microphone(s) and the HMS at zone 5.





Step 1 – Recording[6]

If the vehicle distributes audio signals including the ICC system though the A²B® bus, this and the following step can be simplified.

For recording real driving noise, the A²B® bus is accessed by *lab*CORE equipped with *core*A2B. Running in Proxy mode, *lab*CORE has full access to all signals and nodes on the bus. In this application, *lab*CORE uses the ICC system's inbuilt microphone(s) for recording.

The other components are identical to the example without A²B®. The driver of the car records binaurally at zone 1 with BHS II. During the recording sessions, special attention must be dedicated to road safety.

HMS II.3(-LN) records driving noise binaurally at zone 5. A *lab*CORE powered by *lab*PWR I.2 receives all signals to pass them on to a laptop running ACQUA.

Via the optional adapter CLB I.2, BHS II is connected to labCORE equipped with the ICP® input board *core*IN-ICP4.

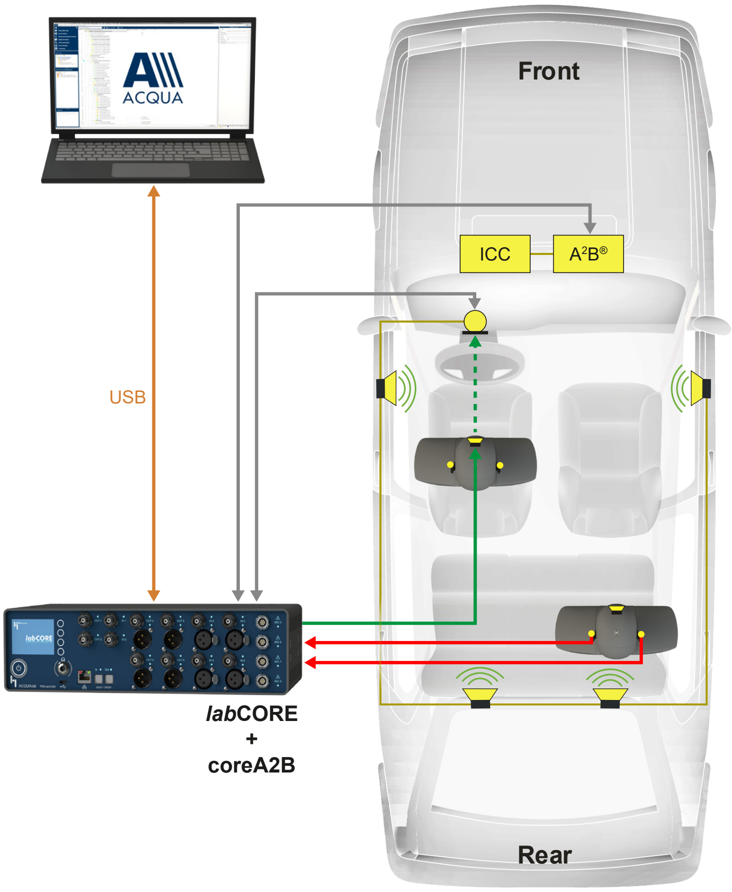
Step 2 – Simulation & measurements

If an A²B® bus is available, the stationary configuration for simulation and measurement is simplified as well. Being able to control the vehicle's A²B® bus system allows to digital insertion of the background noise signal. This makes 3PASS *flex*, *lab*BGN and dedicated loudspeakers for background noise simulation redundant.

The driving noise recorded in step 1 is digitally mixed into the signal from the ICC system's microphone(s). This happens within *lab*CORE in real time during the measurement.

For the binaural signal from the artificial ears of the HMS system in the back seat, driving noise is digitally inserted in post processing. Thus, there is no audible playback of background noise in the vehicle cabin.

The other components are identical to the example without A²B®. *lab*CORE and the laptop running ACQUA are placed outside of the car for easier operation. Two HMS II.3(-LN) at the zones 1 and 5 simulate the car occupants having a conversation via the ICC system of the vehicle.



1) In the current version of Recommendation ITU-T P.1150 (Jan 13, 2020), these chapters exist as placeholders without actual measurement items or rigid pass/fail limits.

2) The listed hardware is for vehicles with one passenger row and up to two measurement microphones. For vehicles with two passenger rows and/or more than two measurement microphones, additional hardware is required (e.g. another coreIN-Mic4 to connect more microphones).

3) If available, respective HMS systems and HMS accessories of the previous generation can be used alternatively.

4) Depending on the type of microphones, the microphone input board coreIN-ICP4 can be used as an alternative.

5) Only required when A²B® is not used.

6) Depending on the exact use-case and preexisting hardware, other solutions for recording may be applicable. Please contact your sales representative for further information.