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HMS II.7
(Code 1707)

HEAD Measurement System, with Artificial Mouth and Free-Field ICP® Microphones (Left & Right)

Overview

HMS II.7 is an artificial head measurement system with an artificial mouth and binaural free-field ICP® microphones. The system is ideally suited for measurements in arbitrary far-from-the-ear sound scenarios in sending and receiving direction, e.g. hands-free systems & devices at home or in vehicles.

The pre-polarized high quality 1/2" microphones of HMS II.7 are embedded in free-field-optimized pinnae. The low self-noise level (15.5 dB$_{SPL}$(A)) of the microphones allows conclusive measurements close to or below the hearing threshold. Combined with an upper limit of 135 dB$_{SPL}$, HMS II.7 covers the majority of hands-free application measurements. When equalized, HMS II.7 can be treated as P.58-compliant in far-field measurement scenarios.

The artificial mouth of HMS II.7 is equipped with a two-way loudspeaker design. It is capable to reproduce the full spectrum of human voice with lowest distortion, allowing high-quality measurements in super-wideband and fullband applications.

Description

HMS II.7 is an artificial head measurement system ideally suited for all free-field measurements in the field of telecommunications under realistic conditions. It provides a recording and speech simulation system and thus supports measurements in sending and receiving direction. HMS II.7 is equipped with two high-sensitivity ICP® microphones attached to free-field pinnae. The pinnae are similar in their general shape to the simplified pinna type 3.4 out of Recommendation ITU-T P.57, but have solid auricles and thus do not allow conclusive measurements of close-to-the-ear devices like headphones, handsets and similar devices. When equalized with the optional *labCORE* extension *coreBEQ*, HMS II.7 can be treated as P.58-compliant in arbitrary far-field measurement scenarios.

With geometrical dimensions meeting ITU-T P.58, HMS II.7 accurately replicates human speech and hearing in any far-from-the-ear sound scenario. The system is ideally suited for binaural testing, measuring and recording hands-free systems and devices used in vehicles, offices, at home and other environments.

Free-field ears & artificial mouth

The two pre-polarized high quality 1/2" microphone capsules in the free-field ears of HMS II.7 provide a low inherent noise floor of typically 15.5 dB$_{SPL}$(A). As such, it is qualified for any measurement scenario with signal levels close to and below the human hearing threshold, e.g. determining higher order distortion of audio equipment, measuring the background noise level of quiet acoustic environments,

Applications

- Free-field measurements in send/receive direction of:
  - In-car hands-free communication & infotainment systems
  - In-car eCall systems
  - Smart speakers
  - Conferencing systems & devices

Key Features

- Geometric characteristics according to ITU-T P.58

Free-field ears

- Binaural free-field ICP® microphones with high sensitivity & low noise floor
- Individual digital equalization via BEQ options
- Can be treated as P.58-compliant for far-field applications when equalized

Artificial mouth

- Low-distortion two-way design with wide frequency range for SWB/FB measurements
- Radiation characteristics according to ITU-T P.58
- Digital equalization in ACQUA

The free-field ears of HMS II.7 precisely emulate human hearing in any far-from-the-ear sound scenario. Thanks to their pre-polarization, the embedded ICP® microphones are convenient to use with stationary and in particular with mobile equipment.

TLP

At the top of HMS, a centrally embedded thread holds top mounted accessories like the laser pointer TLP.

Two additional threads towards the back of the head protect against accidental skew when using rotateable top-mounted accessories.

A dedicated thread at the facial crosshair of HMS II.7 holds the optional artificial nose AN-HMS.

AN-HMS

The artificial mouth's two-way loudspeaker design provides excellent frequency coverage & noise-free operation with *core*OUT-Amp2.

The bottom plate offers a Speakon connector for the artificial mouth and two BNC connectors for left and right to connect to the free-field ears.

A quick-clamping mechanism allows easy and fast attaching of HMS to the supplied torso box HTB VI. The thread below allows to fasten HMS to the torso box.
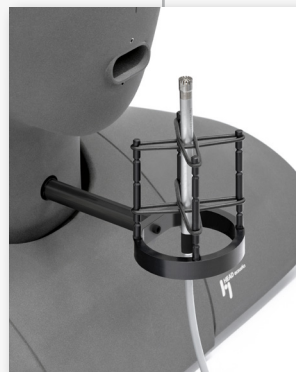
A flange at the throat of HMS II.7 can accommodate the delivered microphone mount for calibration of the mouth. The mount holds the microphone between durable rubber rings and thus allows to insert microphones of different sizes.

HMS II.7 mounted on the supplied torso box HTB VI (above), exemplary measurement setup in a car (right)

and more. The upper sound pressure level limit of 135 dB$_{SPL}$ ensures full usability of HMS II.7 for measurements at medium and high levels.

The artificial mouth of HMS II.7 is compliant with Recommendation ITU-T P.58 in its free-field emission characteristics. Combined with diffraction and reflection at shoulders and torso, it realistically reproduces the acoustic behavior of a talking person.

The two-way loudspeaker design of the mouth provides an excellent frequency response even without software equalization. The frequency range is superior to existing one-way designs in the market, making it ideally suited for measurements in super-wideband and fullband applications. The mouth is optimized for use with the labCORE hardware extension board coreOUT-Amp2. The board provides two class-D-amplified channels for one or two artificial mouths. In this constellation, the artificial mouth of HMS II.7 offers high performance without any notable self-noise.

Playback and recording

For measurements, HMS II.7 connects to the communication analysis system ACQUA via the hardware platform labCORE. The hardware extension board coreIN-ICP4 for labCORE offers connectors for up to four ICP® sensors, e.g. the four microphones two HMS II.7 or two microphones of one HMS II.7 in conjunction with two other ICP® sensors. The microphones of HMS II.7 support TEDS

to exchange information with the hardware platform[1]. In combination with the optional labCORE extension coreBEQ, equalization of binaural acoustical signals is possible. The free-field microphones of HMS II.7 can also be connected to the labCORE hardware extension board coreIN-A2[1].

Alternatively to labCORE, HMS II.7 is ideally suited for recording with hand-held frontends that require pre-polarized microphones, such as SQUadriga III and SQobold.

All connections are made at the bottom panel of HMS II.7. It offers a 4-pin Speakon socket for the artificial mouth and two BNC sockets to connect to the free-field ear microphones.

The delivered microphone fixture for equalization of the artificial mouth is designed for ease of use. It can be inserted into a dedicated flange at the throat of HMS II.7. Flexible rubber bands allow fixing of arbitrary measurement microphones in front of the mouth for quick and convenient equalization in ACQUA.

Free-Field Ears with ICP® Microphones
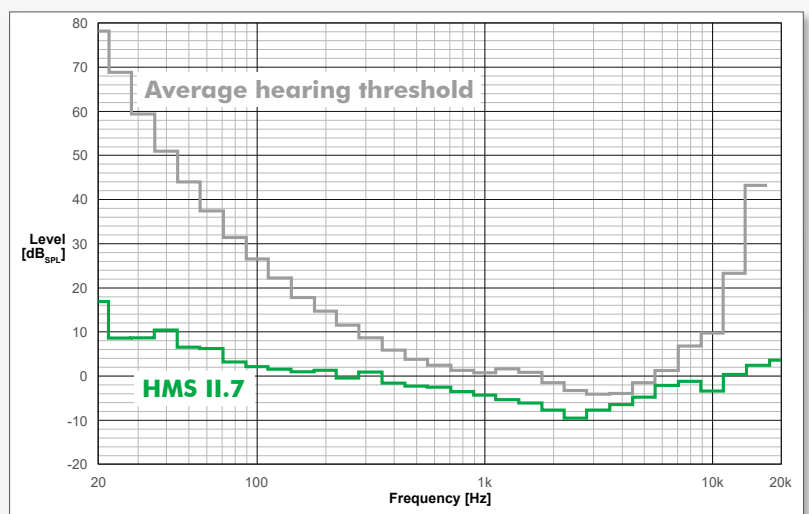
Typical self-noise of HMS II.7 free-field ears vs. human hearing threshold[2]

Accessories

The supplied Torso Box HTB VI acousti-cally simulates a human torso. Its compact design allows easy handling and trans-portation of the complete system, e.g. for mobile applications. The bottom plate of HMS II.7 offers a quick-clamping mecha-nism for convenient mounting on HTB VI. For a more permanent connection, a screw thread allows fixation of HMS on the torso box.

Optional accessories for HMS II.7 are the artificial nose AN HMS for nose-supported devices and the triaxial laser pointer TLP for precise alignment of the HATS. In conjunction with the optional power box *lab*PWR I.2 for *lab*CORE, mobile appli-cation (e.g. in vehicles) is possible with HMS II.7.

General Requirements

Hardware

- *lab*CORE (Code 7700), ACQUAlab modular multi-channel hardware platform for speech & audio quality testing **with**

  – *core*BUS (Code 7710), *lab*CORE I/O bus mainboard

  – *core*OUT-Amp2 (Code 7720), *lab*CORE output module, power amplifier (2 channels)

  – *core*IN-ICP4 (Code 7735), labCORE input module, ICP, (BNC connector, 4 channels)

  or

- SQuadriga III (Code 3324), Handheld 8-channel frontend (for recording purposes only)

  or

- SQobold (Code 3302), Handheld 4-channel frontend, incl. bag, power supply (for recording purposes only)

Software

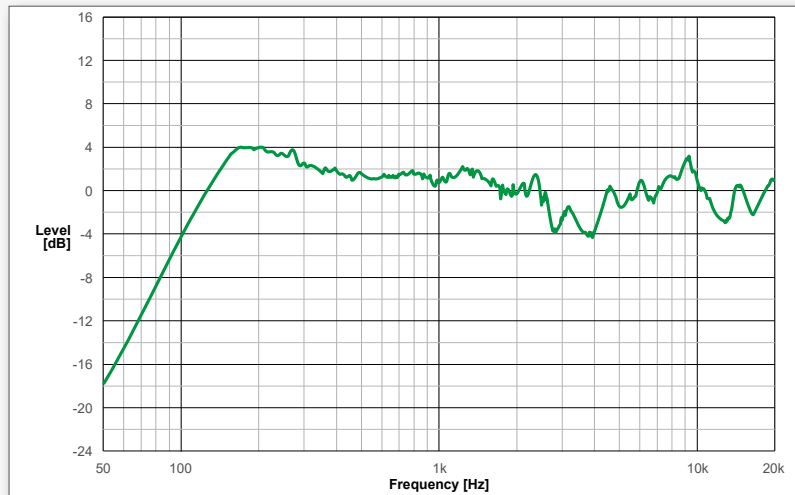- ACQUA (Code 6810 etc.), Advanced Communication Analysis System, Version 4.3.100 or later

  or

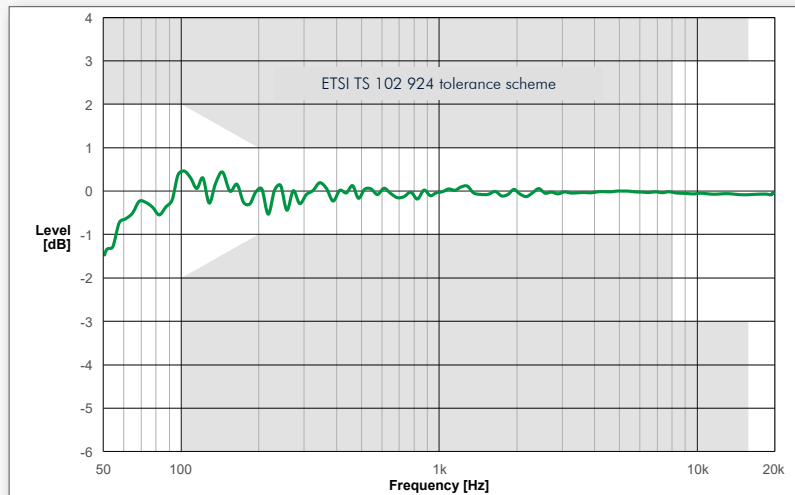- VoCAS (Code 6985), Voice Control Analysis System

Options

- *core*BEQ (Code 7740), *lab*CORE binaural equalization, incl. filter set for one artificial head
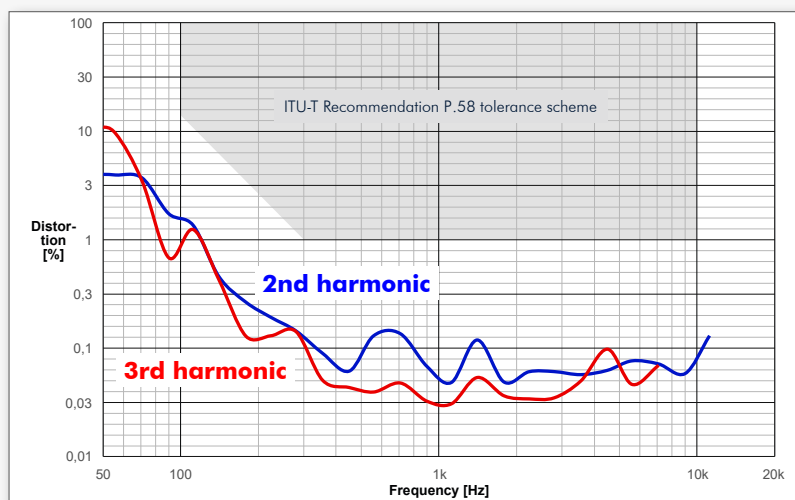
Two-Way Artificial Mouth

Typical frequency response of two-way mouth – unequalized

Typical frequency response of two-way mouth – equalized

Harmonic distortion of equalized two-way mouth at 0 dB$_{Pa}$

Configuration Example: Measurement of In-Car Hands-Free Communication Quality

This exemplary test scenario depicts testing a hands-free communication system in a car with HMS II.7.
*lab*CORE connects to the HATS via *core*IN-IPC4 and *core*OUT-Amp2. A radio communication tester simulates a mobile network for the vehicle's head unit. Background noise is simulated with 3PASS *flex*. For full repeatability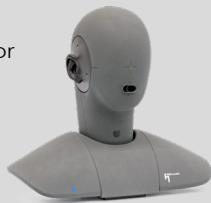 of measurements, background noise playback is synchro-nized by *lab*CORE through a pulse connection to the hardware platform *lab*BGN. ACQUA operates as the central software tool to generate, receive and analyze signals.
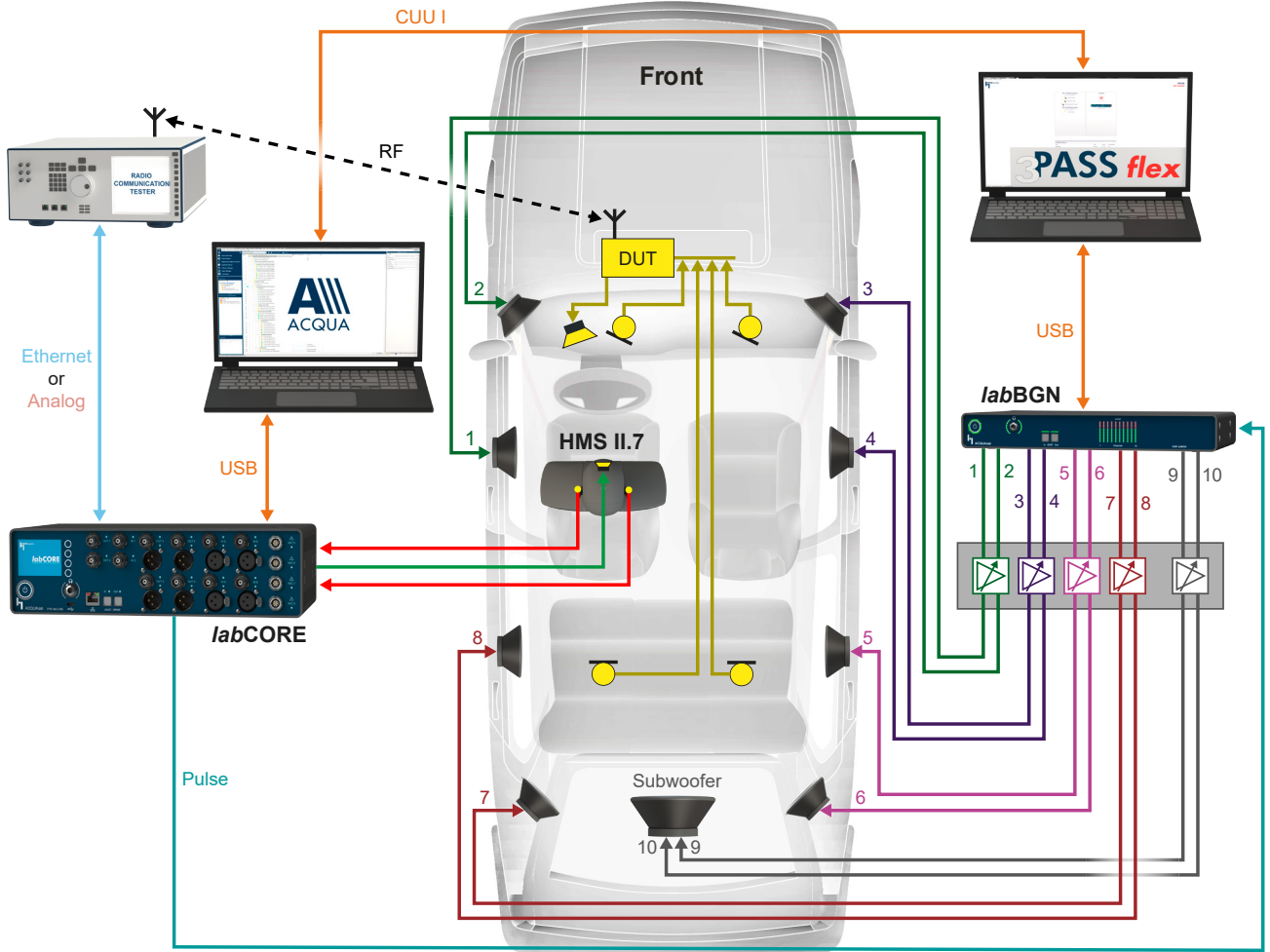
Other HMS Models

HMS II.3

- Anatomically shaped pinnae type 3.3
- Right ear simulator
- Artificial mouth

HMS II.3 LN

- Anatomically shaped pinnae type 3.3
- Low-noise right ear simulator
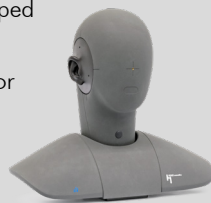- Artificial mouth

HMS II.3 LN HEC

- Anatomically shaped pinnae type 4.4 with human-like ear canal
- Low-noise right ear simulator with human-like ear canal
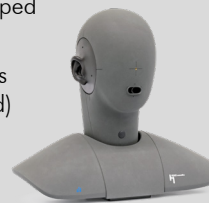- Artificial mouth

HMS II.4

- Anatomically shaped pinnae type 3.3
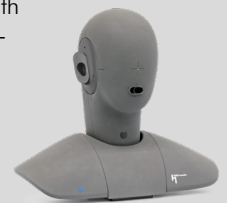- Right ear simulator

HMS II.5

- Anatomically shaped pinnae type 3.3
- No ear simulators (can be retrofitted)
- Artificial mouth

HMS II.6

- Free-field ears with condenser micro-phones
- Artificial Mouth

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

- **AN HMS (Code 1418)**, Extension for HEAD measurement system HMS: Artificial nose

- **HSM V (Code 1520)**, HEAD Seat Mount adapter for artificial head measurement systems or a head-shoulder unit

- **HSC IV-V5 (Code 1524-V5)**, Carrying case for HMS II.x

- **HWS (Code 1960)**, Windshield for outdoor recording

- **HMT III (Code 1961)**, Height-adjustable tripod for HMS

- **TLP (Code 1967)**, Triaxial laser pointer for HMS/HSU positioning incl. two batteries and carrying case

Delivery items

- **HMS II.7 (Code 1707)**, HEAD Measurement System, with artificial mouth and free-field ICP® microphones (left & right)

- **HTB VI (Code 1574)**, HEAD Torso Box for HMS II/III/IV & HSU

- **CSS V.3 (Code 1723-3)**, Mouth loudspeaker cable, Speakon 4-pin male ↔ Speakon 4-pin male, 2.95 m

- **CSB II (Code 9849)**, Adapter Speakon male ↔ Banana plug

- **CBB L I.3 (Code 1724-3)**, Cable BNC male ↔ BNC male, black, 2.95 m

- **CBB R I.3 (Code 1725-3)**, Cable BNC male ↔ BNC male, red, 2.95 m

- **HCC-HMS (Code 1741)**, Carrying case for accessory parts HMS II.x, containing:

  – Microphone holder

  – Lip ring & MRP pointer

  – 2.5 mm Allen key

  – Spare parts:

    ∘ 2 × Throat blind cap

  – Manual

Technical Data	
Microphone Characteristics (receiving direction)	
Transmission range	3.5 Hz – 20000 Hz (± 2 dB)
Dynamic range lower limit	15.5 dB$_{SPL}$(A) typical (without equalization)
Dynamic range upper limit	135 dB$_{SPL}$
Microphone sensitivity	50 mV / Pa
Artificial Mouth (sending direction)	
Loudspeaker configuration	2-way
Power limit	20 W$_{RMS}$, 50 W$_{Peak}$, max. power is electrically limited > 6 kHz
Impedance	4 Ω
Transmission range (equalized)	50 Hz – 20000 Hz
Frequency response (equalized)	Exceeds ETSI TS 102 924
Distortion factor	Exceeds ITU-T P.58
Directivity characteristics	According to ITU-T P.58
Environmental Conditions	
Operating temperature range	0 °C – 50 °C, 32 °F – 122 °F
Storage temperature range	-20 °C – 70 °C, -4 °F – 158 °F
Humidity	20% – 80% relative humidity (non-condensing environment)
Weights and Measures	
Overall dimensions (W x H x D)	450 x 400 x 180 mm (HATS only)
Weight	Approx. 5.4 kg (HATS only)

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1) *core*IN-A2 does not support TEDS. For *lab*CORE to receive TEDS information from the microphones of HMS II.7, *core*IN-ICP4 must be used.

2) All curves are diffuse-field equalized. HMS II.7 is measured with 4096 FFT. The average hearing threshold is according to ISO 389-7.

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