



Description

HMS II.3 LN is a HEAD acoustics artificial head measurement system ideally suited for all measurements in the field of telecommunications under realistic conditions. It comprises an artificial ear as well as an artificial mouth and thus supports measurements in sending and receiving direction. Complying with the geometric and acoustic characteristics of Recommendation ITU-T P.58, HMS II.3 LN is appropriate for close-to-the-ear, but also arbitrary far-field measurement scenarios. It can be used to test all kinds of transducers in e.g.:

- Handsets
- Headsets
- Headphones
- Hands-free devices
- Voice-operated equipment
- Hearing protectors

Ear simulator, pinnae & mouth

Together, the pinna and ear simulator of HMS II.3 accurately replicate the anatomy of the human outer ear. The microphone capsule in the ear simulator of HMS II.3 LN provides an exceptionally low inherent noise floor at 16 dB_{SPL}(A). As such, it is qualified for any measure-

ment scenario with signal levels close to and below the human hearing threshold, measurements of e.g. self-noise and higher order distortion in audio devices, background noise levels of quiet acoustic environments, scenarios with a low signal-to-noise ratio, and more.

The upper sound pressure level limit of 148 dB_{SPL} ensures full usability of HMS II.3 LN for measurements at medium and high levels. In contrast, typical low-noise systems are often limited regarding maximum sound pressure level.

DATA SHEET

HMS II.3 LN (Code 1703.1)

HEAD Measurement System, Low-Noise Version with Right Ear Simulator, 3.3 Pinna & Artificial Mouth

Overview

HMS II.3 LN is an artificial head measurement system with an artificial mouth and a low-noise right ear simulator based on IEC 60318-4. The system is ideally suited for measuring close-to-the-ear transducers in handsets, headsets, headphones, hearing protectors and more. By realistically replicating the relevant structures of the human anatomy, HMS II.3 LN also allows measurements of far-from-the-ear transducers such as hands-free equipment.

The ear simulator and the anatomically shaped pinnae are compliant with the type 3.3 ear simulator laid out in Recommendation ITU-T P.57 (06/2021). The very low self-noise level (16 dB_{SPL}(A)) allows conclusive measurements close to or below the hearing threshold. Combined with the upper limit of 148 dB_{SPL}, this HMS system sets a new standard unrivaled by other artificial heads in the field.

Interchangeable ear simulator components allow flexible adaption and extension of the system, for e.g. binaural measurements or for standards that require type 3.4 / 4.4 ear simulators.

The P.58-compliant artificial mouth of HMS II.3 LN is a two-way loudspeaker design. It is capable of reproducing the full spectrum of human voice with lowest distortion, allowing high-quality measurements in super-wideband and fullband applications.

Key Features

- Geometric and acoustic characteristics according to ITU-T P.58
- Modular design for easy retrofitting with compatible HMS components

Ear simulator:

- High sensitivity microphone with very low inherent noise floor (16 dB_{SPL}(A)) & high SPL limit (148 dB_{SPL})
- Anatomically shaped pinnae type 3.3 according to ITU-T P.57 (06/2021)
- Impedance simulator based on IEC 60318-4 (2010-01)
- TEDS support

Artificial mouth:

- Low-distortion two-way design with very wide frequency range for super-wideband & fullband applications
- Acoustic characteristics according to ITU-T P.58
- Digital equalization is supported by ACQUA
- Noise-free operation with coreOUT-Amp2

Applications

- High precision measurements of:
 - Handsets
 - Headsets
 - Headphones
 - Hands-free devices
 - Voice-operated equipment
 - Active & passive hearing protectors
- Measurements of idle noise in ANC devices (headphones, headsets etc.)
- Assessment of background noise level in quiet acoustic environments (e.g. in optimized office rooms, (semi-)anechoic chambers)
- Measurements of audio devices at low sound pressure levels, e.g.:
 - Self-noise of audio devices
 - Higher order distortion
 - Other low signal-to-noise ratio scenarios

The artificial ear of HMS II.3 LN fully matches the human ear in dynamic range and frequency bandwidth. HMS II.3 LN is delivered with two anatomically shaped pinnae compliant with the type 3.3 ear simulator laid out in Recommendation ITU-T P.57 (06/2021). The impedance simulator of HMS II.3 LN is based on IEC Standard 60318-4 (2010-01) as laid down in ITU-T P.57. Its low-noise microphone entails few small and acoustically irrelevant variations from the standard's formal requirements. Thanks to geometric and acoustic characteristics according to ITU-T Recommendation P.58, HMS II.3 LN is appropriate not only for close-to-the-ear, but also arbitrary far-from-the-ear measurement scenarios. The artificial mouth of HMS II.3 LN is compliant with Recommendation ITU-T P.58 in its free-field emission char-

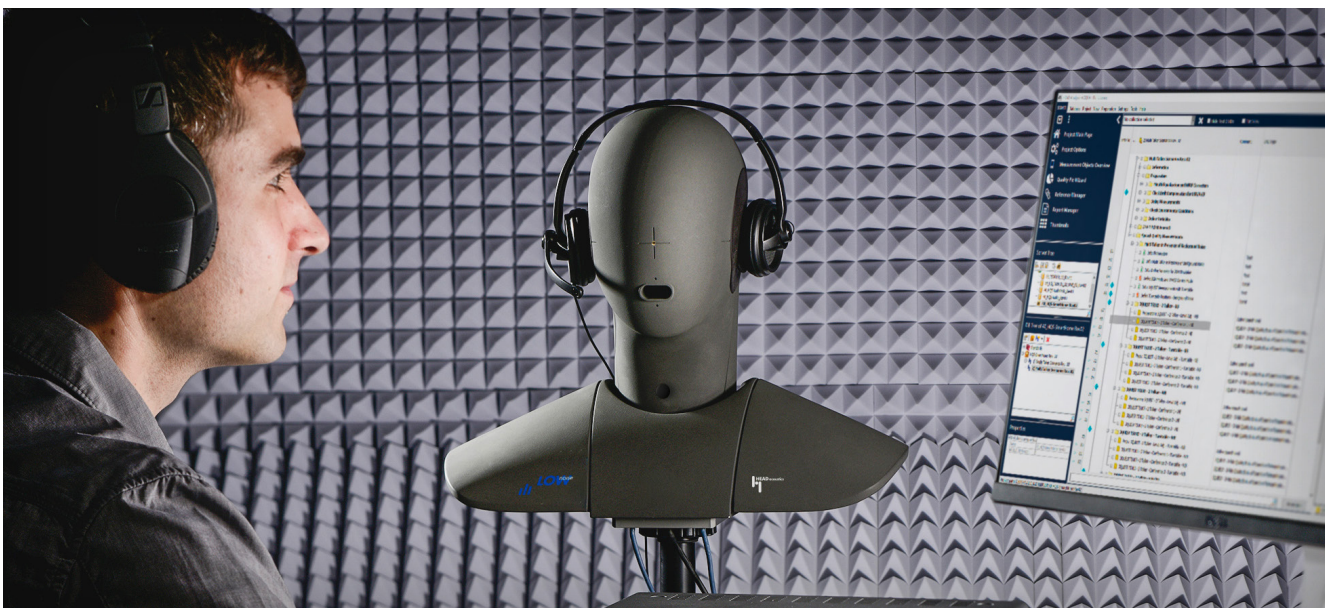
acteristics. Combined with diffraction and reflection at shoulders and torso, it realistically reproduces the acoustic behavior of a talking person. The two-way loudspeaker design of the mouth provides an excellent frequency response even without software equalization. The wide frequency range is superior 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.3 LN offers high performance without any notable self-noise.



HMS II.3 LN mounted on the supplied torso box HTB VI

Modularity

The modular design of the artificial ear allows to quickly add or change ear simulator(s) and pinnae. This can be used to equip HMS II.3 LN with a left-side low-noise ear simulator for binaural measurements. Alternatively, the ear simulator of the regular HMS II.3 (with pinnae type 3.3 or 3.4) or the low-noise variant with a human-like ear canal HMS II.3 LN HEC (with pinnae type 4.4) can be installed. Replacing a pinna or ear simulator requires only the 2.5 mm Allen key that is included in the delivery.



Features of HMS II.3 LN

MSA II



At the top of HMS, a centrally embedded thread holds top mounted accessories like the laser pointer TLP or the microphone arrays MSA I or MSA II. Two additional threads towards the back of the head protect against accidental skew when using rotateable top-mounted accessories.

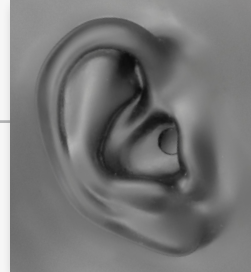
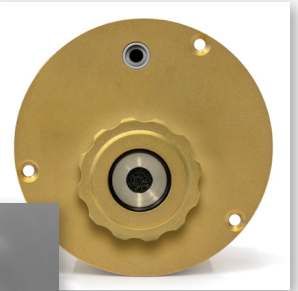
Four neck bolts serve as sturdy mounting points for the manual handset positioner HHP III.1 or the automated handset positioner HHP IV.

HHP IV



The bottom plate offers a Speakon connector for the artificial mouth and two 7-pin LEMO connectors for left and right ear simulator. 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.

The anatomically shaped pinna of HMS II.3 LN replicates the geometry of a human auricle. Beyond, the accompanying impedance simulator HIS R LN precisely recreates the ear's acoustic properties. The modular design of HMS II.3 LN allows to retrofit compatible ear simulators and pinnae (see next page).

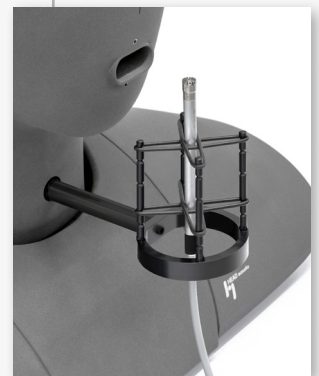


A dedicated thread at the facial crosshair of HMS II.3 LN is prepared to hold the optional artificial nose AN-HMS.

AN-HMS



The artificial mouth's two-way loudspeaker design provides excellent frequency coverage.



A flange at the throat of HMS II.3 LN 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.

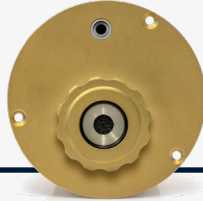
Ear Simulator and Pinna Options

Every HMS II.3 variant comes with a left & right pinna and a right ear simulator for monaural measurements. For binaural testing, a left ear simulator can be added.

The modular nature of HMS systems of the latest generation allows users to build numerous different configurations optimized for specific purposes. HMS II.3 LN is delivered with two anatomically shaped pinnae type 3.3 according to ITU-T P.57 as well as a right-ear low-noise impedance simulator based on IEC 60318-4. All further options for this HMS model are listed below for the right ear. The left ear can be equipped likewise.

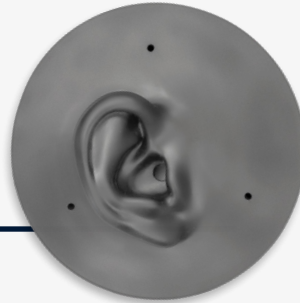
This product:
HMS II.3 LN

Low-noise
impedance simulator
with
straight ear canal



+

Anatomically shaped pinna
type 3.3 with straight ear canal



or

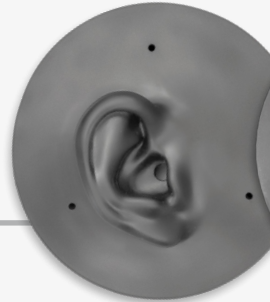
Equal to:
HMS II.3

Impedance simulator
with
straight ear canal



+

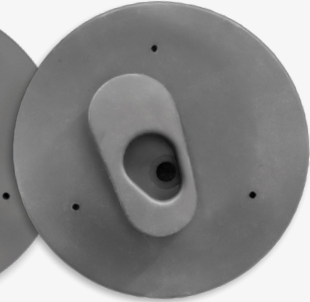
Anatomically shaped
pinna type 3.3 with
straight ear canal



or

+

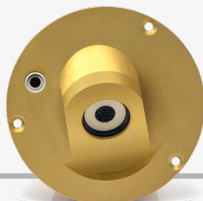
Simplified pinna
type 3.4 with
straight ear canal



or

Equal to:
HMS II.3 LN HEC

Low-noise
Impedance simulator
with
human-like ear canal



+

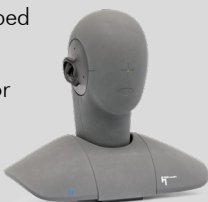
Anatomically shaped pinna type
4.4 with human-like ear canal



Other HMS Models

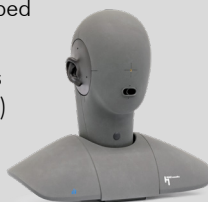
HMS II.4

- Anatomically shaped pinnae type 3.3
- Right ear simulator



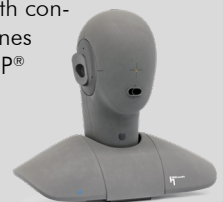
HMS II.5

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



HMS II.6/HMS II.7

- Free-field ears with condenser microphones (HMS II.7 with ICP® microphones)
- Artificial Mouth



HMS II.3 LN includes TEDS (Transducer Electronic Data Sheet) technology that allows ACQUA to determine the type and serial number of the HEAD Impedance Simulator(s) (HIS) as well as the HATS itself.

Playback and recording

For measurements, HMS II.3 LN connects to the communication analysis system ACQUA via the hardware platform *labCORE* equipped with the optional hardware board *coreIN-Mic4*. In combination with the necessary hardware modules including *coreBEQ*, equalization of binaural acoustical signals is possible. This includes support for various equalization variants, e.g. as laid out in Recommendation ITU-T P.581.

The artificial mouth of HMS II.3 LN is powered by the *labCORE*'s optional *coreOUT-Amp2* hardware board. ACQUA allows comfortable and precise equalization of the mouth.

All connections are made at the bottom panel of HMS II.3 LN. It offers the same connectors as an appropriately equipped *labCORE*: a 4-pin Speakon socket for the artificial mouth and two 7-pin LEMO sockets for the artificial ear(s).

The delivered microphone fixture is designed for ease of use. It can be inserted into a dedicated flange at the throat of HMS II.3 LN. Flexible rubber bands allow fixing of arbitrary measurement microphones in front of the mouth for quick and convenient equalization.

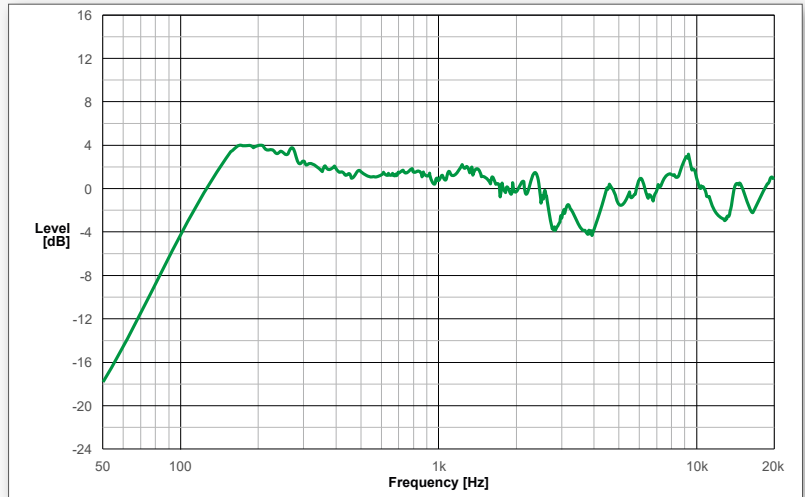
Accessories

For measurements of telephony handsets, HMS II.3 LN can be equipped with the optional handset positioners HHP IV or HHP III.1. The required neck bolts are part of the standard equipment and come pre-installed. HHP IV is fully motorized and remotely controllable and thus fully automatable via ACQUA. HHP III.1 offers manual positioning. Both allow precise positioning of any handset as well as precise adjustment of application forces to the pinna, ensuring meaningful and repeatable measurement results.

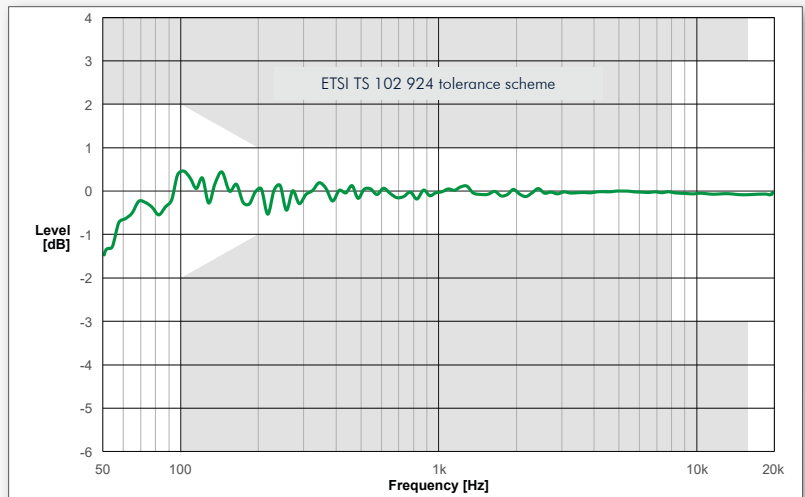
Another accessory for HMS II.3 LN is the artificial nose AN HMS. It makes measurements of nose-supported devices, e.g. AR/VR glasses and headsets, much more precise and convenient to set up.

For own background noise recordings and to perform equalization of a background noise simulation system (e.g. 3PASS *lab/flex*), the microphone surround arrays MSA I or MSA II can be mounted on top of the artificial head. For precise alignment of HMS, the triaxial laser pointer TLP can be mounted here alternatively.

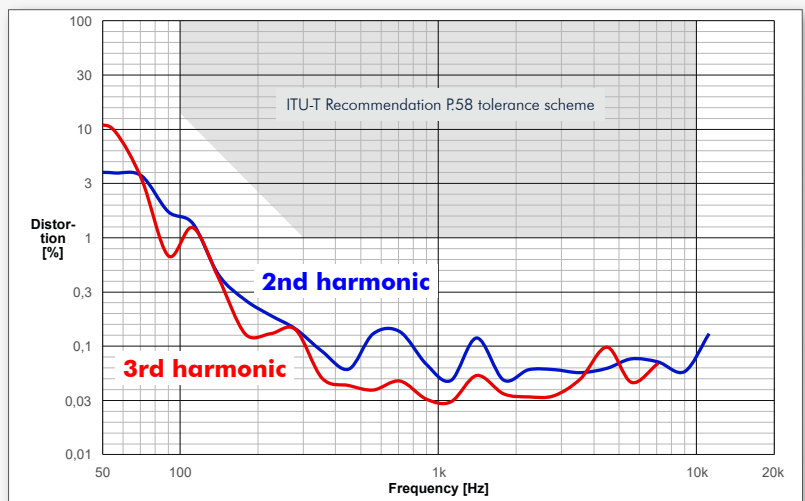
Two-way Artificial Mouth of HMS II.3 LN



Typical frequency response of two-way mouth – unequaled

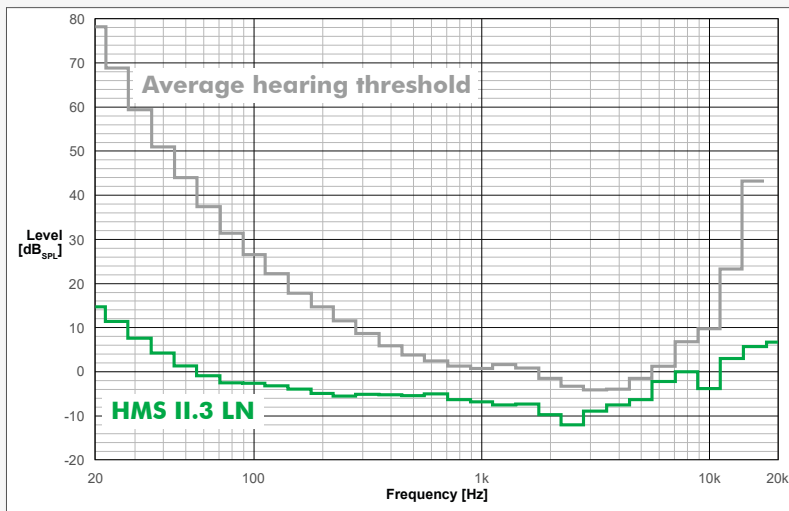


Typical frequency response of two-way mouth – equalized

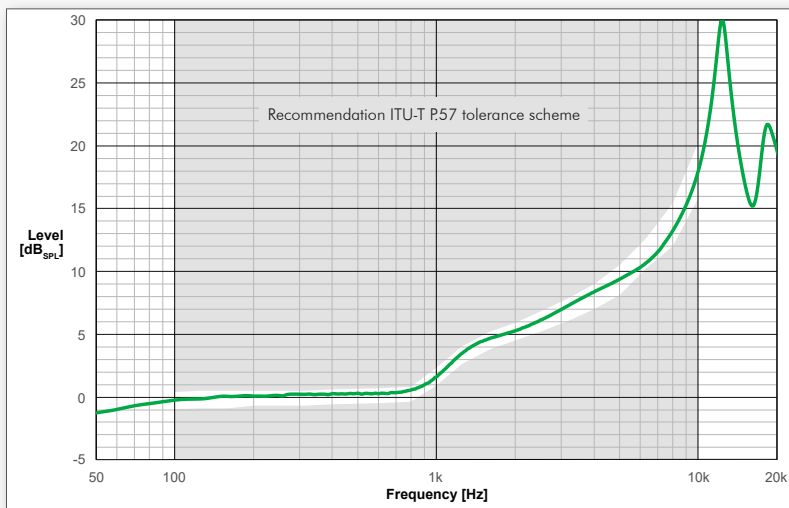


Harmonic distortion of equalized two-way mouth at 0 dB_{p0}

Low Noise Artificial Ear of HMS II.3 LN



Typical self-noise of HMS II.3 LN ear simulator vs. human hearing threshold¹



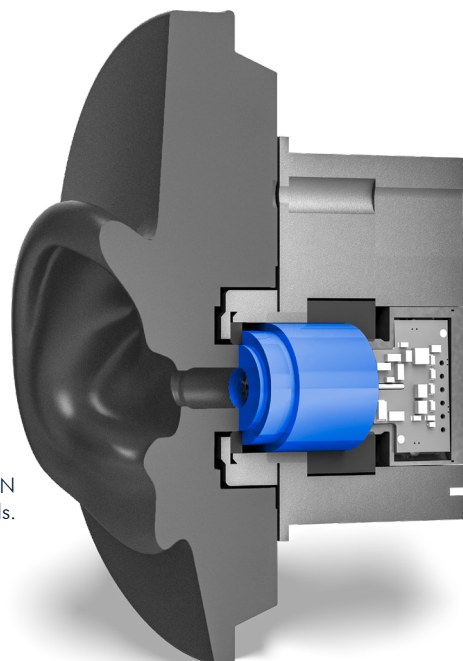
Typical transfer impedance of HMS II.3 LN ear simulator²

A cut through the right ear simulator of HMS II.3 LN shows its inner construction.

The straight ear canal is followed by the acoustic coupler (highlighted in blue) that contains a high-quality low-noise condenser microphone. The microphone covers a wide dynamic range from below to the human hearing threshold (see measurement diagram at the top of this page) up to 148 dB_{SPL}.

The anatomically shaped pinna according to type 3.3 described in Recommendation ITU-T P.57 accurately simulates the properties of the human outer ear. This makes HMS II.3 LN ideally suited for precision measurements in various close-to-the-ear scenarios, e.g. testing the transfer characteristics of handsets. By being suitable also for arbitrary far-from-the-ear scenarios, HMS II.3 LN is a multipurpose HATS with a focus on precision measurements at very low sound pressure levels.

For specialized tasks, other ear simulator(s) and pinnae can be retrofitted.



The supplied Torso Box HTB VI acoustically simulates a human torso. Its compact design allows easy handling and transportation of the complete system, e.g. for mobile applications. The bottom plate of HMS II.3 LN offers a quick-clamping mechanism for convenient mounting on HTB VI. For a more permanent connection, a screw thread allows fixation of HMS on the torso box.

In conjunction with the optional power box *labPWR I.2* for *labCORE*, mobile application (e.g. in vehicles) is also possible with HMS II.3 LN.

General Requirements

Hardware

- **labCORE (Code 7700)**, Modular multi-channel hardware platform
 - **coreBUS (Code 7710)**, I/O bus mainboard
 - **coreOUT-Amp2 (Code 7720)**, Power amplifier board, for sending direction
 - **coreIN-Mic4 (Code 7730)**, Microphone input board, for receiving direction

Software

- **ACQUA (Code 6810 etc.)**, Advanced Communication Analysis System, Version 4.3.100 or later
- or
- **VoCAS (Code 6985)**, Voice Control Analysis System

Options

- **HIS L LN (Code 1701.1)**, HEAD impedance simulator, left, low-noise version, for HMS II.3/4/5 (is delivered with 1721-3, Cable LEMO I 7-pin male ↔ LEMO I 7-pin male, black, 2.95 m, (Code 1721-3))
- **coreBEQ (Code 7740)**, labCORE binaural equalization, incl. filter set for one artificial head (delivered with labCORE)
- **coreBEQ-Add (Code 7741)**, labCORE binaural equalization, additional set of filters for one artificial head (coreBEQ 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
- **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
- **MSA I (Code 6487)**, 8 channel microphone surround array, Asymmetrical, according to ETSI TS 103 224
- **MSA II (Code 6487.2)**, 8 channel microphone surround array, Symmetrical, according to ETSI TS 103 224

Ear Simulator retrofitting

All ear simulators are delivered with a cable LEMO I 7-pin male ↔ LEMO I 7-pin male, black, 2.95 m (Code 1721-3)

- **HIS L (Code 1701)**, HEAD impedance simulator, left, for HMS II.3/4/5

- **HIS L LN HEC (Code 1701.1)**, HEAD impedance simulator, left, low-noise, for HMS II.3/4/5, human-like ear canal version
- **HIS R (Code 1702)**, HEAD impedance simulator, right, for HMS II.3/4/5
- **HIS R LN HEC (Code 1702.2)**, HEAD impedance simulator, right, low-noise, for HMS II.3/4/5, human-like ear canal version

Pinna retrofitting

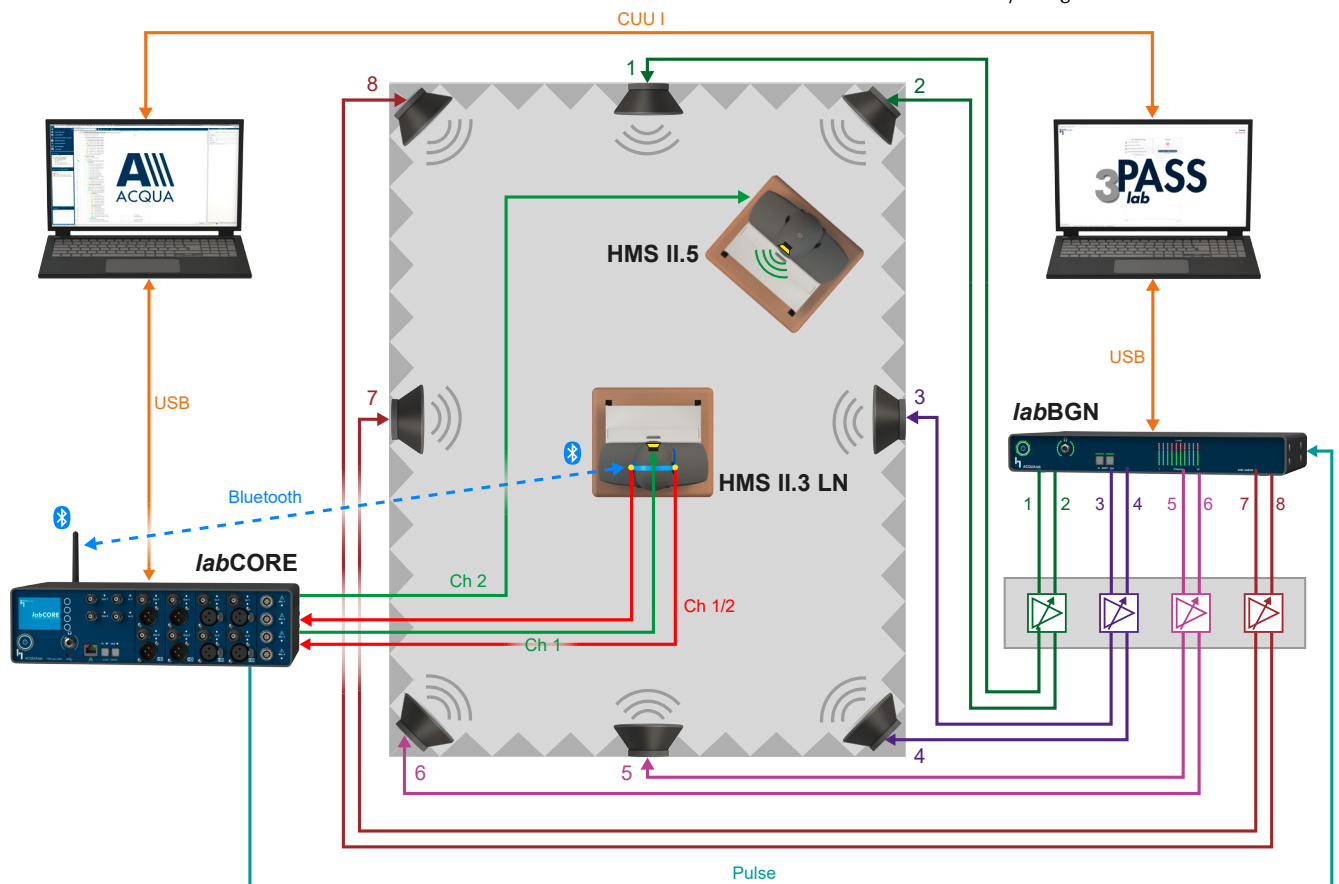
- **HEL 3.4 (Code 1713)**, Flexible pinna for HMS II.3/4, left ear, according to ITU-T P.57 type 3.4
- **HER 3.4 (Code 1714)**, Flexible pinna for HMS II.3/4, right ear, according to ITU-T P.57 type 3.4
- **HEL 4.4 (Code 1715)**, Flexible pinna for HMS II.3/4/5, left ear, according to ITU-T P.57 Type 4.4

Configuration example: Measurement of Bluetooth® Headset with HMS II.3 LN + Second Talker HMS II.5

This exemplary test scenario depicts testing a Bluetooth® on-ear headset with HMS II.3 LN. A HMS II.5 simulates a second talker to test the headset's performance with external speech. This test scenario is part of the HEAD quality standard HQS-ANC-Headset.

labCORE connects to the headset via coreBT. The two HATS are connected to the hardware platform with coreIN-Mic4 (ears of HMS II.3 LN) and coreOUT-Amp2 (mouths of HMS II.3 LN & HMS II.5). Background noise is simulated

with 3PASS lab. For full repeatability of measurements, background noise playback is synchronized by labCORE through a pulse connection to the hardware platform labBGN. ACQUA operates as the central software tool to generate, receive and analyze signals.



- **HER 4.4 (Code 1716)**, Flexible pinna for HMS II.3/4/5, right ear, according to ITU-T P.57 Type 4.4
- **HEL 4.4-V1 (Code 1715-V1)**, Flexible pinna for HMS II.3/4/5, left ear, according to ITU-T P.57 Type 4.4, gray color
- **HER 4.4-V1 (Code 1716-V1)**, Flexible pinna for HMS II.3/4/5, right ear, according to ITU-T P.57 Type 4.4, gray color

Delivery items

- **HMS II.3 LN (Code 1703.1)**, HEAD measurement system, low-noise version with right ear simulator, 3.3 pinna & artificial mouth
- **HIS R LN (Code 1702.1)**, HEAD impedance simulator, right, low-noise version, for HMS II.3/4/5
- **HEL 3.3 (Code 1711)**, Flexible pinna for HMS II.3/4/5, left ear, according to ITU-T P.57 Type 3.3
- **HER 3.3 (Code 1712)**, Flexible pinna for HMS II.3/4/5, right ear, according to ITU-T P.57 Type 3.3
- **CLL-R I.3 (Code 1722-3)**, Cable LEMO I 7-pin male ↔ LEMO I 7-pin male, red, 2.95 m
- **CSS V.3 (Code 1723-3)**, Cable Speakon plug ↔ Speakon plug, 2.95 m
- **CSB II (Code 9849)**, Adapter Speakon male ↔ Banana plug
- **HTB VI (Code 1574)**, HEAD Torso Box for HMS II/III/IV & HSU
- **HCC-HMS (Code 1741)**, Carrying case for accessory parts HMS II.x, containing:
 - Microphone holder
 - Lip ring & MRP pointer
 - Calibration adapter
 - 2.5 mm Allen key
 - Manual
 - Spare parts:
 - 3 × Allen screw for HIS
 - 2 × Throat blind cap

Technical Data	
Artificial Ear (receiving direction)	
Transmission range	3 Hz – 20000 Hz
Dynamic range lower limit	16 dB _{SPL} (A)
Dynamic range upper limit	148 dB _{SPL}
Microphone sensitivity	50 mV / Pa
Frequency response	According to ITU-T P.58
Polarization voltage	200 V
Supply voltage	± 60 V (recommended), + 120 V (possible)
Directivity characteristics	According to ITU-T P.58
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)
Dimensions	
Overall dimensions (W x H x D)	450 x 400 x 180 mm
Weight	Approx. 5.5 kg

1) All curves are diffuse-field equalized. HMS II.3 LN is measured with 4096 FFT. The average hearing threshold is according to ISO 389-7.

2) Curve and tolerance scheme are normalized to 500 Hz.

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