



Code 1703.2

HMS II.3 LN HEC

**HEAD Measurement System, Low-Noise Version with Human Ear Canal Simulator
Right & Artificial Mouth**

OVERVIEW

HMS II.3 LN HEC

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HEAD Measurement System, Low-Noise Version with Human Ear Canal Simulator Right & Artificial Mouth

HMS II.3 LN HEC is an artificial head measurement system with an artificial mouth and a low-noise right ear simulator with a human-like ear canal. The system is ideally suited for measuring arbitrary intra-concha and insert-type devices.

The pinnae and ear simulator(s) are fully compliant with the type 4.4 ear simulator laid out in Recommendation ITU-T P.57 (06/2021). It combines a very low self-noise level with a high upper SPL limit. A type 4.4 left ear simulator can be added as needed.

The P.58-compliant, two-way artificial mouth of HMS II.3 LN HEC 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:

- › Anatomically shaped pinnae (left & right) with human-like ear canals and right ear simulator
- › High sensitivity microphone with very low inherent noise floor & high SPL limit
- › Fully compliant with type 4.4 ear simulator laid out in Recommendation ITU-T P.57

Artificial mouth:

- › Low-distortion 2-way design with wide frequency range for super-wideband & fullband applications
- › Acoustic characteristics according to ITU-T P.58
- › Noise-free operation with coreOUT-Amp2

APPLICATIONS

Comprehensive testing of intra-concha and insert-type devices such as:

- › In-ear headphones & -headsets
- › Hearing aids
- › Active & passive hearing protectors

Measurements at very low sound pressure levels such as:

- › Idle noise of (In-ear) ANC devices
- › Background noise level of quiet environments
- › Higher order distortion

DETAILS

HMS II.3 LN HEC is an artificial head measurement system ideally suited for testing intra-concha and insert-type devices of any kind, e.g. in-ear headsets. It comprises two anatomically shaped pinnae with human-like ear canals, a right side ear impedance simulator as well as an artificial mouth. In addition to in-ear headsets, it can be used to test all kinds of transducers in e.g. handsets, headsets, headphones, hands-free devices, voice-operated equipment, hearing protectors and more.

Ear simulator & pinnae

The pinnae and ear simulator of HMS II.3 LN HEC accurately replicate the anatomy of the human outer ear. The microphone capsule in the ear simulator of HMS II.3 LN HEC has a very low inherent noise floor of 16 dB_{SPL(A)}. As such, it is qualified for any measurement scenario with signal levels close to the human hearing threshold. The very high sound pressure level limit of 148 dB_{SPL} ensures full usability of HMS II.3 LN HEC for measurements up to high levels, too.

HMS II.3 LN HEC is delivered with two anatomically shaped pinnae compliant with the type 4.4 ear simulator laid out in Recommendation ITU-T P.57 (06/2021). This pinna type is based on type 3.3 pinna in its outer shape and additionally models the section leading into a human-like ear canal. This allows comprehensive measurements of arbitrary intra-concha and insert-type devices. The ear canal of HMS II.3 LN HEC is physically modeled up to the reference plane specified in Recommendation ITU-T P.57 (06/2021). Beyond, the impedance simulator of HMS II.3 LN HEC simulates the acoustic properties of this inner section of the human ear canal as described in ITU-T P.57 (06/2021). Together, pinna, ear canal and the impedance simulator create an accurate acoustic simulation of a human ear.

Artificial mouth

The artificial mouth of HMS II.3 LN HEC is fully compliant with Recommendation ITU-T P.58. It realistically reproduces the acoustic behavior of a talking person. The two-way loudspeaker design provides an excellent frequency response. The wide frequency range is superior to existing one-way designs in the market, making



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

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*, offering high performance without any notable self-noise.

Modularity

The modular design of the HMS artificial ear allows to quickly add or change ear simulator(s) and pinnae. This can be used to retrofit HMS II.3 LN HEC with basic ear simulators with straight ear canals together with pinnae type 3.3, e.g. for testing according to standards that require a type 3.3 ear simulator.

The delivered pinnae type 4.4 can be exchanged with the optionally available ViBRIDGE pinnae. These pinnae are equipped with integrated electro-mechanic actuators capable of simulating bone-conducted near-end speech to inserted devices.

HMS II.3 LN HEC is either delivered "ViBRIDGE-ready" or can be modified at HEAD acoustics to become "ViBRIDGE-ready". As ViBRIDGE entails no changes to the physical dimensions of the pinnae, they remain fully compliant with ITU-T P.57 type 4.4 ear simulators. For the same reason, ViBRIDGE pinnae require the same impedance simulators HMS II.3 LN HEC is delivered with.

HMS of this generation include TEDS (Transducer Electronic Data Sheet) technology that allows ACQUA to electrically determine the type and serial number of the HEAD Impedance Simulator (HIS) as well as the HATS itself.

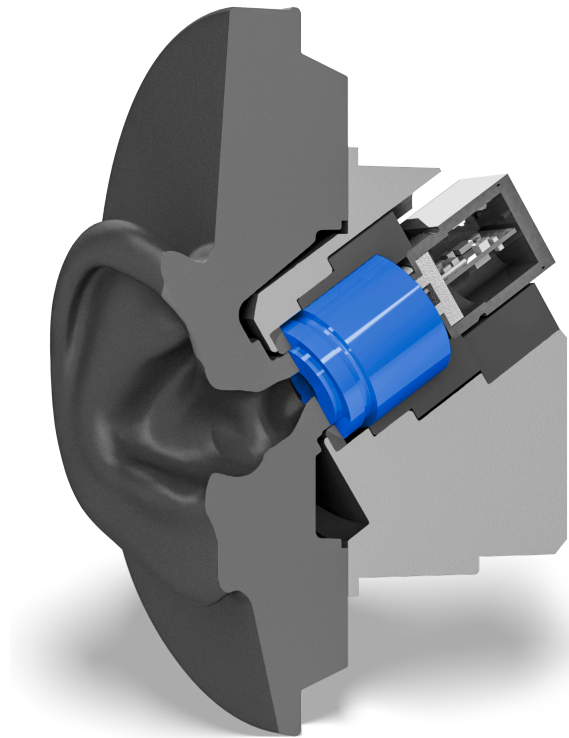
Playback and recording

For measurements, HMS II.3 LN HEC 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 using various equalization variants is possible.

The artificial mouth of HMS II.3 LN HEC is powered by the optional hardware extension board *coreOUT-Amp2* for *labCORE*. The board provides two class-D-amplified channels for one or two artificial mouths. Alternatively, the second output channel of *coreOUT-Amp2* can power the electromechanical actuators of ViBRIDGE pinnae to simulate structure-borne sound in sending direction.

Accessories

Of course, HMS II.3 LN HEC is fully qualified for any measurement scenario outside of in-ear headset testing. For measurements of telephony handsets, HMS II.3 LN HEC can be equipped with the optional handset positioners HHP IV (motorized) or HHP III.1 (manual). Both allow precise positioning of any handset as well



The ear canal and the acoustic coupler of the HMS II.3 LN HEC ear simulator meet each other at a reference plane defined in Recommendation ITU-T P.57.

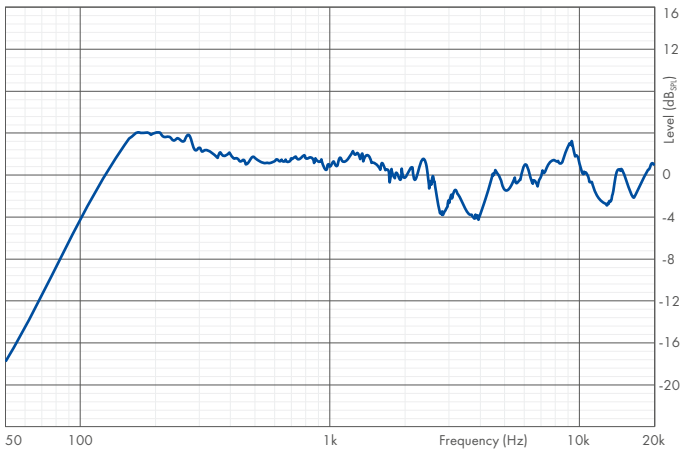
The ear simulator of HMS II.3 LN HEC combines a physically modeled outer ear canal and pinna with a coupler (highlighted in blue) that precisely simulates the acoustic properties of the inner ear canal via specific geometry. This combination allows conclusive measurements of intra-concha and insert-type devices while ensuring high dynamics and very low self-noise via the integrated high-sensitivity microphone capsule.

as precise adjustment of application forces to the pinna, ensuring meaningful and repeatable measurement results.

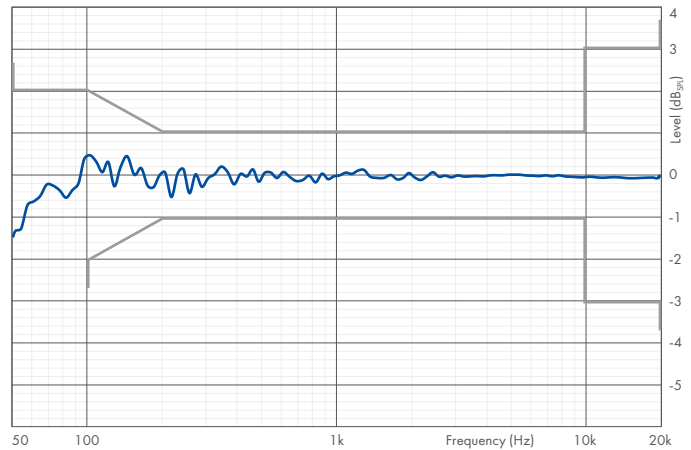
For own background noise recordings and to perform equalization of a background noise simulation system (e.g. 3PASS *lab/flex*), the microphone surround arrays MSA I or MSA II can be mounted on top of the artificial head. For precise alignment of HMS, the triaxial laser pointer TLP can be mounted here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

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.

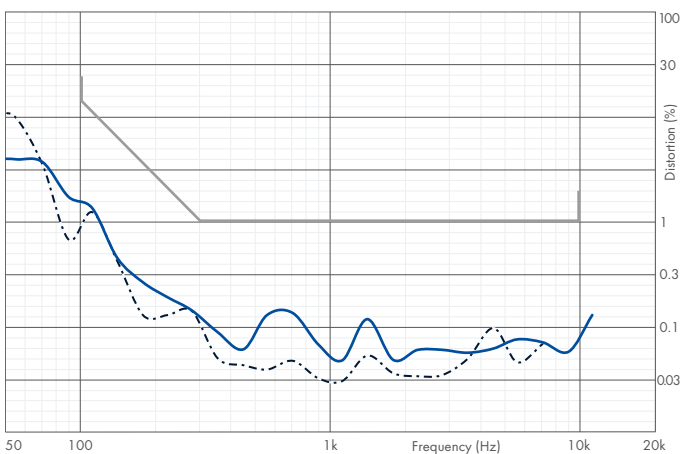
Total Harmonic Distortion (THD) > @ 0 dBPA (94 dB _{SPL}) > @ +6 dBPA (100 dB _{SPL}) > @ +12 dBPA (106 dB _{SPL}) > @ +18 dBPA (112 dB _{SPL})	(at MRP, equalized, with coreOUT-Amp2) < 4 % (100 Hz), < 0,5 % (200 Hz – 20 000 Hz), exceeds ITU-T P.58 < 6 % (100 Hz), < 1 % (200 Hz – 20 000 Hz) < 10 % (100 Hz), < 2 % (200 Hz – 20 000 Hz) < 3 % (200 Hz – 20 000 Hz)
Max. continuous output level > Pink noise > Sine > Real speech acc. ITU-T P.501	(at MRP, equalized, with coreOUT-Amp2) min. 112 dB _{SPL} (50 Hz – 16 000 Hz), min. 106 dB _{SPL} (20 Hz – 20 000 Hz) min. 112 dB _{SPL} (200 Hz – 6 000 Hz) @ THD < 3 %, min. 106 dB _{SPL} (100 Hz – 10 000 Hz) @ THD < 10 % No audible distortion up to approx. 110 dB _{SPL}



Typical frequency response of unequalized two-way mouth (—)



Typical frequency response of equalized two-way mouth (—) vs. ETSI TS 102 924 tolerance scheme (—)



2nd (—) and 3rd (---) order harmonic distortion of equalized two-way mouth at 0 dB_{Pa} vs. Recommendation ITU-T P.58 tolerance scheme (—)

Other

Dimensions and Weight	
Overall dimensions (Width × Height × Depth)	460 × 400 × 210 mm 460 × 790 × 400 mm on Torso Box
Weight	Approx. 6.1 kg (standard options) Approx. 14.1 kg with Torso Box (standard options)
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)

FEATURES & OPTIONS

MSA II

A centrally embedded thread at the top of HMS holds top-mounted accessories such as the Microphone Arrays MSA I, MSA II (shown) or the Triaxial Laser Pointer TLP.

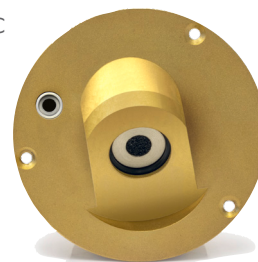
Two additional threads towards the back of the head protect against accidental skew when using rotatable top-mounted accessories.



IMPEDANCE SIMULATOR AND HEC PINNA

The anatomically shaped pinna of HMS II.3 LN HEC replicates the geometry of a human auricle and outer ear canal. Beyond, the accompanying impedance simulator HIS R (shown) precisely recreates the acoustic properties of the inner ear canal.

The modular design of HMS II.3 LN HEC allows to retrofit compatible ear simulators and pinnae (see next page).



HHP IV

Four neck bolts provide sturdy mounting points for an optional handset positioner such as the motorized HHP IV (shown), applicable e.g. for testing handsets according to Recommendation ITU-T P.64 (07/2022).



ARTIFICIAL NOSE & ARTIFICIAL MOUTH

The optional Artificial Nose AN-HMS can be fixed at the facial crosshair of HMS II.3 LN HEC.

The artificial mouth's two-way loudspeaker design provides excellent frequency coverage, a high maximum SPL and very low distortion.



BOTTOM PLATE

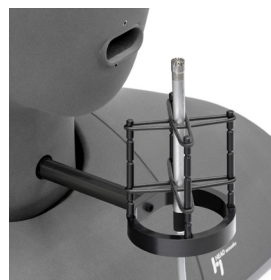
The bottom plate offers a 4-pin speakON connector for the artificial mouth as well as two 7-pin LEMO connectors for the right and optional left ear simulator.

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 on e.g. the optional tripod HMT III.1.



MICROPHONE FIXTURE

A flange at the throat can accommodate the delivered microphone mount for calibration of the mouth. Durable rubber rings can accommodate optional microphones of different sizes.



EAR SIMULATOR & PINNA OPTIONS

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 HEC is delivered with two anatomically shaped pinnae type 4.4 as well as an impedance simulator for the right ear, all according to ITU-T P.57. This standard configuration is the

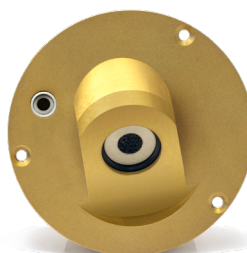
top example below. Retrofit options for this HMS are shown further below.

All configurations on this page are for the right ear, the left ear can be equipped likewise for binaural applications. Type 4.4-pinnae (with and without ViBRIDGE) are also available in a light gray-colored version.



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



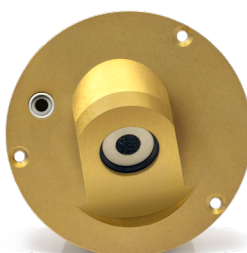
HMS II.3 / II.3 LN

- › Impedance simulator with straight ear canal (HMS II.3) **or**
- › Low-noise impedance simulator with straight ear canal (HMS II.3 LN)
- › Anatomically shaped pinna type 3.3 with straight ear canal



HMS II.3 ViBRIDGE

- › Low-noise impedance simulator with human-like ear canal
- › Anatomically shaped pinna type 4.4 with human-like ear canal and bone conduction simulation

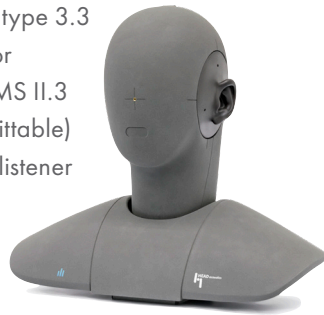


OTHER HMS MODELS

In addition to HMS II.3 LN HEC and its three variants HMS II.3, HMS II.3 LN and HMS II.3 ViBRIDGE, four additional models of the HEAD Measurement System are available.

HMS II.4

- › Anatomically shaped pinnae type 3.3
- › Right ear impedance simulator
- › Ear retrofitting options like HMS II.3
- › No artificial mouth (not retrofittable)
- › Can serve as e.g. a (second) listener



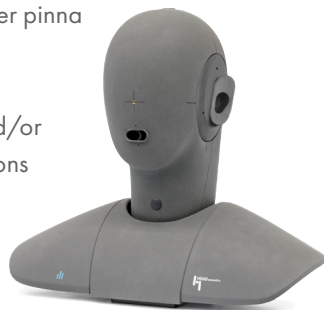
HMS II.5

- › Anatomically shaped pinnae type 3.3
- › No impedance simulators
- › Ear retrofitting options like HMS II.3
- › Artificial mouth like HMS II.3
- › Can serve as e.g. a (second) talker



HMS II.6/7

- › Binaural free-field microphones in solid pinnae with simplified geometry
- › HMS II.6 with high quality condenser microphones
- › HMS II.7 with high quality ICP® microphones
- › Not retrofittable with any other pinna or impedance simulator
- › Artificial mouth like HMS II.3
- › Can serve as e.g. a talker and/or listener in free-field applications



SCOPE OF DELIVERY

HMS II.3 LN HEC (Code 1703.2)

- › HEAD Measurement System, low-noise version with human ear canal simulator right & artificial mouth

HIS R LN HEC (Code 1702.2)

- › HEAD impedance simulator, right, low-noise, for HMS II.3/4/5, human ear canal version

HEL 4.4 (Code 1715)

- › Flexible pinna for HMS II.3/4/5, left ear, according to ITU-T P.57 type 4.4

HER 4.4 (Code 1716)

- › Flexible pinna for HMS II.3/4/5, right ear, according to ITU-T P.57 type 4.4

CLL-L I.3 (Code 1721-3)

- › Cable LEMO I 7-pin male ↔ LEMO I 7-pin male, black, 2.95 m

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 & 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
 - › 3 × Allen screw for HIS (spare parts)
 - › 2 × Throat blind cap (spare parts)
 - › Manual

OPTIONAL ACCESSORIES

General

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 V-V2 (Code 1525-V2)

- › 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, 2.95 m (Codes 1721-3 / x1722-3)

HIS L (Code 1701)

- › HEAD impedance simulator, left, for HMS II.3/4/5

HEC pinnae are available in the regular dark gray color as well as in the light gray variant shown here. The light gray pinnae can be retrofitted, but HMS II.3 LN HEC can also be initially delivered with light gray pinnae (Code 1703.2-V1).

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

One of the following HEAD acoustics Software:

ACQUA (Code 6810)

- › Advanced Communication Quality Analysis Software, Full-license Version (Version 4.3.100 or newer)

ACQUA Compact (Code 6860)

- › (Version 4.3.100 or newer)

RC-labCORE (Code 6984)

- › (Version 1.1.100 or newer)

VoCAS (Code 6985)

- › Voice Control Analysis System (Version 1.2.150 or newer)



HIS R (Code 1702)

- › HEAD impedance simulator, right, for HMS II.3/4/5

HIS L LN (Code 1701.1)

- › HEAD impedance simulator, left, low-noise version, for HMS II.3/4/5

HIS R LN (Code 1702.1)

- › HEAD impedance simulator, right, low-noise version, for HMS II.3/4/5

Pinna retrofitting

Please note that only certain combinations of ear simulators and pinnae are viable, see page eight for further details.

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

HEL 3.4 (Code 1713)

- › Flexible pinna for HMS II.3/4/5, left ear, according to ITU-T P.57 type 3.4

HER 3.4 (Code 1714)

- › Flexible pinna for HMS II.3/4/5, right ear, according to ITU-T P.57 type 3.4

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

HEL 4.4 ViBRIDGE (Code 1717)

- › Flexible pinna for HMS II.3/5, left ear, according to ITU-T P.57 Type 4.4, ViBRIDGE version

HER 4.4 ViBRIDGE (Code 1718)

- › Flexible pinna for HMS II.3/5, right ear, according to ITU-T P.57 Type 4.4, ViBRIDGE version

HEL 4.4 ViBRIDGE-V1 (Code 1717-V1)

- › Flexible pinna for HMS II.3/5, left ear, gray color, according to ITU-T P.57 Type 4.4, ViBRIDGE version

HER 4.4 ViBRIDGE-V1 (Code 1718-V1)

- › Flexible pinna for HMS II.3/5, right ear, gray color, according to ITU-T P.57 Type 4.4, ViBRIDGE version



IN PRACTICE

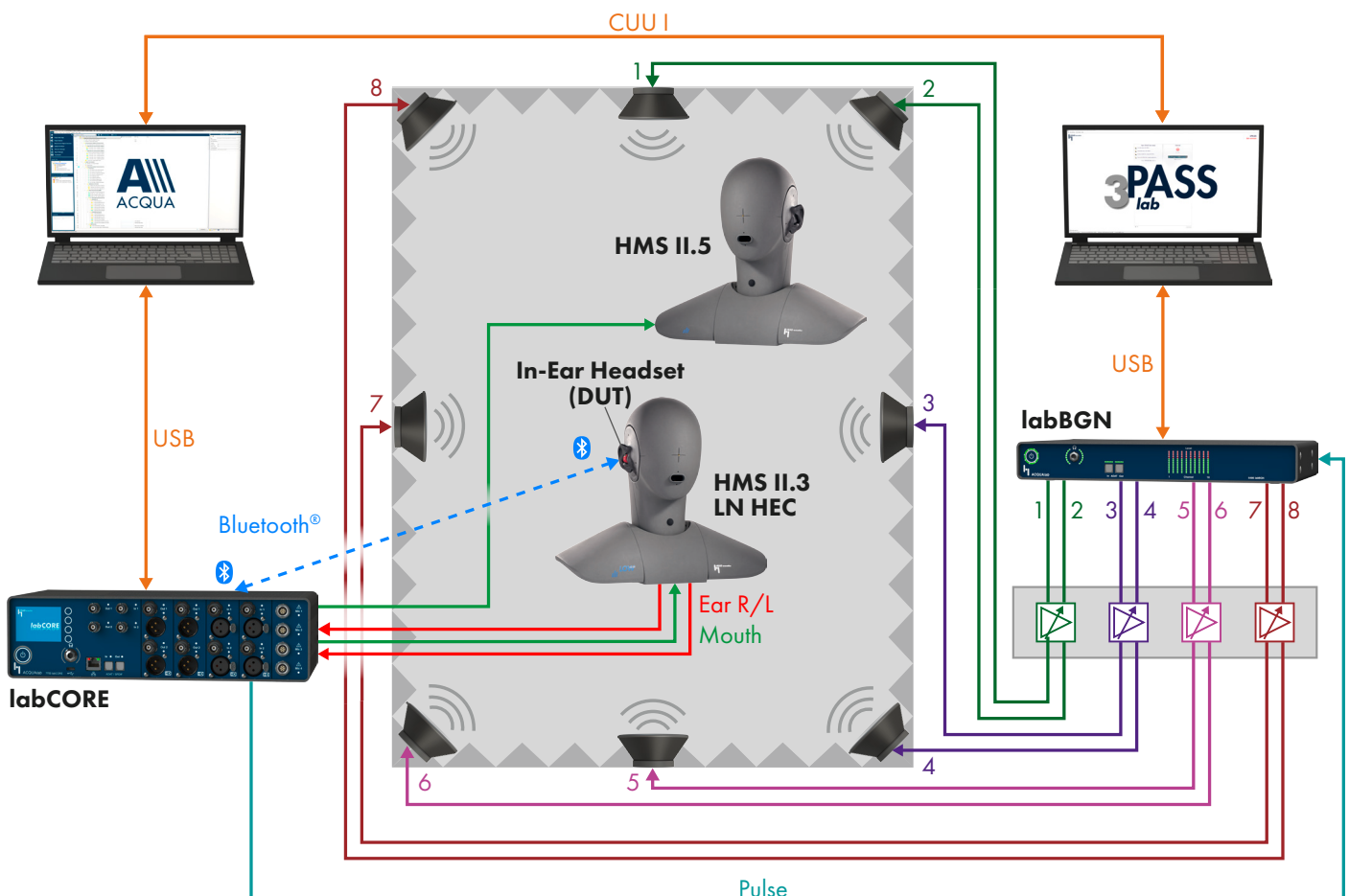
APPLICATION EXAMPLE

Measurement of a “True Wireless” In-Ear Headset with HMS II.3 LN HEC

This exemplary test scenario depicts testing a “true wireless” (TWS) Bluetooth® in-ear headset with HMS II.3 LN HEC. A HMS II.5 simulates a second talker to test the headset’s performance with external speech.

labCORE powers the artificial mouths of the two HMS with the two amplified channels of coreOUT-Amp2. The ear simulators of HMS II.3 LN HEC are connected to coreIN-Mic4. labCORE connects to the headset via coreBT2.

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 in conjunction with labCORE to generate, receive and analyze signals.



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