HEAD acoustics

**APPLICATION
EXAMPLE
INCLUDED**

Code 1703.2

HMS II.3 LN HEC

Head Measurement System, Low-Noise Version with Human Ear Canal Simulator Right and Artificial Mouth

OVERVIEW

HMS II.3 LN HEC

Code 1703.2

Head Measurement System, Low-Noise Version with Human Ear Canal Simulator Right and Artificial Mouth

HMS II.3 LN HEC is an artificial head 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 occluded ear simulator complies with recommendation ITU-T P.57. Accordingly, the anatomically shaped pinnae are compliant with the type 4.4 pinna simulator according to recommendation ITU-T P.57. The very low self-noise level allows conclusive measurements even below the hearing threshold. Combined with a very high upper limit, HMS II.3 LN HEC is ideally suited for all measurements in telecommunication and beyond.

The artificial mouth of HMS II.3 LN HEC is a two-way loudspeaker design and complies with the requirements from recommendation ITU-T P.58. It is capable of reproducing the full spectrum of human voice with lowest distortion, allowing high-quality measurements.

KEY FEATURES

Geometric and acoustic characteristics according to recommendation ITU-T P.58

Modular design for easy retrofitting with compatible components

Ear simulator:
› Anatomically shaped pinnae with human-like ear canals and right ear simulator
› High sensitivity condenser microphone with very low inherent noise floor and high upper limit
› Compliant occluded ear simulator according to recommendation ITU-T P.57
› Compliant with type 4.4 pinna simulator according to recommendation ITU-T P.57
› TEDS support (IEEE 1451.4 class MMI)

Artificial mouth:
› Low-distortion two-way design with very wide frequency range (up to fullband)
› Acoustic characteristics according to recommendation ITU-T P.58
› Digital equalization with ACQUA

APPLICATIONS

Measurements of:
› In-ear headphones and in-ear headsets
› Hearing aids
› Active and passive hearing protectors
› 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 which is ideally suited for low-noise measurements in the field of telecommunications under realistic conditions. It comprises an artificial ear with a human-like ear canal as well as an artificial mouth. Complying with the geometric and acoustic characteristics of recommendations ITU-T P.57 and ITU-T P.58, HMS II.3 LN HEC is appropriate for close-to-the-ear but also arbitrary far-field measurement scenarios. It can be used to test transducers and signal processing of, e.g., handsets, headsets, headphones, hands-free devices, voice-operated equipment, hearing protectors, and more.

DESCRIPTION

Ear Simulator and Pinnae

The pinna and the ear simulator of HMS II.3 LN HEC accurately replicate the anatomy and the performance of the human outer ear. For standard-compliant measurements, the occluded ear simulator and the type 4.4 pinnae comply with recommendation ITU-T P.57. The built-in microphone capsule provides a very low inherent noise floor and has a high sound pressure level limit. As such, it is qualified for any measurement with signal levels below the human hearing threshold as well as for measurements with high levels.

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 makes it ideally suited for measurements in super-wideband and fullband applications. The artificial mouth is optimized for use with the optional *core*OUT-Amp2 hardware board from the *lab*CORE hardware platform.

Playback and Recording

For recordings, HMS II.3 LN HEC connects to the ACQUA communication analysis system via the *lab*CORE hardware platform equipped with the optional *core*IN-Mic4 hardware board. The *core*BEQ software extension for *lab*CORE provides equalization of binaural acoustical signals for recordings with HMS II.3 LN HEC.

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

The artificial mouth of HMS II.3 LN HEC is powered by the optional *core*OUT-Amp2 hardware board from *lab*CORE. ACQUA supports comfortable and precise equalization of the mouth.

Modularity

The modular design of the artificial ear enables adding or changing ear simulator(s) and pinnae quickly. This facilitates the installation of a left-side ear simulator for binaural measurements. Another advantage is the interchangeability with either the ear simulator of the standard variant HMS II.3 (with pinna type 3.3) or the low-noise ear simulator with straight ear canal of HMS II.3 LN (with pinna type 3.3). HMS II.3 LN HEC includes TEDS (Transducer Electronic Data Sheet) technology that enables ACQUA to determine the type and serial number of the ear simulators, as well as HMS II.3 LN HEC itself.
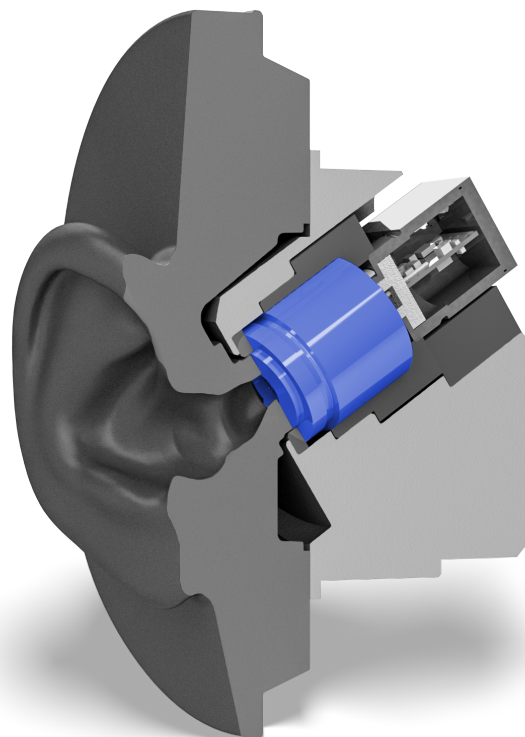
Accessories

For measurements of telephony handsets, HMS II.3 LN HEC is expandable by the optional handset positioners HHP IV or HHP III.1. Both provide precise positioning of any handset as well as precise adjustment of application force from the handset to the pinna.

Another accessory is the AN HMS artificial nose. It makes measurements of nose-supported device e.g., AR/VR glasses and headsets, more reproducible and convenient to set up.

A cut through the right ear simulator of HMS II.3 LN HEC. The human-like ear canal leads to the acoustic coupler (highlighted in blue) that contains a high-quality condenser microphone. The microphone covers a very wide dynamic range from below the human hearing threshold up to 148 dB$_{SPL}$.

HMS II.3 LN HEC has a mounting plate on top for attaching MSA I/MSA II. MSA I/MSA II are microphone surround arrays for recording customized background noises and for an equalized playback via 3PASS. Furthermore, the mounting plate provides fixation for the TLP II triaxial laser pointer for precise alignment of HMS II.3 LN HEC.

The HTB VI torso box simulates a human torso. It is included in the scope of supply by default. HMS II.3 LN HEC mounted on HTB VI forms a head and torso simulator (HATS) according to recommendation ITU-T P.58. The bottom plate of HMS II.3 LN HEC provides a Camlock coupling for convenient mounting on HTB VI.

TECHNICAL DATA

Artificial Ear

Frequency range	3 Hz – 20000 Hz
Frequency responses (FF/DF)	Compliant with recommendation ITU-T P.58
Directivity characteristics	Compliant with recommendation ITU-T P.58
Transfer impedance	Compliant with IEC 60318-4 and recommendation ITU-T P.57
Dynamic range	16 dB(A)$_{SPL}$ – 148 dB$_{SPL}$
Self-noise	Compliant with recommendation ITU-T P.57
Microphone sensitivity	50 mV/Pa
Polarization voltage	200 V
Supply voltages	
› U (recommended)	› ± 60 V
› U (possible)	› + 120 V
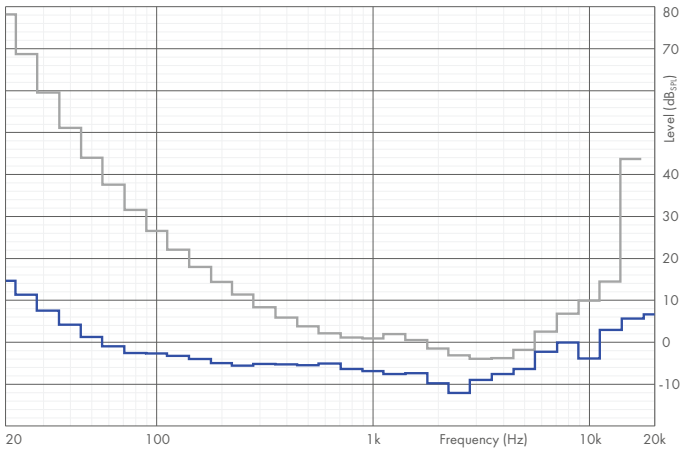
Typical self-noise of HMS II.3 LN HEC ear simulators (—) vs. average human hearing threshold (—)

All curves diffuse-field equalized, HMS II.3 LN HEC measured with 4096 FFT, average hearing threshold according to ISO 389-7
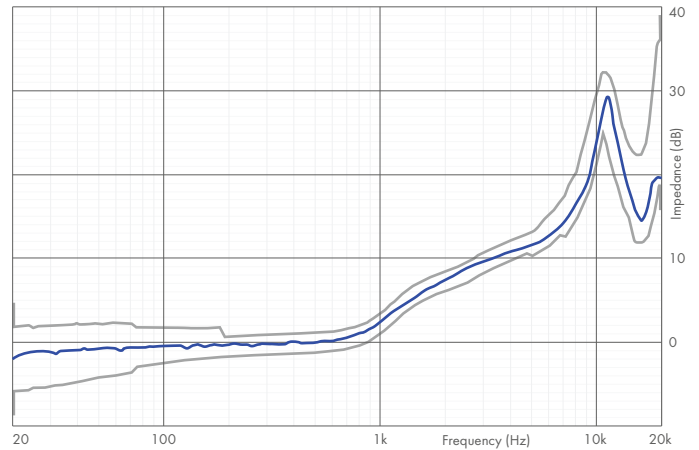

Typical transfer impedance of HMS II.3 LN HEC ear simulator (—) vs. ITU-T P.57 tolerance scheme (—)

*Curve and tolerance scheme normalized to 500 Hz*

Artificial Mouth

Loudspeaker configuration	2-way
Impedance	4 Ω
Frequency range	
› Unequalized	› 100 Hz – 20000 Hz (± 4 dB)
› Equalized	› 50 Hz – 20000 Hz (± 1 dB), exceeds ETSI TS 102 924
Power handling	
› P (continuous)	› 20 W
› P (short-term)	› 50 W (max. power is electrically limited > 6 kHz)
Total Harmonic Distortion (THD)	at Mouth reference Point (MRP), equalized, with *coreOUT-Amp2*
› at 0 dB$_{PA}$ (94 dB$_{SPL}$)	› < 4% (100 Hz), < 0.5% (200 Hz – 20000 Hz), exceeds recommendation ITU-T P.58
› at 6 dB$_{PA}$ (100 dB$_{SPL}$)	› < 6% (100 Hz), < 1% (200 Hz – 20000 Hz)
› at 12 dB$_{PA}$ (106 dB$_{SPL}$)	› < 10% (100 Hz), < 2% (200 Hz – 20000 Hz)
› at 18 dB$_{PA}$ (112 dB$_{SPL}$)	› < 3% (200 Hz – 20000 Hz)
Max. continuous output level	at MRP, equalized, with *coreOUT-Amp2*
› Pink noise	› min. 112 dB$_{SPL}$ (50 Hz – 16000 Hz), min. 106 dB$_{SPL}$ (20 Hz – 20000 Hz)
› Sine	› min. 112 dB$_{SPL}$ (200 Hz – 6000 Hz) at THD < 3%, min. 106 dB$_{SPL}$ (100 Hz – 10000 Hz) at THD < 10%
› Real speech according to recommendation ITU-T P.501	› No audible distortion up to approx. 110 dB$_{SPL}$
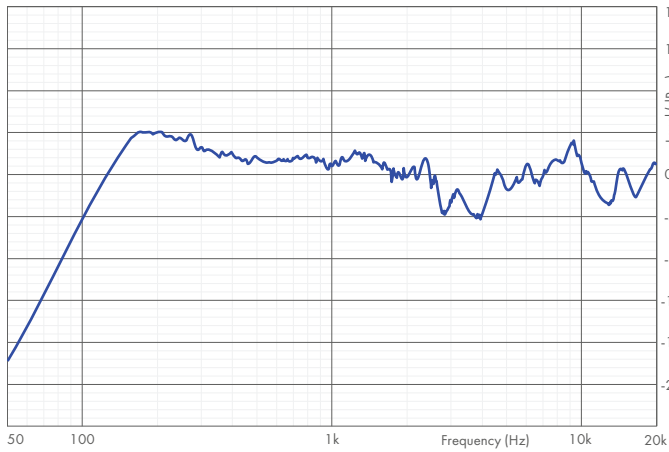
Typical frequency response of unequalized two-way mouth (—)
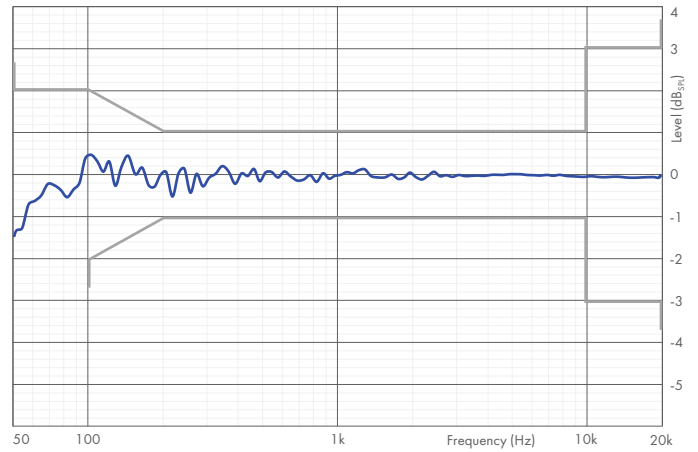
Typical frequency response of equalized two-way mouth (—) vs. ETSI TS 102 924 tolerance scheme (—)
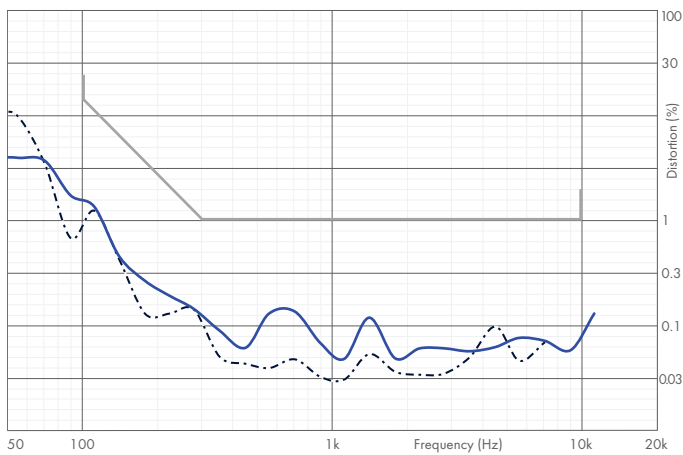
2nd (—) and 3rd (– -) order harmonic distortion of equalized two-way mouth at 0 dB$_{Pa}$ vs. Recommendation ITU-T P.58 tolerance scheme (—)

Other

| Dimensions and Weight	
Overall dimensions (Width × Height × Depth)	460 mm × 400 mm × 210 mm 460 mm × 790 mm × 400 mm mounted on HTB VI
Weight	Approx. 6.1 kg (standard scope of delivery) Approx. 14.1 kg mounted on HTB VI
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

MSA I/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 TLP II Triaxial Laser Pointer.

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. Behind the pinna, the impedance simulator HIS R LN HEC (shown) simulates the ear's acoustic properties.
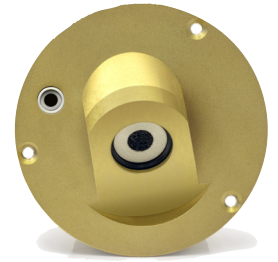
ViBRIDGE PINS

Pin contacts for supplying and controlling the ViBRIDGE actuator of HEL/HER 4.4 ViBRIDGE (-V1).

ARTIFICIAL MOUTH AND ARTIFICIAL NOSE

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

The optional AN HMS artificial nose can be fixed at the facial crosshair of HMS II.3 LN HEC.


BOTTOM PLATE

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

A quick-clamping mechanism enables easy and fast attaching of HMS II.3 LN HEC to the HTB VI torso box. The thread below allows to fasten HMS on, e.g., the optional HMT III tripod.

MICROPHONE HOLDER

A snap lock at the throat can accommodate the delivered microphone mount for calibration of the mouth. Durable rubber rings can accommodate optional microphones of different sizes.
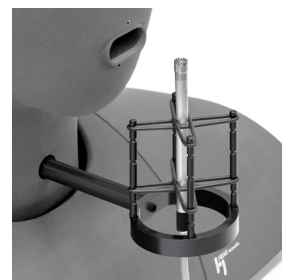
EAR SIMULATOR AND PINNA OPTIONS

By default, HMS II.3 LN HEC has a left and right pinna type 4.4 and a right ear impedance simulator for monaural measurements. It is extendable by a left ear impedance simulator for binaural testing. The modular design of HMS II Series enables to build numerous different configurations optimized for specific purposes.
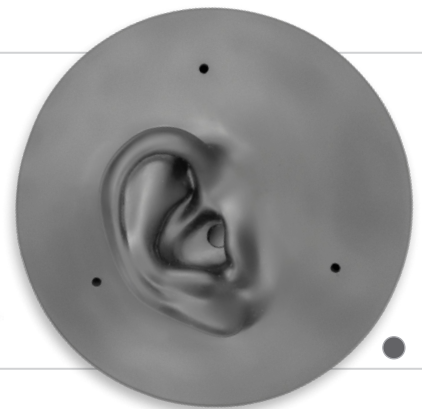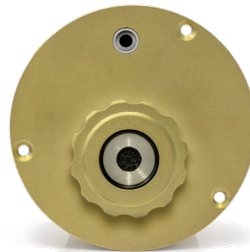
HMS II.3

› Impedance simulator with straight ear canal
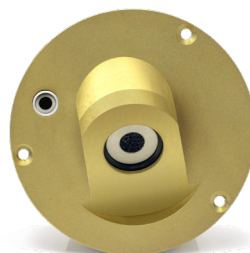› Anatomically shaped pinna type 3.3 with straight ear canal
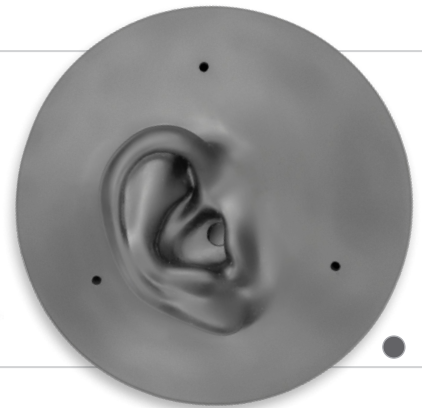
HMS II.3 LN

› Low-noise impedance simulator with straight ear canal
› 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

FURTHER HMS II MODELS

Further specific versions of the HMS II Series are available.

HMS II.4

› Anatomically shaped pinnae type 3.3
› Right ear impedance simulator
› Ear retrofitting options
› No artificial mouth (not retrofittable)

HMS II.5

› Anatomically shaped pinnae type 3.3
› No impedance simulators
› Ear retrofitting options
› Artificial mouth

HMS II.6/7

› Left and right free-field microphones and impedance converter
› Simplified pinnae
› HMS II.6 has condenser microphones
› HMS II.7 has ICP® microphones
› Artificial mouth

OPTIONS

General

*core*BEQ (Code 7740)

› *lab*CORE binaural equalization, incl. filter set for one artificial head

*core*BEQ-Add (Code 7741)

› *lab*CORE binaural equalization, additional set of filters for one artificial head (*core*BEQ required)

SCOPE OF DELIVERY

HMS II.3 LN HEC (Code 1703.2)
› Head Measurement System, low-noise version with human ear canal simulator right and 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-R I.3 (Code 1722-3)
› Cable LEMO 7-pin male <> LEMO 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 and HSU

HCC-HMS (Code 1741)
› Carrying case for accessory parts HMS II.x containing:
  » Microphone holder
  » Lip ring and MRP pointer
  » Calibration adapter
  » 2.5 mm Allen key
  » 3 × Allen screw for HIS (spare parts)
  » 2 × Throat blind cap (spare parts)
  » Manual

AN HMS (Code 1418)
› Extension for HEAD Measurement System HMS: Artificial nose

UG HMS/HSU move°S (Code 1750)
› Upgrade HMS/HSU to move°S, motorized head turning version

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 Head Measurement System

SB HRT (Code 6501)
› Stand base for mounting HMS II.x on HRT I

TLP II (Code 1969)
› Triaxial Laser Pointer for HMS/HSU positioning

Ear Simulator Retrofitting

Delivery of left impedance simulators includes the cable LEMO 7-pin male <> LEMO 7-pin male, black, 2.95 m (Code 1721-3)

HIS L LN HEC (Code 1701.2)
› Head Impedance Simulator, left, low-noise, for HMS II.3/4/5, human ear canal version

HIS L (Code 1701)
› Head Impedance Simulator, left, 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 (Code 1702)
› Head Impedance Simulator, right, 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

GENERAL REQUIREMENTS

Hardware

*lab*CORE (Code 7700)
› Modular multi-channel hardware platform
*core*BUS (Code 7710)
› *lab*CORE I/O bus mainboard
*core*OUT-Amp2 (Code 7720)
› *lab*CORE power amplifier board
*core*IN-Mic4 (Code 7730)
› *lab*CORE microphone input board

Software

One of the following software applications:

ACQUA (Code 6810)
› Advanced Communication Quality Analysis Software, Full license version
ACQUA Compact (Code 6860)
› Compact test system
RC-*lab*CORE (Code 6984)
› Remote configuration software for *lab*CORE
VoCAS (Code 7970)
› Voice Control Analysis System

Type 4.4 pinnae are available in the colors dark gray and light gray. The light gray pinnae are available for retrofitting or initial delivery with HMS II.3 LN HEC.

Pinna Retrofitting

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 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
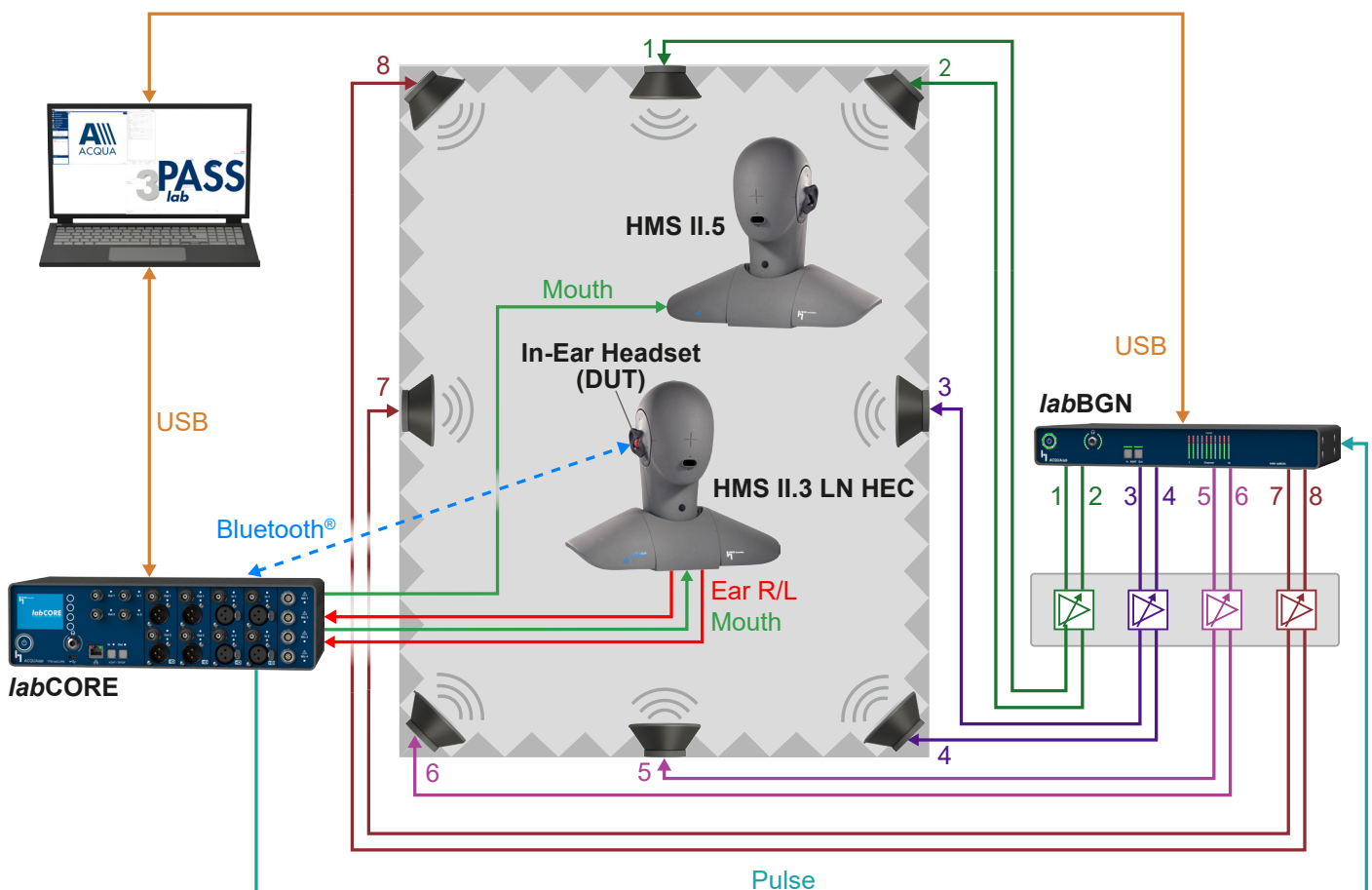
Compatibility of Pinnae and Ear Simulators

Pinna type → / Impedance simulator ↓	HEL 3.3	HER 3.3	HEL 4.4	HER 4.4	HEL 4.4-V1	HER 4.4-V1	HEL 4.4 ViBRIDGE	HER 4.4 ViBRIDGE	HEL 4.4 ViBRIDGE-V1	HER 4.4 ViBRIDGE-V1
HIS L	•									
HIS R		•								
HIS L LN	•									
HIS R LN		•								
HIS L LN HEC			•		•		•		•	
HIS R LN HEC				•		•		•		•

IN PRACTICE

APPLICATION EXAMPLE

Measurement of an In-Ear Headset

This exemplary test scenario depicts testing a Bluetooth® in-ear headset with HMS II.3 LN HEC. HMS II.5 simulates a second talker to test the headset's performance with interfering external speech. *lab*CORE powers the artificial mouths of the two artificial heads with the *core*OUT-Amp2 amplifier board. The ear simulators of HMS II.3 LN HEC are connected to the *lab*CORE. *lab*CORE connects to the headset via the *core*BT2. Background noise is simulated with 3PASS *lab*. For full repeatability of measurements, background noise playback is synchronized by *lab*CORE through a pulse connection to the *lab*BGN hardware platform. ACQUA operates in conjunction with *lab*CORE to generate, receive, and analyze signals.

HEAD acoustics

Contact Information