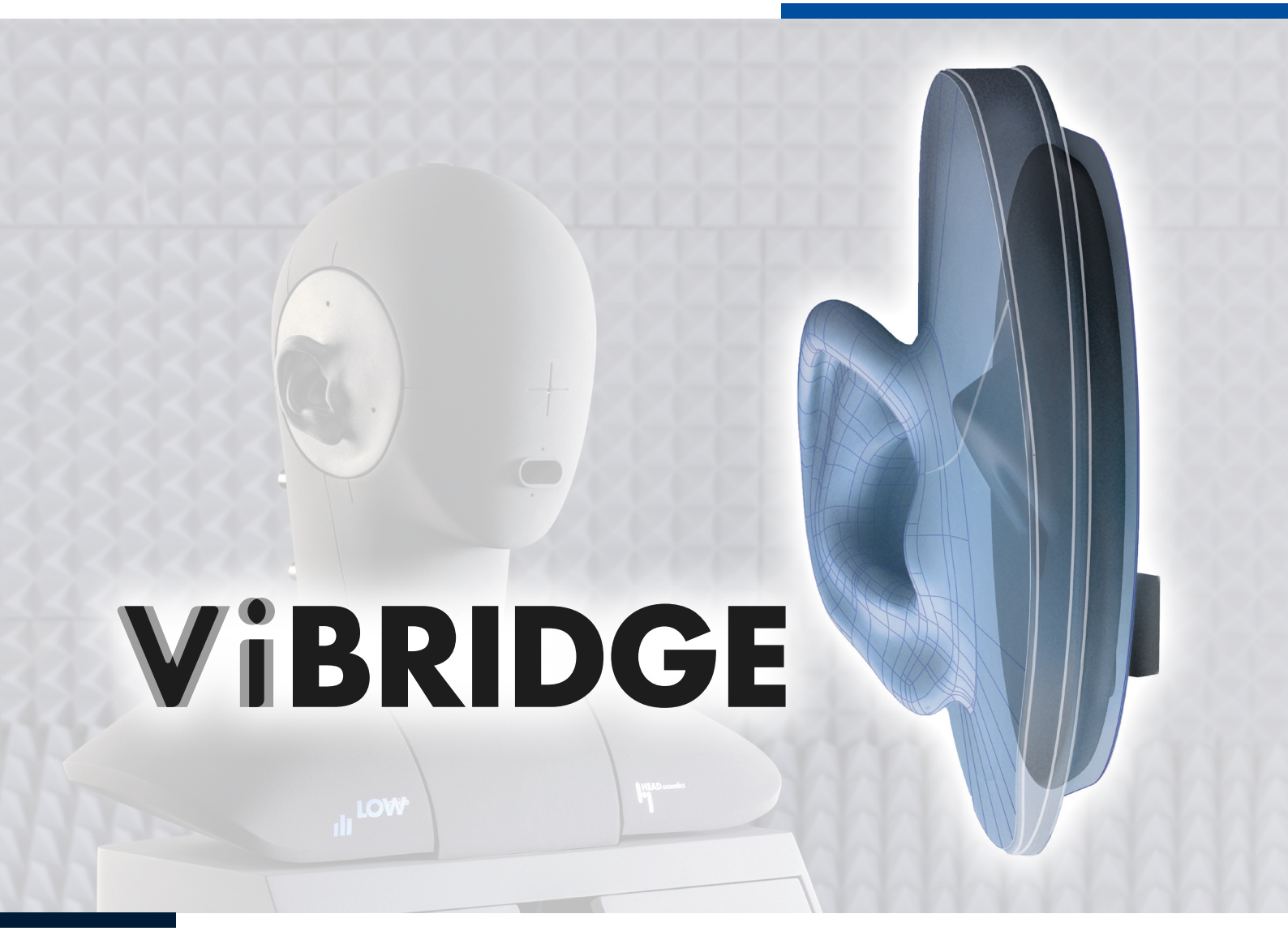
HEAD acoustics

DATA SHEET



Codes 1717(-V1)/1718(-V1)

HEL/HER 4.4 ViBRIDGE

Flexible Pinna Type 4.4 for HMS II.3/5, Left/Right Ear, ViBRIDGE Version

OVERVIEW

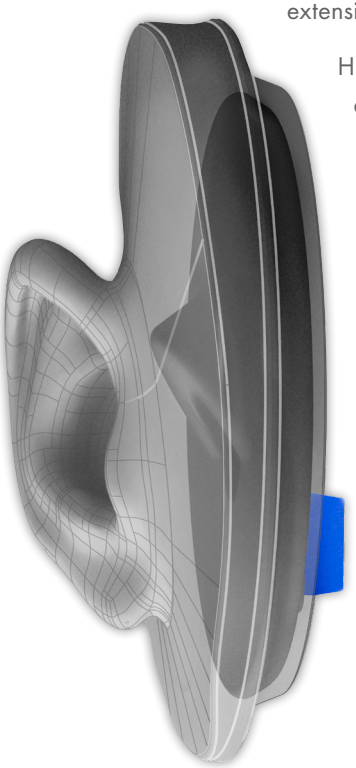
HEL/HER 4.4 ViBRIDGE

Codes 1717(-V1)/1718(-V1)

Flexible Pinna Type 4.4 for HMS II.3/5, Left/Right Ear, ViBRIDGE Version

The pinnae HEL/HER 4.4 ViBRIDGE pinnae combine the ITU-T P.57 type 4.4 pinna with the HEAD acoustics-developed ViBRIDGE technology. With high precision electro-mechanic actuators, ViBRIDGE pinnae realistically simulate bone-conducted near-end speech to any intra-concha- or insert type device.

The signal for the exciters is derived in real time from arbitrary speech signals, amplification is performed e.g. by the second channel of the *lab*CORE hardware extension *core*OUT-Amp2.



HEL/HER 4.4 ViBRIDGE are available as single-piece retrofit parts (products in this data sheet) for qualified HMS as well as delivered with the HMS variant HMS II.3 ViBRIDGE. ViBRIDGE pinnae are also available in light gray color.

Bone-conducted sound is simulated by an electro-mechanic actuator (highlighted in blue) attached to the solid core of ViBRIDGE pinnae

KEY FEATURES

Allows to simulate near-end bone-conducted speech for comprehensive testing of modern in-ear headsets

Unique technology developed by HEAD acoustics

Can be used with any available speech signal

Exciters can be powered by the vacant second channel of *core*OUT-Amp2

HEAD acoustics GmbH can modify suitable existing HMS for ViBRIDGE retrofitting

Future HMS will be retrofittable with ViBRIDGE technology by the customer

APPLICATIONS

Comprehensive testing of in-ear-headsets that utilize near-end structure-borne sound to improve:

- Speech quality in sending direction (especially in the presence of background noise)
- Echo cancellation
- Double-talk performance in sending direction

DETAILS

Advancements in wireless technology allow modern headsets to be completely wireless. This is very convenient for the user, but introduces new challenges for manufacturers. In fully wireless in-ear headsets, the microphone to record near-end speech for communication is positionally bound to the headset and therefore inevitably far away and facing away from the talker's mouth. Consequently, such headsets are very susceptible to picking up surrounding noises and speech from external talkers. The resulting poor signal-to-noise ratio (SNR) degrades the talker's speech quality in communication significantly.

An untapped near-end signal source

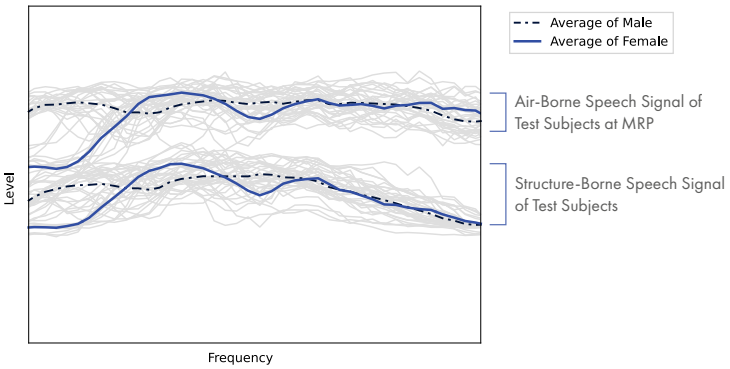
To tackle the issue, manufacturers of headsets have started to integrate vibration sensors into their wireless in-ear headsets. These sensors can pick up the talker's voice conducted by their cranial bones. The bone-conducted signal – while being lower in level and also band-limited – is virtually free of background noise as well as any impairing speech signal from outside sources. Via signal processing, the complementary source of the near-end talker's voice allows a much better separation of speech from impairing noises, improving SNR significantly.

This however introduces new challenges for measurement technology. The communication quality of such headsets can only be tested conclusively by realistically simulating all three at the near end – airborne speech, background noise and bone-conducted speech. For this purpose, HEAD acoustics developed ViBRIDGE. HMS pinnae with ViBRIDGE technology carry high-precision electro-mechanic actuators to simulate near-end bone-conducted speech for a device under test in sending direction.

From cranium to ViBRIDGE

Professional testing in laboratory conditions only yields conclusive results if the test signals fed to a device are reasonably close to real life. To achieve this for structure-borne sound, HEAD acoustics conducted measurements with a large number of participants wearing a modified headset with vibration sensors. The measurement results were recorded, averaged (see left diagram below) and examined.

Based on these results, a dedicated filter function derives the signal for the ViBRIDGE actuators from the speech signal for the near-end artificial mouth. An advantage of deriving the bone-conducted signal from the signal for the artificial mouth is that ViBRIDGE can be used with any existing speech file, delivered or self-recorded.

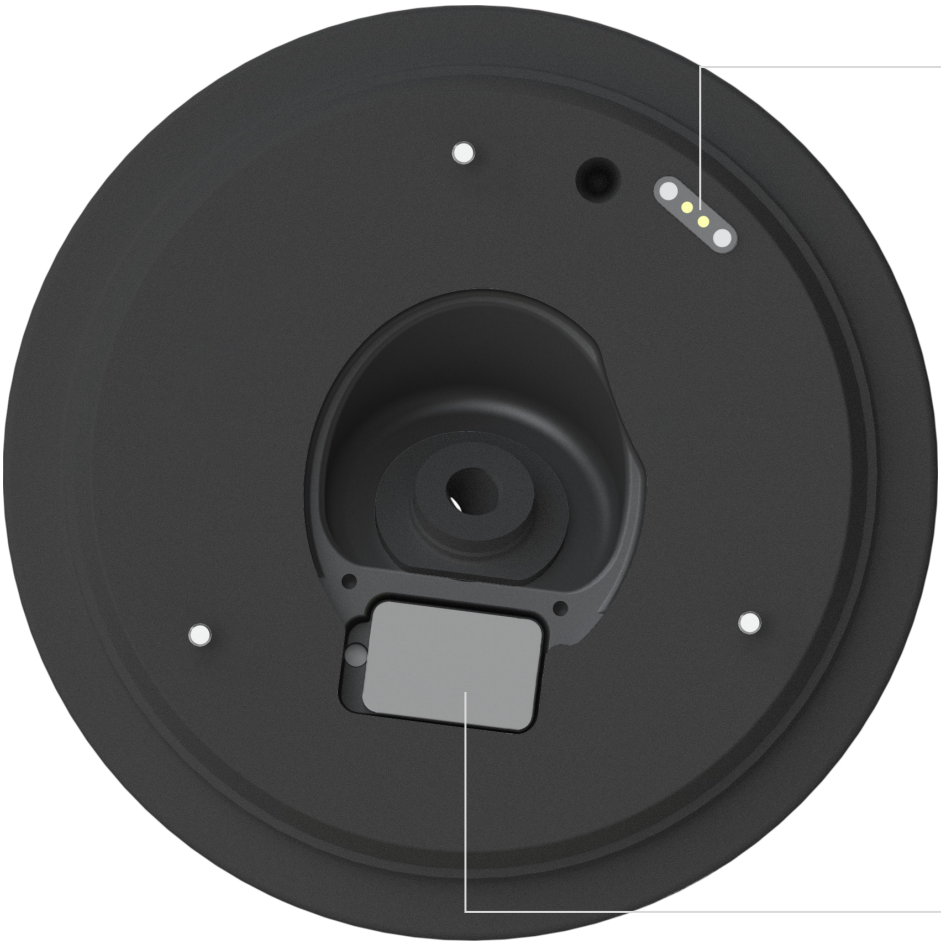


The averages (blue) of all curves measured on numerous test subjects (light gray) show a high spectral correlation between bone-conducted speech (lower graphs) and airborne speech (upper graphs). Towards higher frequencies, bone conducted sound slowly decreases in level in respect to airborne sound.

ViBRIDGE PINNA FEATURES

With the exception of the electro-mechanic actuator, a ViBRIDGE pinna is identical to the type 4.4 pinna laid out in Recommendation ITU-T P.57. As the actuator does not change the geometry of the pinna or the impedance simulator behind it, the ViBRIDGE pinna is also fully compliant with the recommendation.

Its human-like ear canal makes the type 4.4 artificial ear ideally suited for testing intra-concha- and insert type-devices. Simulating bone-conducted sound has become crucial for comprehensive testing of the latest generation of ear-worn devices that utilize bone-conducted sound to improve speech quality in communication.



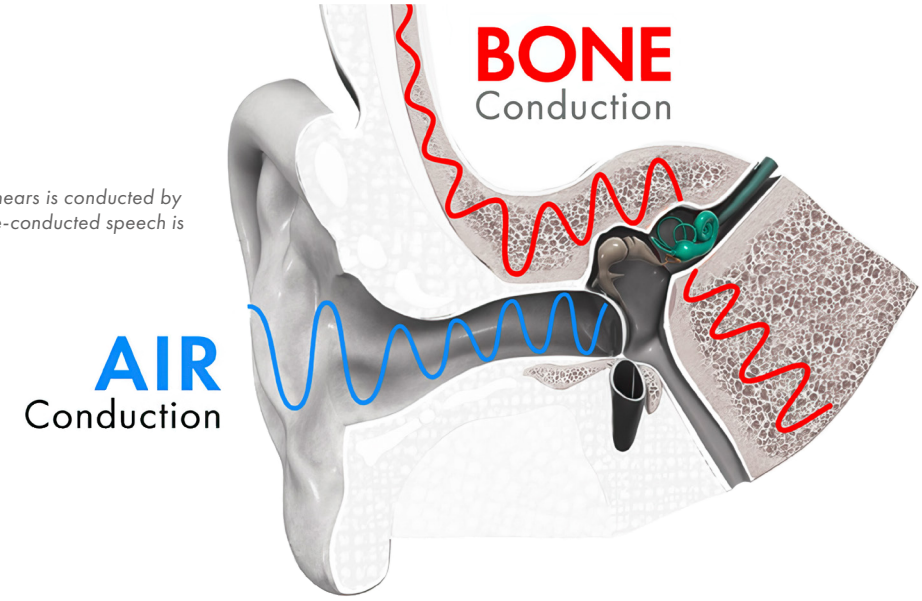
ELECTRICAL CONTACTS

The ViBRIDGE actuator connects via these two gold-plated contact areas on the inner side of the pinna. Corresponding spring-loaded contact pins automatically make contact when the ViBRIDGE pinna is mounted to a supported and suitably prepared HEAD Measurement System (HMS).

ViBRIDGE ACTUATOR

The precision actuator for ViBRIDGE is mechanically coupled to the solid inlay of the pinna. The signal driving the actuator is derived from the signal for the artificial mouth of HMS in real time.

A significant portion of the own speech signal a talker hears is conducted by their cranial bones. In contrast to airborne speech, bone-conducted speech is virtually free of any interfering outside noise.



Simulating structure-borne sound

Through high precision actuators, HMS with ViBRIDGE simulates near-end bone-conducted-speech in addition to the regular airborne speech played back by its artificial mouth.

Naturally, bone-conducted speech from the far-end talker can not be available at the near end, thus headsets only have near-end structure-borne speech available. Consequently, only the speech signal in sending direction, echo cancellation and double-talk performance in sending direction can be improved by utilizing bone-conducted speech. Additionally, the headset must have a reasonably close mechanical bonding in order to pick up bone-conducted speech, therefore the technology is only applicable for in-ear headsets.

The signal for the ViBRIDGE actuators can be amplified via the – most often unused – second amplifier channel of the *lab*CORE hardware extension *core*OUT-Amp2. This extension is present virtually everywhere a HMS with an artificial mouth is used. HEAD acoustics speakON cables for use with *core*OUT-Amp2 generally come wired for use of both amplifier channels, thus they can be employed for this purpose. Therefore, if *core*OUT-Amp2 and associated cabling are present, only the HMS needs to be modified to support ViBRIDGE.

ViBRIDGE pinnae are available in the regular dark gray color as well as in this light gray variant.

GENERAL REQUIREMENTS

Hardware

A HEAD Measurement System equipped with:

- HIS L/R LN HEC (Codes 1701.2/1702.2)
  - HEAD Impedance Simulator, left/right, low-noise, for HMS II.3/4[1]/5, human-like ear canal version
- Artificial Mouth[1]
  - Artificial mouth integrated in all HMS II.3 variants and HMS II.5
- Modification[2] for ViBRIDGE (Code 1730)
  - Mechanical and electric modification for ViBRIDGE support

*lab*CORE (Code 7700)

- Modular multi-channel hardware platform

*core*BUS (Code 7710)

- I/O bus mainboard

*core*OUT-Amp2 (Code 7720)

- Power amplifier board, for artificial mouth and ViBRIDGE actuator(s)

Software

One of the following HEAD acoustics software:

ACQUA (Code 6810)

- Advanced Communication Quality Analysis Software, Full-license Version (Version 5.2.100 or newer)

ACQUA Compact (Code 6860)

- (Version 5.2.100 or newer)

1. HMS II.4/II.6/II.7 can not be retrofitted with ViBRIDGE technology. HMS II.4 does not have (and can not be retrofitted with) an artificial mouth, HMS II.6 and HMS II.7 do not support impedance simulators.
2. In the future, HMS II.3 and HMS II.5 will be delivered with built-in ViBRIDGE support. Therefore, the modification (Code 1730) is only needed for existing HMS II.3 and HMS II.5

HMS Prerequisites

If a suitable HMS (see adjacent box 'General Requirements') is available, the artificial head must be modified for ViBRIDGE one time at HEAD acoustics GmbH. This is necessary only for HMS of the 2021 generation the field today. In the future, suitable HMS will be delivered ViBRIDGE-ready. HMS of the previous generation (codes 12xx and 13xx) are generally not ViBRIDGE-capable.

The modification of suitable HMS comprises laborious internal modification and adding further associated components. Modification is generally performed binaurally to support every possible configuration with ViBRIDGE. In the near future, all suitable HMS will be initially delivered with ViBRIDGE support and therefore will not require any modification.

With the ViBRIDGE contacts located in the HIS mounting ring and not its impedance simulators themselves, existing HEAD Impedance Simulators HIS L/R LN HEC do not require any modification. When modified for ViBRIDGE, present type 4.4 pinna(e) can be exchanged for ViBRIDGE pinna(e) by the customer on site. As the geometry of the outer ear, the inner ear and the ear canal remain unaltered by ViBRIDGE, the ear simulator(s) still are fully compliant with the type 4.4 ear simulator as laid out in Recommendation ITU-T P.57.

SCOPE OF DELIVERY

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

or

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

or

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

or

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

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HEAD acoustics

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