HEAD acoustics

DATA SHEET

Code 3710

labHSU

labHSU is a 2-channel frontend optimized for binaural measurements that can also be used without a computer, with just a smartphone or tablet. Measurements with artificial heads or other binaural sensors can be performed stand-alone, equalized directly on labHSU, and played back aurally-accurately using headphones from HEAD acoustics.

OVERVIEW

*lab*HSU

Code 3710

*lab*HSU is a flexible, binaural frontend in the format of the HEAD*lab* family devices with HEAD*link* 2.0 transmission protocol. It has been optimized for data acquisition using artificial heads and binaural measurement systems. In addition, *lab*HSU provides connection options for conventional Line, IEPE, ICP®, and pulse sensors, condenser microphones, and headphones.

One of *lab*HSU's outstanding features is its stand-alone mode for performing binaural measurements using only a smartphone or tablet. In addition, *lab*HSU provides many other features, such as Dual ADC technology, extremely high dynamics, ease of use, and direct playback, making it a versatile measurement system for a wide range of applications.

KEY FEATURES

HEAD*link* 2.0 transmission protocol (as of firmware 2.1)

Maximum sampling rate: 204.8 kHz

Three operating modes
- Controller mode (with connection to a computer)
- Module mode (using a HEAD*lab* controller without connecting *lab*HSU to a computer)
- Stand-alone mode (the Stand-alone Recording tool pack (Code 3710-01) is required)

Connection options
- HSU III.2, HSU III.3, HMS V, and HMS IV (no longer available) artificial heads
- BHM III.3 Binaural Head Microphone
- Line, IEPE, ICP sensors (TEDS), condenser microphones, and an RPM sensor

Recording equalization on *lab*HSU

Equalized, aurally-accurate playback using headphones from HEAD acoustics

High-dynamic wide-range input thanks to Dual ADC technology

Flexible power supply

Electrical isolation of the inputs from each other and from those of other modules in a HEAD*lab* system as well as from the PC interface

APPLICATIONS

Data acquisition using artificial heads or other binaural measurement systems from HEAD acoustics and a maximum sampling rate of 204.8 kHz

DETAILS

*lab*HSU is a flexible HEAD*lab* frontend featuring the second-generation controller function with HEAD*link* 2.0 that can be used both stand-alone and in two other modes. Stand-alone measurements together with HSU artificial heads are particularly convenient, as they can be performed in an aurally-accurate, binaural, and completely self-sufficient way.

Stand-Alone Recording: High Quality, Self-Sufficient, and Extremely Convenient

In order to perform stand-alone measurements quickly and with ease, connect *lab*HSU to an HSU III.2 or HSU III.3 artificial head in just a few simple steps. Thanks to the "Auto Sensor" function, you thus receive a calibratable measurement system that is comparable to the well-known HMS V artificial head measurement system. Since the necessary equalizations have already been integrated in *lab*HSU, no equalization is required in postprocessing.

*lab*HSU has an internal storage where you can store your measurements directly. You also have the option of connecting an additional storage medium of your choice via USB.

To become completely self-sufficient, combine *lab*HSU with a *lab*PWR I.3 supply module. The *lab*PWR I.3 battery supplies your system with power for several hours. In addition, *lab*PWR I.3 has an auto-on function, enabling you to switch your measurement system on and off remotely using an external power source.

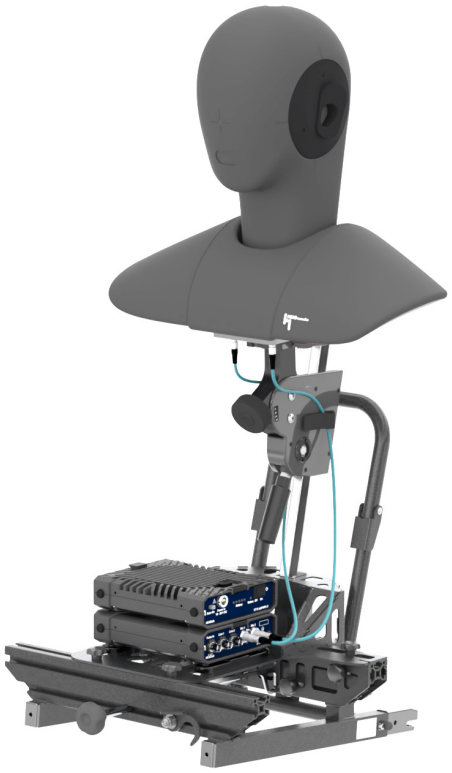
If you wish to expand your system and require additional input channels, you have the option of connecting a second *lab*HSU directly, for example.

In stand-alone mode, all you need for configuring and controlling is a smartphone or tablet. *lab*HSU can be conveniently operated via the browser-based user interface.

Note

The *lab*HSU TP 01 Stand-alone Recording tool pack (Code 3710-01) is mandatory for stand-alone mode and when using third-party software.

To connect to a smartphone/tablet, the HEAD acoustics USB WLAN stick (Code 0275) is required, which is connected to *lab*HSU via USB.



Self-sufficient measurement system consisting of: labHSU with labPWR I.3, HSU III.2 artificial head on MDM I.7 using MDM I.0.

*lab*HSU – The Individual Features

Three Different Operating Modes

- Stand-alone mode
  - Wireless (WLAN) operation with a computer, notebook, tablet, or smartphone
  - Easy operation via the browser-based user interface, providing easy and clear access to the functions of *lab*HSU. You can configure the input channels, perform recordings, monitor recordings, manage recordings, work with presets, and use filters for binaural recording systems from HEAD acoustics.
  - Using a USB WLAN stick, *lab*HSU sets up its own wireless network to which you connect the desired terminal device and have access to functions and configuration options via the browser.
  - Another *lab*HSU or an HMS V artificial head measurement system can be directly connected.
- Frontend mode
  - Frontend mode when connecting to a computer via USB/LAN and operation via the Recorder (APR 040) of ArtemiS SUITE.
  - You also have the option of connecting another HEAD*lab* module to *lab*HSU directly.
- Module mode
  - Integration as a module into a HEAD*lab* system.
  - Once you have connected *lab*HSU to a controller or a compact module, you can use *lab*HSU like a HEAD*lab* input module.

Interfaces for Connecting Other HEAD*lab* Products

- HEAD*link*
  - Use the HEAD*link* interface to integrate *lab*HSU into a HEAD*lab* system with just one cable.
  - In this scenario, *lab*HSU behaves like a HEAD*lab* input module, transferring the recorded signals to the controller. The controller supplies *lab*HSU with power via the HEAD*link* connection.
- HEAD*link*+
  - Use the HEAD*link*+ interface to connect any HEAD*lab* module in frontend mode. In this way, the measurement can be flexibly expanded by measurement channels. The HEAD*link*+ interface supplies the connected module with power.
  - The HMS V and HMS IV (including an adapter) artificial head measurement systems can also be used at the HEAD*link*+ interface.
  - HEAD*link*+ (configured as an AES interface) can also be used to connect *lab*HSU to measurement systems from other manufacturers. Using embedded HMS data, *lab*HSU can communicate its channel settings to the other system.

HEAD*link* 2.0 Transmission Protocol

*lab*HSU is characterized by the HEAD*link* 2.0 transmission protocol, which, at up to 204.8 kHz, enables twice the sampling rate with the same number of channels compared to the HEAD*link* 1.0 transmission protocol of the first-generation *lab*HSU (with up to 102.4 kHz).

Equalization and Aurally-Accurate Playback

- Equalization filters
  - In stand-alone mode, our binaural sensors are equalized directly on *lab*HSU using digital, programmable filters. As no equalization is required in postprocessing, user convenience is significantly increased.
  - On *lab*HSU, the following equalizations are available for our binaural sensors: Independent of Direction (ID), Free Field (FF), and Diffuse Field (DF). This makes measurements particularly convenient, especially with our HSU III.2 and HSU III.3 artificial heads.
- Headphone output for aurally-accurate playback
  - The headphone connector provides standard equalizations (ID, FF, and DF) for selected headphones from HEAD acoustics (e.g., HD CL I.1).
  - You can either make the equalization settings for playback manually or have them made automatically using the information from the playback file.
- More features
  - Activatable limiter
  - Real-time monitoring of a single channel or a pair of channels via the headphones

Pulse Input

The pulse input is configured in the Recorder of ArtemiS SUITE or in the user interface of the *lab*HSU TP 01 Stand-alone Recording tool pack (Code 3710-01). The pulse input is electrically isolated and provides numerous configuration options:

- More features
  - Pulse source sampling with up to 3.28 MHz
  - Integrated signal conditioning to amplify or clean up the signals
  - High sensitivity
  - Adjustable trigger thresholds
  - Selectable circuitry for sensors with an push-pull or open collector output

Available External Power Supply

- Power adapter
- *lab*PWR I.3 supply module (optional on the vehicle on-board power supply)
- Via HEAD*link* and the connected controller

More Features Provided by lab*HSU*

- Extremely high dynamic range thanks to Dual ADC technology
  - Elimination of manual measurement range switching and reduction of the risk of incorrect measurements due to overload
- Switchable highpass filter 22 Hz
- Internal storage (64 GB), expandable with external storage media
- BNC inputs with activatable ICP® supply (22 V/4 mA)
- Mic inputs for condenser microphones with polarization voltage (+200 V, switchable per channel)
- Electrical isolation of the inputs from the other modules in a HEAD*lab* system and from the PC interface
- Cable break and short-circuit detection for ICP sensors

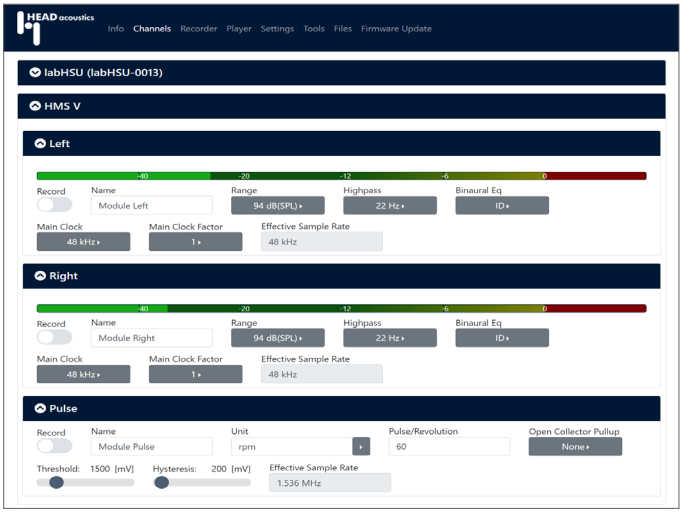
Operation and Control

Operating and controlling *lab*HSU depends on the mode in which *lab*HSU is operated:

- Stand-alone mode
  - Use the *lab*HSU Stand-alone Recording tool pack (*lab*HSU TP 01) to easily connect *lab*HSU to a notebook, tablet, or smartphone using the optional USB WLAN stick and operate it with a browser (a network connection is required).
  - *lab*HSU sets up its own wireless network to which the desired terminal device has to be connected.
- Frontend mode
  - Operating and controlling your *lab*HSU connected to a computer via USB/LAN is done with the well known Recorder of ArtemiS SUITE (APR 040 is required) that can be used for all kinds of measurements.
- Module mode
  - In this mode, you operate your *lab*HSU via the controller/compact module to which *lab*HSU is connected.

Tool Pack labHSU TP 01 – Stand-Alone Recording

- User interface
  - The browser-based user interface of the Stand-alone Recording tool pack provides easy-to-use selection fields, enabling you to easily access the configuration options of the input channels.
  - The user interface adapts to the screen format and provides easy and clear access to the functions of *lab*HSU. Configuring input channels, performing recordings, monitoring recordings, managing recordings, working with presets, and using filters for binaural recording systems from HEAD acoustics are options you can choose from.
- Configuring external channels
  - The channels of a second *lab*HSU or an HMS V or HMS IV artificial head measurement system connected to *lab*HSU can also be conveniently configured in the user interface. All options are displayed just as clearly as native *lab*HSU channels.
- Monitoring and aurally-accurate playback



  - The *lab*HSU headphone output enables you to use the interface and HEAD acoustics headphones to monitor recordings in progress or to play back stored recordings using the integrated Player. A limiter prevents damage to hearing caused by excessive levels.
- Working with presets
  - The preset function enables you to handle changing measurement tasks most efficiently. You can use the presets to save detailed configurations and access and apply them again with just one click. In addition, you can define which configuration is loaded at system startup.
- *lab*HSU as a stand-alone measurement system
  - The Auto-On function, together with *lab*PWR I.3, enables you to work completely self-sufficiently, e.g., in closed rooms or in a vehicle in a wind tunnel.

CONNECTIONS

Control/Power Supply/Extensions

Interface/Connections

HEAD*link*
- › *lab*CTRL II.1 controller
- › *lab*COMPACT12 II/*lab*COMPACT24 II compact systems
  - » *lab*HSU power supply via controller/compact module

HEAD*link*+ (power supply via *lab*HSU)
- › *lab*HSU
- › HEAD*lab* module
- › HMS V artificial head

LAN
- › Computer

USB type C
- › Computer
- › External storage media

USB type A
- › External storage media
- › USB WLAN stick
- › RC X.1 remote control

Power In
- › Power supply module
  - » *lab*PWR I.3 (recommended)
  - » *lab*PWR I.1
  - » *lab*PWR I.2
  - » PS 24-60-L4

Data Acquisition/Playback

Connection of Sensors

HSU III.2, HSU III.3 artificial heads

BHM III.3 Binaural Head Microphone

Condenser microphones

Voltage/ICP sensors

RPM sensor

Headphones

Scope of Delivery

3710	*lab*HSU	HEAD*lab* high-end 2-channel frontend
5476-XX	CUSB IV.XX	Cable USB-A to USB-C with side screw locking

Optional Accessories

Hardware Accessories

Power Supply

0617B	PS 24-60-L4	Desktop power adapter 24 V, 60 W, LEMO 4-pin
3711	*lab*PWR I.1	HEAD*lab* supply module (max. 40 W)
3712	*lab*PWR I.2	HEAD*lab* supply module (max. 100 W)
3713	*lab*PWR I.3	HEAD*lab* supply module for *lab*HSU, small HEAD*lab* systems, SQuadriga III (max. 35 W)

Connection and Adapter Cables

3780-1	CLL X.1	Connection cable module –> controller, 1m
3780-5	CLL X.5	Connection cable module –> controller, 5 m
3780-10	CLL X.10	Connection cable module –> controller, 10 m
3797-1	CLX X.1	Adapter cable AES/EBU for *lab*P2 or *lab*O2, 1 m
3798	CMB I	Adapter Microdot –> BNC (male)

Adapters

3785	*lab*OA	Adapter for optical data transmission (no longer available)
3789	*lab*RFC	Active adapter/converter HEAD*link* to RJ45/CAT5
3794	*lab*ADAT	Adapter HEAD*link* – ADAT

Miscellaneous

3716-V1	PDB II.1-V1	HEAD*lab* Power Distribution Box for connection using XLR 4-pin plug, connection to power adapter type M6056
3770	*lab*CASE I.1	HEAD*lab* Carrying Case Peli 1510 with case divider kit

Software Accessories

Required (when Connecting *lab*HSU to a Computer)

50000	APR 000	APR Framework	Basis of ArtemiS SUITE	Prerequisite
50040	APR 040	Recorder	Universal recorder	Data Acquisition

Required for Stand-Alone Mode

3710-01	*lab*HSU TP 01	*lab*HSU Tool Pack Stand-alone Recording	Prerequisite
0275	USB WLAN stick	USB WLAN adapter for *lab*HSU and HMS V	Prerequisite

HARDWARE COMPATIBILITY

HEAD*lab* Controller

3702	*lab*CTRL I.2	*No longer available*
3704	*lab*CTRL II.1	
31020	*lab*COMPACT12 II	
31021	*lab*COMPACT24 II	

HEAD*lab* Modules

3724	*lab*M6	*No longer available*
3725	*lab*CF6	
3726	*lab*T6	
3727	*lab*SG6	*As of revision 03*
3728	*lab*V6HD	
3731	*lab*O2	
3743	*lab*HRT6	
3752	*lab*VF6 II	
3753	*lab*V12 II	
3754	*lab*M6 II	
3755	*lab*V24 II	
3756	*lab*V8x3-Iso II	*As of firmware 2.1*
3757	*lab*VF6-Iso II	*As of firmware 2.1*
3759	*lab*V12-O4 II	*As of firmware 2.1*

Binaural Recording Systems

1307	HMS III	*No longer available*
1323	HSU III	*No longer available*
1326	HSU III.3	
1391	HSU III.2	
1500	HMS IV	*No longer available*
1502	HMS V	

Artificial Head Microphones

1302	BHM III.2	*No longer available*
1303	BHM III.3	

Binaural Sensors

1508	BSU	

Headphones

2380	HD IV.1	*No longer available*
2481	HD IV.2	*No longer available*
2511.1	HD OP I.1	
2512.1	HD OP II.1	
2521.1	HD CL I.1	
2522.1	HD CL II.1	

USB Devices

3334-64	HUSB III.64	*USB storage device*

Remote Controls

9850	RC X.1	
9851	RC X.2	*Wireless module for RC X.1*

Mount Devices

3760	*lab*MA-a	
3761	*lab*MA-p	
3762	*lab*SMP I.1	
3763	*lab*RCH I.1	
3769	*lab*MM	

TECHNICAL DATA

General

Data acquisition/data generation connections	2 x voltage/ICP® In, 2 x Mic In, 1 x Pulse In, 1 x headphone output
Communication interfaces	1 x HEAD*link*, 1 x HEAD*link*+, 1 x USB device, 2 x USB host, 1 x LAN
Supply connection	LEMO 4-pin, HEAD*link* (input), HEAD*link*+ (output)
Supply voltage	10 V_{DC} to 28 V_{DC}
Max. power consumption during operation – devices only	10 W
Max. power consumption with sensors connected	15 W
Maximum power consumption in standby mode	0.03 W
System sampling rate	32.768 (2^n) kHz, 44.1 kHz, 48 kHz, 51.2 kHz
Min. to max. sampling rate @ 32.768 (2^n) kHz	32.768 kHz to 131.072 kHz
Min. to max. sampling rate @ 44.1 kHz	44.1 kHz to 176.4 kHz
Min. to max. sampling rate @ 48 kHz	48 kHz to 192 kHz
Min. to max. sampling rate @ 51.2 kHz	51.2 kHz to 204.8 kHz
Synchronization	internal, external HEADlink
Max. sampling rate	204.8 kHz
Cooling	Convection (without fan)
Operating temperature	-10 °C to +60 °C, +14 °F to +140 °F
Storage temperature	-20 °C to +70 °C, -4 °F to +158 °F
Dimensions (W x H x D)	148 mm x 48 mm x 185 mm
Weight	750 g
Storage capacity	64 GB internal, at least 50 GB for recordings and configurations

Digital HEAD*link*

Plug connector	1 x LEMO 8-pin
Number of interfaces	1
HEAD*link* version	HEAD*link* 1.0, HEAD*link* 2.0
Supply voltage	10 V_{DC} to 28 V_{DC}
Electrical isolation	No
Synchronization	32.768 (2^n) kHz, 44.1 kHz, 48 kHz, 51.2 kHz
Maximum cable length	60 m

Digital HEADlink+

Plug connector	1 x LEMO 8-pin
Number of interfaces	1
Output voltage	10 V_{DC} to 28 V_{DC}
Max. output power	10 W
Standard	HEAD*link* 1.0, HEAD*link* 2.0, AES (via CLX X cable)
Electrical isolation	No
Synchronization	32.768 (2^n) kHz, 44.1 kHz, 48 kHz, 51.2 kHz
Maximum cable length	60 m

Digital USB Device

Plug connector	1 x USB type C with side screw locking
Number of interfaces	1
USB specification	USB 2.0
Data rate (gross)	480 Mbit/s
Electrical isolation	No

Digital USB Host

Plug connector	2 x USB type A
Number of interfaces	2
USB specification	USB 2.0
Data rate (gross)	480 Mbit/s
Output voltage	5 V_{DC}
Total output current	0.65 A
Output current per interface	0.5 A
Max. output power	3.2 W
Electrical isolation	No

Digital Input Pulses

Plug connector	1 x BNC
Number of channels	1
Switchable power source (substitute for pull-up)	5 mA (±1 mA)/5V
Maximum pulse frequency	1000 kHz
Threshold value digitally adjustable	Yes
Hysteresis digitally adjustable	Yes
Resolution of threshold value/hysteresis	40 mV
Input impedance	36 kΩ
Input voltage range	0 V to 10 V
Electric strength	±50 V
Electrical isolation	Yes

Digital LAN

Plug connector	1 x RJ45
Number of interfaces	1
Standard	IEEE 802.3ab
Data rate (gross)	1000 Mbit/s
Electrical isolation	No
Power over Ethernet	No

Analog Output Headphones

Plug connector	1 x jack 3.5 mm
Number of channels	2
Output impedance	10 Ω
DC capable	No
S/N	115 dB(A)
THD+N	-105 dB
Electrical isolation input/output	Yes, the analog inputs and outputs are electrically isolated from HEAD*link*, Power, LAN, USB
Electrical isolation, per channel	No
Resolution	24 bits (DA converter)
Maximum voltage	9.6 V_p
Maximum level	16.6 dB(V)
Nominal level	0 dB(V)
Maximum output power per channel	0.45 W

Analog Input Microphone

Plug connector	2 x LEMO 7-pin
Number of channels	2
Measured quantity	Voltage
Measurement ranges	-36 dB(V), -26 dB(V), -16 dB(V), -6 dB(V), 4 dB(V), 14 dB(V), 24 dB(V)
Measurement ranges HD mode	10 dB(V)
Input impedance	100 kΩ
Coupling	AC
Analog highpass filter	1.75 Hz, 2nd order, ±10%; 22 Hz, 2nd order, switchable, ±5%
Digital highpass filter @ fs = 48 kHz, proportional to fs	1 Hz
Resolution	32 bits
Equalization	Lin, FF, ID, DF
Electrical isolation input/output	Yes, the analog inputs and outputs are electrically isolated from HEAD*link*, Power, LAN, USB
Electrical isolation, per channel	No
Electric strength	±120 V
Microphone voltage, switchable	±15 V, ±60 V, +120 V
Microphone current	20 mA @ ±15 V, 10 mA @ ±60 V, 10 mA @ +120 V
Polarization voltage	200 V
Polarization current	0.2 mA
Read TEDS (IEEE 1451.4)	TEDS class 1, shared return wire (versions 0.9 and 1.0)

Analog input, voltage/ICP

Plug connector	2 x BNC
Number of channels	2
Measured quantity	Voltage
Measurement ranges	-36 dB(V), -26 dB(V), -16 dB(V), -6 dB(V), 4 dB(V), 14 dB(V), 24 dB(V)
Measurement ranges HD mode	10 dB(V)
Input impedance	100 kΩ
Coupling	AC, ICP

Analog input, voltage/ICP

Analog highpass filter	1.75 Hz, 2nd order, ±10%; 22 Hz, 2nd order, switchable, ±5%
Digital highpass filter @ fs = 48 kHz, proportional to fs	1 Hz
Resolution	32 bits
Equalization	Lin, FF, ID, DF
Electrical isolation input/output	Yes, the analog inputs and outputs are electrically isolated from HEAD*link*, Power, LAN, USB
Electrical isolation, per channel	No
Electric strength	±70 V
ICP voltage	22 V
ICP current	4 mA (±25%)
Cable break and short-circuit detection for ICP sensors	Yes
Read TEDS (IEEE 1451.4)	TEDS class 1, shared signal wire (versions 0.9 and 1.0)

Analog Input/Microphone Measurement Ranges[1]

Measurement range [dB(V)]	**-36 dB(V)**	**-26 dB(V)**	**-16 dB(V)**	**-6 dB(V)**	**4 dB(V)**	**14 dB(V)**	**24 dB(V)**	**10 dB(V) (HD)**
S/N	98 dB(A)	108 dB(A)	115 dB(A)	120 dB(A)	121 dB(A)	108 dB(A)	115 dB(A)	139 dB(A)
Crosstalk at 1 kHz	-102 dB	-102 dB	-110 dB	-114 dB	-114 dB	-103 dB	-97 dB	-114 dB
THD+N	-87 dB	-97 dB	-104 dB	-106 dB	-107 dB	-99 dB	-100 dB	-107 dB
Dynamics 5 Hz analysis bandwidth	134 dB	144 dB	151 dB	156 dB	157 dB	144 dB	151 dB	175 dB
Input-related noise (24 kHz bandwidth)	0.8 µV	0.8 µV	1.13 µV	2 µV	5.7 µV	79.9 µV	112.6 µV	1.42 µV
AC accuracy @ 1 kHz	0.6%	0.4%	0.5%	0.3%	0.5%	0.4%	0.4%	0.4%
Frequency response 20 Hz to 20 kHz @ fs = 48 kHz referenced to 1kHz	0.04 dB, -0.02 dB	0.04 dB, -0.02 dB	0.04 dB, -0.02 dB	0.04 dB, -0.02 dB	0.04 dB, -0.02 dB	0.04 dB, -0.02 dB	0.04 dB, -0.02 dB	0.04 dB, -0.02 dB
Frequency response 20 Hz to 40 kHz @ fs = 96 kHz referenced to 1 kHz	0.05 dB, -0.04 dB	0.05 dB, -0.04 dB	0.05 dB, -0.04 dB	0.05 dB, -0.04 dB	0.04 dB, -0.1 dB	0.04 dB, -0.1 dB	0.04 dB, -0.2 dB	0.04 dB, -0.2 dB
Frequency response 20 Hz to 80 kHz @ fs = 192 kHz referenced to 1 kHz	0.1 dB, -0.04 dB	0.1 dB, -0.04 dB	0.1 dB, -0.04 dB	0.1 dB, -0.04 dB	0.04 dB, -0.15 dB	0.04 dB, -0.15 dB	0.04 dB, -0.4 dB	0.04 dB, -0.4 dB
Linearity: 0 dB to 80 dB under full scale	0.03 dB	0.02 dB	0.04 dB	0.09 dB	0.06 dB	0.14 dB	0.11 dB	0.05 dB
Linearity: 0 dB to 100 dB under full scale	0.05 dB	0.04 dB	0.03 dB	0.14 dB	0.13 dB	0.72 dB	1.55 dB	0.05 dB

[1] Valid for: Ambient temperature 23 °C, 73.4 °F (±3 °C, ±5.4 °F), operating time ≥1 h. Vibration excitation may cause deviations.

Dynamics

There is no standardized calculation method for the term “dynamics”.

Therefore, the Signal to Noise Ratio (SNR or S/N) value is given for *lab*HSU. It is calculated from the level of a sinusoidal tone with maximum modulation in relation to the overall relevant bandwidth noise floor level of *labHSU*.

In some literature, the term “dynamics” is used by analogy with the S/N value, however, this is often based on a narrow-band calculation of the inherent noise. Depending on the analysis bandwidth, *labHSU* will then have a much higher “dynamic range” value.

HEAD acoustics

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