HEADlab (Code 3700)

Multi-channel 24-bit front-end system for mobile data acquisition of sound and vibration examinations

Overview

HEADlab is a modular front-end system consisting of one or several controllers, various input, playback, and power supply modules, as well as a wide range of accessories. The modular design allows users to set up customized solutions for their specific requirements. The core of each HEADlab system is the powerful controller. It takes care of data concentration and synchronization, distributes power to the connected modules, and establishes the connection to the PC. By combining several controller modules, the system can be scaled up to several hundreds of channels. The high-quality input and playback modules cover a wide range of possible applications. Equipped with outstanding technology, they are rugged, silent, and extremely versatile. A high degree of mobility can be achieved by using the battery of the power boxes. The system can be controlled via the proven Data Acquisition Module (HEAD Recorder) of ArtemiS SUITE, which has been appreciated by its users for many years due to its easy handling and extensive functionality.

Features

Modular

• A HEADlab system consists of a controller and a power box or power adapter and can be equipped with up to ten different input and playback modules
• Multiple HEADlab systems can be combined into larger, synchronized systems with several hundreds of channels
• Individual modules within a system can be easily replaced in a few steps
• Thanks to the star wiring topology, only one cable is required between the controller and each signal or playback module

Flexible

• Various modules, such as labM6 or labV12, are available in several variants and can be further extended with adapters
• HEADlab systems require only a single USB or LAN cable for the connection to the PC or laptop

Versatile

• The various signal modules allow a wide range of sensors to be connected directly or via adapters, including binaural sensors (artificial heads, the BHS II headset etc.), microphones (ICP or condenser microphones), RPM, pressure, charge, or temperature sensors, measurement bridges (strain gauges), CAN FD, CAN, OBD-2, and FlexRay sources, GPS receivers, high-resistance voltage sources and many others

Precise

• In a HEADlab system, the controller synchronizes all external channels with one-sample precision
• The input modules excel with a high phase accuracy of the 24-bit data and an excellent signal-to-noise ratio

Autonomous

• The rechargeable battery of the power boxes can supply a HEADlab system with power for several hours of operation depending on the configuration.
• The modules and controllers have a low power consumption

User-friendly

• HEADlab systems are configured and controlled via the programmable Data Acquisition Module (HEAD Recorder) software of ArtemiS SUITE

Future-proof

• Additional modules extending the product family are in preparation
Sensors to be connected (HEADlab system)

Controllers and input modules are available for various types of sensors, which can be connected either directly or via adapters:

- Artificial heads of the HMS III and HMS IV generation
- Binural sensors from HEAD acoustics, e.g. the headset BHS II or the binaural head microphones BHM III
- ICP sensors (TEDS)
- Condenser microphones, incl. low-noise microphones (TEDS)
- Pressure and temperature sensors (DC) etc.
- Measuring bridges (Strain Gauges)
- Charge sensors
- RPM sensors
- CAN FD, CAN, OBD-2 (WWH OBD incl.), FlexRay
- High-impedance voltage sources
- GPS receiver
- Audio, ADAT and AES devices, sine generators and oscilloscopes, headphone amplifiers, etc.

Software: ArtemiS SUITE Data Acquisition Module

A HEADlab system is controlled via the Data Acquisition Module (HEAD Recorder), the recording software of ArtemiS SUITE.

- Straightforward, flexibly customizable interface
- Intuitive system configuration via graphical representations (including offline configuration for later transfer to the actual hardware)
- Calibration of sensors and uncomplicated acquisition of all sensor signals
- Trigger functions, real-time monitoring of input signals, etc.
- Automated measurement procedures with the programmable Flow Control functionality (inclusion of Automation Projects or Standardized Testing Projects is possible)
- Saving of recordings including user documentation for use in ArtemiS SUITE

Using larger HEADlab systems: Up to two controllers can be connected to the PC via USB, supporting up to 120 external channels with a sampling rate of 48 kHz, or up to 240 channels with a sampling rate of 24 kHz. Via LAN, the maximum number of controllers and external channels only depends on the network capacity and the computing power of the PC. With an off-the-shelf PC, it is possible to record, for example, 300 channels with a sampling rate of 48 kHz, 600 channels with a sampling rate of 24 kHz, etc.
## Overview modules

### Controller

| **labCTRL I.2**  
(Code 3702) | • Central connection unit of a HEADlab system  
• Connecting of up to 10 input and playback modules  
• USB or LAN connection to the PC  
• Connecting a digital artificial head HMS III or HMS IV, two pulse sensors, and CAN / OBD-2 sources  
• Several controllers (systems) can be synchronized and combined into larger systems |

### Input modules

#### labV6HD

| (Code 3728) | • 6 channels  
• Connecting analog / ICP sensors (TEDS)  
• High-dynamic input range (HD Mode, Dual ADC)  
• Dynamic range of 168 dB  
• „0 Hz ICP/DC Coupling“ from HEAD acoustics for measuring very low-frequency signals |

#### labV6

| (Code 3721) | • 6 channels  
• Connecting analog / ICP sensors (TEDS)  
• Signal-to-noise-ratio of 108 dB(A)  
• 24 bit data with excellent phase accuracy  
• Variant labVF6 with additional low-pass filters |

#### labV12

| (Code 3723) | • 12 channels  
• Connecting analog / ICP sensors (TEDS)  
• Recordings with a doubled sampling frequency via dual-link  
• Signal-to-noise-ratio of 108 dB(A)  
• Variants labV12-V1 and labV12-V2 with a higher input impedance and a lower AC cut-off frequency |

#### labM6

| (Code 3724) | • 6 channels  
• Connecting condenser microphones with impedance converters (±60 V) and with 200 V polarization voltage, switchable channel by channel  
• Connecting the binaural headset BHS II (recording) or ICP sensors via adapters  
• Variant labM6-V1 with a reduced supply voltage of the impedance converter, e.g. for connecting low-noise microphones |

#### labCF6

| (Code 3725) | • 6 channels  
• Connecting Charge or ICP sensors (Charge or ICP mode adjustable channel by channel)  
• Charge amplifier for Charge sensors  
• Up to 96 kHz sampling rate (3 channels) |
**labT6**  
(Code 3726)  
- 6 channels  
- Connecting thermocouples type K and RTD (PT100, PT1000)  
- Cold Junction Compensation  
- Module equipped with a measurement curve linearization  
- Automatic sensor failure detection / cable break detection

**labSG6**  
(Code 3727)  
- 6 channels  
- Connecting resistive measuring bridges (strain gauges) as well as sensors with symmetric or asymmetric outputs and unipolar or bipolar supply  
- Auto zero function for the automatic bridge balancing  
- Channel-wise programmable power supply

**labDX**  
(Code 3741)  
- 6 channels  
- Connecting a digital artificial head HMS III or HMS IV and two pulse sensors  
- 2 x CAN FD (labDX as of version B)/CAN / OBD-2 and 1 x FlexRay  
- Configurable pulse inputs for recording a high maximum pulse rate (with or without signal conditioning)  
- Connecting a GPS receiver (instead of the artificial head HMS)

**labHMS**  
(Code 3742)  
- 6 channels  
- Connecting of up to three digital artificial heads HMS III or HMS IV  
- Connecting a GPS receiver (instead of one artificial head)  
- Operation with four artificial heads, e.g. for wind tunnel applications (via labCTRL I.2)

**Options: input modules with other front ends from HEAD acoustics**

<table>
<thead>
<tr>
<th>Module</th>
<th>Front Ends</th>
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</thead>
<tbody>
<tr>
<td>SQuadriga III</td>
<td>labV6HD / labM6 (as of rev. 02)</td>
</tr>
<tr>
<td>SQuadriga II</td>
<td>labV6 / labM6</td>
</tr>
<tr>
<td>MMF III (BrakeOBSERVER)</td>
<td>labV6HD / labV12 / labM6 / labHMS / labT6 / labSG6 / labDX / labCF6</td>
</tr>
<tr>
<td>VMA (HEAD VISOR)</td>
<td>labV6 / labV12 / labM6 / labHMS / labT6 / labSG6</td>
</tr>
</tbody>
</table>
Power Boxes

**labPWR I.1** (Code 3711)
- Power box for power supply of individual modules or smaller HEADlab systems up to 40 W
- Battery (55 Wh) to supply a system without external power supply
- Uninterruptible switching between external supply and battery operation

**labPWR I.2** (Code 3712)
- Power box for power supply of larger HEADlab systems up to 100 W
- Battery (55 Wh) to supply a system without external power supply
- Uninterruptible switching between external supply and battery operation

Playback modules

**labO2** (Code 3731)
- 2-channel playback equalizer with Line outputs (equalization filters: FF, ID, DF, USER)
- Connecting power amplifiers for playback via subwoofers, shakers etc.
- Connecting the headphone amplifier HDA IV
- Can be used in USB mode or as a HEADlab module
- Creating a synchronized playback system with several labO2 or labP2 units

**labP2** (Code 3732)
- Binaural headphone equalizer (equalization filters: FF, ID, DF, USER)
- Realistic playback of aurally accurate recordings with two individually-equalized headphones
- Can be used in USB mode or as a HEADlab module
- Creating a synchronized playback system with several labP2 or labO2 units

Power consumption: HEADlab modules and Compact modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Power Consumption</th>
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<tbody>
<tr>
<td><strong>labCTRL I.2</strong> (controller)</td>
<td>10 W</td>
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<tr>
<td><strong>labV6HD</strong></td>
<td>7 W</td>
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<tr>
<td><strong>labV6 / labVF6</strong></td>
<td>4,8 W</td>
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<tr>
<td><strong>labV12 / labV12-V1 / labV12-V2</strong></td>
<td>7,5 W</td>
</tr>
<tr>
<td><strong>labM6 / labM6-V1</strong></td>
<td>10 W</td>
</tr>
<tr>
<td><strong>labHMS</strong></td>
<td>2,5 W</td>
</tr>
<tr>
<td><strong>labT6</strong></td>
<td>2 W</td>
</tr>
<tr>
<td><strong>labSG6</strong></td>
<td>9,5 W</td>
</tr>
<tr>
<td><strong>labDX version A</strong></td>
<td>2,5 W</td>
</tr>
<tr>
<td><strong>labDX version B</strong></td>
<td>7 W</td>
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<tr>
<td><strong>labCF6</strong></td>
<td>8 W</td>
</tr>
<tr>
<td><strong>labP2 / labP2-V1</strong></td>
<td>10 W</td>
</tr>
<tr>
<td><strong>labO2 / labO2-V1</strong></td>
<td>10 W</td>
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<tr>
<td><strong>labCOMPACT12</strong></td>
<td>14 W</td>
</tr>
<tr>
<td><strong>labCOMPACT24</strong></td>
<td>20 W</td>
</tr>
</tbody>
</table>
## Connection options

<table>
<thead>
<tr>
<th>Artificial head</th>
<th>CAN/FD</th>
<th>FlexRay</th>
<th>GPS</th>
<th>Headphones HD IV.1/...</th>
<th>Headphone HD V.1 for audiometry</th>
<th>Loudspeakers HPL</th>
<th>Subwoofers HWS</th>
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</thead>
<tbody>
<tr>
<td>HMS</td>
<td>labHMS</td>
<td>labDX (version A/B)</td>
<td>labCTRL 1.2</td>
<td>labP2</td>
<td>labO2</td>
<td>labO2</td>
<td>labO2</td>
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<tr>
<td>Binaural headset BHS II</td>
<td>labV6HD</td>
<td>labV6/labV6</td>
<td>labV12/-V1/-V2</td>
<td>labM6/-V1</td>
<td>labCF6</td>
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<tr>
<td>ICP/ analog sensors</td>
<td>labV6HD</td>
<td>labV6/labV6</td>
<td>labV12/-V1/-V2</td>
<td>labM6/-V1</td>
<td>labCF6</td>
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<td>Condenser microphones</td>
<td>labM6/-V1</td>
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<td>Pulse sensors</td>
<td>labDX (version A/B)</td>
<td>labCTRL 1.2</td>
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<tr>
<td>Temperature sensors</td>
<td>labT6</td>
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<td>Strain Gauges</td>
<td>labSG6</td>
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<tr>
<td>High-impedance voltage sources</td>
<td>labV6HD</td>
<td>labV12-V1</td>
<td>labV12-V2</td>
<td>labV6/labVF6</td>
<td>labCF6</td>
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<tr>
<td>Charge sensors</td>
<td>labCF6</td>
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<tr>
<td>CAN/ (WWH) OBD-2</td>
<td>labDX (version A/B)</td>
<td>labCTRL 1.2</td>
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<tr>
<td>CAN FD</td>
<td>labDX (version B)</td>
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</table>
Software (required)
- ArtemiS SUITE Data Acquisition Module (Code 5004)
- ArtemiS SUITE Basic Framework (Code 5000)

Software (recommended)
- For further processing of CAN, OBD-2, FlexRay, and GPS data
- ARM R24 (Code 5024) of ArtemiS suite is required
- ArtemiS SUITE (Code 5000ff)
- Additional ArtemiS SUITE modules

Binaural sensors
- BHS II (Code 3322)
  Binaural headset (recording) [→ Adapter CLB I.2]
- HMS IV 0 (Code 1500) /
  Digital artificial head measurement system with CompactFlash and USB interface
- BHM III.2 (Code 1302) / BHM III.3 (Code 1303) / Binaural head microphone
- HSU III (Code 1323) / HSU III.2 (Code 1391) / HSU III.3 (Code 1326)
  Head-shoulder unit for binaural recordings

Headphones
- HD IV.1 (Code 2380)
  Dynamic, open headphone
- HD IV.2 (Code 2481)
  Dynamic, open headphone
- HD VII (Code 2497)
  Dynamic, open headphone
- HD VIII (Code 2498)
  Dynamic, open headphone
- HD V.1 (Code 2495)
  Closed, dynamic headphone for audiometry

Loudspeaker
- HPL (Code 2968)
  2 x High Precision Loudspeaker

Subwoofer
- HSW I (Code 2950)
  2 x HEAD subwoofer
  - KMT power amplifier DC 5
- HSW II.1 (Code 2952)
  HEAD subwoofer
  - KMT power amplifier DC 3

GPS receiver
- CDG I.1 (Code 3796)
  GPS receiver [→ labDX / labHMS]

Power supply
- Power boxes
  - labPWR I.1 (Code 3711)
    Power box for HEADlab systems (up to max. 40 W) [→ labCTRL I.2]
  - labPWR I.2 (Code 3712)
    Power box for HEADlab systems (up to max. 100 W) [→ labCTRL I.2]
- Power supplies
  - 15 V / 60 W / LEMO 2-pin
    90 to 275 V AC, 50 to 60 Hz [→ labPWR I.1]
  - 15 V / 144 W / LEMO 2-pin
    85 to 264 V AC, 47 to 63 Hz [→ labPWR I.1 / labPWR I.2]
  - 24 V / 60 W / LEMO 4-pin
    90 to 275 V AC, 50 to 60 Hz [→ labCTRL I.2]
  - 24 V / 150 W / LEMO 2-pin
    100 to 240 V AC, 50 to 60 Hz [→ labCTRL I.2 (only for systems with more than 40 W total power consumption)]
- PDB II.1 (Code 3716)
  Power Distribution Box
  Passive Power Distribution Box [→ up to 4 HMS artificial heads e.g. via labHMS]

Adapter / adapter cables / cables
Connections to the PC
- CUSB II.xx (Code 5478-xx)
  Cable USB (USB type A → B)
- Cable CAT5e
  Standard network cable CAT5e, 5 m (196.9")
- CLAN I.xx (Code 9864-xx)
  Network cable CAT6a (rugged network cable for use in harsh environmental conditions)

Connections between the modules
- CLL X.xx (Code 3780-xx)
  Cable HEADlink
  LEMO 8-pin ↔ LEMO 8-pin [input/playback module ↔ labCTRL I.2; synchronizing labCTRL I.2 ↔ labCTRL I.2]
- labGIB (Code 3714)
  labGIB-V1 (Code 3714-V1)
  Galvanically isolated HEADlink booster with external supply connection
- labRFC (Code 3789)
  Active adapter for loss-free extension of HEADlink connections with a CAT5 cable; the total length of the cable can be up to 180 m / 590 ft long

Adapter / adapter cables / cables
- labOA (Code 3785)
  Optical adaptor (optical / electrical) for data transmission between controller and input module across a distance of up to 1000 m / 3280 ft using two labOA devices
- Optical Cable
  LWL-patch cable multimode Duplex, SC/PC ↔ SC/PC [→ labOA]

Power supply
- labSPA (Code 3715)
  Safe Power Adapter
  [DC voltage source 18 to 35 V (adapter cable CSL X.3) ↔ labCTRL I.2]
- CLL XI.xx (Code 3781-xx)
  Power supply cable
  LEMO 4-pin ↔ LEMO 4-pin [labPWR I.1 / labPWR I.2 ↔ labCTRL I.2]
- CSL X.3 (Code 3787-3)
  Cable Speakon
  Speakon 2-pin ↔ LEMO 2-pin, 3 m (118") [labPWR I.1 / labPWR I.2 ↔ PDB II.1)
- CLO X.3 (Code 3782-3)
  Power supply cable
  2 x cable lug ↔ LEMO 2-pin, 3 m (118") [DC power source ↔ labPWR I.1 / labPWR I.2 / labSPA]
- CLL XII.10 (Code 3795-10)
  Extension cable
  LEMO 4-pin ↔ LEMO 4-pin, 10 m (394") [power supply M6052 ↔ labCTRL I.2]

Analog / BNC sensors
- SCU-V2 (Code 3394)
  2-channel impedance converter
  Connecting high-impedance voltage sources [→ labV12 / labV6 / labCF6]
- CDB II.1 (Code 3556)
  Breakout cable
  D-Sub 25-pin ↔ 6 x BNC, male, 1 m (39") [→ labV12]
- CBL X.01 (Code 3791-01)
  Adapter cable
  LEMO 7-pin ↔ BNC, 10 cm (3.9") [→ labM6]
- CDB X.1 (Code 3792)
  Breakout cable
  D-Sub 25-pin ↔ 6 x BNC, female, 1 m (39") [→ labV12]
- CDG X.03 (Code 3793-03)
  Breakout cable
  D-Sub 25-pin ↔ 6 x Microdot, 30 cm (11.8") [→ labV12]
Adapter / adapter cables / cables

- CLB I.2 (Code 9847)
  Adapter cable
  LEMO 14-pin ↔ 2 x BNC, male
  [BHS II ↔ labV6HD / labV6 / labV12 / labCF6 / labM6
  (CBL X.01)]

Digital connections

- labADAT (Code 3794)
  ADAT adapter
  [ADAT devices ↔ labCTRL I.2 / labO2 / labP2]
- CLX X.1 (Code 3797-1)
  AES/EBU adapter cable
  LEMO 8-pin ↔ XLR 3-pin, male / XLR 3-pin, female, 1 m (39")
  [labO2 / labP2 ↔ labO2 / labP2; AES/EBU devices ↔ labO2 / labP2]
- CDX X.3 (Code 3783-3)
  HMS connecting cable
  XLR 3-pin, male / XLR 3-pin, female / D-Sub 9-pin ↔ D-Sub 9-pin, 3 m (118")
  [HMS artificial head ↔ labCTRL I.2 / labDX / labHMS]
- CXII X.3 (Code 5177-3)
  AES/EBU cable
  XLR 3-pin, male ↔ XLR 3-pin, female, 3 m (118") [→ labO2]

CAN FD, CAN, OBD-2, FlexRay, pulse connections

- SCU-P2 (Code 3393)
  2-channel pulse conditioning and output of TTL-compatible pulses
  [→ labCTRL I.2]
- CDO X.3 (Code 3786-3)
  OBD-2 connecting cable
  OBD plug, type B ↔ D-Sub 9-pin, 3 m (118") [→ labCTRL I.2 / labDX
  (a user-specific CAN/OBD-2 cable is additionally required)]
- CMD 0.12 (Code 3788)
  CAN FD, CAN, OBD-2, FlexRay adapter cable
  D-Sub 9-pin ↔ 3 x D-Sub 9-pin
  (CAN 1 / CAN 2 / FlexRay), 12 cm (4.7") [→ labDX]

Strain gauges connections

- CDL III.1 (Code 9818-1)
  Adapter cable
  LEMO 8-pin ↔ D-Sub 9-pin, 1 m (39") [→ labSG6]

Charge connections

- CMB I (Code 3798)
  Microdot adapter
  BNC ↔ Microdot [→ labCF6]

Attachment / transport

- HSM V (Code 1520)
  HEAD seat mount adapter for HMS IV, HEADlab etc.
- labCASE I.1 (Code 3770)
  Carrying case for HEADlab
- labMA-a (Code 3760)
  labMA-p (Code 3761)
  Mount adapters for HEADlab systems, active / passive lock
- labSMP I.1 (Code 3762)
  Mounting plate, e.g. for car seats
- labRCH I.1 (Code 3763)
  Retractable carry handle for HEADlab systems
- labMM (Code 3769)
  Magnetic mounts for attaching HEADlab systems

Safety

A HEADlab system can be assembled very quickly and offers a high degree of safety and stability. The controllers and the individual modules are equipped with a built-in locking mechanism. In a few easy steps, the modules can be assembled into a stable unit, and can be separated again just as easily.

Additional accessories (holding and mounting plates, handles, magnets) allow HEADlab systems to be conveniently transported and to be fixed safely in almost any place.

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