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SQuadriga III (3324)

Mobile recording and playback system with sound level measurement function – as a stand-alone system or USB front-end

Features

- Two application modes
  - *Stand-alone* mode for mobile working
  - *Frontend mode* with USB or LAN connection to a computer with ArtemiS SUITE Data Acquisition Module ASM 04

- Gigabit LAN connection for file manager access to the internal storage, remote control option via web interface (both with option package SQ3 TP 06 only), saving measurements to a LAN computer

- Large touchscreen (7″ / 18 cm)

- Storage expansion with USB stick

- Video camera connection via USB for video or photo (with optional package SQ3 TP 03)

- Power supply (electrically isolated) from power supply, PowerBox (*lab*PWR I.1 /*lab*PWR I.2 /*lab*PWR I.3) or onboard power supply, also for charging the internal battery

- Windows mass storage device mode via the USB C connector

- Sensor identification via TEDS

- FFT-based real-time analysis: Time signal, FFT, octave, third octave, level over time, loudness, sharpness, specific loudness, articulation index, order spectrum, sound intensity, cross correlation

- Playback analysis of saved recordings

- Adjustable IIR filter for playback and monitoring

- Real-time decoding and display of CAN FD, FlexRay, pulse, and GPS data as single values or tachometers

- Playback limiter

- Automatic measurement range configuration (auto range) for individual or all active channels

- Sound level measurement function for one or two channel measurements (with optional package SQ3 TP 02)

Connectors

- BHS connector for aurally-accurate recording and playback with BHS II and for monitoring. Connection of additional sensors via cable adapters.

- Equalized headphone output, e.g., for HD IV.1 headphones

- Six BNC connectors with selectable ICP supply as analog inputs, analog outputs, or AC or DC inputs

- Two SMB connectors for Pulse In (electric. isolated)

- Three USB A connectors for storage media, remote control RC X, video camera, USB audio device (BSU/ SQope) connection

- USB C connector to connect to Windows PC/notebook/tablet PC

- HEAD*link* LEMO connector for HEAD*lab* system integration (electric. isolated)

- HEAD*link*+ LEMO connector for HEAD*lab* modules, HMS III/ HMS IV/HMS V artificial heads, SQuadriga II, or SQuadriga III

- D-Sub connector for CAN FD (CAN FD, CAN, OBD, WWH-OBD) and FlexRay bus systems (electrically isolated)

- RJ45 connector for gigabit LAN

- Internal GPS receiver (active rod antenna included

Overview

SQuadriga III is a recording and playback system with sound level meter function. The compact dimensions, powerful battery, and wide variety of connectivity options offer versatile functionality, high mobility, and variable applications. In stand-alone mode, recordings are stored on the internal storage or on a connected USB stick. In frontend mode, on a computer via USB or LAN. Operation is via the touchscreen or the ArtemiS SUITE Data Acquisition Module (ASM 04; ArtemiS SUITE Recorder and HEAD Recorder).

Supported sensors are connected directly to corresponding connectors. These include ICP microphones, ICP acceleration sensors, the calibratable BHS II headset, pulse sensors, and sensors for bus systems such as CAN FD, OBD and WWH-OBD, and FlexRay.

Channel and sensor settings can be configured directly on the device, saved to SQuadriga III, and reused at any time. Settings that have been configured with SQuadriga II, for example, can be transferred to and used with SQuadriga III.

Thanks to its powerful battery, SQuadriga III offers several hours of operation without requiring an external power supply. In addition, it can also supply a connected HEAD*lab* module.

With SQuadriga III-V1 (code 3324-V1), a battery-free variant is available that you can use in measurement situations where a battery-powered device is not allowed.

SQuadriga III works silently and is ready for use a few seconds after switch-on.

Features

Compact and powerful

- Compact overall dimensions of
  193 x 41 x 154 mm (7.6 x 1.7 x 6.1"; WxHxD)

- Powerful dual-core processor

- 60 GB internal storage for audio and video recordings

Touchscreen

- Capacitive multi-touch color display (7" / 17.8 cm,
  1024 x 600 pixels)

- Supports swipe gestures, zoom, double-click

Aurally-accurate recording and playback

- Direct connection of the calibratable BHS II headset for
  binaural recordings (BHS II not included)

- *Independent of direction* (ID) recording equalization

- Playback equalization *Independent of direction* (ID),
  free field (FF), *diffuse field* (DF), and *linear* (LIN, no
  equalization)

Binaural sensors

- Connection and equalization of the binaural head
  microphone BHM III.3 or the artificial head microphone
  HSU III.2 at the BHS connector with the cable adapter
  CLB I.3

- Connection (BNC inputs) and equalization of up to three
  BHM III.3 or HSU III.2

Playback via headphones

- 3.5 mm headphone jack at the front to connect, e.g.,
  HD IV.1 headphones

- Additional headphones at the BHS connector with the
  CLJ I cable adapter

- Selectable limiter

- Installation of headphones equalization filters

- Real-time monitoring by headphones
  (individual channels/channel pair)

Sound level meter function

- One- or two-channel measurements (two channels with a
  binaural sensor)

- Simultaneous time and frequency weighting (F, S, I time
  weighting/A, C, Z frequency weighting)

- Equivalent continuous sound level L_{eq}

- Time-weighted momentary and maximum sound pressure
  level, sound exposure level, level over time

- Loudness (ISO 531-1/DIN 45631/A1), sharpness
  (DIN 45692), octave, third octave and FFT spectra, per-
  centile

HEAD*link*

- Connection to a HEAD*lab* controller

- Integration of six of the eight SQuadriga III analog chan-
  nels in a HEAD*lab* system

- Electrical isolation between the HEAD*lab* system and
  SQuadriga III

HEAD*link+*

- Connection to a second SQuadriga III

- Connection and power supply of the following HEAD*lab*
  modules:
  - *lab*M6 (code 3724B Rev. 02)
  - *lab*CF6 (code 3725)
  - *lab*T6 (code 3726)
  - *lab*SG6 (code 3727 Rev. 3)
  - *lab*V6HD (code 3728)
  - *lab*VF6 II (code 3752)
  - *lab*M6 II (code 3754)
  - *lab*HSU (code 3710)

- Electrical isolation between HEAD*lab* module and
  SQuadriga III

- Connection to SQuadriga II via CLL XIV.1 cable adapter
  (code 3363-1)

- Connection to an HMS III/HMS IV/HMS V artificial
  head (additional USB connection (CUSB II) between
  HMS III/HMS IV and SQuadriga III necessary)

FFT based real-time analyses with filtering

- Time signal/FFT/octave/third octave/level over time/
  specific loudness/order spectrum/order spectrum over
  time

- Loudness over time/sharpness over time

- Articulation index/extended articulation index (e.g., for
  speech intelligibility)

- Transfer function/coherence/impulse response/last
  impulse as time signal or spectrum

- Real-time filters with individual frequency, quality, and
  attenuation adjustment

- Sound intensity (measurement with PP probe)

Vehicle bus systems

- CAN FD/CAN/OBD/WWH-OBD

- FlexRay

- Real-time decoding and display of up to four CAN FD,
  OBD, or FlexRay quantities per channel during recording,
  also with AUTOSAR sensors

- Data stream recording in a separate channel

- Simultaneous recording of several supported bus systems
  with the adapter CMD 0.12 (optional accessory)

Pulse

- Real-time decoding and display of up to two pulse sources during recording

- Pulse source recording in a separate channel

- Up to 1 MHz pulse source sampling

- Built-in signal conditioning to amplify or clean signals

- High sensitivity

- Adjustable trigger thresholds

GPS

- Internal GPS receiver with connector for an external, active antenna (active rod antenna included)

- Real-time decoding and display of GPS quantities, such as speed and altitude

- PPS (pulses per second) for later synchronization and merge of spatially separated and unsynchronized recordings made with SQuadriga III, SQuadriga II and SVA II, or with SQobold

- Support of GPS, Galileo, BeiDou, GLONASS

- Combined use of multiple satellite systems

- GPS quantities as start/stop triggers (e.g., position, altitude, speed)

Battery-free variant 3324-V1

- Low maximum power consumption

- Capacitor-buffered real-time clock; capacitor is charged during power supply.

Scope of delivery and optional accessories

Scope of delivery

- SQuadriga III (code 3324)
  Mobile recording and playback system with sound level measurement function

- Power supply 24 V, 60 W, LEMO 4-pin

- CUSB IV.1 (code 5476; 1 m/3.2 ft) USB A to USB C cable with screw connection

- Active CGA I.1 GPS rod antenna (code 9856)

- Two CSB VII.0 pulse cables (code 3350; 0.15 m/5.9")

- DPF III display screen protector (code 9863)

- HSC V.3 case (code 3333)

- Data medium

- Manual

Optional accessories

- Dynamic headphones
  HD IV.1 (code 2380)/HD IV.2 (code 2481)

- BHS II binaural headset (code 3322)

- HUSB III.64 USB storage (code 3334; capacity: 64 GB, sequential reading speed: 200 MB/s)

- CLL XIV.1 adapter cable (code 3363-1) to connect to SQuadriga II

- CLO VIII.3 power in cable (code 3364-3; 3 m/9.8 ft)

- HEAD*link* cable CLL X.xx (code 3780-xx); available lengths: 0.17 m/6.6"; 0.26 m/10.2"; 0.36 m/14.1"; 0.5 m/1.6 ft; 1 m/3.2 ft; 1.5 m/4.9 ft; 2.5m/8.2 ft; 5 m/5.4 yd; 10 m/10.9 yd; 20 m/21.9 yd, 25 m/27.3 yd; 30 m/32.8 yd; 40 m/43.7 yd; 50 m/54.6 yd; 60 m/65.6 yd

- *lab*MA-a (active)/*lab*MA-p (passive) mounting adapter for mechanical connection to a HEAD*lab* controller/ HEAD*lab* module

- CDO X.3 OBD connection cable (code 3786-3; 3 m/9.8 ft)

- CMD 0.12 cable adapter (code 3788)
  D-Sub to two CAN/CAN FD and one FlexRay connector

- CLX X.1 AES cable (code 3797-1; 1 m/3.2 ft)

- CUSB II.xx USB cable (code 5478; included with HMS IV) HMS IV remote controlling; available lengths: 1.5 m/4.9 ft, 3 m/9.8 ft; 5 m/5.4 yd

- CLB IV.1 adapter cable (code 9826)
  Both BHS channels as analog outputs

- CLB I.2 adapter cable (code 9847)
  connecting BHS II to BNC connectors (channels 3 – 8)

- CLB I.3 cable adapter (code 9848)
  Both BHS channels as BNC inputs with ICP supply

- RC X.1 remote control (code 9850) with optional RC X.2 radio module (code 9851)

- 0271 USB video camera
  HD 720 (1280x720 px), 30 fps,
  auto focus: 10 cm to 10 m (3.9" to 10.9 yd),
  available from HEAD acoustics

- CGA I.0 active GPS antenna with cable (code 9855)

- CLJ.I cable adapter (code 9858)
  14 pin LEMO to 3.5 mm headphones jack to connect HD IV.x headphones to the BHS connector

Optional firmware packages – overview

Advanced Online Analysis (SQ3 TP 01, Code 3324-01)

This optional package adds further online analyses, such as FFT over time (3D analysis), order analyses, loudness over time, specific loudness, sharpness over time, articulation index, and sound intensity as well as online filters.

Level Meter (SQ3 TP 02, Code 3324-02)

With this optional package, you can utilize the extensive functionality of the built-in sound level meter and measure a number of physical and psychoacoustic quantities. This includes among others A, C, and Z weighting, current and maximum sound pressure level with time weighting, equivalent continuous sound pressure level, loudness (ISO 531-1/ DIN 45631/A1) and sharpness (DIN 45692), octave and third octave spectra, percentiles.

Video Support (SQ3 TP 03, Code 3324-03)

This optional package adds the video function. Simply connect the USB video camera 0271 (optional accessory) to SQuadriga III and document your measurement situation in video. During playback of the recording, the simultaneously recorded video is also played back so that you can always reproduce the recording situation. In addition, you can take single pictures to document sensor positions, for example.

System Analysis (SQ3 TP 04, Code 3324-04)

This optional package includes the system analyses *Transfer function*, *Coherence*, *Impulse response*, *Cross correlation,* and *Cross correlation vs. time*. Furthermore, the Play & Record functions and the signal generator providing the *Generate and Record* and the *Generate and Analyze* functions are included. Both functions enable you to stimulate a structure using a played back or generated signal and simultaneously record the sound events, vibrations, or electrical impulses resulting from the excitation. The signal generator provides several signal types with adjustable frequency, amplitude, and period duration.

Controller Mode (SQ3 TP 05, Code 3324-05)

This optional package allows you to connect a second SQuadriga III, a SQuadriga II, or a HEAD*lab* module. Here, SQuadriga III controls the configuration and the recording of the connected device's signals. A connected HEAD*lab* module and the sensors connected to it are supplied by SQuadriga III. A connected SQuadriga II or SQuadriga III supplies itself and the connected sensors from its own battery.

Network Access (SQ3 TP 06, Code 3324-06)

This optional package allows remote control of some functions of SQuadriga III using a web interface. You can access the web interface with any browser. Furthermore, SQ3 TP 06 offers access to the internal SQuadriga III storage via LAN to exchange files between SQuadriga III and your computer with a file manager such as Windows Explorer, for example.

SQuadriga III — versatile, intuitive, mobile

Intuitive multi-touch operation

You operate the full range of SQuadriga III functions via the display. Familiar gestures that you use on your mobile phone on a daily basis are also used for SQuadriga III: you tap to press buttons and start functions, and swipe to scroll through lists, for example, stored files lists or settings options. Using two fingers, you can zoom into the analysis diagrams or adjust the video image.

Operating modes

The two operating modes allow for a high degree of flexibility in a multitude of recording situations. A powerful battery, convenient handling, intuitive gesture operation, and a large internal storage offer an independent stand-alone mode. This allows for complete autonomy in many measuring situations. Recordings are saved to the internal storage or to a connected USB stick. This is even possible together with a connected HEAD*lab* module, which is powered by SQuadriga III's internal battery.

In frontend mode – for example, on a test rig – you connect SQuadriga III to the measuring computer via USB or LAN and control the recording with the ArtemiS SUITE Data Acquisition Module (ASM 04; ArtemiS SUITE Recorder and HEAD Recorder). In this mode, the recordings are saved on the computer.

HEAD*link* and HEAD*link+*

The two HEAD*link* and HEAD*link+* interfaces on the back allow for the integration of SQuadriga III into a HEAD*lab* system, the connection of an additional SQuadriga III, or the connection of an artificial head measurement system.

For integration into a HEAD*lab* system, SQuadriga III is connected to a HEAD*lab* controller and then acts like a module. SQuadriga III then transmits the signals of six of its eight analog channels to the controller.

You can connect a HEAD*lab* module *(see box Compatible HEADlab modules)*, a second SQuadriga III, a SQuadriga II, or an HMS V artificial head to the HEAD*link+* interface. In both frontend and stand-alone modes, SQuadriga III controls the configuration of the module channels, handles data storage to the internal storage or to a USB stick, and supplies the HEAD*lab* module and sensors connected to it with voltage.

If you connect an additional SQuadriga III, you specify which of the two devices functions as the controller, and records the channels of the other device. The other SQuadriga III assumes the role of the module and transmits the signals from its eight analog channels (BHS connection and BNC connections) to the controlling SQuadriga III.

Artificial heads such as HMS III, HMS IV, or HMS V are connected to the HEAD*link+* interface. This connection transfers the audio data. HMS III and HMS IV are additionally connected to one of the USB A interfaces through which SQuadriga III controls and configures the artificial heads.

> *Compatible HEADlab modules:*
> - *lab*M6 (code 3724B Rev. 02)
> - *lab*CF6 (code 3725)
> - *lab*T6 (code 3726)
> - *lab*SG6 (code 3727 Rev. 3)
> - *lab*V6HD (code 3728)
> - *lab*VF6 II (code 3752)
> - *lab*M6 II (code 3754)
> - *lab*HSU (code 3710)

Power supply

The power connector for the electrically isolated power supply on the back of SQuadriga III provides a wide range input (10 – 30 V DC), which you can connect to the power supply provided, to a PowerBox (*lab*PWR I.1 /*lab*PWR I.2 /*lab*PWR I.3), or an onboard power supply.

Even when SQuadriga III is switched off, any connected external power supply is used to fully charge the internal battery.

SQuadriga III informs you about the charge level of a connected PowerBox and also about whether it is charged via its own power supply.

Display and operation

A 7" touchscreen is located on the top of SQuadriga III with a resolution of 1024 x 600 pixels. All menus and functions are operated via the display with the press of a finger or swipe gestures so that neither a computer nor a tablet is necessary.

This allows you to monitor and document measurements even during mobile use, carry out complex analyses, and play back recordings via BHS II or headphones.

Binaural BHS II headset

The calibratable BHS II headset is the ideal addition to SQuadriga III for fast and simple binaural recording.

With the BHS connector, SQuadriga III provides a dual channel input tuned specifically to BHS II, which is configured and equalized automatically for both recording and playback.

Its light weight and high wearing comfort allow you to use BHS II comfortably over a longer period of time. Its earpieces and headband adapt to any head shape.

When you connect BHS II to the BHS connector, SQuadriga III automatically configures the corresponding channels and enables the appropriate equalization filter. You can start recording immediately. SQuadriga III and BHS II are a perfectly matched combination to perform binaural recordings very easily and also play them back with BHS II.

Binaural recording and playback

SQuadriga III continues the established HEAD acoustics technology of aurally compensated recording, analysis, and playback and combines ease of use and mobility with high performance and reliability.

Not only can you use SQuadriga III together with the binaural BHS II headset. In addition, you can further connect up to four binaural recording devices, such as the head microphone BHM II.3 or the artificial head microphone HSU III.2.

You can start the playback of a recording you just made directly within the Recorder view and listen to it via a connected BHS II. Recordings that are stored in the internal storage of SQuadriga III can be played back as easily from the File system view.

SQuadriga III ensures aurally compensated playback, even when the recording was made using another HEAD acoustics recording device; for example, SQuadriga II or SQobold.

Advantages of binaural recording and playback

Unlike stereo recordings with conventional microphones, binaural SQuadriga III recordings contain – in addition to timbre and volume that remain faithful to the original – full spatial sound field representation.

During playback of a recording via the BHS II headset or another HEAD acoustics playback device – for example, a *lab*P2 with headphones – the spatial representation is precisely reproduced.

This provides you with the auditory impression of the original sound field, since your hearing can select and locate the different sound sources, exactly as within the original sound field.

Comparability with conventional recordings

To ensure that binaural and conventional recordings are comparable to each other and can be analyzed together, SQuadriga III uses ID (independent of direction) equalization for recordings with BHS II.

ID equalization was developed by HEAD acoustics and is suitable for most sound fields that occur frequently in practice. Equalizations such as Free field oder Diffuse field equalization are intended for sound fields with precisely defined general conditions as they occur under laboratory conditions, in which BHS II is generally not used as a binaural sensor. Information about the equalization used and the recording level is stored within the recording.

Other HEAD acoustics playback systems read this information, automatically configure the playback, and thus ensure correctly equalized and level-accurate playback.

Analyzing recordings

Aside from conventional analysis functions such as FFT or octave analyses, SQuadriga III also provides psychoacoustic analyses such as loudness and sharpness.

Psychoacoustics considers that sound events are perceived differently by human beings than by a measuring device. Psychoacoustic analyses allow the exact and standardized description of the human hearing sensation of sound events.

The selected analysis can be configured regarding FFT size, window function (Hanning, rectangle, flat-top), the frequency weighting, and the level scale.

With SQuadriga III, you can use analyses during recording, while playing back, and during monitoring to identify abnormalities in a noise or a noise scenario and find approaches for sound quality improvement.

Already while monitoring analyzed channels, you can suppress or amplify signal components by means of a filter and adjust frequency, quality, and attenuation easily with a slider control. You can monitor the unfiltered as well as the filtered signal and additionally have the filtered signal displayed in the diagram.

In combination with the ArtemiS SUITE Advanced Filters Module (ASM 19), you are able to identify disturbing elements in sounds already during recording and find approaches for a more detailed analysis at a very early stage. Here you can also change quality, frequency, and attenuation of the real-time filters in ArtemiS SUITE and monitor the optimized signal using headphones. Additionally, the unchanged original noise is recorded and available for further analysis.
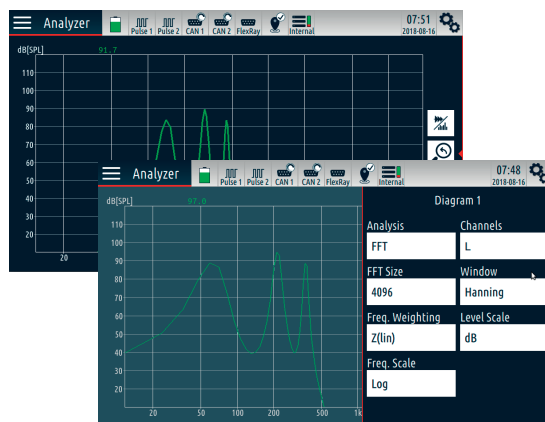
Analyzing during recording

During recording, all Analyzer functions are available to analyze the incoming signals in real-time. For this, you activate the Analyzer with a button in the Recorder while the recording takes place, select up to two channels, and configure the analysis as usual. The analysis result is displayed in a diagram that provides the same configuration options as the Analyzer diagram.

Analyzing during playback

FFT and octave as well as psychoacoustic analyses are available for analysis during playback. You can select and configure these analyses during playback and thus analyze individual recordings stored on your device.

During playback, the signals of the channels played back are analyzed and the results are displayed in a diagram. You can replace and reconfigure the analysis used, adjust the level, fast-forward or rewind, and limit the playback area at any time during playback.

Video function (optional package)

Via a connected USB video camera, you can record a video in MJPEG format with a resolution of up to 1280x720 px and up to 30 fps parallel to the audio recording. The video image can also be displayed in real time during recording. If a video file is stored for a recording saved on SQuadriga III, it will be played on the display during playback of the recording.

In addition, you can capture single frames with the video camera during recording in order to separately document the exact sensor positions or specific situations during a measurement.

Satellite-based position tracking

SQuadriga III supports common satellite navigation systems (GPS, GLONASS, BeiDou, and Galileo) and allows not only precise position fixing, but also determination of other parameters, such as speed and altitude.

All GPS data are recorded and displayed on the screen in real time. Using the data recorded, you can, for example, display the distance traveled during measurement in ArtemiS SUITE on a map based on OpenStreetMap.

The PPS signal allows for later synchronization of temporally overlapping recordings of multiple, spatially separated SQuadriga III devices. To do this, use the "Merge Recordings" function of Mobile Frontend Tools or HEAD Companion, or the ArtemiS SUITE file merge function (ASM 20 - Signal Editor Module). GPS quantities can be used to trigger the starting or stopping of a recording, for example, when a specific GPS speed is reached.

SQuadriga III in a network

If you connect SQuadriga III to a network, you can access SQuadriga III from any computer on the same network that runs the ArtemiS SUITE Data Acquisition Module (ASM 04; ArtemiS SUITE Recorder and HEAD Recorder) and make recordings. Just as easily, you can use Mobile Frontend Tools and, for instance, install a new firmware version on SQuadriga III via network.

For connection to a network, the LAN port on the rear panel of SQuadriga III is available, into which you insert a CAT 5 network cable. SQuadriga III receives the network configuration via DHCP. Alternatively you can enter the necessary settings manually.

Connecting to SQuadriga III via a network is supported by ArtemiS SUITE as of version 11.5, HEAD Recorder as of version 11.2, and Mobile Frontend Tools as of version 1.0.

Web interface and storage access via LAN

With the optional package SQ3 TP 06 *Network Access*, you can control some SQuadriga III functions remotely via a web browser and configure channels, start and stop recordings, manage device configurations, manage files, and update the firmware, for example.

Additionally, the optional package enables the storage access via LAN. You can then manage files and folders from any computer in the network in the internal storage of your SQuadriga III. For example, using the well known Windows Explorer functions.
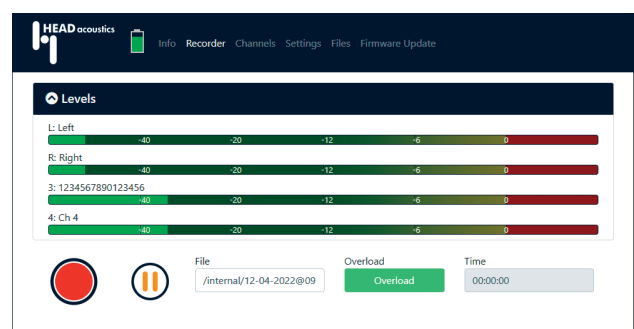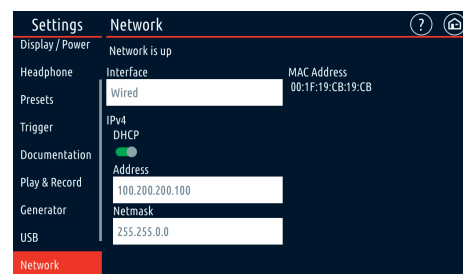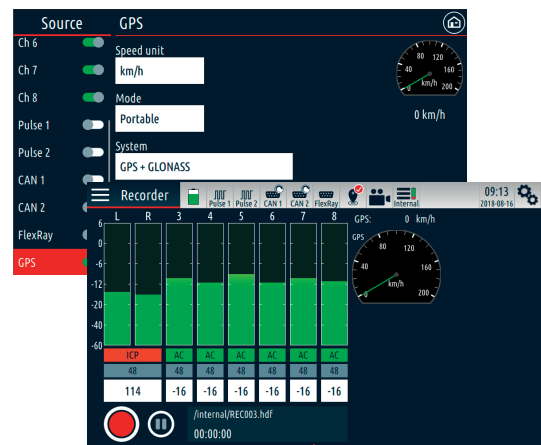
Trigger

You can use the incoming signals of the Pulse, GPS, CAN, FlexRay, and audio channels or a time as triggers for starting or stopping a recording.

A trigger can react to an ascending or a descending signal edge and SQuadriga III is able to record signals that occur before (so called pre trigger) or after (so called post trigger) reaching the start or stop threshold.
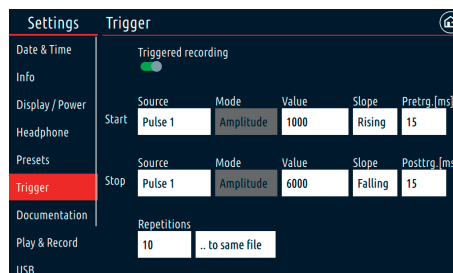
Documentation

Efficient management of a large number of recordings requires access to descriptive information. For this, the SQuadriga III documentation function is an extremely easy-to-use solution for describing each recording.

Using documentation templates created in ArtemiS SUITE and transferred to SQuadriga III via USB, you can specify the information to be stored for a recording. This can be details of type and model, a vehicle configuration description, or information about external conditions. Many familiar form elements such as input fields, selection fields, and lists facilitate the process of measurement documentation.

You can assign a documentation template to existing recordings that do not yet contain documentation and add documentation afterwards.
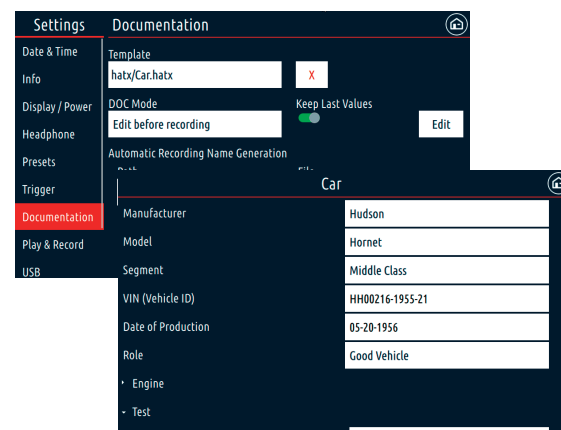
Context-sensitive online help

The comprehensive context-sensitive online help supports you with information about dialogs and functions and offers detailed help for the operation of your SQuadriga III. It is available in German and English on the device and you can easily switch between both languages.

The online help is always available via a button and always opens exactly the section that describes the current view. In addition, the interactive table of contents provides access to all help topics which you then open simply by tapping.
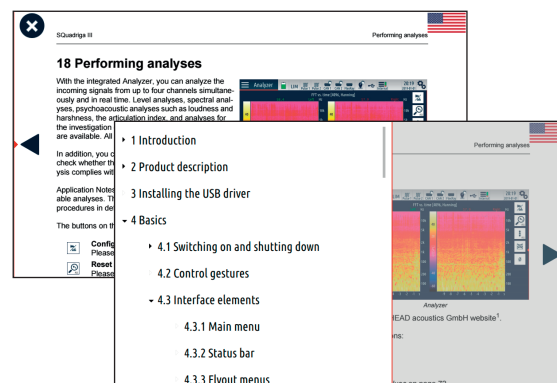
Sensor Library

If you organize sensors in ArtemiS SUITE using a Sensor Library, you can use this library with SQuadriga III. Simply copy the library to the internal storage of SQuadriga III, afterwards you can access the information stored therein during channel configuration and assign readily configured sensors to the channels.

Details like sensor type, sensitivity, calibration date and factors, and also equalization filters stored in the sensor library are automatically used for a channel without having to enter any data manually. Furthermore, this information is stored in the recording and is later available in the Channel Editor for follow-up and analysis in ArtemiS SUITE.
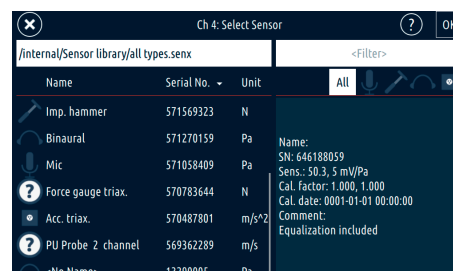
Sound Level Meter function

Using the Sound Level Meter function of SQuadriga III, you can determine sound pressure levels and quantify noise. Thus, an informed assessment of, for example, environmental noise or noise at the workplace is possible. The measurable physical and psychoacoustic quantities include among others current, maximum, and peak sound pressure levels, sound pressure levels resolved into octave or third-octave spectra, as well as loudness and sharpness with up to three percentile values each. Several measured levels of up to two channels can be monitored simultaneously during measurement via the display and saved as single values for later analysis. Additionally, you can record the measurements and display them over time in diagrams. You can also record the time signal in order to play it back later. Via a connected video camera (with optional package SQ3 TP 03, code 3324-03), you can display a video preview and record the video image simultaneously to the time signal.
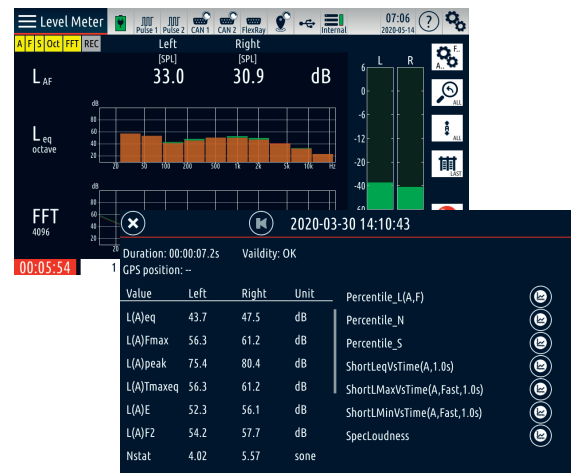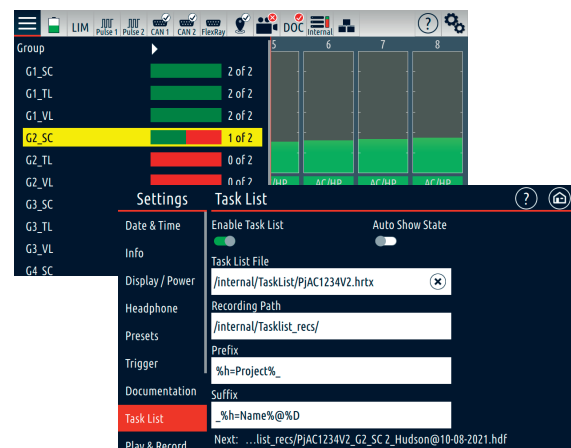
USB audio devices

With USB audio devices such as BSU and SQope, you make binaural recordings very straightforward. USB audio devices are connected with one of the USB ports on the back. If you connect a USB audio device to SQuadriga III, you can record both audio channels of the USB audio device and analyze the signals with the level meter function or the Analyzer, for example. Additionally, the GPS signal of SQuadriga III and the signal of a video camera connected to SQuadriga III can be recorded, although the analog SQuadriga III channels are deactivated. Recordings are stored on SQuadriga III and can be transferred to a computer and analyzed with ArtemiS SUITE, for instance.

Task lists

With a Task list, you can configure and perform a defined sequence of recordings to be made. This is especially useful for performing a measurement series, for example in the context of standardized tests for quality control with the ArtemiS SUITE Standardized Testing Module. Task lists are configured in ArtemiS SUITE via a Standardized Test Project or via the Recorder Task List, are then saved as an HRTX file and can be transferred to SQuadriga III. As soon as you activate and start a Task list, SQuadriga III automatically performs the measurements sequentially. You can play back each measurement for review and reject it, if necessary. The processing status of the Task list is displayed in a flyout and updated after each accepted measurement. The configured Task list measurements can contain trigger conditions with which recordings can be started and stopped automatically.

Connectors available on the front

Analog In with ICP · **Analog Out** · **BHM III.3** · **HSU III.2** · **CLB I.2**

Headphone · **BHS** · **BHS II** · **CLB I.3** · **HSU III.2** · **BHM III.3** · **CSB VII.0**

Headphone output

You can connect dynamic HEAD acoustics headphones to the headphone output and use it to play back recordings correctly equalized. Available equalizations are *Independent of direction* (ID), *Free field* (FF), *Diffuse field* (DF), *user specific* (USER), and *linear* (LIN, no equalization).

BHS

The BHS connector is intended for connecting the BHS II headset. Using this headset, you can record and play back noise events binaurally and aurally accurate. The connector has its own A/D and D/A converters, switchable high-pass filter, and a calibration function for the ICP microphones of BHS II. Using the cable adapter CLB I.3, you can connect a binaural head microphone BHM III.3 or an artificial head microphone HSU III.2, or use the channels as input channels with selectable ICP supply or as analogue output channels. Using the CLJ I cable adapter, you can connect an additional pair of headphones.

BNC 3 – 8

The six AC- and DC-enabled BNC inputs can be used as analog inputs or as inputs with selectable ICP supply. They each have switchable HP filters (2 Hz and 22 Hz), and the input sensitivity can be adjusted individually. In addition, they can each be configured as analog outputs; for example, as a monitoring channel or in order to make a playback-controlled recording (Play & Record). Furthermore, ICP/DC coupling is available with which you can measure signals below 2 Hz with ICP sensors.

Pulse In

You can connect pulse sources directly to the Pulse In 1 and Pulse In 2 pulse inputs. Pulse signals are sampled at 32 times the main sampling rate. At a 48 kHz main sampling rate, a maximum pulse frequency of 600 kHz is available; at 96 kHz, 1 MHz is available.

Connectors available on the back

Power

This connection supplies SQuadriga III with power from the power supply provided (24 V, 60 W, LEMO 4-pin), or from *lab*PWR I.1/*lab*PWR I.2/labPWR I.3.

HEAD*link*

Via this electrically isolated connection, you can connect SQuadriga III to a HEAD*lab* controller; thus integrating it in a HEAD*lab* system. In this case, SQuadriga III behaves in the same way as a HEAD*lab* module. In addition, you can connect another SQuadriga III that functions as the controller and takes over channel configuration and signal recording. In this scenario, one SQuadriga III controls the configuration of the other and records the signals from the sensors connected to both SQuadriga III devices.

HEAD*link+*

You can connect a HEAD*lab* module to this connector and supply it with voltage. You can also connect a SQuadriga II, an HMS III/HMS IV/HMS V artificial head or another SQuadriga III. SQuadriga III configures and records the channels of any connected device.

CAN – FlexRay

This connector allows you to connect SQuadriga III to the CAN and FlexRay vehicle field buses. There are two CAN channels for CAN, CAN FD, and OBD and one channel for FlexRay available. SQuadriga III is able to decode up to four variables per CAN or FlexRay channel and display them as single numbers in real time. Six of the decoded variables can additionally be displayed in form of tachometers.

USB (type A)

The three type A USB ports allow you to connect a range of USB devices, for example, a video camera, USB storage media, or the RC X.1 remote control (with optional RC X.2 radio module). The connected devices are supplied with voltage via the USB port.

USB (type C)

Via this screwable connector, SQuadriga III is connected to a computer. The screw connection makes sure that even with vibration the cable connection to the computer cannot be disconnected. For the operating system to detect SQuadriga III, the HEAD USB driver must be installed on the computer. This USB connection enables the frontend mode, in which recordings are made with the ArtemiS SUITE Data Acquisition Module ASM 04 (ArtemiS SUITE Recorder and HEAD Recorder) on the computer.

Furthermore, this connection enables the usage of SQuadriga III as a mass storage device, so that you can download recordings from SQuadriga III or save files to the internal storage of SQuadriga III (e.g., sensor libraries, documentation templates, or configuration settings.

LAN

You can operate SQuadriga III in frontend mode in a network using the LAN connector so that signals can be recorded on a computer (with ArtemiS SUITE Data Acquisition Module ASM 04). Furthermore, with the optional package SQ3 TP 06, you can remote control SQuadriga III via a network and access the storage from a computer.

GPS

You can connect an active GPS antenna (included in the scope of delivery) to the GPS connector and link SQuadriga III to global navigation satellite systems (GPS, Galileo; GLONASS, BeiDou). With an active link, position, speed information, and determined altitude are recorded in a separate channel of the recording. If necessary, the internal time of SQuadriga III is synchronized to the global navigation satellite system time.

Technical specifications

General

Number of channels (direct connections)	13
Connectors	6 x Line-/ICP-In, BHS connector (2-channel), 2 x Pulse In, 2 x CAN (CAN/CAN FD/OBD-2), 1 x FlexRay,
Interfaces	
Front	1 x 3.5 mm jack plug, 1 x LEMO 14-pin, 6 x BNC, 2 x SMB
Back	1 x LEMO 4-pin, 2 x LEMO 8-pin, 1 x D-Sub 9-pin, 3 x USB type A, 1 x USB type C, 1 x LAN, 1 x SMA socket
Resolution (audio)	24 bit
Supply voltage	10 – 30 V DC
Power consumption	Max. 35 W
Charging	18 W with device off. Battery charging with 1 A
Operation	7 W
Standby	6 W with display off, 8 active channels with ICP (2 mA)
Quiescent current	Max. 300 µA (for battery meter and real-time clock)
ICP supply	23 V
ICP current	Optionally 2 mA (-10 % / +25 %) or 4 mA (±25 %) shared for all channels with ICP supply
Sampling frequencies	Main sampling rates 32 / 44.1 / 48 / 51.2 / 65.536 / 88.2 / 96 kHz; adjustable sub-sampling rates: ½, ¼, ⅛ of main sampling rate HEAD*link*: 48 / 51.2 kHz
TEDS	Readout of sensor type, calibration, calibration date, serial number
Standard	IEEE 1451.4
Touchscreen	LCD, TFT, multi-touch capable
Color depth	16.7 million colors
Resolution	WSVGA with 1024x 600 pixels
Size	7"/17.8 cm (155 x 92 mm)
Background illumination	Manually adjustable, automatic dimming
Processor	ARM Cortex A9, dual-core 800 MHz
Storage capacity	64 GB internal, approx. 60 GB for recordings and configurations
Cooling	Convection, without fan
Battery	Lithium-ion battery, 14.8 V, 4000 mAh
Operating time	7 h during typical operation (battery-powered, no connected HEAD*lab* module or USB devices, stand-alone mode, dimmed display, 80 % of the time in standby) max. 8 h (8-channel recording without ICP supply, display in standby, no additional functions)
Charge time on ext. supply	max. 8 h with device off, ambient temperature 25 °C
Charge process	CCCV, monitoring of temperature, end-of-charge voltage, charge time
Housing dimensions (WxHxD; overall)	194 x 42 x 155 mm (7.6 x 1.7 x 6.1")
Weight	1.3 kg

Shock (EN 60068-2-27)	26 g (260 m/s^2; 853 ft/s^2), six axis				
Vibration (EN 60068-2-6)	4.5 g (46 m/s^2; 151 ft/s^2), 5 Hz – 500 Hz				
IP degree of protection	41				
Operating temperature					
Stand-alone mode	Typical operation: -20 °C – +45 °C (-4 °F – 113 °F)				
	Min. operation: -20 °C – +50 °C (-4 °F – 122 °F)				
Frontend mode	Typical operation: -20 °C – +40 °C (-4 °F – 104 °F)				
	Min. operation: -20 °C – +50 °C (-4 °F – 122 °F; forced ventilation)				
Charging (device off)	-20 °C – +50 °C (-4 °F – 122 °F)				
Storage temperature	-20 °C – +60 °C (-4 °F – 140 °F)				

BHS input

Connector	LEMO 14-pin; connection and detection of binaural BHS II headset for aurally compensated recording and playback, no BHS I support
Input impedance	100 kΩ
Equalization types	Recording: ID Playback: LIN (no equalization), ID, FF, DF, USER

Measurement ranges *(plus ~6 dB head room)*	-29 dB(V)	-19 dB(V)	-9 dB(V)	+1 dB(V)	+11 dB(V)
Accuracy					
DC (% full scale)	±0.3	±0.25	±0.17	±0.16	±0.16
AC (% full scale at 1 kHz)	0.53	0.59	0.5	0.59	0.5
AC (dB)	+0; -0.24	+0; -0.24	+0; -0.24	+0; -0.3	+0; -0.29

Analog inputs

Connectors	6 BNC (2 additional when using CLB I.3 in the BHS connector)
Frequency range	0 Hz – 20 kHz (DC capable)
Input impedance	100 kΩ

Measurement range BNC *(plus ~6 dB head room)*	-36 dB(V)	-26 dB(V)	-16 dB(V)	-6 dB(V)	+4 dB(V)	+14 dB(V)
S/N	88 dB(A)	95 dB(A)	98 dB(A)	99 dB(A)	98 dB(A)	99 dB(A)
THD+N *(1 kHz, -1 dBFS)*	-73 dB	-83 dB	-91 dB	-89 dB	-92 dB	-71 dB
Crosstalk *(1 kHz)*	-100 dB	-100 dB	-100 dB	-100 dB	-100 dB	-100 dB
Accuracy *(1 kHz)*						
DC (% full scale)	±0.38	±0.25	±0.25	±0.2	±0.17	±0.15
AC (% full scale at 1 kHz)	1.1	0.55	0.55	0.73	0.73	0.73
AC (dB)	+0; -0.22	+0; -0.22	+0; -0.22	+0; -0.22	+0; -0.28	+0; -0.28

Analog outputs

Connectors	6 BNC (input switching); 2 additional when using CLB IV.1 on the BHS connector)
Frequency range	20 Hz – 20 kHz (not DC capable)
Maximum level	-4 dB(V)
Output impedance	250 Ω

HEAD*link+* connector

Connector	LEMO 8-pin
Supply output	Max. 10 W (external modules supply)

HEAD*link* connector

Connector	LEMO 8-pin
Supply input	Max. 12 W (powered by HEAD*lab* controller, no charging)
Channels	Max. 6 analog channels when connecting a HEAD*lab* module
	Max. 8 analog channels when connecting SQuadriga III
Electrically isolated	Yes

Pulse In

Connector	SMB, 2 pulse inputs
Electrically isolated	Both pulse inputs together
Input impedance	36 kΩ
Input voltage	0 – +10 V (operation); ±50 V (absol. max.), adjustable trigger threshold
Max. pulse frequency	600 kHz at f_s = 48 kHz; 1 MHz at f_s = 96 kHz Recording at 32 times the main sampling rate, max. 1 MHz

FlexRay

Connector	D-Sub 9-pin
Standard	FlexRay V2.1, Rev. B
Data rate	Bus rate 10 Mbit/s, recording with up to 1.1 Mbit/s at 48 kHz (1 audio channel, filtered data)
Termination	External

CAN / CAN FD

Connector	D-Sub 9-pin	
Standards		
CAN / CAN FD	ISO 11898-2	
OBD-2	ISO 15765-4	
Identifier	11 bit (CAN 2.0A) and 29 bit (CAN 2.0B)	
Data rate CAN FD	Bus rate 5 Mbit/s, recording with up to 1.1 Mbit/s at 48 kHz (backwards compatible with CAN with 1 Mbit/s)	
Termination	120 Ω (optionally electronically switchable)	

LAN

Connector	RJ45
Cable category	CAT 5
Status LED	green: 1 Gbit/s; yellow: 100 Mbit/s (transfer)
Data rate	10 / 100 / 1000 Mbit/s
Standard	IEEE 802.3ab

Galvanic isolation only with unshielded cable.

Satellite systems

Connector	SMA socket
Supply for active antenna	3 V, max. 20 mA
Frequency	L1=1.575 GHz
Update rate	Max. 10 Hz
Operating modes	Air, car, boat, pedestrian, stationary, off
Global navigation satellite systems	GPS, Galileo, GLONASS, BeiDou
Receiver	Two; combined reception possible
Satellite system combinations	GPS/Galileo; GPS/GLONASS; GPS/BeiDou; GPS/Galileo/GLONASS; GPS/Galileo/BeiDou; Galileo/GLONASS; Galileo/BeiDou; GLONASS/BeiDou
Synchronization	PPS; allows later synchronization of recordings from separate devices; accurate time stamp within the recording (HDF file)

USB host

Connector	USB type A; three ports for USB sticks, video camera, or remote control
Voltage	5 V DC
Current	500 mA per port
Total output	max. 6 W shared for all interfaces

USB device

Connector	USB type C with screw connection
Data rate	USB 2.0 (480 Mbit/s)
Access to USB mass storage	Read up to 5 Mbyte/s; write up to 3 Mbyte/s

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