HEAD acoustics

DATA SHEET

PRACTICAL CHAPTER INCLUDED

Code 3324

SQuadriga III

Mobile Recording and Playback System with Sound Level Meter Function

OVERVIEW

SQuadriga III

Code 3324

Mobile recording and playback system with sound level meter function – as a stand-alone system or as a network or USB frontend

SQuadriga III is a handy and powerful recording and playback system that comes with a sound level meter function and provides a variety of connection options, extensive functionality, high mobility, and variable application possibilities. SQuadriga III operates silently and is ready for use within seconds after being switched on.

In stand-alone mode, recordings are stored on the internal memory or on a connected USB stick, while in frontend mode they are saved on the computer connected via USB or LAN. Operation is via the touchscreen, the Recorder of ArtemiS SUITE (APR 040 — Recorder), or via the web interface (optional package SQ3 TP 06 (Code 3324-6) *Network Access*).

Supported sensors are connected directly to the corresponding connectors. These include ICP microphones, ICP accelerometers, the calibratable BHS II headset, pulse sensors, sensors for bus systems, such as CAN FD, OBD-2, WWH-OBD, and FlexRay, artificial head measurement systems from the HMS family, and HEAD*lab* modules.

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 using the SQuadriga III Simulator, 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 power to a connected HEAD*lab* module.

As an alternative, you can use SQuadriga III-V1 (Code 3324-V1), a battery-less variant that can be used in measurement situations where a battery-powered device is not intended.

KEY FEATURES

Two application modes: Stand-alone and frontend mode

Several hours of self-sufficient measurements in battery mode or power supply and charging of the battery via the power adapter or a Power Box

Operation via capacitive multi-touch color display

Aurally-accurate recording and playback via the BHS II binaural headset (BHS II is not included in the scope of delivery)

Connection of up to four binaural sensors BHM III.3 and HSU III.2

Equalized playback via headphones

Sound level meter function for up to four channels

FFT, octave, and psychoacoustic real-time analyses with filtering

Connection and real-time decoding of the vehicle bus systems CAN, OBD-2, CAN FD, and FlexRay

Connection of a HEAD*lab* module or integration into a HEAD*lab* system

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

Recording of the GPS, Galileo, BeiDou, and GLONASS satellite navigation systems

Optional packages for customizing the functional scope of the firmware

APPLICATIONS

Mobile sound and vibration measurement

Mobile real-time analysis

Sound level measurement and analysis

DETAILS

Compact and Powerful

- Compact dimensions of 193 x 41 x 154 mm
- Powerful dual-core processor
- 60 GB internal memory for audio and video recordings
- Stand-alone mode for mobile working
- Frontend mode with USB or LAN connection to a computer using the Recorder of ArtemiS SUITE (APR 040 — Recorder)

Touchscreen

- Capacitive multi-touch color display (7"/17.8 cm, 1024 x 600 pixels)
- Supports swipe gestures, zoom, double-tapping

Power Supply

- Rechargeable battery for several hours of measurements in stand-alone mode
- ICP supply for connected sensors
- Power supply and charging of the battery via the power adapter supplied or a Power Box (*lab*PWR I.1/*lab*PWR I.2/*lab*PWR I.3)
- Power supply to a connected HEAD*lab* module

Aurally-Accurate Recording and Playback

- Direct connection of the BHS II binaural headset (BHS II is not included in the scope of delivery)
- Recording equalization Independent of Direction (ID)
- Equalized playback via BHS II or compatible headphones
- Playback equalization Independent of Direction (ID), Free Field (FF), Diffuse Field (DF), and Linear (LIN, no equalization)

Binaural Sensors

- Connection and equalization of up to four binaural sensors
  - BHM III.3 Binaural Head Microphone or HSU III.2 Artificial Head Microphone at the BHS input (CLB I.3 cable adapter is required)
  - Up to three BHM III.3 or HSU III.2 at the BNC inputs 3 – 8
- The optional firmware package SQ3 TP 05 (Code 3324-05) SQuadriga III Tool Pack Controller Mode enables additional binaural sensors to be recorded using a connected HEAD*lab* module

Playback via Headphones

- 3.5 mm headphone socket at the front to connect compatible headphones, e.g., HD OP I.1 or HD CL I.1
- Model-specific standard equalization for compatible headphones
- Additional headphones at the BHS connector with the CLJ I cable adapter

Sound Level Meter Function

- Using the optional package SQ3 TP 02 (Code 3324-02) Level Meter
- Measurements with up to four channels
- Simultaneous time and frequency weighting (F, S, I time weighting/A, C, Z frequency weighting)
- Momentary, peak, and maximum sound pressure level, equivalent continuous sound level, sound exposure level, level over time with time and frequency weighting
- Averaging, minimum and maximum short-term level
- Third-octave, octave, and FFT spectra
- Loudness (ISO 532-1, DIN 45631/A1):
- Sharpness (DIN 45692): momentary, maximum, percentile, and stationary sharpness
- Percentiles (exceedance level)

HEAD*link*

- Connection to a HEAD*lab* controller
- Integration of six analog channels of SQuadriga III in a HEAD*lab* system
- Electrical isolation between the HEAD*lab* system and SQuadriga III
- Connection to a second SQuadriga III configured as a controller

HEAD*link+*

- Connection to a second SQuadriga III configured as a module
- Connection and power supply of compatible HEAD*lab* modules
- Electrical isolation between the HEAD*lab* module and SQuadriga III
- Connection to an HMS V artificial head

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, cross spectrum, cross correlation
- Triggered operation mode for impact measurements (most recent impulse as time signal or spectrum)
- Real-time filtering with individual frequency, quality, and attenuation adjustment
- Sound intensity measurement (using a 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
- Support of AUTOSAR sensors
- Data stream recording in a separate channel
- Simultaneous recording of several supported bus systems using the CMD 0.12 adapter (optional accessory)

Pulse

- Real-time decoding and display of up to two pulse sources
- Pulse source recording in a separate channel
- Pulse source sampling with up to 3 MHz (32 x 96 kHz)
- Built-in signal conditioning to amplify or clean signals
- High sensitivity
- Adjustable trigger thresholds

Trigger

- Multiple trigger sources for starting/stopping a recording
  - Decoded quantity from a Pulse, CAN, FlexRay channel
  - Longitude/latitude, speed, altitude determined via satellite
  - Sensor value on an analog channel (1 – 8)
  - Time
- Pretrigger and posttrigger: additional signal recording before or after the trigger conditions occur
- Multiple triggered recordings in one common or in individual files
- Trigger based on a rising/falling signal edge
- Time trigger for starting up SQuadriga III with subsequent recording and automatic shutdown via device configuration

Satellite Navigation Systems

- Connector for the external, active antenna (included in the scope of delivery)
- Real-time decoding and display of quantities, such as speed or altitude
- PPS (pulses per second) for later synchronization and merging of spatially separated, non-synchronized recordings made with SQuadriga III or SQobold
- Support of the GPS, Galileo, BeiDou, GLONASS satellite navigation systems
- Combined use of several supported satellite navigation systems

SQuadriga III-V1 (Code 3324-V1)

- Battery-less variant for measurement situations that do not allow battery-powered devices
- Identical range of functions as SQuadriga III
- Lower maximum power consumption (30 W)
- Capacitor-buffered real-time clock (capacitor is charged via the power supply)

CONNECTORS ON THE FRONT

Headphone Output


HD OP I.1


HD CL I.1


HD OP II.1


HD CL II.1

You can connect one of our compatible headphones to the headphone output and use it to play back correctly equalized recordings.

The following equalizations are available: Independent of Direction (ID), Free Field (FF), Diffuse Field (DF), and Linear (LIN, no equalization).

Pulse In


CSB VII.0

The two pulse inputs Pulse In 1 and Pulse In 2 are available for direct connection of pulse sources. The pulse signals are sampled at 32 times the main sampling rate. At a main sampling rate of 48 kHz, a maximum pulse frequency of 600 kHz is available; at 96 kHz, the maximum pulse frequency is 1 MHz.

BHS


BHS II


CLB I.3

The BHS connector is intended for the BHS II headset that can be used for binaural and aurally-accurate recording and playback of noise events. The connector has its own A/D and D/A converters, switchable highpass filters, and a calibration function for the two ICP microphones of BHS II.

Using the CLB I.3 cable adapter, you can use the two BHS channels as inputs with selectable ICP supply for sensors with BNC connectors, e.g., for the BHM III.3 Head Microphone and the HSU III.2 Artificial Head Microphone. The two channels may also serve as analog outputs. Using the CLJ I cable adapter, you can connect another pair of headphones.

Analog Inputs (3 – 8)


Analog In with ICP


Analog Out


BHM III.3


HSU III.2


CLB I.2

The six AC and DC enabled BNC inputs can be used as analog inputs or inputs with selectable ICP supply. They are each equipped with switchable HP filters (2 Hz and 22 Hz), and adjustable input sensitivity.

In addition, they can each be configured as analog outputs, e.g., as a monitoring channel or for the Play & Record function.

ICP/DC coupling is also available, enabling you to measure signals below 2 Hz using ICP sensors.

CONNECTORS ON THE BACK

HEADlink


labCTRL II.1


SQuadriga III (controller)

Use this connector to connect SQuadriga III to a HEADlab controller and integrate it into a HEADlab system. SQuadriga III then operates like a HEADlab module.

You also have the option of connecting another SQuadriga III which will then operate as a controller, configuring and recording the sensors connected to both SQuadriga III devices.

HEADlink+


HMS V


SQuadriga III (module)


HEADlab module

Use this connector to connect a HEADlab module (optional package SQ3 TP 05 is required) and supply it with power via SQuadriga III.

There is also the option of connecting an HMS V artificial head or another SQuadriga III.

The channels from the device connected to the HEADlink+ connector are configured and recorded by SQuadriga III.

CAN – FlexRay


FlexRay


CAN FD

This connector enables you to connect SQuadriga III to the CAN and FlexRay vehicle field buses. There are two channels for CAN, CAN FD, and OBD as well as a FlexRay channel.

SQuadriga III decodes up to four variables per CAN or FlexRay channel and displays them as numerical values in real time. Six of these decoded variables can also be displayed in the form of tachometers.

Power


labPWR I.x


Power adapter


On-board power supply

Use this connector to connect the power adapter or a compatible Power Box (labPWR I.x).

You can use the CLO VIII.3 (Code 3364-3) cable to supply SQuadriga III via the on-board power supply of a vehicle.

GPS

Satellite navigation

Use the GPS connector to connect the CGA I.1 active rod antenna (included in the scope of delivery; CGA I.0 (Code 9855) is available as a wired alternative), to record data from the satellite-based GPS, Galileo, GLONASS, and BeiDou navigation systems. With an active connection, the position, speed information, and determined altitude are stored in a separate channel in the recording. The system time of SQuadriga III is synchronized with the satellite navigation time if necessary.

USB Host (Type A)


Video camera


Storage location


Remote Control RC X


SQope

There are three connectors for USB devices, such as the video camera (Code 0271), a USB storage device, the RC X.1 Remote Control (with the optional RC X.2 wireless handheld transmitter), or USB audio devices such as the digital binaural headset SQope.

Connected devices are supplied with power via the USB port. When recording with a USB audio device, you can also record the GPS channel and the signal from the video camera.

USB (Type C)


Computer

This screw-on connector is used to connect SQuadriga III to a computer that has our USB driver installed. This connection enables frontend mode for recordings on the computer using the ArtemiS SUITE Recorder (APR 040 – Recorder).

You can also use this connection to operate SQuadriga III as a mass storage device and download recordings from the internal memory or transfer files, e.g., sensor libraries, documentation templates, or configuration settings.

LAN


Network

The LAN connector can be used to operate SQuadriga III in frontend mode in a network, with signals being recorded on a computer (using APR 040 – Recorder).

You also have the option of controlling SQuadriga III remotely via the network using the optional package SQ3 TP 06 – Network Access (Code 3324-06) and accessing the internal memory from a computer.

HARDWARE COMPATIBILITY

HEAD*lab* Controller

3702	*lab*CTRL I.2	✓	*No longer available*
3704	*lab*CTRL II.1	✓	

HEAD*lab* Modules

3710	*lab*HSU	✓	
3724	*lab*M6	✓	*As of version B, Rev 02; no longer available*
3725	*lab*CF6	✓	
3726	*lab*T6	✓	
3727	*lab*SG6	✓	*As of Revision 03*
3728	*lab*V6HD	✓	
3752	*lab*VF6 II	✓	
3754	*lab*M6 II	✓	

Artificial Head Measurement Systems

1307	HMS III	✓	*No longer available*
1500	HMS V	✓	*No longer available*
1502	HMS V	✓	

Artificial Head Microphones

1391	HSU III.2	✓	

Binaural Sensors

1303	BHM III.3	✓	
1508	BSU	✓	
3300	SQope	✓	
3322	BHS II	✓	

Power Supply

3711	*lab*PWR I.1	✓	
3712	*lab*PWR I.2	✓	
3713	*lab*PWR I.3	✓	

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	✓	

Frontends

3320	SQuadriga II	✓	*No longer available*
3324	SQuadriga III	✓	

USB Devices

0271	USB camera	✓	
3334- 64	HUSB III.64	✓	

Remote Controls

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

Mounting Adapters

3760	*lab*MA-a	✓	
3761	*lab*MA-p	✓	

OPTIONAL FIRMWARE PACKAGES

Our optional firmware packages supplement the basic version of SQuadriga III and can be used to individually expand the range of functions. The basic version includes the Recorder, the Player, the Analyzer with the *FFT, Time Signal, Octave, 3rd Octave,* and *Level vs. Time analyses,* as well as the file management in the internal memory.

SQ3 TP01 (Code 3324-01) Advanced Online Analysis

This optional package provides the Analyzer with further analyses: FFT vs. Time (3D analysis), order analyses, Loudness vs. Time, specific loudness, Sharpness vs. Time, articulation index, online filters, sound intensity.

SQ3 TP 02 (Code 3324-02) Level Meter

This optional package adds the sound level meter function and enables the measurement of physical and psychoacoustic quantities, such as A, C, and Z weighting, momentary and maximum sound pressure level with time weighting, equivalent continuous sound level, loudness (ISO 531-1, DIN 45631/A1), and sharpness (DIN 45692), octave and third-octave spectra, percentiles.

SQ3 TP 03 (Code 3324-03) Video Support

This optional package adds the video function so that you can use the USB video camera 0271 (optional accessory) to document your measurement situation in video or single frames. When playing back the audio recording on SQuadriga III or in ArtemiS SUITE, the video recorded in parallel is also played back in the Player or in the Video Viewer of ArtemiS SUITE. This enables you to replay the recording situation and to use the single-frame function to document sensor positions, for example.

SQ3 TP 04 (Code 3324-04) System Analysis

This optional package includes the system analyses *Transfer function, Coherence, Impulse response,* as well as *Cross correlation, Cross correlation vs. time,* and *Cross spectrum*. In addition, the *Play & Record* function and the signal generator providing the *Generate and Record* and *Generate and Analyze* functions are available. The two functions of the signal generator can be used to excite a structure with a reproduced or generated signal and simultaneously record the sound events, vibrations, or electrical impulses resulting from the excitation. To this end, the signal generator provides several signal types with configurable frequency, amplitude, and period duration.

SQ3 TP 05 (Code 3324-05) Controller Mode

This optional package is used to connect another SQuadriga III or a HEAD*lab* module. SQuadriga III configures and records the signals from the connected device and also supplies power to a connected HEAD*lab* module and the sensors connected to it.

SQ3 TP 06 (Code 3324-06) Network Access

This optional package enables SQuadriga III to be operated remotely using a web interface. The web interface can be accessed and navigated using any web browser. In addition, SQ3 TP 06 provides network access to the internal memory of SQuadriga III in order to exchange files between SQuadriga III and your computer, e.g., via Windows Explorer.

SCOPE OF DELIVERY

- SQuadriga III (Code 3324)
  Handheld 8-channel recording and playback system with sound level meter function
- Power adapter 24 V, 60 W, LEMO 4-pin
- CUSB IV.1 (Code 5476-1)
  Cable USB-A to USB-C with side screw locking, 1 m
- CGA I.1 (Code 9856)
  Active GPS rod antenna
- 2x CSB VII.0 (Code 3350)
  Cable SMB ↔ BNC, Pulse in, 0.15 m
- DPF III (Code 9863)
  Screen Protector for SQuadriga III
- HSC V.3 (3333)
  Carrying Bag for SQuadriga III and accessories
- Manual

OPTIONAL ACCESSORIES

- Headphones with model-specific standard equalization
  - HD OP I.1 (Code 2511.1)
    Open dynamic headphones with high-performance transducer for excellent bass and treble playback
  - HD OP II.1 (Code 2512.1)
    Open headphones with vented magnet system for minimized distortion
  - HD CL I.1 (Code 2521.1)
    Closed headphones with bass reflex system for detailed reproduction, especially at low frequencies
  - HD CL II.1 (Code 2522.1)
    Closed headphones with detailed, powerful, and vibrant sound for a wide range of applications
- BHS II (Code 3322)
  Binaural Headset for aurally-accurate recording and playback
- HUSB III.64 (Code 3334-64)
  USB Stick for SQuadriga III, 64 GB, with a sequential read speed of up to 200 MB/s
- CLL XIV.1 (Code 3363-1)
  Adapter cable for connecting SQuadriga II
- CLO VIII.3 (Code 3364-3)
  Cable with cable lugs, e.g., for connecting a battery, 3 m
- CLL X.xx (Code 3780-xx)
  Connection cable between input module and controller; available lengths: 0.17 m, 0.26 m, 0.36 m, 0.5 m, 1 m, 1.5 m, 2.5 m, 5 m, 10 m, 20 m, 25 m, 30 m, 40 m, 50 m, 60 m
- *lab*MA-a (active)/labMA-p (passive) (Codes 3760 / 3761)
  HEAD*lab* mount adapters for mechanical connection to a HEAD*lab* controller or HEAD*lab* module
- CDO X.3 (Code 3786-3)
  Connection cable for OBD2 (CAN), 3 m
- CMD 0.12 (Code 3788)
  Cable adapter D-Sub ↔ 3 x D-Sub (CAN FD and FlexRay)
- CLX X.1 (Code 3797-1)
  Adapter cable AES/EBU for *lab*P2 or *lab*O2, 1 m
- CLB IV.1 (Code 9826)
  Cable Line Out for using the BHS channels as analog outputs
- CLB I.2 (Code 9847)
  Adapter cable (passive), BHS II ↔ Line/ICP input, connecting BHS II to channels 3 – 8 (LEMO ↔ BNC)
- CLB I.3 (Code 9848)
  Adapter 2*BNC ↔ LEMO for using the BHS channels as BNC inputs with ICP supply
- RC X.1 (Code 9850)
  Remote Control for starting and stopping recordings and activating real-time filters, USB including the optional RC X.2 wireless handheld transmitter (Code 9851)
- USB video camera (Code 0271)
  HD 720 (1280x720 px); auto focus: 10 cm to 10 m (3.9″ to 10.9 yd); 30 fps; available through HEAD acoustics
- CGA I.0 (Code 9855)
  Active GPS antenna with cable, 5 m
- CLJ I (Code 9858)
  Adapter cable LEMO ↔ 3.5 mm headphone jack for connecting headphones to the BHS connector

TECHNICAL DATA

General

Number of channels	14
Channels per connector BHS BNC Pulse In CAN - FlexRay GPS	 2 x analog (1 – 2) 6 x analog (3 – 8) 2 2 x CAN FD / 1 x FlexRay 1
Connectors on the front	Headphones (jack plug 3.5 mm), BHS (two-channel, LEMO 14-pin), BNC 3 – 8 (analog inputs), 2 x Pulse In (SMB)
Connectors on the back	Power (LEMO 4-pin), HEAD*link* (LEMO 8-pin), HEAD*link*+ (LEMO 8-pin), CAN FD/FlexRay (D-Sub 9-pin), 3 x USB hosts (type A), USB device (type C), RJ45 (LAN), GPS (SMA)
Resolution (audio)	24 bits
Supply voltage	10 – 30 V DC
Power consumption Charging (only 3324) Operation Standby	3324: max. 35 W 3324-V1: max. 30 W 18 W with the device switched off, battery charging with 1 A 7 W 6 W with the display switched 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 %) oder 4 mA (±25 %) for all channels with ICP supply together
Sampling rates	Main sampling rates: 32 kHz, 44.1 kHz, 48 kHz, 51.2 kHz, 65.536 kHz, 88.2 kHz, 96 kHz; sub-sampling rates: adjustable as ½, ¼, ⅛ of the main sampling rate HEAD*link* sampling rates: 44.1 kHz, 48 kHz, 51.2 kHz
TEDS Standard	Readout of sensor type, calibration, serial number IEEE 1451.4
Touchscreen Color depth Resolution Size Backlight	LCD, TFT, multi-touch capable 16.7 million colors WSVGA with 1024 x 600 pixels 7"/17.8 cm (155 x 92 mm) Manually adjustable, automatic dimming
Processor	Dual-core ARM Cortex-A9, 800 MHz
Storage capacity (internal)	64 GB in total, approx. 60 GB for recordings and configurations
Cooling	Convection, without fan
Battery (only 3324) Operating time Charging time with ext. power supply	Lithium-ion battery (14.8 V, 4000 mAh) 7 h in typical operation (battery supply, no HEAD*lab* module and no USB devices connected, stand-alone mode, dimmed display, 80% of the time in standby) max. 8 h (eight-channel recording without ICP supply, display in standby, no other functions) max. 8 h with device switched off, ambient temperature 25 °C
Charging process	CCCV, monitoring of temperature, end-of-charge voltage, charging time
Housing dimensions	194 x 42 x 155 mm (WxHxD; overall)
Weight	1.3 kg
Shock (EN 60068-2-27)	26 g (260 m/s^2), six axes
Vibration (EN 60068-2-6)	4.5 g (45 m/s^2), 5 Hz – 500 Hz
IP code	41

Operating temperature Stand-alone mode Frontend mode Charging (device off)	 -20 °C – +45 °C (typical operation) / -20 °C – +50 °C (min. operation) -20 °C – +40 °C (typical operation) / -20 °C – +50 °C (min. operation, forced ventilation) -20 °C – +50 °C
Storage temperature	-20 °C – +60 °C

BHS Input

Connector	LEMO 14-pin; Connection and recognition of the binaural BHS II headset for aurally-accurate recording and playback; BHS I not supported Using the CLB I.3 cable adapter, the two BHS channels can be used as BNC inputs.					
Input impedance	100 kΩ					
Equalization types	Recording: ID Playback: LIN (no equalization), ID, FF, DF					
Analog highpass filters	2 Hz or 36 Hz, switchable, 1st order, ±10%					
Measurement range (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)	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	Six BNC (channels 3 – 8); two additional inputs (channels 1 – 2) when connecting CLB I.3 to the BHS connector (for technical data, please refer to section BHS input)						
Frequency range	0 Hz – 20 kHz (DC capable)						
Input impedance	100 kΩ						
Analog highpass filters	2 Hz or 22 Hz, switchable, 1st order, ±10%						
Analog lowpass filter	80 kHz, 1st order						
Digital highpass filter	1 Hz (with f_S=48 kHz, proportional to f_S)						
Digital lowpass filter	23 kHz, higher order						
Measurement ranges (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 at 1 kHz, -1 dB_{fs}	-73 dB	-83 dB	-91 dB	-89 dB	-92 dB	-71 dB	
Crosstalk at 1 kHz	-100 dB	-100 dB	-100 dB	-100 dB	-100 dB	-100 dB	
Accuracy							
DC (% full scale)	±0.38	±0.25	±0.25	±0.2	±0.17	±0.15	
AC (% full scale)	0.11	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 (By Switching The Analog Inputs)

Connectors	Six BNC (channels 3 – 8); two additional outputs (channels 1 – 2) when connecting CLB IV.1 to 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	Supply of connected HEAD*lab* modules with a maximum of 10 W
Channels HEAD*lab* module SQuadriga III/SQuadriga II	 Max. 6 additional analog channels Max. 8 additional analog channels

HEAD*link* Connector

Connector	LEMO 8 pin
Supply input	Powered by HEAD*lab* controller (no charging) with a maximum of 12 W
Electrical isolation	Yes

Pulse-In Connector

Connector	SMB, two pulse inputs
Electrical isolation	Both pulse inputs together
Input impedance	36 kΩ
Input voltage	0 – +10 V (operation); ±50 V (absolute maximum), adjustable trigger threshold
Maximum pulse frequency	600 kHz at fs = 48 kHz; 1 MHz at fs = 96 kHz Recording at 32 times the main sampling rate

FlexRay

Connector	D-Sub 9 pin
Standard	FlexRay V2.1, Rev. B
Data rate	Bus rate 10 Mbit/s, recording with up to 1.5 Mbit/s at 48 kHz (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 6
Status LED	Green: 1 GB; yellow: 100 Mbit/s (transfer)
Data rate	10/100/1000 Mbit/s
Standard	IEEE 802.3ab
Electrical 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
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; exact time stamp in 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 Mbits/s)
Access as USB mass storage	Reading up to 15 Mbyte/s; writing up to 5 Mbyte/s

IN PRACTICE

Intuitive Operation

The complete range of SQuadriga III functions can be operated via the 7“ touchscreen (1024 x 600 pixels). Familiar gestures you use with your mobile phone on a daily basis can also be used here: tap to press buttons and start functions, and swipe to scroll through lists, such as the list of saved files or settings options. Using two fingers, you can zoom into analysis diagrams or adjust the video image.

During a measurement, all relevant information is shown on the display in real time, e.g., the levels of the active channel and tachometers or single values of parameters, such as pulses, GPS speed, FlexRay, or OBD variables. This allows you to track all aspects of a measurement, document the measurement, and subject the recorded signals to complex real-time analyses during the recording.

Two Operating Modes

The two operating modes enable flexible use in a wide range of recording situations. The powerful battery, convenient handling, intuitive gesture control, and a large internal memory enable several hours of independent stand-alone mode. This way, you are completely independent in many measurement situations.

Recordings are stored in the internal memory of SQuadriga III or on a connected USB stick. This is even possible with a HEAD*lab* module connected.

For frontend operation, e.g., in a test bench, you connect SQuadriga III to the measurement computer via USB or LAN and control the recording via the Recorder of ArtemiS SUITE (APR 040 – Recorder). The recordings are stored on the computer.

HEAD*link* and HEAD*link*+

The two HEAD*link* and HEAD*link*+ interfaces on the back enable you to integrate SQuadriga III into a HEAD*lab* system, add another SQuadriga III, or connect an artificial head measurement system.

To integrate SQuadriga III into a HEAD*lab* system, the HEAD*link* interface of the device is connected to a HEAD*lab* controller. SQuadriga III then operates like a HEAD*lab* module and transmits the signals from six of the eight selectable analog channels to the controller.

In both operating modes, the HEAD*link*+ interface can be used to connect a compatible HEAD*lab* module, a second SQuadriga III, or an HMS V artificial head. SQuadriga III will then control the configuration of the channels of the connected device and save the data in its internal memory, on a connected USB stick, or transmit them to the computer in frontend mode. A connected HEAD*lab* module as well as the sensors connected to it are also supplied with power by SQuadriga III.

When connecting another SQuadriga III, one of the two devices serves as a controller, recording the channels of the other device. The other SQuadriga III serves as a module, transmitting the signals of the eight analog channels (BHS connector and BNC connectors) to the controlling SQuadriga III.

Artificial heads such as HMS V are connected to the HEAD*link*+ interface. This connection is used to transmit the audio data.

SQuadriga III connected to a labCTRL II.1 HEADlab controller via the HEADlink interface

labVF6 II HEADlab module connected to the HEADlink+ interface of SQuadriga III via HEADlink

Power Supply

The power connector for electrically isolated power supply on the back of SQuadriga III provides a wide range input (10 – 30 V DC) that can be connected to the power adapter supplied or a Power Box (labPWR I.1/labPWR I.2/ *lab*PWR I.3). Using the CLO VIII.3 cable adapter (Code 3364-3), SQuadriga III can also be supplied via the on-board power supply of a vehicle.

Even with SQuadriga III being switched off, a connected external power supply is used to fully charge the internal battery.

SQuadriga III informs you about the battery charge status of a connected Power Box and also whether it is being charged via its own power supply.

Power supply using a labPWR I.1 Power Box

BHS II Binaural Headset

The calibratable BHS II headset is the ideal complement to SQuadriga III for quick and easy binaural recordings.

With its BHS connector, SQuadriga III features a two-channel input that is specially designed for BHS II and automatically configured and equalized for both recording and playback.

Its light weight and high level of comfort make BHS II easy to wear for long periods of time. Its earpieces and headband perfectly adapt to the shape of your head.

When connecting BHS II to the BHS connector, SQuadriga III automatically configures the relevant channels and activates the appropriate equalization filter. After that, you can start recording immediately. SQuadriga III and BHS II are a perfectly matched combination for performing binaural recordings very easily and playing them back with BHS II.

BHS II Binaural Headset connected to the BHS connector

Binaural Recording and Playback

SQuadriga III continues the established HEAD acoustics technology of aurally-accurate 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 BHS II binaural headset. You can also connect a maximum of three other binaural recording systems, such as BHM III.3 Mobile HEAD Microphone or HSU III.2 Artificial Head Microphone.

You can start playback of the most recent recording directly in the Recorder view and listen to it using a connected BHS II. The same applies to recordings stored in the internal memory, which can be played back just as easily from the file system view.

SQuadriga III also ensures aurally-accurate playback of recordings made with another of our recording systems such as SQobold.

Why Binaural?

Unlike stereo recordings made with conventional microphones, binaural recordings not only contain the original timbre and volume but also the full spatial imaging of the sound field.

When playing back the recording using the BHS II headset or another of our playback devices, such as *lab*P2 with headphones, the spatial imaging is precisely reproduced. This gives you the impression of hearing the original sound field, because your hearing can select and locate the various sound sources just as it would in the original sound field.

Comparability

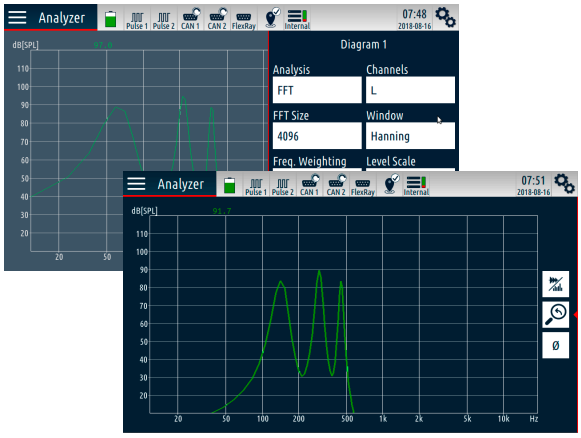
To ensure that binaural and conventional recordings are comparable and can be analyzed together, SQuadriga III uses ID equalization (**I**ndependent of **D**irection) for recordings with BHS II.

ID equalization was developed by HEAD acoustics and is suitable for sound fields that occur frequently in practice. Equalization, such as Free Field or Diffuse Field equalization, is intended for sound fields with precisely designed framework conditions such as those that may occur under laboratory conditions. In these situations, BHS II is usually not used as a binaural sensor.

Information on the equalization used and the recorded measurement range are stored in the recording file. The HEAD acoustics playback systems evaluate this information, automatically configure themselves accordingly, and thus ensure correctly equalized and level-accurate playback.

Analyzing Recordings

In addition to conventional analysis methods, such as FFT or octave analyses, psychoacoustic analyses, such as loudness and sharpness, are also available. Psychoacoustics takes into account that sound events are perceived differently by humans than by a measurement instrument. Psychoacoustic analyses allow for precise and standardized descriptions of the human auditory sensation of sound events. The selected analysis can be configured with regard to the FFT size, the window function (Hanning, rectangle, flat-top), the frequency weighting, and the level scale.



With SQuadriga III, you can use analyses during recording, playback, and monitoring to identify distinctive elements in a sound or in a sound scenario and find approaches for improving the sound quality.

Right from the monitoring of analyzed channels, you can suppress or emphasize signal components using a filter, and easily adjust the frequency, quality, and gain of the filter using sliders. You can listen to both the unfiltered and the filtered signal and also display the filtered signal in the diagram.

The Real-Time Filtering of ArtemiS SUITE (APR 110 – Playback Filters) enables you to identify and filter noise components in a sound even during recording, thus providing you with an early starting point for even more targeted analysis. Here, too, you can change the quality, frequency, and damping of the real-time filtering in ArtemiS SUITE and listen to the optimized signal in real time via SQuadriga III using headphones. At the same time, the original sound is recorded unaltered and is available for further

analysis.

Analyzing During Recording

During recording, all Analyzer functions are available to analyze incoming signals in real time. To do this, you activate the Analyzer via a button in the Recorder while recording is in progress, select up to four channels, and configure the analysis as usual. The analysis result is displayed in a diagram that provides the same configuration options as the diagram in the Analyzer.

Analyzing During Playback

FFT and octave analyses, as well as psychoacoustic analyses, are also available for analysis during playback. These analyses can be selected and configured during playback, enabling you to individually analyze the recordings stored on your device.

During playback, the signals of the channels being played back are analyzed, and the results are displayed in a diagram. Meanwhile, you may replace and reconfigure the analysis used, adjust the level, fast-forward or rewind, and limit the playback range at any time.

Video Function (Optional Package)

Using a connected USB video camera, you can record a video with a resolution of up to 1280x720 pixels and up to 30 fps as an AVI file (MJPEG format) while recording the sound event.

The video image can also be displayed in real time during recording. If a video file is available for a recording stored on SQuadriga III, it will be played back on the display during playback.

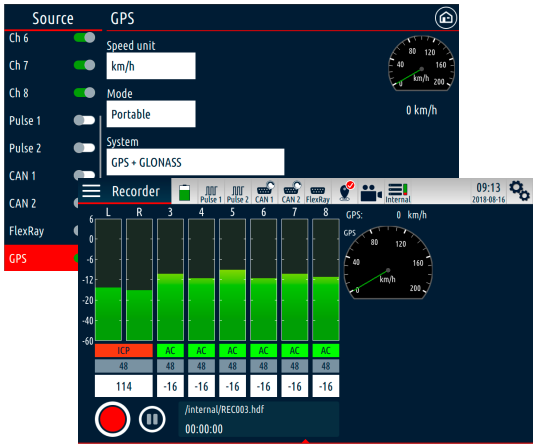
You also have the option of taking single frames with the video camera before or during the recording in order to separately document the exact positions of the sensors or special situations during a measurement.

Satellite-Based Position Tracking

SQuadriga III supports the GPS, GLONASS, BeiDou, and Galileo satellite navigation systems and, in addition to precise location determination, also enables the determination of other parameters, such as speed and altitude.

The GPS data is recorded and shown on the display in real time. You can use the recorded GPS data, for example, to display the distance covered during the measurement on a map in ArtemiS SUITE.

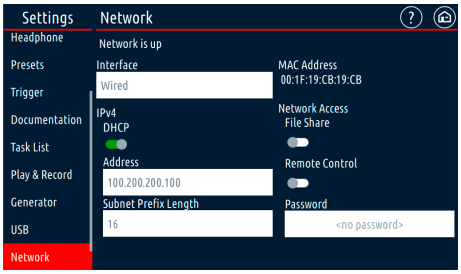
Using the PPS signal, temporally overlapping recordings of several spatially separated SQuadriga III devices can be subsequently synchronized. To this end, use the “Merge Recordings” function of HEAD Companion or the “File Merge” function of ArtemiS SUITE (APR 200 – HDF Tools). GPS values can be used as triggers to



start or stop a recording when a certain GPS speed is reached, for example.

SQuadriga III in a Network

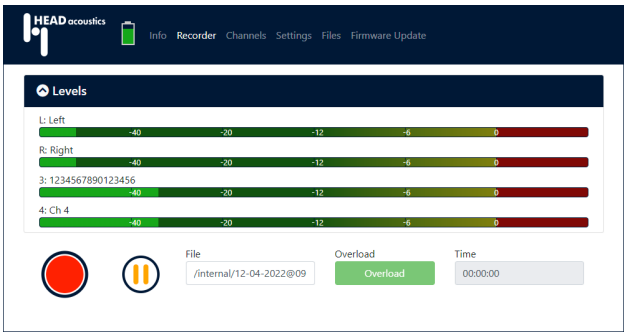
When connecting SQuadriga III to a network, you can use SQuadriga III for recording or playback from any computer in the same network via the Recorder of ArtemiS SUITE (APR 040 – Recorder). It is just as easy to perform playback on SQuadriga III via the Player of ArtemiS SUITE or to use HEAD Companion to install a new firmware version via the network, for example. The LAN port on the back of SQuadriga III can be used to connect to a network. The network connection is configured either manually on SQuadriga III or via a DHCP server in the network.



Web Interface and Network Access

The optional package SQ3 TP 06 *Network Access* (Code 3324-06) provides remote control of some SQuadriga III functions via a web browser, enabling you to configure channels, start and stop recordings, manage device configurations, manage devices, configure triggers, and edit user documentation, for example.

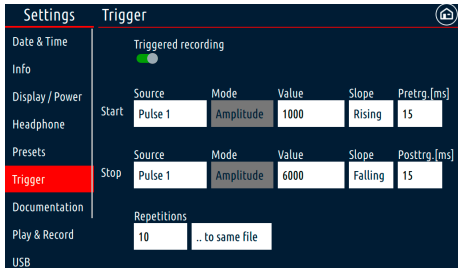
The optional package also provides access to the internal memory via LAN. This enables you to manage the files and directories in the internal memory of SQuadriga III from a computer in the network, using the familiar Windows Explorer functions, for example.



Triggers

Use the incoming signals of the Pulse, GPS, CAN, FlexRay, and audio channels or a time as triggers to start or stop recordings.

A trigger may respond to a rising or falling signal edge and record signals that were present before (pretrigger) or after (posttrigger) the start or stop threshold was reached.

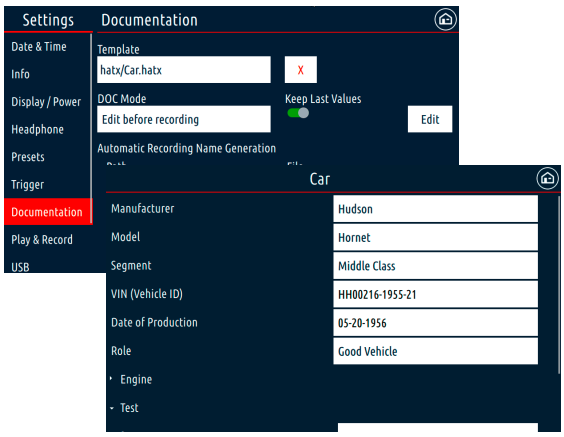


User Documentation

Efficient handling of large numbers of recordings requires access to descriptive information. With its documentation function, SQuadriga III provides a very easy-to-use solution for describing every recording.

You can use documentation templates created in ArtemiS SUITE and then transferred to SQuadriga III to determine which information is stored for a recording. This may include type or model details, a description of a vehicle configuration, or information on external conditions. Many familiar form elements, such as input fields, selection fields, and lists, help to keep the documentation of a measurement simple.

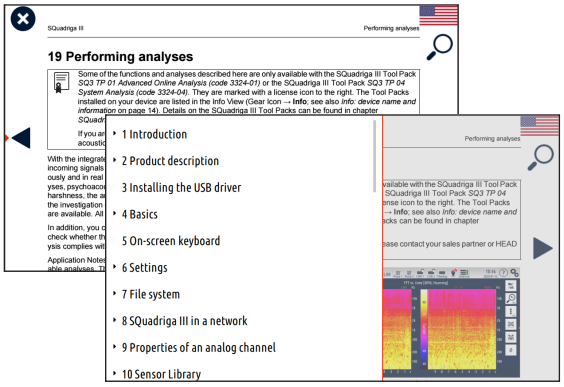
If no documentation is available for an existing recording, you



can subsequently assign a documentation template and add documentation afterwards.

Context-Sensitive Online Help

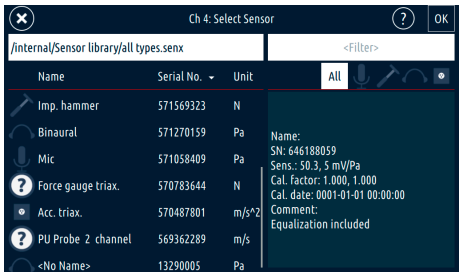
The comprehensive, context-sensitive online help provides information on the function of dialogs and detailed help on how to operate SQuadriga III. It is available in German and English on the device, and users can easily switch between the two languages. The online help is always available via a button and always opens the section that describes the current view. In addition, the interactive table of contents and the search function provide easy access to all help topics.



Sensor Library

Sensor Libraries for managing your sensors with ArtemiS SUITE can also be used on SQuadriga III. Simply transfer the Sensor Library to the internal memory of SQuadriga III and assign the fully configured sensors stored in it to the channels during channel configuration.

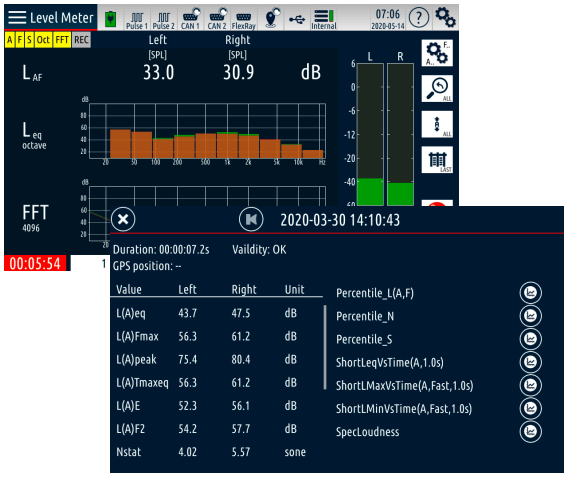
Details, such as sensor type, sensitivity, calibration date, and factors, as well as the equalization filters stored in the Sensor Library, are automatically used in the respective channel. This information is also stored in the recording and will be made available later via the Channel Editor for post-processing and analysis in ArtemiS SUITE.



Sound Level Meter Function (Optional Package)

The optional package SQ3 TP 02 *Level Meter* (Code 3324-02) activates the sound level meter function, enabling you to determine sound pressure levels and quantify sounds in order to provide a sound evaluation of ambient noise or noise at the workplace, for example. The measurable physical and psychoacoustic quantities include momentary, maximum, and peak sound pressure levels, sound pressure levels parsed into third-octave or octave spectra, as well as loudness and sharpness, each with up to three percentile values.

Several measured levels from up to four channels can be monitored simultaneously via the display during the measurement and stored as single values for later evaluation. You also have the option of recording the measurements and displaying them later in diagrams over time. In addition, you can record the time signal to play it back at a later date. Using a connected video camera (with the optional package SQ3 TP 03 *Video Support*, Code 3324-03), you can display a video preview, record the video image in parallel to the time signal, and record and store the measurement situation as a single frame.



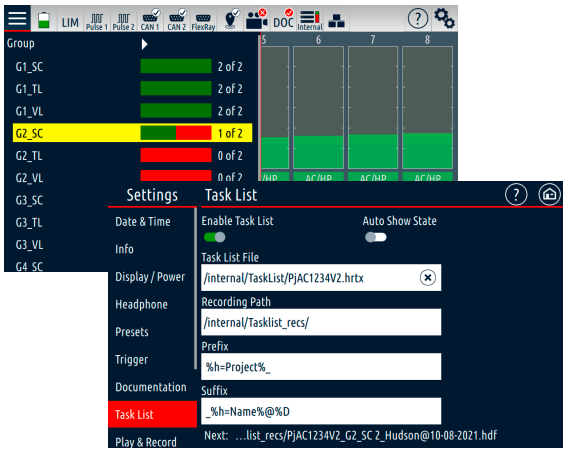
USB Audio Devices

USB audio devices, such as BSU and SQope, enable very straightforward binaural recordings. USB audio devices are connected to one of the USB host ports on the back. Once you have connected a USB audio device, you can record both audio channels of the USB audio device with SQuadriga III and examine the signals using the sound level meter function or the Analyzer, for example. You also have the option of recording the GPS signal from SQuadriga III and the signal from a video camera connected to SQuadriga III. The analog channels of SQuadriga III are being deactivated. The recordings are stored on SQuadriga III and can be transferred from there to a computer and then analyzed with ArtemiS SUITE, for example.

Task Lists

Task Lists can be used to configure and perform defined sequences of measurements that are to be generated. This is particularly useful in performing a series of measurements, e.g., as part of standardized tests for quality assurance using the Standardized Test Project of ArtemiS SUITE (APR 220 – Standardized Test Project). Task Lists may be configured in ArtemiS SUITE via a Standardized Test Project or via the Recorder Task List, saved as HRTX files, and transferred to SQuadriga III.

Once you have activated and started a Task List, SQuadriga III will automatically perform the measurements in the specified order. To check the measurements, you can play back each measurement and discard it if required. The processing status of the Task List is displayed in a flyout and updated after each accepted measurement. The configured measurements of a Task List may include trigger conditions that can be used to start and stop recordings automatically.



HEAD acoustics

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