



Code 3324

SQuadriga III

Mobile Recording and Playback System With Sound Level Meter Functionality

OVERVIEW

SQuadriga III

Code 3324

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

SQuadriga III is a compact and powerful recording and playback system featuring integrated sound level meter functionality. It provides a wide range of connectivity options, comprehensive functions, high mobility, and flexible application possibilities. SQuadriga III operates noiselessly and is ready for use within seconds after being switched on.

In stand-alone mode, recordings are stored on the internal storage or on a connected USB flash drive, whereas in frontend mode they are stored on the computer connected via USB or LAN. Operation is performed via the touchscreen, the Recorder of ArtemiS SUITE (APR 040 – Recorder), or the web interface (SQ3 TP 06 – Network Access option package, Code 3324-06).

Supported sensors are connected directly to the corresponding connectors. These include, among others, IEPE/ICP microphones, IEPE/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 HEADlab modules.

Channel and sensor settings can be configured directly on the device, stored on SQuadriga III, and reused at any time. Settings that were configured, for example with SQuadriga III Simulator, can be transferred to and used on SQuadriga III.

Thanks to its high-performance battery, SQuadriga III can be operated for several hours without the need for an external power supply. In addition, it can also supply power to a connected HEADlab module.

As an alternative, SQuadriga III-V1 (Code 3324-V1) is available as a battery-less variant that can be used in situations where the use of a battery-powered device is not feasible.

KEY FEATURES

Two application modes: stand-alone and frontend mode

Multi-hour autonomous measurements in battery operation, or power supply and battery charging via the power adapter or a supply module

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 functionality for up to four channels

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

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

Connection of a HEADlab module or integration into a HEADlab system

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

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

Option 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 storage 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
- › Power supply for connected sensors (IEPE/ICP)
- › Power supply and battery charging via the supplied power adapter or a supply module (*labPWR I.1* / *labPWR I.2* / *labPWR I.3*)
- › Power supply to a connected HEADlab 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 units at the BNC inputs 3–8
 - » HSU III.2 equipped with the move°S upgrade for motorized head rotation
- › The optional SQ3 TP 05 – Controller Mode firmware package (Code 3324-05) enables the recording of additional binaural sensors via a connected HEADlab module

Playback via Headphones

- › 3.5 mm headphone socket at the front to connect compatible headphones, such as 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 Functionality

- › Using the SQ3 TP 02 Level Meter option package (Code 3324-02)
- › 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
- › 3rd Octave, Octave, and FFT Spectra
- › Loudness (ISO 532-1, DIN 45631/A1):
- › Sharpness (DIN 45692): momentary, maximum, percentile, and stationary sharpness
- › Percentiles (exceedance level)

HEADlink

- › Connection to a HEADlab controller
- › Integration of six analog channels of SQuadriga III in a HEADlab system
- › Electrical isolation between the HEADlab system and SQuadriga III
- › Connection to a second SQuadriga III that takes on the role of a controller

HEADlink+

- › Connection to a second SQuadriga III that takes on the role of a module
- › Connection and power supply of compatible HEADlab modules
- › Electrical isolation between the HEADlab 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 multiple supported bus systems using the CMD 0.12 adapter (optional accessory)
- › Optional recording of the decoded signals in separate channels

Pulses

- › 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 gain or clean signals
- › High sensitivity
- › Adjustable trigger thresholds

Triggers

- › 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 performed with SQuadriga III or SQobold
- › Support of the GPS, Galileo, BeiDou, GLONASS satellite navigation systems
- › Combined use of multiple 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

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



HD CL I.1

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



HD OP II.1



HD CL II.1

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. With a main sampling rate of 48 kHz, a maximum pulse frequency of 600 kHz is available; at 96 kHz, a maximum of 1 MHz is available.



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 comes with its own A/D and D/A converters, switchable high-pass 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 IEPE/ICP supply for sensors with BNC connectors, such as the BHM III.3 headset microphone and the HSU III.2 artificial head microphone. The two channels can also operate as analog outputs. Using the CLU I cable adapter enables the connection of an additional pair of headphones.

Analog Inputs (3–8)



Analog In with ICP



Analog Out



BHM III.3



HSU III.2



CLB I.2

The six BNC inputs, supporting both AC and DC coupling, can be used as analog inputs or as inputs with selectable sensor supply (IEPE/ICP). Each input provides 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 IEPE/ICP sensors.

CONNECTORS ON THE BACK

HEADlink



Using this connector enables you to connect SQadriga III to a HEADlab controller and integrate it into a HEADlab system. SQadriga III then operates like a HEADlab module.

You also have the option of connecting an additional SQadriga III which will then function as a controller, configuring and recording the sensors connected to both SQadriga III devices.

HEADlink+



This connector enables you to connect a HEADlab module (the SQ3 TP 05 option package is required) and supply it with power via SQadriga III.

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

The channels of the device connected to the HEADlink+ port are configured and recorded by SQadriga III.

CAN – FlexRay



This port enables a connection to the CAN FD and FlexRay automotive fieldbuses. There are two channels for CAN, CAN FD, and OBD as well as one FlexRay channel.

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

Power



Use this port to connect the power adapter or a compatible supply module (labPWR I.x).

Using the cable CLO VIII.3 (Code 3364-3), SQadriga III can also be supplied with power from a vehicle on-board power supply.

GPS



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

USB Host (Type-A)



Three connectors are available for USB devices, including the video camera (Code 0271), a USB storage medium, 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 USB audio devices are supplied with power via the USB port. The channels of the USB audio device are recorded in addition to the other channels of SQadriga III.

USB (Type-C)



The connection to a computer with our USB driver installed is established through this screw-lock connector. This connection enables frontend mode for recordings on the computer using the Recorder of ArtemiS SUITE (APR 040 – Recorder).

You can also use this connection to operate SQadriga III as a mass-storage device and download recordings from the internal storage or transfer files, e.g., Sensor Libraries, Documentation Templates, or configuration settings.

LAN



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

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



HARDWARE COMPATIBILITY

HEADlab Controllers

3702	labCTRL I.2	✓	No longer available
3704	labCTRL II.1	✓	

HEADlab Modules

3710	labHSU	✓	
3724	labM6	✓	Version B, Revision 02 or later no longer available
3725	labCF6	✓	
3726	labT6	✓	
3727	labSG6	✓	Revision 03 or later
3728	labV6HD	✓	
3752	labVF6 II	✓	
3754	labM6 II	✓	
3757	labVF6-Iso II	✓	

Artificial Head Measurement Systems

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

Artificial Head Microphones

1391	HSU III.2	✓	move°S upgrade included
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Binaural Sensors

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

Power Supply

3711	labPWR I.1	✓	
3712	labPWR I.2	✓	
3713	labPWR 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	✓	USB storage medium

Remote Controls

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

Mount Adapters

3760	labMA-a	✓	
3761	labMA-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, Third-Octave*, and *Level vs. Time* analyses, as well as the file management in the internal storage.

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

This option 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*.

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

This option 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.

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

This option package adds the video functionality, enabling you to use the USB video camera (Code 0271), which is available as an optional accessory, to document your measurement situation in video or single frame. When playing back the audio recording on SQuadriga III or in ArtemiS SUITE, the video recorded in parallel is played back in the Player or in the Video Viewer of ArtemiS SUITE. This enables you to recapitulate 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 option package includes system analyses such as *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 option package is used to connect an additional SQuadriga III or a HEADlab module. SQuadriga III configures and records the signals from the connected device and also supplies power to a connected HEADlab module and the sensors connected to it.

SQ3 TP 06 (Code 3324-06) Network Access

This option 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 storage 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 frontend recording and playback system with sound level meter function
- › Power adapter 24 V, 60 W, LEMO 4-pin
- › CUSB IV.1 (Code 5476)
cable USB-A to USB-C with screw connection, 2 m
- › CGA I.1 (Code 9856)
Active GPS rod antenna
- › 2 x CSB VII.0 (Code 3350)
Cable SMB ↔ BNC, Pulse input, 0.15 m
- › DPF III (Code 9863)
Display protection film
- › HSC V.3 (Code 3333)
Carrying case for SQuadriga III and its accessories
- › Manual

OPTIONAL ACCESSORIES

- › Headphones with a model-specific standard equalization
 - » HD OP I.1 (Code 2511.1)
Premium open-back headphones Natural, precise sound with good spatial sound characteristics
 - » HD OP II.1 (Code 2512.1)
High-end open-back headphones Particularly accurate reproduction with vivid timbre
 - » HD CL I.1 (Code 2521.1)
Premium closed-back headphones Balanced timbre with a particularly neutral voice reproduction.
 - » HD CL II.1 (Code 2522.1)
High-end closed-back headphones Very clear analytic timbre with a high level of detail
- › BHS II (Code 3322)
Binaural headset for aurally-accurate recording and playback
- › HUSB III.64 (Code 3334)
USB storage device with 64 GB and a sequential read speed of up to 200 MB/s
- › CLL XIV.1 (Code 3363-1)
Adapter cable for connecting to SQuadriga II
- › CLO VIII.3 (Code 3364-3)
Cable with cable lugs for connecting to a battery, for example
- › CLL X.xx (Code 3780-xx);
Connection cable between the input module and the 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
- › labMA-a (active) / labMA-p (passive)
Mount adapters for mechanical connection to a HEADlab controller or HEADlab module
- › CDO X.3 (Code 3786-3)
OBD2 connection cable, 3 m
- › CMD 0.12 (Code 3788)
D-Sub cable adapter ↔ 3 x D-Sub (CAN FD and FlexRay)
- › CLX X.1 (Code 3797-1)
AES/EBU adapter cable for labP2 or labO2, 1 m
- › CLB IV.1 (Code 9826)
Line-out cable 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 x BNC ↔ LEMO for using the BHS channels as BNC inputs with sensor supply voltage (IEPE/ICP)
- › RC X.1 (Code 9850)
Remote control for starting and stopping recordings and activating real-time filters, USB, with optional RC X.2 wireless module (Code 9851)
- › USB video camera (Code 0271, available through us);
HD 720 resolution, 30 fps frame rate, autofocus 0.1 m to 10 m, with tripod mount
- › CGA I.0 (Code 9855)
Active GPS antenna with cable
- › CLJ I (Code 9858)
Adapter cable LEMO ↔ 3.5 mm headphone jack for connecting headphones to the BHS connector

TECHNICAL DATA

GENERAL INFORMATION

Data acquisition / data generation connections	6 x voltage / IEPE / ICP-In, BHS connector (2-channel), 2 x Pulse-In, 2 x CAN (CAN / CAN FD / OBD-2), 1 x FlexRay, 1 x GPS
Communication interfaces	1 x HEADlink, 1 x HEADlink+, 1 x USB device, 3 x USB host, 1 x LAN
Connection via adapter/adapter cable	2 x Analog-In (BNC) with CLB I.3 adapter on the BHS connector, e.g., for HSU III. 2 / BHM III.3
Supply connection	LEMO 4-pin, HEADlink (input), HEADlink+ (output)
Supply voltage	10 V _{DC} –30 V _{DC}
Reverse polarity protection	Yes
Max. power consumption Operation, device only With connected sensors Standby	10 W 12 W 6 W
System sampling rates	32 kHz, 44.1 kHz, 48 kHz, 51.2 kHz, 65.536 kHz (2 ⁿ)/88.2 kHz, 96 kHz
Sampling rates (min.–max.) At 32 kHz At 44.1 kHz At 48 kHz At 51.2 kHz At 65.536 kHz At 88.2 kHz At 96 kHz	4 kHz–32 kHz 5.5125 kHz–44.1 kHz 6 kHz–48 kHz 6.4 kHz–51.2 kHz 8.192 kHz–65.536 kHz 11.025 kHz–88.2 kHz 12 kHz–96 kHz
Max. sampling rate	96 kHz
Synchronization	Internal; external via HEADlink; or external via AES
Cooling	Convection, without fan
Temperature Operation Operation in stand-alone mode Operation in frontend mode Charging (device powered off) Storage	-20 °C–+50 °C (-4 °F–+122 °F) -20 °C–+50 °C (-4 °F–+122 °F) -20 °C–+50 °C (-4 °F–+122 °F) -20 °C–+50 °C (-4 °F–+122 °F) -20 °C–+60 °C (-4 °F–+140 °F)
Relative humidity	0%–90%, non-condensing
Minimum ambient pressure	Corresponds to the static atmospheric pressure at max. 2000 m above sea level
Sound level meter according to EN 61672	In frontend operation, validation of the measurement chain in accordance with IEC 61672 Class 1 is possible
Shock according to EN 60068-2-27	Sawtooth, 26 g (260 m/s ²), 11 ms, 18 shocks (3 in each direction of the X, Y, and Z axes)
Vibration according to EN 60068-2-6	Sine, 4.5 g (45 m/s ²), 10 Hz–500 Hz
Housing dimensions	194 mm x 42 mm x 155 mm
Weight	1300 g
Tripod thread	1/4"

Processor	ARM Cortex A9, Dual Core 800 MHz
Storage capacity	64 GB internal storage, approx. 60 GB of which for recordings and configurations

Battery

Max. power consumption Including charging Charging only	35 W 18 W
Seamless switching between external power and battery operation	Yes
Type	Li-Ion
Capacity	4 Ah
Voltage	14.8 V
Energy	59.2 Wh
Operating time	7 h
Discharge duration resulting from self-discharge	200 days
Charging time Device powered off Device powered on	Max. 8 h at an ambient temperature of +25 °C (+77 °F) Typ. 10 h in minimal-operation mode
Charging cycles	500
Charge-level indicator On the device Via software monitoring	Yes, via display Yes, in 1% increments

Display

Display	LCD, TFT
Touch capable	Multi-touch, capacitive
Display resolution	WSVGA with 1024 x 600 pixels
Display size	7" / 17.8 cm (155 mm x 92 mm)
Display color depth	16.7 million colors
Display backlight	Manually adjustable, automatic dimming

COMMUNICATION INTERFACES

USB Host

Plug connector	3 x USB-A
Number of interfaces	3
USB specification	USB 2.0
Data rate (gross)	480 Mbit/s
Output voltage	5 V _{DC}
Total output current	1.2 A
Output current per interface	0.5 A
Max. output power	6 W
Electrical isolation	No

USB Device

Plug connector	1 x USB-C with screw connection
Number of interfaces	1
USB specification	USB 2.0
Data rate (gross)	480 Mbit/s
Electrical isolation	No
Max. USB mass-storage read rate	7 MB/s
Max. USB mass-storage write rate	3 MB/s

LAN

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

HEADlink

Plug connector	1 x LEMO 8-pin
Number of interfaces	1
Supply voltage	18 V _{DC} –28 V _{DC}
HEADlink version	HEADlink 1.0
Electrical isolation	Yes
Synchronization	44.1 kHz / 48 kHz / 51.2 kHz
Maximum cable length	60 m

HEADlink+

Plug connector	1 x LEMO 8-pin
Number of interfaces	1
Output voltage	13 V _{DC} –24 V _{DC}
Max. output power	10 W
Standard	HEADlink 1.0, AES (via CLX X cable)
Electrical isolation	No
Synchronization	44.1 kHz / 48 kHz / 51.2 kHz

ANALOG INPUTS

Voltage/IEPE/IEPE/ICP

Plug connector	6 x BNC					
Number of channels	6					
Measured quantity	Voltage					
Measurement ranges	0.0448 V _p , 0.142 V _p , 0.448 V _p , 1.42 V _p , 4.48 V _p , 14.2 V _p					
Measurement ranges	-36 dB(V), -26 dB(V), -16 dB(V), -6 dB(V), 4 dB(V), 14 dB(V)					
Input impedance	100 kΩ					
Coupling	DC, AC, IEPE/ICP					
Analog high-pass filter	2 Hz or 22 Hz, switchable, 1st order, ±10%					
Analog low-pass filter	80 kHz, 1st order					
Digital high-pass filter @f _s =48 kHz, proportional to f _s	1 Hz					
Digital low-pass filter @f _s =48 kHz, proportional to f _s	23 kHz					
Resolution	24 bit (Delta-Sigma AD converter)					
Equalization recording	LIN, ID, FF, DF					
Electrical isolation Input/output Channel by channel	Yes No					
Electric strength	±30 V					
IEPE/ICP voltage	23 V					
IEPE/ICP current	Optionally 2 mA (-10% / +25%) or 4 mA (±25%)					
TEDS (IEEE 1451.4) read	TEDS Class 1, shared return wire (versions 0.9 and 1.0)					
Measurement ranges in V _p	0.0448 V _p	0.142 V _p	0.448 V _p	1.42 V _p	4.48 V _p	14.2 V _p
Measurement ranges in dB(V)	-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)
Crosstalk at 1 kHz	-100 dB	-100 dB	-100 dB	-100 dB	-100 dB	-100 dB
THD+N	-73 dB	-83 dB	-91 dB	-89 dB	-92 dB	-71 dB
DC accuracy	0.38%	0.25%	0.25%	0.2%	0.17%	0.15%
AC accuracy at 1 kHz	1.1%	0.55%	0.55%	0.73%	0.73%	0.73%
Accuracy for frequencies 20 Hz..20 kHz @f _s =48 kHz re 1 kHz	+0.0 dB -0.22 dB	+0.0 dB -0.22 dB	+0.0 dB -0.22 dB	+0.0 dB -0.22 dB	+0.0 dB -0.28 dB	+0.0 dB -0.28 dB

BHS

Plug connector	1 x LEMO 14-pin
Number of channels	2
Measured quantity	Voltage
Measurement ranges	-29 dB(V), -19 dB(V), -9 dB(V), 1 dB(V), 11 dB(V)
Input impedance	100 kΩ
Coupling	DC, AC, ICP
Analog high-pass filter	2 Hz or 36 Hz, switchable, 1st order, ±10%
Analog low-pass filter	80 kHz, 1st order
Digital high-pass filter @f _s =48 kHz, proportional to f _s	1 Hz

Digital low-pass filter @ $f_s=48$ kHz, proportional to f_s	23 kHz, of higher order				
Resolution	24 bit (Delta-Sigma AD converter)				
Equalization	ID				
Electric strength	± 30 V				
Electrical isolation Input/output Channel by channel	Yes No				
IEPE/ICP voltage	23 V				
IEPE/ICP current	Optionally 2 mA (-10% / +25%) or 4 mA ($\pm 25\%$)				
TEDS (IEEE 1451.4) read	TEDS Class 1, shared return wire (versions 0.9 and 1.0)				
Measurement ranges	-29 dB(V)	-19 dB(V)	-9 dB(V)	1 dB(V)	11 dB(V)
S/N	95 dB(A)	100 dB(A)	101 dB(A)	98 dB(A)	100 dB(A)
S/N	93 dB	98 dB	99 dB	96 dB	98 dB
Crosstalk at 1 kHz	-100 dB	-100 dB	-100 dB	-100 dB	-100 dB
DC accuracy	0.3%	0.25%	0.17%	0.16%	0.16%
AC accuracy at 1 kHz	0.53%	0.59%	0.5%	0.59%	0.5%
Accuracy for frequencies 20 Hz..20 kHz @ $f_s=48$ kHz re 1 kHz	+0.0 dB -0.24 dB	+0.0 dB -0.24 dB	+0.0 dB -0.24 dB	+0.0 dB -0.3 dB	+0.0 dB -0.29 dB

ANALOG OUTPUTS

Voltage

Plug connector	6 x BNC (2 more when using CLB I.3 on the BHS connector)
Number of channels	6
Voltage range	$0.89 V_p$
Output impedance	250Ω
DC capable	No
Frequency range	20 Hz–20 kHz
Electrical isolation Input/output Channel by channel	Yes No
Resolution	24 bit (Delta-Sigma DA converter)
Equalization	No
Maximum voltage	$0.89 V_p$
Maximum level	-4 dB(V)
Digital low-pass filter @ $f_s=48$ kHz, proportional to f_s	24 kHz

BHS

Plug connector	LEMO 14-pin
Number of channels	2
Output impedance	1.5Ω
DC capable	No
Frequency range	20 Hz–20 kHz

S/N	87 dB
THD+N	-57 dB
Crosstalk at 1 kHz	-100 dB
Electrical isolation Input/output Channel by channel	Yes No
Resolution	24 bit (Delta-Sigma DA converter)
Equalization	LIN, FF, ID, DF
Nominal level	110 dB(SPL)
Digital low-pass filter @ $f_s=48$ kHz, proportional to f_s	24 kHz

Headphones

Plug connector	1 x jack 3.5 mm
Number of channels	2
Output impedance	1.5 Ω
DC capable	No
Frequency range	20 Hz–20 kHz
S/N	85 dB(A)
THD+N	-73 dB
Crosstalk at 1 kHz	-64 dB
Electrical isolation Input/output Channel by channel	Yes No
Resolution	24 bit (Delta-Sigma DA converter)
Equalization	LIN, FF, ID, DF
Maximum voltage	4.5 V _p
Digital low-pass filter @ $f_s=48$ kHz, proportional to f_s	24 kHz

DIGITAL INPUTS/OUTPUTS

Pulse

Plug connector	2 x SMB
Number of channels	2
Maximum pulse frequency	1000 kHz
Threshold value digitally adjustable	Yes
Hysteresis digitally adjustable	Yes
Resolution of threshold value/hysteresis	40 mV
Input impedance	36 k Ω
Input voltage range	0 V – 10 V
Electric strength	± 50 V
Electrical isolation Channel by channel	Yes No

CAN FD

Plug connector	1 x D-Sub 9-pin
Number of interfaces	2
Data rate (gross)	5 Mbit/s
Electrical isolation Channel by channel	Yes No
Identifier	11 Bit (CAN 2.0A) and 29 Bit (CAN 2.0B)
Standards	ISO 11898-2; ISO 15765-4
Termination	120 Ω , switchable
Electric strength	± 35 V

FlexRay

Plug connector	1 x D-Sub 9-pin
Number of interfaces	1
Data rate (gross)	1.1 Mbit/s
Electrical isolation Channel by channel	Yes No
Termination	None
Standard	FlexRay V2.1 Rev. B
Electric strength	± 60 V

Satellite Systems

Plug connector	1 x SMA
Supply voltage active antenna	3 V
Supply current active antenna	20 mA
Maximum repetition rate	10 Hz
Satellite Systems	GPS, Galileo, GLONASS, BeiDou
PPS synchronization	Yes
Electrical isolation	No
Number of receivers	2

AES/EBU

Plug connector	2x XLR with CLX X.1 cable (Code 3797-1) to HEADlink+
AES Out synchronization	32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz
AES In synchronization	32 kHz, 44.1 kHz, 48 kHz, 88.2 kHz, 96 kHz

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IN PRACTICE

Intuitive Operation

The complete range of SQuadriga III functions can be operated via the 7-inch touchscreen (1024 x 600 pixels). Common gestures, such as those used routinely on a smartphone, can also be used here: tapping activates buttons and initiates functions, while swipe gestures enable you to scroll through lists—for example, the list of stored files or settings. 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, such as the levels of the active channels and tachometers, as well as single-value parameters including pulses, GPS speed, and FlexRay or OBD quantities. 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 storage enable several hours of independent stand-alone mode. This way, you are completely independent in many measurement situations.

Recordings are stored in the internal storage of SQuadriga III or on a connected USB flash drive. This is even possible with a HEADlab module connected.

For frontend mode—for example, in a test bench—SQuadriga III is connected to the measurement computer via USB or LAN, and the recording is controlled via the Recorder of ArtemiS SUITE (APR 040 – Recorder). The recordings are stored on the computer.



HEADlink and HEADlink+

Using the HEADlink and HEADlink+ interfaces on the back, you can integrate SQuadriga III into a HEADlab system, connect an additional SQuadriga III, or attach an artificial head measurement system.

For integration into a HEADlab system, the HEADlink interface of SQuadriga III is connected to a HEADlab controller. SQuadriga III will then operate like a HEADlab module and transmit the signals from six selectable out of its eight analog channels to the controller.

In both operating modes, a compatible HEADlab module, a second SQuadriga III, or an HMS V artificial head can be connected to the HEADlink+ interface. SQuadriga III will then control the configuration of the channels of the connected device and store the data in its internal storage, on a connected USB flash drive, or transmit them to the computer in frontend mode. Both a connected HEADlab module and the sensors attached to it are also supplied with power by SQuadriga III.

When connecting an additional SQuadriga III, one of the two devices operates as the controller, recording the channels from the other device. The other SQuadriga III operates as a module, transmitting the signals from its eight analog channels (BHS connector and BNC connectors) to the SQuadriga III device operating as a controller.

Artificial heads such as HMS V are connected to the HEADlink+ interface.

Power Supply

The power connector for electrically isolated power supply on the back of SQuadriga III is a wide-range input ($10\text{ V}_{\text{DC}} - 30\text{ V}_{\text{DC}}$) that may be connected to the supplied power adapter or a supply module (labPWR I.1, labPWR I.2, or labPWR I.3). Using the CLO VIII.3 cable adapter (Code 3364-3), SQuadriga III can also be supplied with power from a vehicle's on-board power supply system.

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

SQuadriga III provides information on the charge status of a connected supply module and additionally indicates whether this module is being charged from its own power source.



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 using a labPWR I.1 supply module

Binaural Headset BHS II

The calibratable BHS II headset is the ideal complement to SQadriga III for performing binaural recordings quickly and efficiently.

With its BHS connector, SQadriga 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 wearing comfort make BHS II easy to use for extended periods. Its ear cups and headband conform optimally to the shape of your head.

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

Binaural Recording and Playback

SQadriga III advances the technology we have been instrumental in establishing for aurally-accurate recording, analysis, and playback, uniting ease of operation and mobility with high performance and reliability.

SQadriga III can not only be used in combination with the BHS II binaural headset, but it also supports connecting up to three additional binaural recording systems—for example, the BHM III.3 headset microphone or the 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. Recordings stored in the internal storage can likewise be played back directly from the file system view.

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

SQadriga III and HSU III.2 with move°S

The move°S upgrade for HSU III.2 enables bidirectional rotation of the HSU III.2 head by means of an integrated motor.

Connecting HSU III.2 with the move°S upgrade to SQadriga III enables you to configure the rotation speed, rotation angle, and number of rotations via SQadriga III and have the configured rotation carried out during the recording.



BHS II Binaural Headset connected to the BHS connector



Why Binaural?

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

When the recording is played back with the BHS II headset or another of our playback devices—for example, *labP2* or play-Basic used with headphones—the spatial image is accurately reproduced. This provides you with the auditory impression of the original sound field, as your hearing can separate and localize the individual sound sources exactly as in the original sound field.

Comparability

To ensure that binaural and conventional recordings are mutually comparable and can be analyzed jointly, SQadriga III applies ID equalization (**I**ndependent of **D**irection) when recording with BHS III.

ID equalization was developed by our engineers 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. Our playback systems analyze this information and automatically configure themselves accordingly, ensuring correctly equalized and level-accurate playback.

Analyzing Recordings

In addition to conventional analysis methods, such as FFT or octave analyses, psychoacoustic analyses—including Loudness and Sharpness—are likewise available. Psychoacoustics takes into account that sound events are perceived differently than by measurement instruments. Psychoacoustic analyses enable precise and standardized descriptions of the human auditory perception of sound events. The selected analyses can be configured in terms of FFT size, window function (Hanning, rectangular, flat-top), frequency weighting, and level scale.

SQadriga III enables you to use analyses during recording, playback, and monitoring to identify irregularities in a sound or sound scenario and to derive strategies for improving sound quality.

Even while monitoring analyzed channels, you can use a filter to attenuate or accentuate specific signal components and adjust the



filter's frequency, quality factor, and gain conveniently by means of sliders. You can monitor both the unfiltered and the filtered signal, and you can also have the filtered signal displayed in the diagram.

Using the real-time filtering of ArtemiS SUITE (APR 110 – Playback Filters), you can identify and filter interference components in a noise signal already during the recording process, giving you early indications for a more targeted analysis. Here, too, you can modify the quality, frequency, and attenuation parameters of the real-time filtering in ArtemiS SUITE and monitor the optimized signal in real time via SQuadriga III using headphones.

Analyzing During Recording

During recording, all analyzer functions are available for real-time analysis of the incoming signals. To use them, activate the Analyzer via a button in the Recorder while recording is in process, select up to four channels, and configure the analyses 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

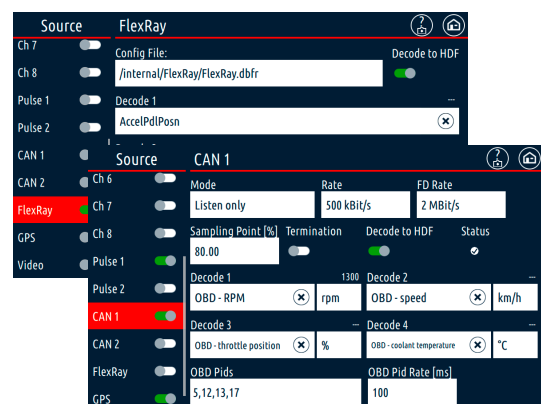
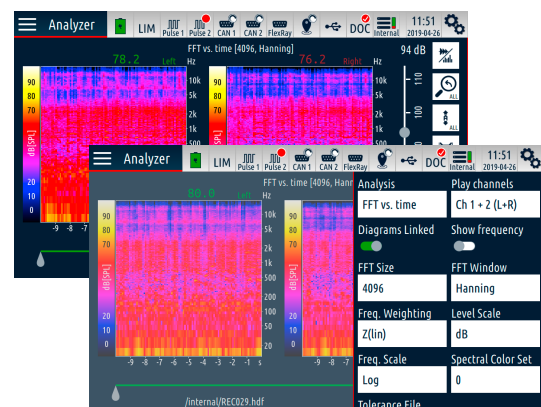
FT and octave analyses as well as psychoacoustic analyses are also available for analysis during playback. These analyses can be selected and configured during playback, enabling you to individually analyze the recordings stored on your device.

During playback, the signals of the channels being played back are analyzed, and the results are displayed in diagrams. In the meantime, you can replace or reconfigure the analyses in use at any time, select other channels, adjust the level, navigate forward or backward, and limit the playback range.

CAN FD and FlexRay Bus Systems

SQuadriga III provides two channels for recording CAN FD data and one additional channel for recording FlexRay data. SQuadriga III records the entire CAN FD data stream. From the FlexRay bus, it records the sections that contain the requested parameters. When analyzing the recordings in ArtemiS SUITE, you can decode the stored data, store it in additional channels, and use it for subsequent analyses.

A maximum of four quantities per CAN FD or FlexRay channel can be decoded and displayed as numerical values in the Recorder. Furthermore, up to six of these quantities can be displayed as tachometers. The decoded quantities can also be stored in the recording as separate channels.



Video Function (Option Package)

Using a connected USB video camera (Code 0271), you can record video at resolutions of up to 1280 x 720 pixels and 30 fps while simultaneously recording the sound event, and store it as an AVI file (MJPEG format).

The video image can also be displayed on the screen in real time during recording. If a video file is associated with a recording stored on SQuadriga III, it will be played on the screen during playback.

You can also use the video camera to capture single frames before or during the recording to separately document exact sensor positions or special situations during a measurement.

Satellite-Based Position Tracking

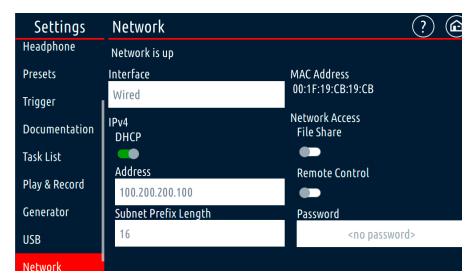
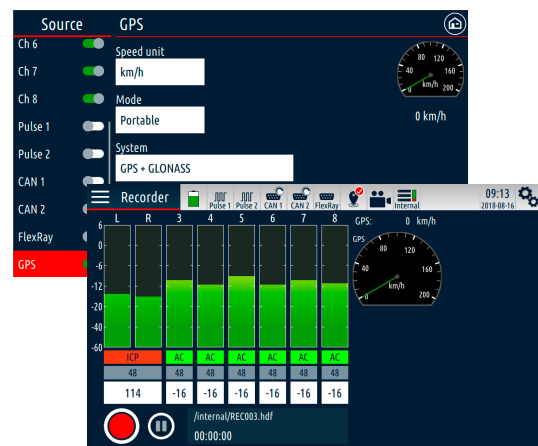
SQuadriga III supports the GPS, GLONASS, BeiDou, and Galileo satellite navigation systems, providing precise position determination as well as additional parameters, including speed and altitude.

The GPS data is recorded and displayed in real time on the screen, and can also be stored in the recording as decoded channels. 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 from multiple spatially separated SQuadriga III devices can be synchronized retroactively. To this end, use the "Merge Recordings" function of HEAD Companion or the "File Merge" function of ArtemiS SUITE (APR 200 – HDF Tools). GPS quantities can be used as triggers to start or stop a recording, for example upon reaching a specified GPS speed.

SQuadriga III in a Network

When you connect SQuadriga III to a network, you can access it from any computer on the same network via the Recorder of ArtemiS SUITE (APR 040 – Recorder) and use it for recordings or for playback, for example to play an excitation signal. Playback on SQuadriga III via the Player of ArtemiS SUITE is just as easy, as is using HEAD Companion to install a new firmware version over the network, for example. A LAN port on the back of SQuadriga III is available for network connection. The network connection can be configured either via a DHCP server in the network or manually on SQuadriga III.



Web Interface and Network Access

Using the SQ3 TP 06 Network Access option package (Code 3324-06), you can remotely control multiple SQadriga III functions via a web browser—for example configuring channels, starting and stopping recordings, managing device configurations, handling files, configuring triggers, and editing the User Documentation.

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

Triggers

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

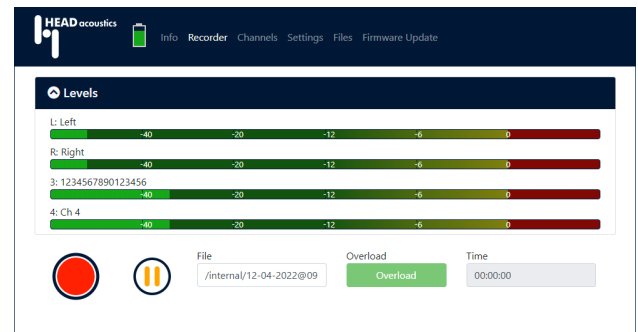
A trigger may respond to a rising or falling signal edge and record signals that were present before (pretrigger) or after (posttrigger) the start or stop threshold was reached.

User Documentation

Efficient handling of large numbers of recordings requires access to descriptive information. To this end, SQadriga III provides a highly user-friendly documentation function that enables you to describe each recording.

You can use documentation templates created in ArtemiS SUITE and then transferred to SQadriga 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 common 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.



Settings Trigger

Triggered recording

Start Source: Pulse 1 Mode: Amplitude Value: 1000 Slope: Rising Pretrg [ms]: 15

Stop Source: Pulse 1 Mode: Amplitude Value: 6000 Slope: Falling Posttrg [ms]: 15

Repetitions: 10 ... to same file

Settings Documentation

Template: hatx/Car.hatx X

DOC Mode: Edit before recording Keep Last Values Edit

Automatic Recording Name Generation: Keep Last Values

Car

Manufacturer: Hudson

Model: Hornet

Segment: Middle Class

VIN (Vehicle ID): HH00216-1955-21

Date of Production: 05-20-1956

Role: Good Vehicle

Engine

Test

Context-Sensitive Online Help

The comprehensive, context-sensitive online help provides information on the function of dialogs and detailed help on how to operate SQQuadriga 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

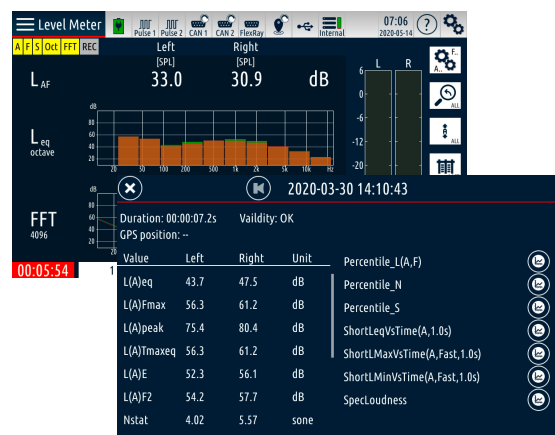
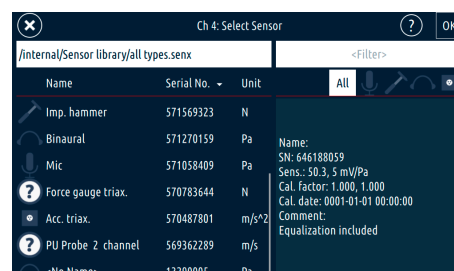
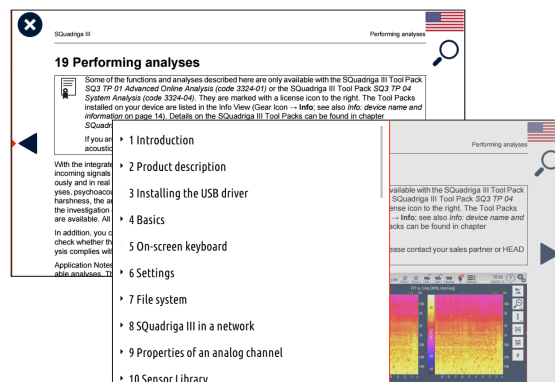
Sensor Libraries for managing your sensors with ArtemiS SUITE can also be used on SQQuadriga III. Simply transfer the Sensor Library to the internal storage of SQQuadriga III and assign the fully configured sensors stored in it to the channels during channel configuration.

Details, such as sensor type, sensitivity, calibration date, calibration factor, and the equalization filters stored in the Sensor Library, are automatically used in the respective channel. These details are also stored in the recording and later made available via the Channel Editor for post-processing and analysis in ArtemiS SUITE.

Sound Level Meter Function (Option Package)

The SQ3 TP 02 *Level Meter* option package (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.

Multiple measured levels from up to four channels can be monitored simultaneously on the display during the measurement and stored as single values for subsequent analyses. You also have the option to record the measurements and subsequently display them in diagrams over time. The time signal can likewise be recorded for later playback. Using a connected video camera (with the SQ3 TP 03 *Video Support* option package, 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.



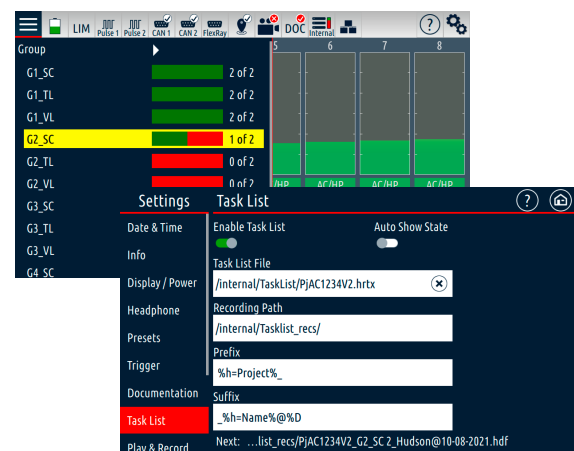
USB Audio Devices

USB audio devices such as BSU and SScope enable you to perform binaural recordings with very little effort. The USB audio devices are connected to one of the USB host ports on the back. Connecting a USB audio device enables you to record the two audio channels alongside the channels of SQuadriga III and analyze the signals, for example, using the sound level meter function or the Analyzer. The recordings are stored on SQuadriga III and can also be transferred to a computer, where they can then be analyzed—for example, using ArtemiS SUITE.

Task Lists

Using a Task List enables you to configure and perform a defined sequence of measurements. This is particularly useful when performing a series of measurements, for instance within the scope of standardized quality-assurance tests using the Standardized Test Project of ArtemiS SUITE (APR 220 – Standardized Test Project). Task Lists can 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 for starting and stopping recordings automatically.



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