



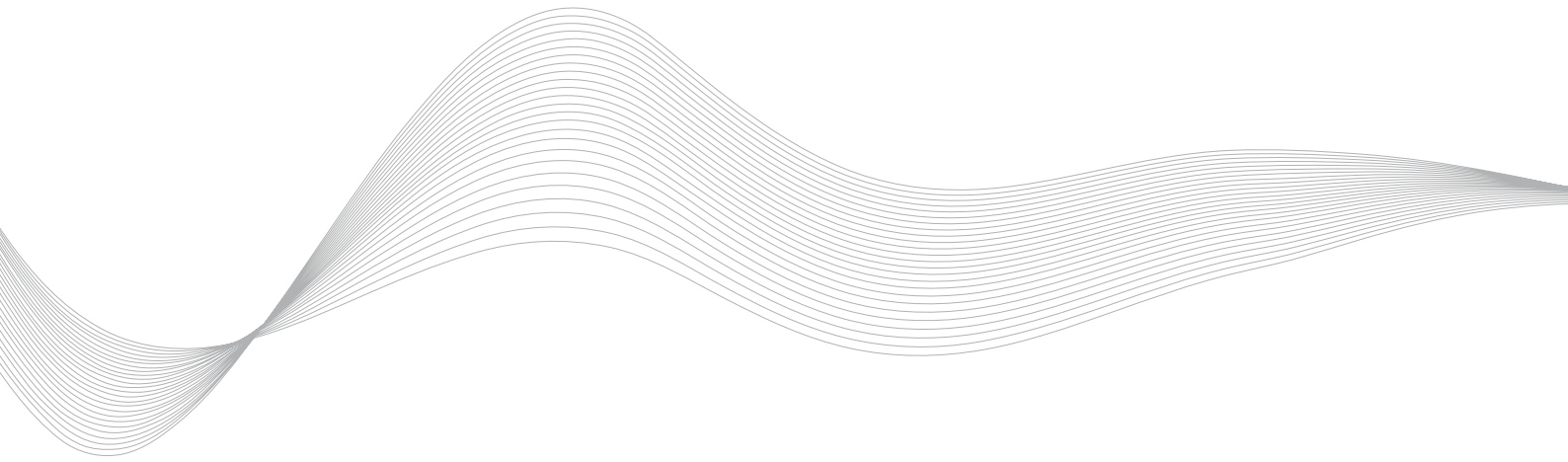
optimize
**SOUND &
VIBRATION**

REAL-LIFE-PROOF.



— *optimize*

**SOUND &
VIBRATION**




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About

Setting the global benchmark



Binaural recording and playback technologies are the root and basis for HEAD acoustics' continued success.

Over the years, we have added helpful analyses and measurement devices to our portfolio to better support our customers' development work. Binaural sound recording and its evaluation by analyses and listening tests represent the end of the toolchain. Getting there requires a multi-faceted approach, including assessing and analyzing, for example, forces, structural vibration, transfer behavior, and airborne sound radiation. These steps are essential to optimize your product during the development process efficiently. Our customers appreciate us for the broad and modular HEAD acoustics portfolio and especially for the intuitive operating concept of our software. Digitalization and artificial intelligence open abundant possibilities to support our customers on their way, which we are working on with enthusiasm. Already today, our tools offer:

- » Efficient test planning, execution of measurements, and structural dynamic analyses involving CAD models
- » Direct comparison of vibration shapes determined experimentally or with simulations
- » Hybrid Transfer Path Analysis (TPA) models combine experiment and simulation thanks to Blocked Forces source description
- » Evaluation of your experimental or simulation results using listening tests or automated metrics
- » Interactive experience and evaluation of test and simulation data with the NVH Simulator PreSense

Always aHEAD

Digitalization offers exciting opportunities and challenges; therefore, HEAD acoustics participates in national and international research projects and keeps incorporating innovative ideas and visions into its products and services. Our international customers, which include leading automobile, industrial, and aerospace manufacturers, benefit from these technologies and our expertise and greatly appreciate the competitive advantages that product sound optimization gives them.

HEAD acoustics, with its know-how and modular and comprehensive state-of-the-art product portfolio, is your strong partner for the successful digitalization of the product development process.

Sound & Vibration Analysis

ArtemiS SUITE

ArtemiS SUITE is an integrated software solution allowing you to perform virtually any sound and vibration analysis task. Enjoy the efficient and natural workflow within ArtemiS SUITE, where all applications interact seamlessly.



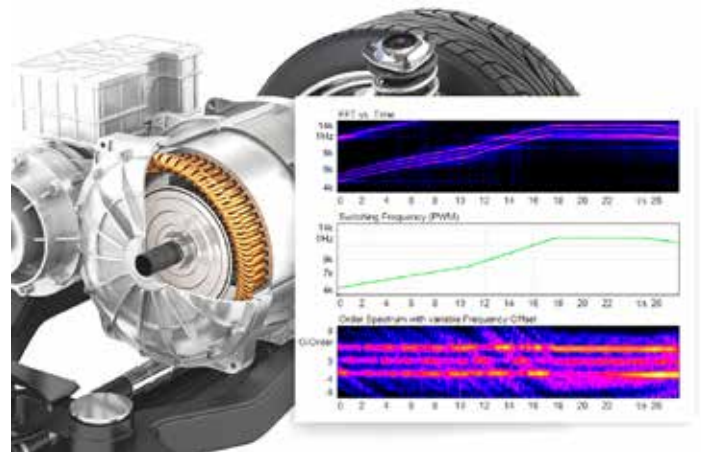
ArtemiS SUITE is leading in useability, performance, scope of operability, and connectivity.



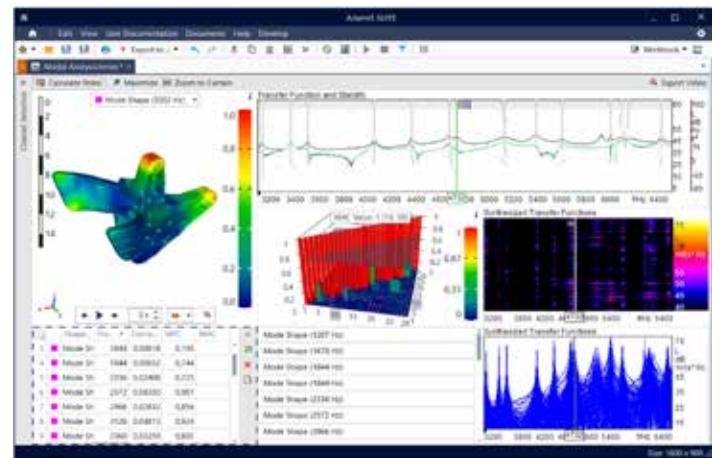
ArtemiS SUITE is the universal software solution for your sound and vibration analysis.

ArtemiS SUITE combines all the tools required for performing comprehensive measurements and in-depth analyses with functions for data management, report generation, and automation – all in a consistent software environment. In addition, ArtemiS SUITE makes structural analysis straightforward for everyone: Clearly defined and perfectly harmonized, its structural dynamic tools are seamlessly integrated with the tried-and-tested ArtemiS SUITE software. They enable users to analyze time domain animation, modal, and operating deflection shape.

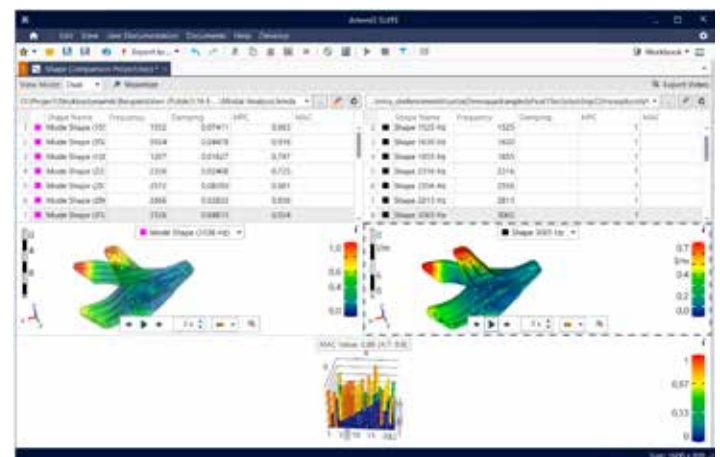
You can intuitively import 3D and CAD object data from different file formats and use them to animate the determined vibration mode shapes and patterns. The shape comparison module provides an easy-to-use tool for validating simulations against actual measurements or evaluating component modifications by comparing the coupled animation of different variants.



Use a CAD model to visualize its mode shapes



Comparing EMA with numerical modal analysis



Structural Analysis

APR 04x

Structural Dynamics tool pack

The design and dimensioning of newly developed machine components significantly influence the acoustic vibration behavior of the entire machine. For a targeted component design, it is thus essential to determine the natural vibration modes of all components to be used in a mechanical system during development.

With the ArtemiS SUITE and the APR 04x Structural Dynamics tool pack, such analyses can be performed quickly and easily. You have a complete portable system for analyzing vibrational behavior with just a laptop computer, a mobile recording frontend (such as SQadriga III or SQobold), an accelerometer, and an impact hammer.

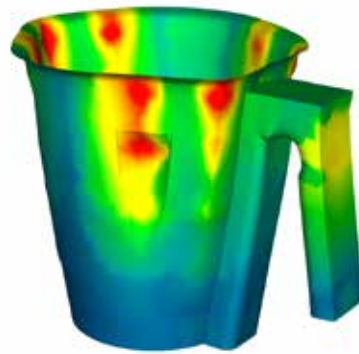
The versatile and user-friendly Impact Measurement function for acquiring measurement data was primarily designed for occasional modal analysis users. Step by step, the straightforward user interface guides you through the entire application until your measurement data are completely analyzed.

A handy feature is the fully automated configuration of all required measurement parameters, such as sampling rate, block size, and windowing, specifically for the object to be measured and the type of hammer tip used. This feature ensures that even inexperienced users achieve optimal measurement results immediately.





Modal amplitudes on a complete CAD model



Modal amplitudes with motion and colors



Wireframe representation to look through objects and see the backsides

Of course, all settings can also be configured manually. During data acquisition, the software indicates which points will be struck next and monitors the strikes' quality. Unsuitable double strikes, strikes exceeding the measurement range, or strikes with low coherence are discarded automatically. In contrast, data from successful strikes are collected, averaged, and saved to a documented HDF file.

The acquired data can be viewed in a Data Viewer, included in an automatically generated report.

Structural analysis with ArtemiS SUITE assures you get the results you need with the ease and efficiency you know from working with HEAD acoustics.



Transfer Path Analysis

ArtemiS TPA Project

Build a transfer path model and calculate source characteristics and path contributions in the time domain

Easy transfer functions recording, transfer path analysis, and input data set creation

To perform a transfer path analysis or to create data sets for PreSense and Prognose, the TPA Project enables the vibroacoustic characterization of measurement objects using transfer path synthesis. The TPA Project calculates the individual noise contributions of the paths from transfer functions and operational measurements and generates a vibroacoustic model that describes the noise/vibration transmission.

Step by step, our TPA solution guides the user through the procedure. With the help of the Measurement Point Library, the 3D model, and the clear model tree, the entire TPA model can be constructed quickly and clearly.





Users maintain a complete overview even with larger models because all presentation options are interconnected. For example, the model tree displays the corresponding locations with a click on a measuring point in the 3D model. This interconnection is also available for the matrix, which interacts automatically with the model tree and the 3D model.

For the required measurements of the transfer functions, the TPA Data Acquisition Project is available, which uses the TPA model to configure the measurement setup.

TPA Data Acquisition is easy to use and guides users through the setup and all measurement procedures. It utilizes the Recorder of ArtemiS SUITE for the measurements, which integrates seamlessly into the process.

The Measurement Point Library and the 3D model can also be used here to perform all necessary tasks quickly and safely.



KEY FEATURES

- » Blocked forces (in-situ and test bench)
- » Component-based TPA
- » Matrix inversion for structure-borne and airborne sound
- » Effective mount transfer functions
- » Hybrid TPA: combining test and simulation data
- » Measure on the test bench, listen in the vehicle
- » Binaural TPA in the time range
- » Numeric TPA

Jury Testing

SQala

With SQala, you can quickly and easily set up jury tests and perform them in a single-user system or a listening studio. SQala supports playback of binaural recordings and enables product or ambient noises to be rated flexibly and aurally accurately no matter where or when.



Once created, a SQala Project can be used for various jury testing scenarios and types



Clear, solution-oriented and intuitive user interface

Possible modifications to product noise can then be carried out seamlessly in ArtemiS SUITE and tested again in SQala before being implemented in actual prototypes.



The test coordinator can use interactive tools to supervise, manage, and control jury testing. The results are stored on the SQala Server. A seamless connection to the ArtemiS SUITE software platform offers a wide range of noise pre- and post-processing functions.

SQALA OFFERS THE FOLLOWING JURY TESTING METHODS:

- » Category judgment
- » Simultaneous category judgment
- » Ranking with category
- » Paired comparison
- » Semantic differential

Binaural Recording

HMS/HSU

Record sounds true to reality

With binaural recording systems, you can record sounds true to reality. Our artificial heads accurately capture all acoustically relevant events. Ear simulators with different microphones enable aurally accurate recordings.

The analog HSU (HEAD Shoulder Unit) artificial head microphone series is the perfect solution for creating reproducible binaural recordings



Reality is always binaural

Humans usually hear binaurally, i.e., with both their ears. Based on these two ear signals, the brain evaluates the sound.

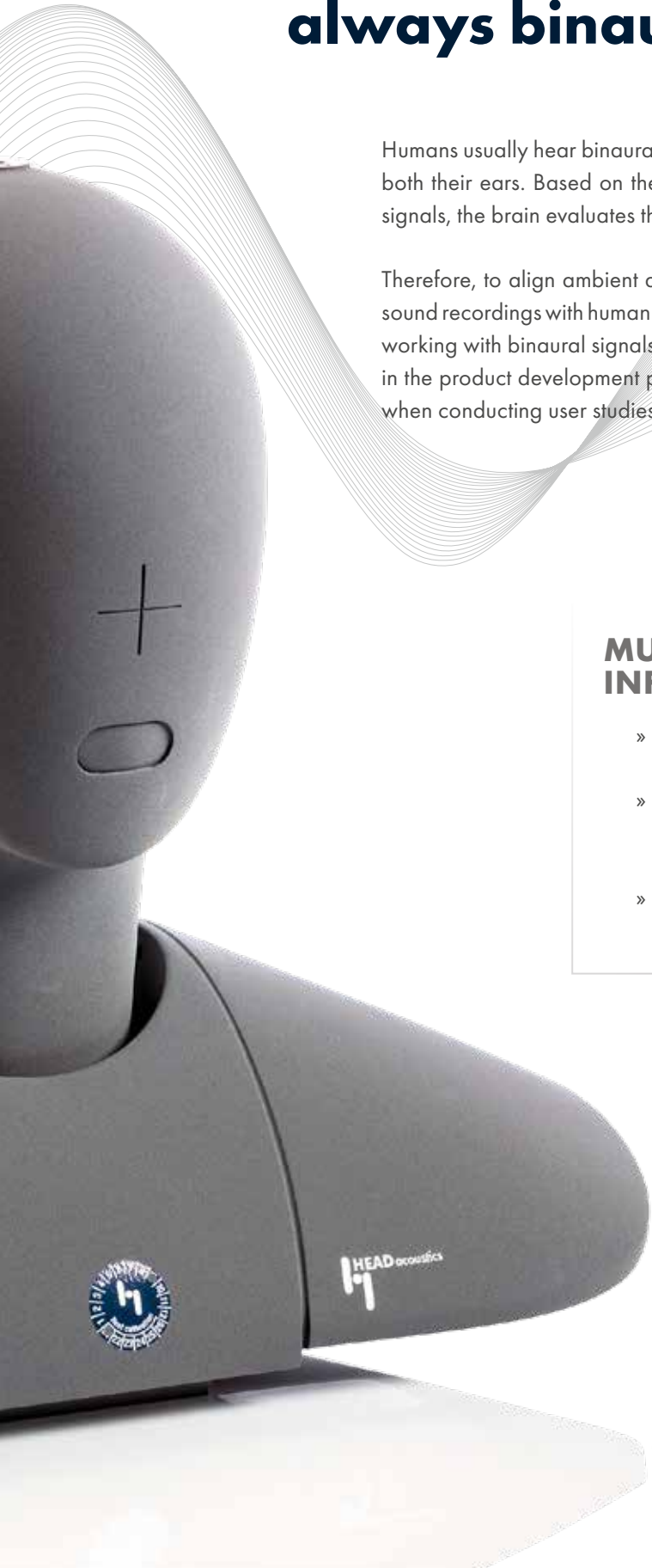
Therefore, to align ambient and product sound recordings with human perception, working with binaural signals is essential in the product development process and when conducting user studies.



MULTIPLE FACTORS INFLUENCING THE SOUND


- » The listener's body changes the sound field.
- » Due to the influence of shoulders, head, and ears, the ear signals are direction-dependent and differ.
- » Every device in the measurement and playback chain impacts the signal.

Only if these influences are considered in the binaural recording can listeners genuinely perceive it as if they were present in the original sound field, including directional hearing and the differentiation and separation of sound sources.



Digital Artificial Head

HMS V



The HMS V digital artificial head combines cutting-edge technology, high flexibility, and ease of use. With its Dual ADC technology (two parallel analog-to-digital converters), the HMS V covers the entire audible dynamic range, rendering measuring range changes obsolete. With the HMS V, you perform binaural equalization immediately during the measurement, and its headphone jack enables playback or monitoring during measurement using HEAD acoustics headphones.

HMS V offers a broad range of interfaces

The HMS V integrates seamlessly into HEADlab systems as a binaural sensor. It constitutes a comprehensive measurement system combined with other artificial heads or linked to other devices, such as the HEAD VISOR (acoustic camera) or the SQuadriga III (mobile frontend). A PC with the ArtemiS SUITE recorder software connected via USB or LAN takes over control in frontend mode. Integrating an additional HEADlab module allows you to adapt the system flexibly to specific measurement tasks.

KEY FEATURES

- » Digital measurement system for aurally correct recording and accurately equalized playback
- » High-end audio quality with high dynamic range
- » With Dual ADC technology no switching of measuring ranges necessary
- » Versatile applications due to many interfaces, extensions, and operating modes
- » Stand-alone recordings with internal memory and battery power supply

HMS V even offers convenient stand-alone recordings (SAR) with internal memory for the signal data and a high-capacity battery. You can increase the autonomous runtime with a labPWR battery module and USB memory. During SAR, you configure and control HMS V using an intuitive web interface on a smartphone, tablet, or PC connected wirelessly or via cable.



Digital Binaural Headset

SQope

SQope, combined with the HEAD B2U app, is the easiest way to make, save, and play back mobile binaural recordings.



*Handy and comfortable
binaural headset*



After installing the HEAD B2U app (free via the Apple Store), connect SQope to your mobile device via USB, start the app, and record immediately. The USB connection powers SQope, so you are entirely autonomous and can move around freely. Your recordings are saved on the mobile device and can be played back via SQope or transferred to a computer for later analysis with ArtemiS SUITE.

SQope is also a perfect partner for the ArtemiS SUITE APR 100 Compact Analysis Module, which allows you to examine a recorded measurement with just a few clicks.

SQope correctly equalizes recordings and playbacks fully independent of a mobile device or computer. The necessary equalization filters are already installed, so you can record and play back correctly equalized right from the start.

Thanks to its low weight and ease of use, SQope is suitable for a wide range of applications.

Data Acquisition

HEADlab II

Modular and mobile multi-physics data acquisition



Next-generation multi-channel performance

The second HEADlab generation offers higher sampling rates, more channels, an ultra-compact 24-channel input module, independent HEADlab systems synchronized via GPS or PTP (Precision Time Protocol), standalone recording, and more.

Thanks to its modular design, you can set up the new generation of HEADlab in any way, combining individual modules into customized solutions for the most extensive measurement tasks. The heart of the HEADlab II system is the powerful controller labCTRL II.1. With its new interface protocol, HEADlink 2.0, it enables sample rates from 8 to 204.8 kHz per channel. labCTRL II.1 bundles and synchronizes data, supplies power to connected modules, and establishes the connection to a PC. Connecting multiple controllers allows expanding systems up to several hundred channels.

Its straightforward, rugged design and flexibly combined and noise-free modules make HEADlab II even more suitable for challenging mobile applications than its predecessor. An integrated locking mechanism allows the modules to form securely dovetailed units that can be easily disconnected after use. All modules of the HEADlab generations I and II are fully compatible.

labCOMPACT is a compact and simplified HEADlab system that combines a controller's essential functions with a multi-channel module. The "single module" technology is a flexible and affordable solution for multi-channel analysis, particularly in developing household appliances and office equipment. You can easily extend labCOMPACT with an additional HEADlab module, and its direct connection to a laptop or PC via USB or LAN ensures a secure and stable data transfer.

HEADlab systems are versatile and easy to configure to match your application.



Users choose which modules to combine with a controller.



Accessories for safe operation



Data Acquisition

A selection of HEADlab Modules



labCTRL II.1

LAN/USB controller for data bundling and synchronization of HEADlab systems. labCTRL II.1 features pulse inputs, CAN-FD, GPS, PTP synchronization, fanless and noise-free operation, and allows stand-alone operation with power boxes.

labV24 II

24-channel voltage/ICP[®] input module of the 2nd HEADlab generation for applications with high channel numbers

labV12 II

12-channel voltage/ICP[®] input module of the 2nd HEADlab generation for applications with larger numbers of channels

labVF6 II

6-channel voltage/ICP[®] input module of the 2nd HEADlab generation for applications with high channel numbers



labT6

labT6 is a 6-channel input module for connecting up to six thermal elements of types K and RTD (PT100 and PT1000). Each channel features a characteristic curve correction including cold-junction compensation (CJC). The device offers automatic thermal element breakage/cable breakage detection.



labM6 II

6-channel voltage/microphone input module of the 2nd HEADlab generation with HD wide-range input (High Dynamics)



labV6HD

6-channel line-/ICP module. All channels can be used as high-dynamic wide-range input or conventionally with fixed measuring ranges from 10 mV to 30 V.



labSG6

Flexible 6-channel input module for connecting resistive measuring bridges (full, half, and quarter bridges) and for sensors with balanced or unbalanced outputs and uni- or bipolar power supply.



labCOMPACT 24 II

24-channel Line/ICP[®] module with optional per-channel high-pass filters. The analog inputs work with sampling rates up to 48 kHz on all 24 channels or 96 kHz on twelve channels. This handy module excels with high phase accuracy of 24-bit data and a signal-to-noise ratio of up to 109 dB(A), phase accuracy of 24-bit data and a signal-to-noise ratio of up to 109 dB(A).



labCOMPACT12 II

12-channel Line/ICP[®] module with optional per-channel high-pass filters. The analog inputs work with sampling rates up to 96 kHz on all twelve channels or 192 kHz on six channels. This handy module excels with high phase accuracy of 24-bit data and a signal-to-noise ratio of up to 109 dB(A).



Mobile Data Aquisition

SQuadriga III

Direct sound intensity
calculation with the optional
Advanced Online Analysis
firmware package



The industry standard for mobile data acquisition, playback, and analysis

The overwhelming success of the SQQuadriga products is due to its compact design and high level of functionality in stand-alone mode. Engineers tasked with finding and fixing problems need only carry a SQQuadriga III and the necessary transducers into the field – a computer is not necessary.

The hand-held system SQQuadriga III has eight analog channels, various digital inputs, a built-in display, a GPS receiver, a battery, and memory. It is ideal for mobile sound and

vibration measurements in any industrial application. Thanks to the many integrated interfaces and functionalities, adapters are unnecessary. With the BHS II headset, you can use binaural recording and playback technology anywhere. Combine SQQuadriga III with other modules and increase the number of channels or extend the analysis capability with firmware packages. It performs conventional analyses (FFT, octave bands) and calculates and visualizes psychoacoustic analyses, sound intensity, transfer functions, coherence, etc.



Mobile Data Aquisition

SQobold



Measure everywhere

KEY FEATURES

- » Extremely compact binaural recording and playback system
- » Four-channel data acquisition system
- » Sound pressure level measurement and psychoacoustics
- » Long battery life (up to six hours)
- » High-quality color display with capacitive touchscreen
- » Large storage capacity (64 GB of internal storage)
- » Real-time filtering
- » Video and GPS function
- » ICP®, AC and DC couplings can be switched independently

SQobold is a compact, versatile, and portable data acquisition system with four analog channels, a built-in display, battery, memory, and GPS receiver for state-of-the-art sound and vibration measurement.

SQobold supports CAN FD/OBD-II to help with automotive characteristics such as speed, engine RPM, etc. Yet SQobold can do much more than that: The versatile stand-alone system is a reliable sound level meter that can visualize physical and psychoacoustic variables. Psychoacoustic aspects are becoming even



Portable and compact stand-alone sound and vibration measurement and integrated analysis

more critical as criteria for evaluating noise in directives and regulations. With SQobold, it is possible to monitor conventional sound pressure levels as accurately and efficiently as the psychoacoustic phenomena of loudness and sharpness in line with the DIN 45631/A1 and 45692 standards. With a battery life of up to six hours, a compact size of 14.3 cm, and a weight of just 485 g, SQobold can be used anywhere.

The acquired signals' spectral distribution can be displayed in the field with online FFT analysis. Level over time, one-third octave and other FFT-based analyses are possible. Moreover, psychoacoustic measurements can be conducted, such as loudness over time, sharpness over time, and specific loudness.

With SQobold, it is possible to experience the sound and the visuals of a recording. The measurement process can also be documented with videos or photos. The integrated GPS receiver stores the exact time of each measurement, as well as the location.

Acoustic Camera

HEAD VISOR VMA V

Flexible, large-format microfone array

The portable, hand-held acoustic camera HEAD VISOR VMA V offers unprecedented ease of use and uncomplicated, versatile handling. By integrating a battery, a touch display, and all essential operating buttons, it redefines flexibility and usability. All relevant inputs and outputs are already integrated into the light and compact HEAD VISOR VMA V.

The MEMS microphones provide a high dynamic range and high resolution. Thanks to its modular concepts, you can use it without or with the array arms, choosing between a 30-cm (60 microphones) or 100-cm (120 microphones) diameter – more than twice the amount of our previous generation.

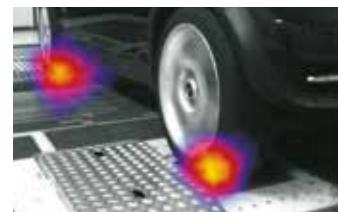
Unlike smaller stand-alone devices, HEAD VISOR VMA V yields highly accurate results, making it the first choice for professional users.

HEAD VISOR PROBE

Hunting for low-frequency noise

To effectively reduce the low-frequency noise components often generated and emitted by machines, it is essential to identify the exact source of the sound events. The HEAD VISOR PROBE, which can now be connected directly with the HEAD VISOR VMA V, supports you in localizing the sources of airborne sound.

Beamforming results





HEAD VISOR LICENSES – MATCHING FOR ANY NEED

- » HEAD VISOR complete: Full license
- » HEAD VISOR snap: Analyze a fleeting sequence and export an image or movie
- » HEAD VISOR record: Only recording function and online view, always requires an array
- » HEAD VISOR core: Analysis license without array, project view, and export functions

HEAD VISOR Software

Beamforming, recording, evaluation, and presentation of the highest-quality acoustic measurements

The intuitive HEAD VISOR software immediately displays the complete results of all functions of the HEAD VISOR VMA V microphone arrays and the HEAD VISOR PROBE without delay, significantly speeding up your work.

All measurement data are saved as raw files, allowing you to retroactively apply any settings – such as distance measurements, frequency ranges, and algorithms – at any time. Highly sophisticated additional algorithms provide further insight into the acoustics of complex measurement objects. Emitted sounds can be differentiated by location, frequency, order, or sound components and sorted by signal levels. The obtained detailed results can be

compiled and documented into a single overall image with a dynamic range of up to 30 dB (HDR function). The system can automatically start and stop measurements using sophisticated trigger functions and sort the results accordingly.

The built-in screen recorder “films” the entire user interface during your evaluation. All results are thus directly converted into an audiovisual movie that you can include in the presentation of your results. Creating impressive presentations has never been so quick and easy.

Interactive NVH Simulator

PreSense

Virtual Engineering & prototyping

Interfaces to, e.g., third-party software solutions like IPG CarMaker®, significantly extend its capabilities. Save expensive prototypes with virtual test drives: With our NVH simulator, PreSense, users experience vehicle acoustics before it is even possible to combine all the individual components and assemblies physically. PreSense uses simulation data (CAE), measurement data, and results from binaural transfer path analyses to create an interactive acoustic vehicle simulation.

*PreSense – Interactive
NVH simulator for virtual
engineering & prototyping*





Different configurations and immersion levels

Furthermore, PreSense can also be used as an interactive sound design studio for ASD. The driver acts and behaves like driving an actual vehicle, while a driving model calculates vehicle speed, engine speed(s), and load(s). The NVH simulator auralizes the corresponding sounds, e.g., from powertrain, tire/road, and wind, in real time.

During the simulation, users can virtually replace, add, or modify powertrains, components, and other sound sources. Changes are immediately audible and enable the driver of the virtual vehicle to undertake a valid acoustic assessment without in-depth specialist knowledge. The possibility to experience sound and vibrations supports quick and safeguarded decisions.

Active Sound Design



Interactive NVH simulator

PreSense is a scalable solution

The NVH simulator is a scalable solution in different configurations and levels. Interfaces to, e.g., third-party software solutions like IPG CarMaker[®], significantly extend its capabilities.

Desktop simulator

The desktop simulator offers calibrated and aurally accurate sound reproduction via a binaural headset. Pedals, steering wheel, and a monitor simulate the driving situation.



SoundSeat

Combined with the Sound Seat, the NVH simulator can be operated like an actual vehicle. The user accelerates, brakes, and changes gear while the system adapts sounds and vibrations to the driving situation in real-time.



SoundCar

Integrated into an adapted vehicle, the NVH simulator facilitates playback in a natural vehicle environment. Both the acoustic and technical vibration-specific aspects of sound perception are considered. The system reproduces sound scenarios recorded in the vehicle by simultaneously generating airborne sound and vibration stimulus, e.g., from the steering column and driver's seat.



Complete vehicle simulator

PreSense can be integrated as a subsystem in a full-fledged vehicle simulator with a movable platform. To correspondingly adapt sounds in the NVH simulation software, the vehicle software transmits operating state variables such as engine speed, vehicle speed, and load via a software interface.



Mobile NVH simulator

As a mobile version with ANC headphones, the NVH simulator can be used in a vehicle without costly conversion measures. Virtual vehicle sounds are played back in a driving situation, and the operating state variables are transmitted via the CAN bus.



Engineering Services

Always at your side

In the lab and the field

In your laboratory, in our laboratory, on the test bench, roads, and test tracks: We perform testing under controlled conditions based on the latest, proven findings and using state-of-the-art technology.

Sharing knowledge

In projects and training, we share our knowledge while working on your specific tasks, resulting in shorter training times and stringent approaches.

Your strong partner. Solution- and resource-oriented

As experts in acoustics, sound and vibration, vehicle NVH, communication, and speech and audio and quality, we support our customers with their individual requirements and complex projects anywhere around the globe. Benefit from innovative, scientifically-based methods and three decades of experience and expertise. Together, we identify your project goals and implement the resulting requirements successfully. We will find the best solution as an independent partner or in collaboration with your team.

Product sound optimization

Leading binaural technology that focuses not only on raw data but also the human perception.





Mobile measurements

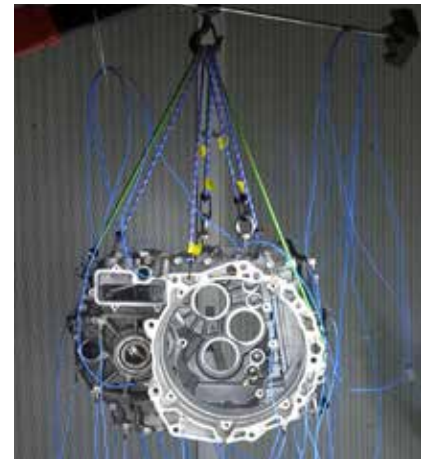
With our state-of-the-art mobile data acquisition systems, we perform measurements in any location.

OUR ENGINEERING SERVICES

- » Benchmarking
- » Transfer Path Analysis: Follow the airborne or structure-borne sound paths
- » Structural Analysis
- » Simulation
- » Auralization of CAE data
- » Active Sound Design: Create synthetic sound components to achieve the perfect target sound
- » Development of sound quality metrics based on machine learning
- » EoL/Quality Monitoring:
 - » Prediction of perceived sound quality through machine learning
 - » Vibroacoustic classification (e.g., for OK/NOK ratings)
 - » Creation of classifiers for end-of-line systems
- » ASX as an Engineering Service: Provision of customized system solutions to extend ArtemiS SUITE (e.g., SQala step, Matlab Add-In for ISO standards)

Development support

We support your product development with analyses and customized solutions based on both experimental and numerical methods.



System analysis

A clearly defined, structured approach and scalable measurement and analysis tools enable us to measure and analyze any complex system from hair dryer to complete vehicle.



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