HEAD acoustics



optimize

SPEECH & AUDIO QUALITY

REAL-LIFE-PROOF.

optimize

SPEECH & AUDIO QUALITY

Human-like Recording and Speech Generation

Artificial Heads 4 – 5
Modular & Unique 6 – 7

Communication and Audio Analysis

ACQUA 8 – 9
LEAP, Speech-Based Distortion Measure, MDAQS, ABLE 10 – 11
HEAD Standards 12 – 13

Speech Recognition

VoCAS + VoCOPTS 14 – 15

Data Acquisition

labCORE 16 – 17
Integrated labCORE Extensions 18 – 19

Sound Field Simulation

3PASS lab, flex, reverb 20 – 21

Dynamic and Time-Variant Testing

Accessories (move°S) 22 – 23

Human-like Recording and Speech Generation

Artificial heads

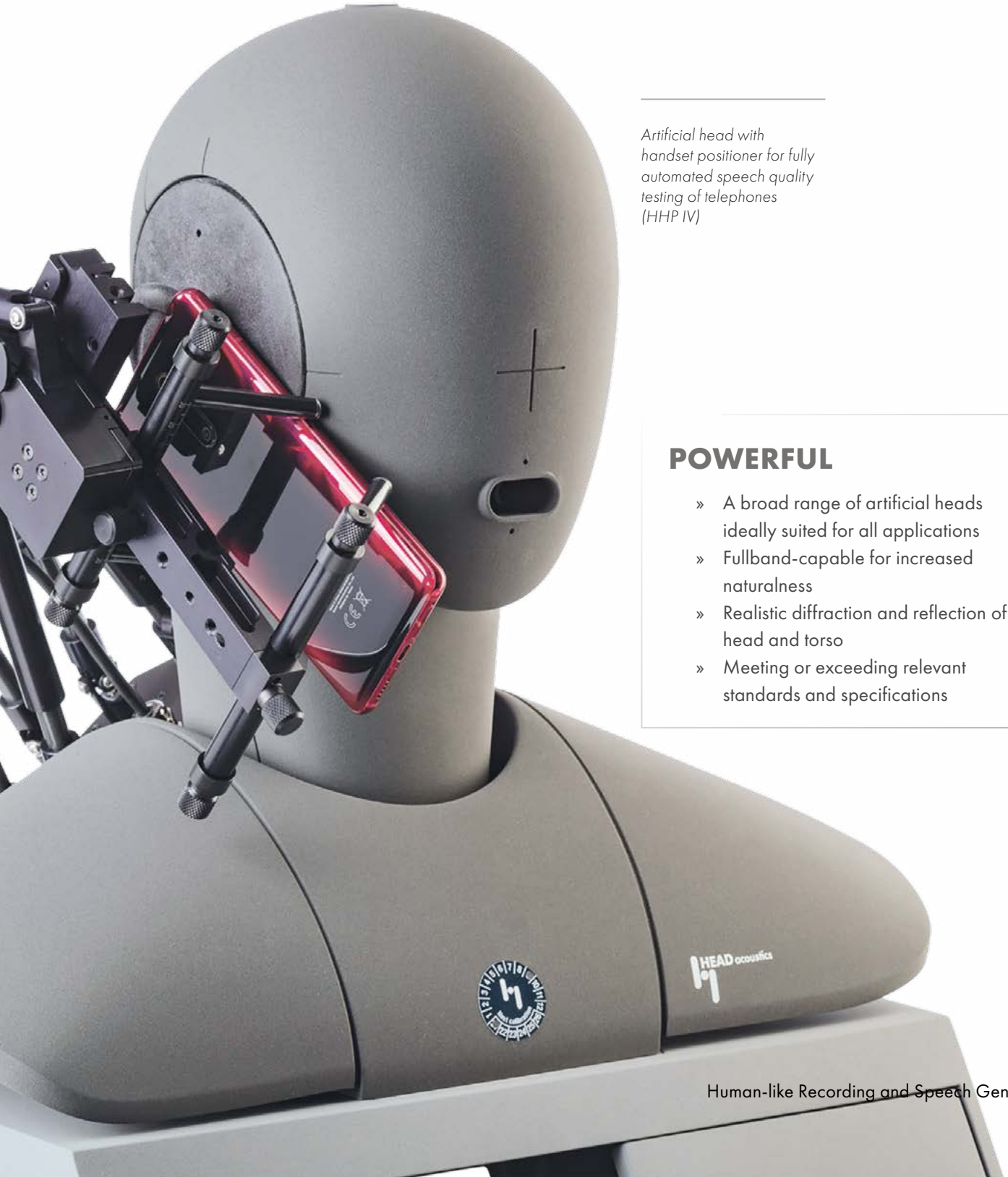
HEAD acoustics' artificial heads combine cutting-edge technology, high flexibility, and ease of use that help advance your development and improve your products. They are ideal for measuring speech and audio quality in virtually any conceivable application scenario, in sending and receiving directions, for close-to-ear audio and telecommunication devices, as well as for far-to-ear communication devices.





Realistic headset testing with human-like pinnae

With our artificial heads, we meet the highest demands for quality and faithfulness to reality in the lab – we make your testing real-life-proof.



Artificial head with handset positioner for fully automated speech quality testing of telephones (HHP IV)

POWERFUL

- A broad range of artificial heads ideally suited for all applications
- Fullband-capable for increased naturalness
- Realistic diffraction and reflection of head and torso
- Meeting or exceeding relevant standards and specifications

Human-like Recording and Speech Generation

Modular & unique



Replaceable impedance simulators with human-like impedances

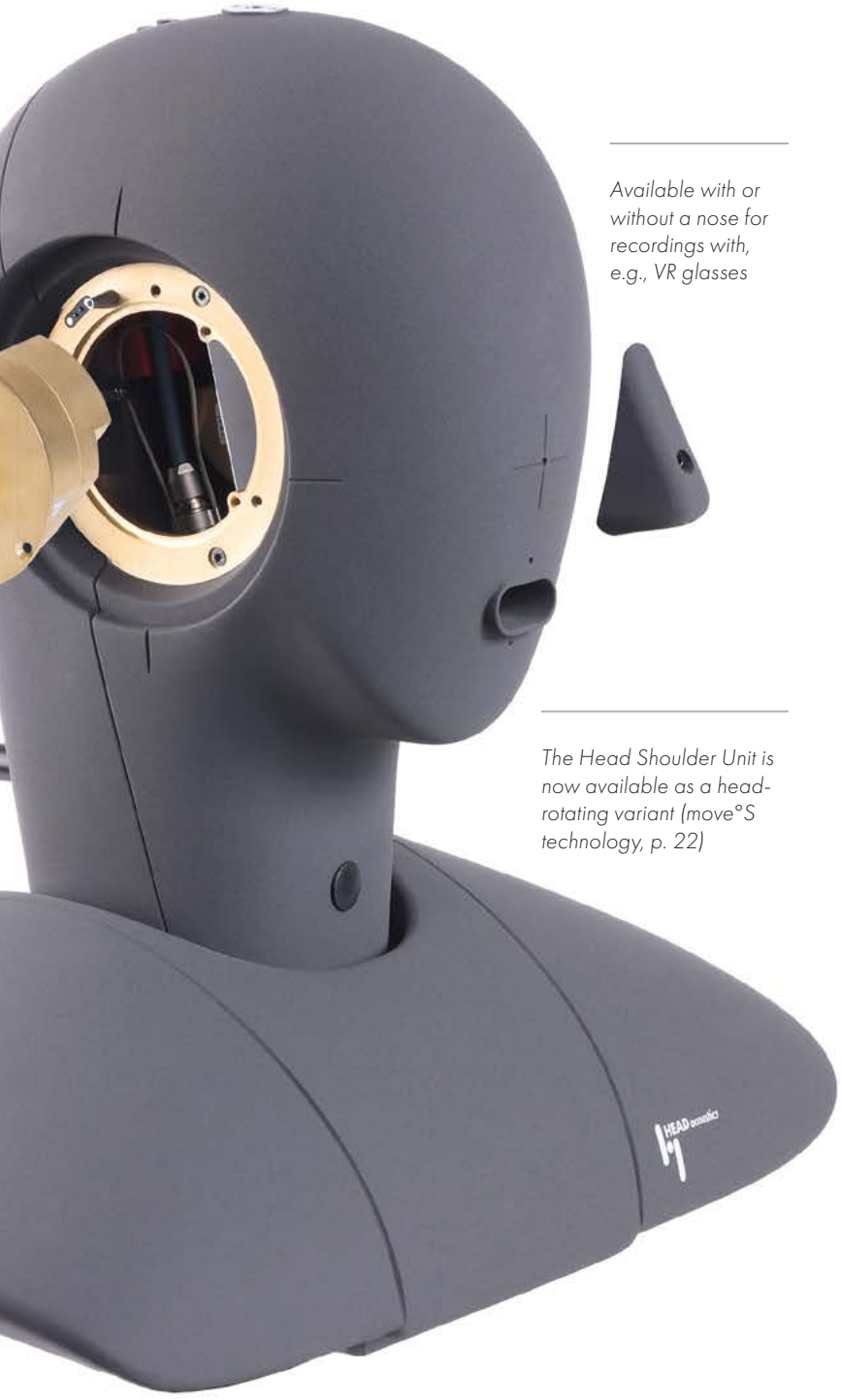
Replaceable anatomically shaped pinnae

VERSATILE

- Close-to-ear: mobile phones, handsets, ANC headphones/ headsets, and smart speakers in the nearfield
- Far-to-ear: hands-free systems or smart speakers
- Sending and receiving directions



Its modularity makes the HEAD acoustics range of Artificial Heads uniquely versatile.



Available with or without a nose for recordings with, e.g., VR glasses

The Head Shoulder Unit is now available as a head-rotating variant (move°S technology, p. 22)

The unique modular concept of our HMS Artificial Heads gives you unprecedented possibilities. You can equip the Artificial Head with various realistically shaped ear simulators and, depending on the model, an artificial mouth. You can even upgrade an existing HMS II.3 LN HEC with our ViBRIDGE technology to simulate Bone Conduction. This modularity makes the HEAD acoustics range of Artificial Heads uniquely versatile.

MODULAR

- Adapt your HMS quickly and efficiently to alternating tasks with state-of-the-art accessories
- Comprehensive choice of pinnae, ear canal simulators, and an artificial mouth
- Exclusive bone conduction variant ViBRIDGE for in-ear headsets using a structure-borne sound simulator
- Handset positioners HHP III.1 and fully automated HHP IV place handheld devices in standard or user-defined positions

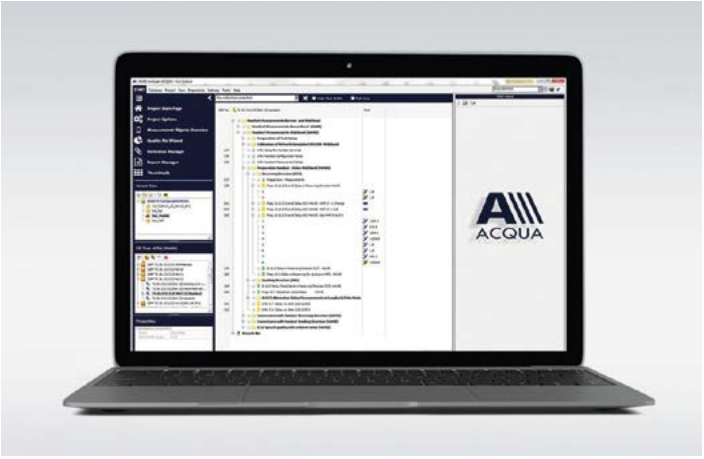
Communication and Audio Analysis

ACQUA

Advanced communication quality analysis

ACQUA is a highly sophisticated measurement and analysis software for optimizing speech and audio quality. The software, combined with the hardware platform labCORE, forms a precise, automated, and flexible system for R&D, conformance tests, and quality control of devices and systems.

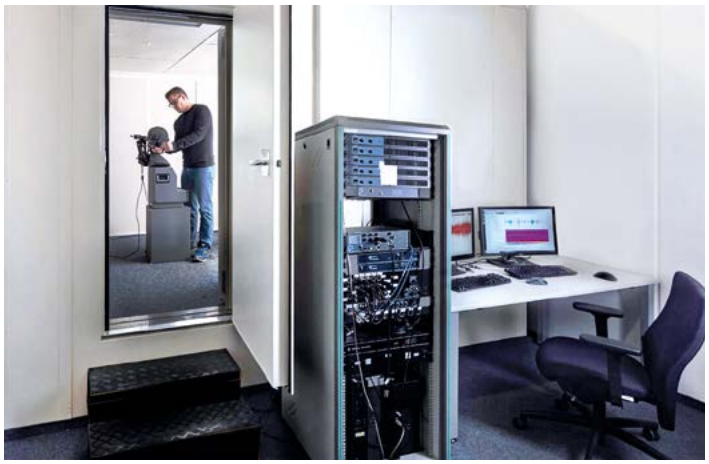
ACQUA is the reliable basis for the complete measurement chain – from the generation of complex excitation signals to the automated conduct of measurements and the analysis of measurement signals to secure storage and documentation.



KEY FEATURES

- Analyses in the time domain: level, level vs. time, delay, etc.
- Analyses in the frequency domain: frequency response, loudness ratings, echo loss, distortion, background noise, out-of-band signals, etc.
- Database-controlled configuration & control of test procedures, front ends, and hardware platforms
- Predefined test cases for automated & guided measurements according to various – partly mandatory – international standards
- Digital real-time equalization of any ITU-T-compliant artificial mouth
- Individual default settings definable
- Modifiable measurement descriptors
- Automated measurement sequences







ACOPTs – ACQUA options for extended software functionality

Our ACQUA options, so-called ACOPTs, make it easy to tailor the software individually to your requirements. The ACOPTs cover a broad range of tools and methods for any conceivable application and need, for example

- tools for signal generation and analysis
- unique calculation methods for psychoacoustics
- exclusive perception-based methods for instrumental speech quality evaluation using Mean Opinion Score (MOS) values
- convenient options for clear and concise result presentation, e.g., one-view visualizations according to ITU-T

Communication and Audio Analysis

ACOPTs

A small selection from our various options for ACQUA

LEAP

Predicting Listening Effort without a Reference Signal

LEAP (Listening Effort Prediction from Acoustic Parameters) predicts the perceived listening effort associated with a degraded speech signal. The single-ended algorithm analyzes only the recorded signal and requires no undisturbed reference signal. This makes LEAP suitable for synthetic speech from smart speakers, navigation systems, or text-to-speech engines, as well as announcements at train stations and airports, where reference signals are often unavailable. Developed by Fraunhofer IDMT-HSA, LEAP enables reliable and efficient listening effort assessment in laboratory and real-world applications.

Speech-Based Distortion Measure

Speech-Based Analysis of Distortion

Speech-Based Distortion Measure (ACOPT 41) identifies and quantifies distortion in modern speech communication terminals according to ETSI TS 104 063. Instead of artificial test signals such as sine tones or sweeps, the method uses natural speech to assess nonlinear behavior across the complete transmission path. It is particularly suitable for devices employing advanced signal processing or codecs that may filter out artificial signals and make conventional distortion metrics unreliable.








MDAQS

A Milestone in Instrumental Audio Quality Evaluation

The ACQUA option MDAQS uses binaural recordings to mimic human hearing and the acoustics involved. It merges three key MOS values for audio playback quality – timbre, distortion, and immersiveness – into one overall MOS value for a quick assessment and good comparability, making it the world's first binaural, perception-based measurement tool that assesses device audio quality in a scientific and quantifiable way. MDAQS, ACQUA, and the labCORE hardware easily replace your current measurement gear for unrivaled versatility and performance, delivering fast, consistent, and comparable results that no other audio quality measurement system offers today.

- Uses advanced metrics and AI to recreate the human perception
- Substitutes naïve listener evaluation in the audio device development process
- Achieves more reliable and meaningful audio quality testing results
- Speeds up the development process

Find out everything about all ACQUA Options:

ABLE

Objective Assessment of Listening Effort in Telecommunications



ACQUA Option ABLE is a prediction algorithm that enables an instrumental method for determining listening effort, complying with ETSI TS 103 558. In several studies, the perceived listening effort proved to be a more suitable measure than speech intelligibility when it comes to analyzing near-end speech communication quality in the presence of background noise, benchmarking, and comparing system and device performance in crowded rooms, noisy cars, etc.

ABLE uses noisy speech signals as perceived by users as input and Mean Opinion Scores (MOS) for quick evaluation and comparison of results. The highly accurate 3PASS background noise simulation complements the setup. Measurements with ABLE are a simple but universal, efficient, and conclusive method for comprehensively analyzing near-end speech communication quality in telecommunication, thus ensuring consistent, fully repeatable testing.

Communication and Audio Analysis

HEAD Standards

ACQUA Standards

Automated Test Suites for ACQUA

ACQUA standards provide complete implementations of all relevant international standards, for example, from 3GPP, ITU-T, ISO, IEC, ETSI, TIA, GCF, CTIA, GSMA, and Microsoft (Teams) for speech and audio quality. HEAD acoustics implements the ACQUA standards in databases for automated testing according to typical requirements. The more than sixty test suites provide advanced testing methods and focus on audio, speech, and communication quality.





HQS-Car-Audio measurement configuration for comprehensive in-car audio quality testing

HEAD acoustics Quality Standards (HQS)

Optimize Product Quality Beyond International Specifications

The international standardization bodies define specifications that cover a wide range of measurements and analyses for evaluating and optimizing communication systems. HEAD acoustics Quality Standards (HQS) go one step further: The test suites developed by HEAD acoustics enable manufacturers to measure and analyze their products beyond international specifications and optimize product quality.

Speech Recognition

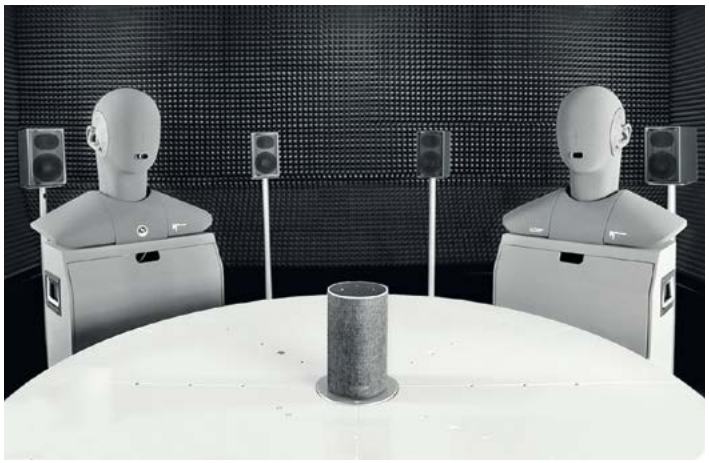
VoCAS (Voice Control Analysis System)

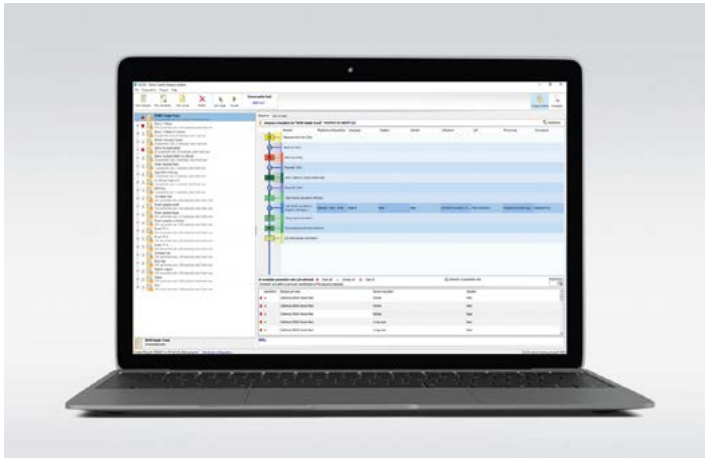
Test speech recognition performance – bring reality into the lab

The VoCAS software objectively tests and evaluates speech recognition performance in a smart home, vehicle, or smartphone – to name a few – in a realistic environment. VoCAS is part of HEAD acoustics' sophisticated measuring and playback framework that mimics real-life situations as closely as possible, incorporating critical factors in measuring speech recognition quality with a so far unknown scope: VoCAS considers the acoustic environment, background noise, different talkers, different languages, and even accents.

VoCAS Core is the basic framework of VoCAS.
It features

- test sequence templates for creating test cases to test and train ASR systems
- remote control of background noise and reverberation simulation software
- remote control of turntable HRT I







Make any speech-activated device understand and perform better with VoCAS and VoCOPTs

VoCOPTs

Build VoCAS Applications According to Your Requirements

VoCAS Options (VoCOPTs) extend the VoCAS Core with additional features and can be freely combined. The VoCOPTs fit any customer requirements.

VoCAS Options allow you to

- record and edit customized audio files
- create customized audio source databases for application in VoCAS
- distract and test ASR systems with concurrent talkers
- automate and accelerate test sequences with Python scripting
- control VoCAS remotely
- generate audio file batches with different parameters to train or test ASR systems

Data Acquisition

labCORE

Modular multi-channel hardware platform
for speech and audio quality testing



Up to 32 channels at 48 kHz or up to 8 channels at 192 kHz sampling rate, high-end inputs and outputs, and programmable interfaces

labCORE is a high-precision speech and audio quality testing hardware platform tailored to the ACQUA measurement and analysis software.

Up to 32 channels at 48 kHz or up to 8 channels at 192 kHz sampling rate, high-end inputs and outputs, and programmable interfaces: the state-of-the-art all-in-one solution offers and combines numerous features, so you can adapt labCORE precisely to your individual test scenarios and expand the hardware platform flexibly whenever needed. This modularity makes labCORE future-proof: New technologies can be added quickly and easily via optional hardware or software extensions.

Use labCORE for

- testing speech and audio quality of communication devices
- measuring loudspeakers and high-quality audio devices
- testing transmission systems such as networks and routers
- research and development (R&D)
- conformance testing
- quality control

KEY FEATURES

- High-precision measurement technology
- High-performance digital & analog inputs and outputs
- Modular: up to 10 optional hardware extension boards and numerous software extensions
- Up to 32 channels at 48 kHz or up to 8 channels at 192 kHz
- Versatile, individual tailoring to specific measurement tasks
- Future-proof – conveniently implement new technologies and interfaces
- Fast, easy configuration and control via ACQUA
- Silent operation, no fan

Data Acquisition



Integrated labCORE extensions

Adapt labCORE to your needs

These are some of the essential *lab*CORE extensions.

- **coreOUT-Amp2** is a power amplifier board that adds two separate power amplifiers to the system, each providing 20W RMS, allowing the simultaneous operation of two artificial heads' mouths or two loudspeaker drivers, for example, for in-car communication measurements (ICC).
- **coreIN-ICP4** provides four high-precision low-noise analog input channels for pre-polarized ICP® sensors, e.g., ICP® microphones. Each of the four inputs supports TEDS for data exchange with the connected sensor.
- **coreOUT-A2** and **coreIN-A2**: Analog input and Analog output boards. These labCORE extensions provide two analog input or output channels with XLR and BNC sockets. Both inputs and outputs offer the highest signal precision, achieving the lowest distortion and inherent noise.
- **coreBEQ** enables labCORE to equalize the binaural ear simulators of HEAD acoustics artificial heads. The extension consists of a set of equalization filters for one user-selected artificial head.
- **coreIP:** With coreIP, labCORE becomes a reference gateway for speech quality measurements of IP-based communication devices using VoNR, VoIP, or VoLTE. It supports numerous internationally relevant codecs and, with coreIP-IMP, enables the reproducible simulation of network impairments such as jitter, delay, packet loss, and packet duplication.
- **Bluetooth® connections**, including the Bluetooth® Low Energy Audio, Unicast, and Auracast: Realistically and reproducibly testing speech and audio quality via a Bluetooth connection (as transmitter and receiver) poses a real challenge for manufacturers since Bluetooth connections can significantly impact both the communication and audio quality.

You can find the complete overview on our website:



Other special extensions:

- The **coreA2B-Basic** interface connects labCORE to an A2B® network in four selectable modes, including operation as a main or sub node and passive listening. Optional Bus Monitor and Proxy extensions add bus-traffic monitoring and full control over receiving and inserting customized signals.
- **coreIP-IMP** simulates network conditions like jitter, delay, and packet loss.
- **coreIP-OPUS** provides the audio codec Opus.
- **coreIP-Alexa** enables the hardware platform to act as an Amazon Alexa reference client.
- **coreI/O-Dante** enables labCORE to transmit and receive multichannel audio via a Dante network.
- **corePDM-Rec** enables direct, simultaneous acquisition of up to eight PDM signals from MEMS microphones, providing a flexible, firmware-based solution for electroacoustic testing in telecommunications, automotive, hearing-aid, and wearable applications.

With the coreA²B board, labCORE connects to Analog Devices' A²B® bus in four user-selectable modes. Together with the extensions coreIN-Mic4 (LEMO) or coreIN-ICP4, it forms an ideal solution for automotive applications.



The analog input and output extension cards coreIN-A2 and coreOUT-A2 are highly precise, low-noise interfaces for analyzing broadband audio signals such as speech, music, or noise. They feature two in- or outputs respectively.



Sound Field Simulation

3PASS lab, flex, reverb

Background noise and reverberation can impair speech recognition system quality, speech quality, and speech intelligibility during phone conversations. To evaluate communication devices as well as systems with complex microphone setups, they must be tested with realistic and reproducible background noise and reverberation simulation. Our 3PASS simulation integrates into the powerful labCORE and ACQUA tool framework, offering unprecedented possibilities and ease of use.

3PASS lab

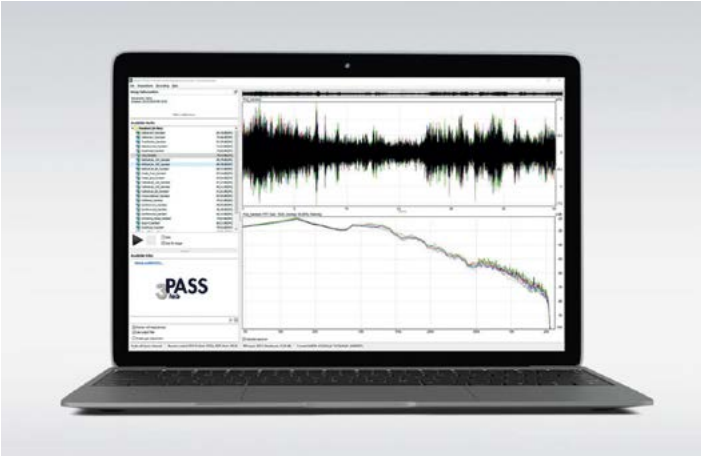
Fully automated background noise simulation for communication device testing

3PASS flex

Fully automated background noise simulation for distributed and complex microphone setups

3PASS reverb

Room reverberation simulation – controlled via 3PASS lab or 3PASS flex



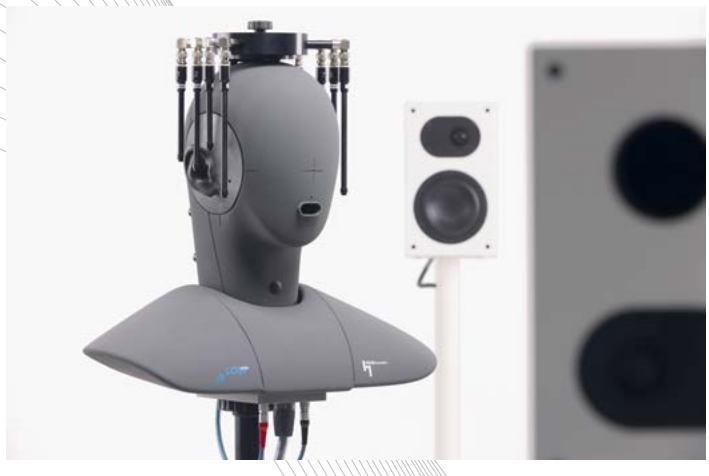
Automated background noise and reverb simulation with 3PASS

Find out everything about products related to playback and noise simulation:



MSA I

Asymmetrical 8-Channel Microphone Surround Array for recording three-dimensional sound scenarios for mobile phone applications



MSA II

Symmetrical 8-Channel Microphone Surround Array for recording three-dimensional sound scenarios for binaural applications

MSA I & MSA II

Microphone Arrays for Three-Dimensional Noise Recordings

The microphone arrays MSA I (asymmetrical microphone setup) and MSA II (symmetrical microphone setup) enable recording, equalizing the associated loudspeaker setup and realistically reproducing background noise and reverberation across laboratories.

HAE-car & HAE-BGN

Background Noise Playback and Semi-Automated Equalization in a Lab and Vehicle

The HAE-car and HAE-BGN software allow semi-automated equalization and enable automated playback of background noise in a vehicle cabin (HAE-car) and a lab (HAE-BGN). The equalization makes it possible to reproduce previously recorded noises in level and spectrum at an arbitrary location in the vehicle.

labBGN

Hardware Platform for Background Noise Simulation

labBGN is an audio distribution interface for up to ten channels. You can use this ACQUAlab generation platform with all our background noise simulation systems for fully repeatable testing of telecommunication and other devices in the presence of background noise.

Dynamic and Time-Variant Testing

Accessories

move°S

High-Precision Ultra-Silent Motorized Head Shoulder Unit

move°S rotates the 2021-generation HMS II.x and all Head Shoulder Units (HSU) III of the 2021 generation 1 with high precision and full repeatability. move°S can realistically simulate the head movements of a real person. The mechanism operates virtually noiseless and, therefore, can also turn the artificial head during measurements at all reasonable speeds.



Comprehensive testing of, e.g.:

- virtual/augmented reality (VR/AR) headsets
- in-vehicle communication systems & devices (ICC, eCall, hands-free communication, etc.)
- effects of acoustic reflections on shoulders and nearby surfaces, e.g., in vehicles
- arbitrary applications using head tracking
- systems with direction-dependent behavior, e.g., multi-user conferencing systems
- Head-tracked binaural rendering

KEY FEATURES

- Upgrades qualified HMS II and HSU III with a motorized turning of the artificial head
- Realistically simulates the head movements of a natural person
- Virtually noiseless operation – move°S can be used between and during measurements
- Software-controlled movement via USB or pulses, e.g., for full automation in HEAD acoustics test suites



HRT I

High-Precision Ultra-Silent Turntable for Orientation-Dependent Acoustic Tests

The HRT I high-precision turntable rotates test objects, e.g., telephony devices, (video) conferencing systems, loudspeakers, microphones, or measurement equipment like the HMS to specific angles in the measurement field while emitting no noise at the target positions. HRT I can perform fully automated tests offering a 360° rotation range in 0.1° steps and a reproduction accuracy of 0.02°.



HRR I

Rotating Sound Reflector

During acoustic tests, the HRR I noiseless motorized rotating reflector influences the acoustic coupling between the loudspeaker and microphones, allowing you to quickly change and reset the acoustic echo path, e.g., in hands-free communication. You can use HRR I in any hands-free situation and location as an automated and noise-free acoustic reflector, giving you complete control and precise repeatability.

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