HEAD acoustics

DATA SHEET

Code 7500ff

HEAD VISOR

Software for Localizing Sound Sources in Real Time

OVERVIEW

HEAD VISOR

Code 7500ff

Software for localizing sound sources in real time

HEAD VISOR is a sophisticated beamforming software for sound identification and analysis. In combination with an acoustic camera such as VMA V, HEAD VISOR enables sounds to be attributed to objects within the camera image. An acoustic camera like VMA V records all sound sources with its microphone array and then displays information about these sound sources such as position and noise levels in real time within the video image. Various additional features enable detailed insights into the acoustic characteristics of complex measurement objects and adaptations to a wide range of requirements.

HEAD VISOR offers a multitude of features and still remains an easy-to-use tool. It provides a clear and concise user interface that gives an overview of all relevant information, quick access to important features, and an easy way to monitor the effect of modifications like filters or other changes applied to the sound source in real time.

HEAD VISOR is ready to use as soon as the acoustic camera is switched on and connected. The measured data is transmitted from the camera's microphone array to HEAD VISOR via a LAN connection and is buffered by the permanently active FreezeBuffer. With this raw data, you access an unaltered representation of all test parameters after the measurement so that you can perform analyses very flexibly, even offline and in retrospective.

KEY FEATURES

Quick and precise representation of sound sources

Non-destructive handling of measurement data

Intuitive software
- Easy-to-use and familiar project structure
- Determine the distance to various objects
- Identify sound sources in the video image
- Analyze results retroactively thanks to FreezeBuffer
- Apply multiple analysis parameters in parallel
- Monitor modifications in real time

Detailed acoustic insights into complex objects
- Stationary/non-stationary sound sources with high time resolution
- Rotating or RPM-variant measurement objects
- Large sound-emitting surfaces
- Moving objects

Exporting and reporting
- WAV, video, and PowerPoint export options
- Connection to ArtemiS SUITE via Automation Projects/Reports

Flexible licensing model
- Several application-focused base versions
- Tool Packs with carefully selected additional features to extend the base version

APPLICATIONS

Troubleshooting/Quality management/Testing/Leak detection

Analyzing and optimizing sounds

Room and structural acoustics

Test benches
- Detecting sound-radiating components
- Visualizing acoustic weak points

Wind tunnels
- Eliminating rough edges having major impact on interior wind noise

Wind turbines
- Auralizing locations with the most sound energy
- Localizing typical wind turbine noise sources
- Analyzing the acoustic effect of different rotor designs

DETAILS

HEAR MORE WITH YOUR EYES

The base version of HEAD VISOR provides extensive functionality for recording, analyzing, and exporting measurements. It has a modular design and offers all essential features from data acquisition, measurement data management, configuring analysis parameters to displaying the calculated results image in a straightforward interface. HEAD VISOR can be extended by Tool Packs, with each Tool Pack containing a feature set tailored for a specific application.

Real-Time Principle

HEAD VISOR works based on the real-time principle. All process stages are performed live and the effects of modifications, filtering, or changes made to the sound source are immediately visible and audible.

FreezeBuffer

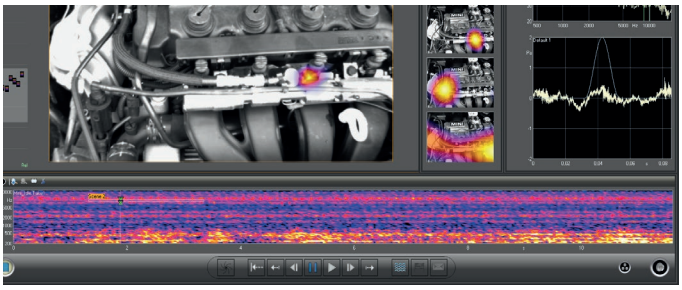
FreezeBuffer is a permanently active circular recording buffer that continuously stores up to 30 seconds of raw measurement data as received from the microphone array. This data can be accessed even retrospectively and can also be played back like a regular recording. You can apply different analyses, use filters, and modify measurement parameters just as with live data.

Raw Data Processing in Offline Mode

Every measurement performed with HEAD VISOR and stored on the computer contains raw data from the cameras and the microphones.

In Offline Mode, you can work with recorded measurements as if an acoustic camery like VMA V was connected. You can change test parameters and filters, place virtual microphones, monitor the camera image even in slow motion, listen to the audio data, and create scenes even after the measurement.

Our hand-held acoustic camera system VMA V is designed to be combined with HEAD VISOR. VMA V provides up to 120 high-resolution MEMS microphones for fast, intuitve, and professional real-time sound source localization.

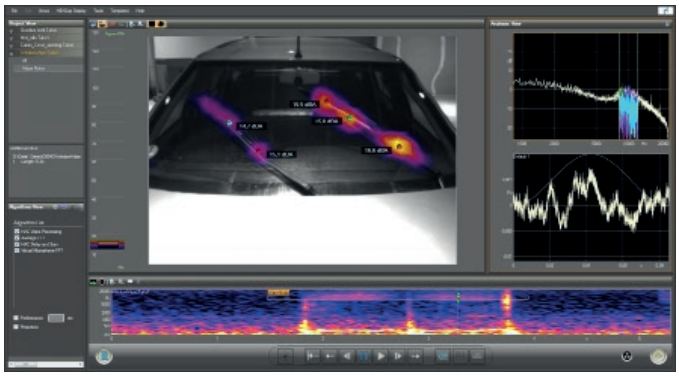


You can access up to 30 seconds of measurement data via the FreezeBuffer control at the bottom of the HEAD VISOR user interface.

Playback and Virtual Microphones

Playback and analyses can be performed in slow motion (forward and backward), in a loop, or alternately between individual scenes. Besides playing back the complete sound, you can also isolate sound components or orders by filtering and playing them back individually.

In order to focus the playback on a particular sound source, you can place virtual microphones in the video image and listen to the emitted sound as if a real recording device had been placed. Virtual microphones can be freely moved via drag-and-drop to anywhere on the camera image.



Virtual microphones enable the playback of sound emissions at different positions on the measurement object.

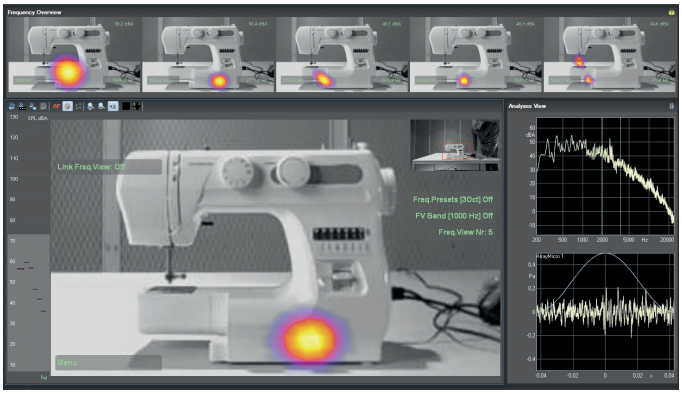
Range Meter

The Range Meter displays the levels of the acoustic map. Furthermore, the Range Meter enables level range adjustment, thus concentrates the display on a specific dynamic range. For better interpretability, the color map of the level range display can be adjusted so that plot dynamics are overlaid by a color scale.

The color map overlay either adaptively highlights the loudest sound source at any given moment or alternatively with an absolute level assignment in order to ensure direct comparability of two measurements.

Multi-Band Mapping

With the multi-band mapping function, you can analyze and display multiple additional frequency ranges in parallel. This enables even wide frequency ranges to be monitored and evaluated.



Multiple additional images are displayed above the main camera view with each image showing the analysis result for a particular frequency range.

Trigger

Triggers are used to start and stop recordings depending on configured trigger conditions. As soon as an event fulfills the trigger condition, the recording starts or stops respectively. You can define these trigger conditions using specific frequencies, signal levels, or time events. Furthermore, external channels can be used for triggering the start or the stop of a measurement.

Export and Screen Recorder

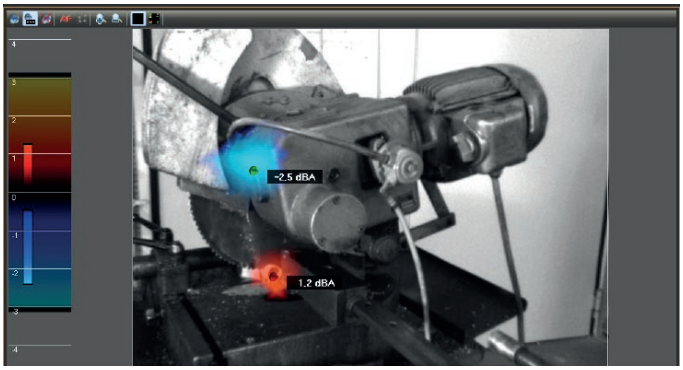
Measurements and their results can be exported as video, as still images, as a PowerPoint file, or as measured and calculated time-domain signals (AVI with sound, PNG, JPG, BMP, WAV, HDF). You can further process exported measurements, for example, in ArtemiS SUITE.

With the Screen Recorder, you can record the complete user interface during a measurement and embed the recording into a presentation. Additionally, you can export the complete user interface including all its reactions to user input, for example, like parameter or setting changes.

Comparative Functions

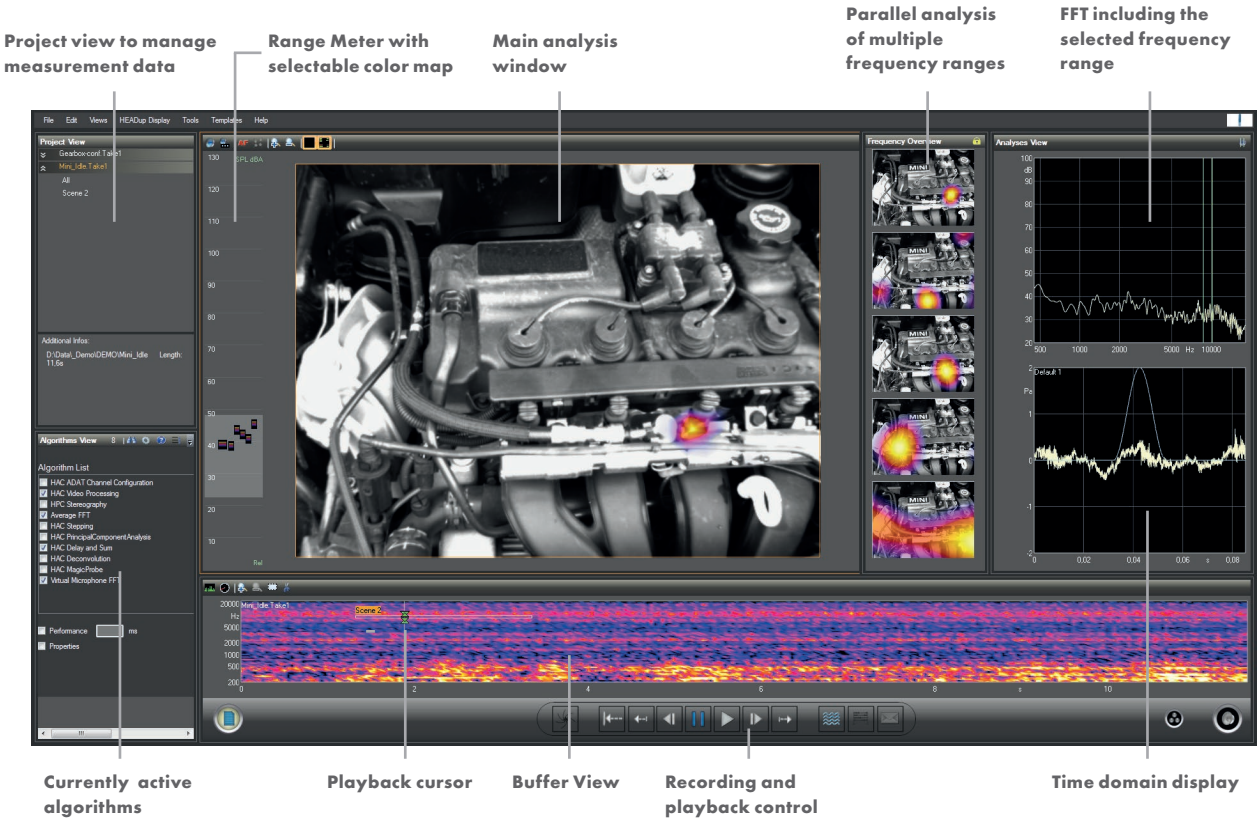
To better evaluate or compare sound sources, HEAD VISOR comes with additional functions:

- **Synchronized Ranges:** This function displays loaded measurements with the same color coding as the previous measurement.
- **Delta Mapper:** The Delta Mapper function highlights small, relative changes between two setups in a difference image.
- **HDR function:** The HDR function combines detailed results from multiple analyses into a single result image with a high dynamic range.



Delta Mapper: Only differences to the original state are colorized and highlighted.

USER INTERFACE



LICENSES

HEAD VISOR is available in the following application-based base licenses. Each base license includes the Algorithms, the Frequency Overview, and Virtual Microphones. The base licenses can be further extended with Tool Packs which are listed in more detail below. The following table shows the modules that are included in each license.

	HEAD VISOR (Code 7500)	**HEAD VISOR core (Code 7510)**	**HEAD VISOR record (Code 7511)**	**HEAD VISOR snap (Code 7512)**
Recording	✓		✓	
Online View	✓		✓	✓
FreezeBuffer	✓			✓
Online Analysis	✓		✓	✓
Offline Analysis	✓	✓		
Export	✓	✓		✓
Project View	✓	✓		
Algorithms	✓	✓	✓	✓
Frequency Overview	✓	✓	✓	✓
Virtual Microphones	✓	✓	✓	✓

The combination of HEAD VISOR core and HEAD VISOR record (e.g., via two dongles) provides the same functionality as HEAD VISOR.

Tool Pack Licenses

- **HEAD VISOR TP01** (Code 7501)
  - Multiple Eye
  - Depth Map Autofocus
- **HEAD VISOR TP02** (Code 7502)
  - Order Detection
  - Pulse Gate
  - Derotation
- **HEAD VISOR TP03** (Code 7503)
  - Neural Deconvolution
  - Coherence
  - Stepping
  - PCA
- **HEAD VISOR TP04** (Code 7504)
  - Software option to measure with HEAD VISOR Probe and to analyze HEAD VISOR Probe measurements

Which License Do I Need?

The **HEAD VISOR** license (Code 7500) gives you the complete power of HEAD VISOR and VMA V. You can use all functionality this easy-to-use and highly efficient combination has to offer.

The **VISOR core** license (Code 7510) provides all features necessary to analyze sound sources. This license is appropriate, for example, if you want to separate analysis from recording. Then, VMA V can be used for further recordings, e.g., using a VISOR record license, while earlier recordings are being analyzed. VISOR core also gives you access to the Project View so that you can work with all previously recorded raw data and the respective projects.

The **VISOR record** license (Code 7511) gives you all possibilities to record sound sources. This license is suitable, for example, if you want to separate recording from analysis. In such a scenario, VMA V can be used to make further recordings while finalized recordings are analyzed somewhere else, e.g., using a VISOR core license.

The newly introduced **VISOR snap** license (Code 7512) is our most affordable license especially if you use the base array only. With VISOR snap, you can use the online mode and analyze sound sources in real time. Although recording is not possible, you still have the FreezeBuffer to go back in time and apply different analyses, use filters, and modify measurement parameters. Furthermore, you can take pictures and record videos of the measurement situation providing you with a permanent result.

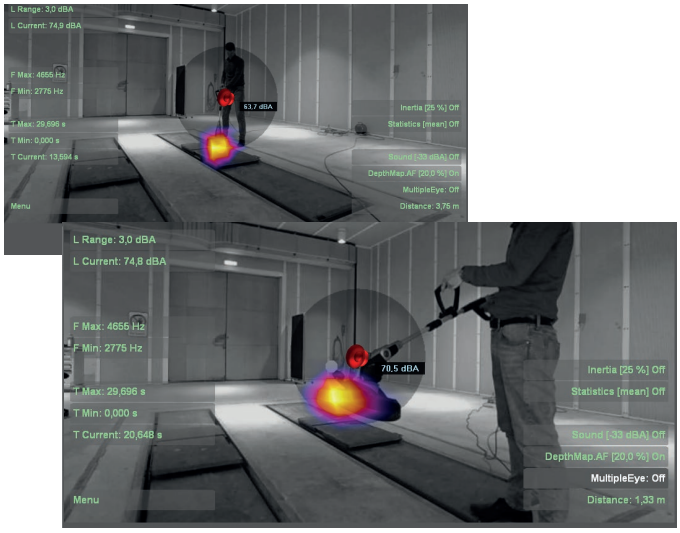
TOOL PACKS

HEAD VISOR TP01
MultipleEye Focus

To locate a sound source with high-precision, the beamforming algorithm requires exact data about the distance between the array and the sound source. While it would be possible to manually measure the distances to individual objects, the exact point where the sound is emitted is still unknown.

The unique MultipleEye technology combines the images of the cameras to optically determine the distance between the array and the measurement objects in the camera image. The distance can be determined in real-time or retroactively in offline mode, since all relevant information is included in a recording.

With this advanced technology, it is possible to focus the array on different objects in the camera image during evaluation and to calculate the beamforming with the precise distance to the object currently in focus.



Real-time auto-focussing on a moving object with the Depth Map Auto Focus feature.

HEAD VISOR TP02
Order Analysis Module

RPM Acquisition

Two rotational speeds can be acquired by means of pulse signals and conveniently monitored on tachometers. RPM values can also be used as start and stop triggers.

Order Detection

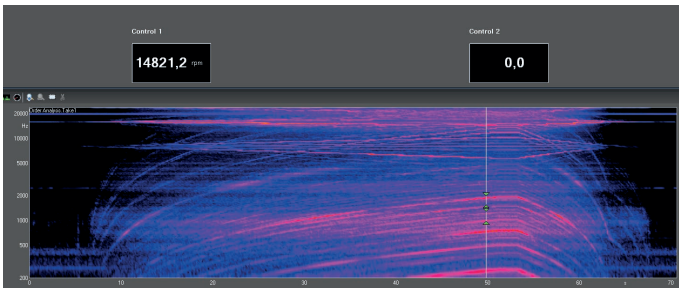
Orders can be detected by means of rotational speed data and highlighted, e.g., in order to analyze RPM-variant run-ups.

Pulse Gate

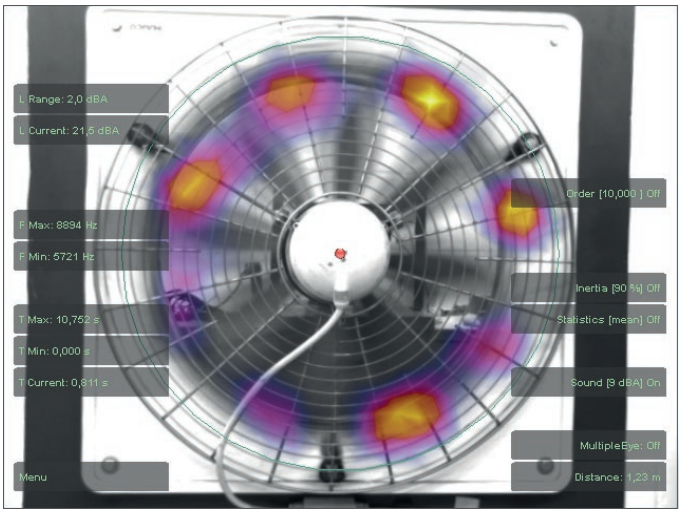
This analysis focuses on a specific time range within a cycle, e.g., in order to analyze the noise emissions of an engine at a specific ignition point.

Derotation

The Derotation algorithm enables you to compensate the rotation of a component in order to examine, for example, sound phenomena that occur at the tips of the individual blades of a rotating fan.



Order Detection applied to an engine run-up measurement. The analysis displays the detected orders with their individual frequency and level progression over time in a 3D diagram.



Compensating the component rotation of a fan with the Derotation algorithm precisely locates the sound phenomena on the tips of the blades.

HEAD VISOR TP03
Advanced Algorithms

Neural Deconvolution

Neural Deconvolution is an AI-based algorithm that utilizes neural networks to improve the localization and quantification of sound sources when using beamforming.

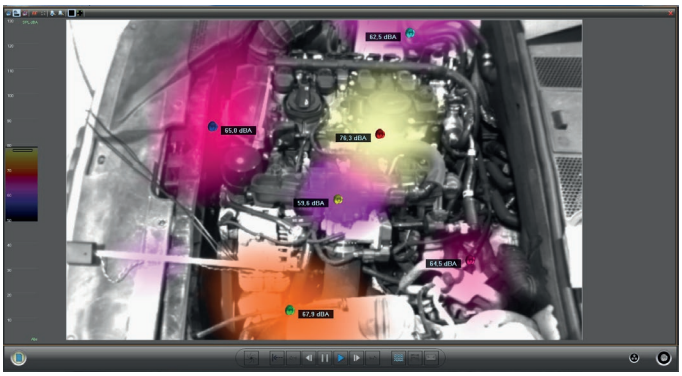
In conventional beamforming, as a principle, the discrete sampling of the measuring device strongly influences the result. This means that the sound sources shown in the acoustic camera image are the real sources influenced by discrete sampling. This influence can be expressed as a convolution between the sources and the array's Point Spread Function (PSF), which describes the sampling's influence on individual sources. As a result, the array may mask certain sound sources and distort their strength estimates.

The Neural Deconvolution method aims to remove the effect of the PSF by, firstly, analyzing the beamforming result and estimating the focus points of the sources. Secondly, an analytical deconvolution is performed only on these points to correct the sources' amplitudes. The Neural Deconvolution algorithm is currently the only commercially available method capable of performing real-time deconvolution.

The same measurement situation without Neural Deconvolution (smaller picture above) and with Neural Deconvolution.

Stepping Algorithm

Up to eight sound sources can be removed from the measurement, e.g., for an easier analysis of background noise with low signal levels, simply by clicking with the mouse.



The stepping algorithm enables step-by-step detection of sound sources and combines them into an overall HDR image.

Principal Component Decomposition

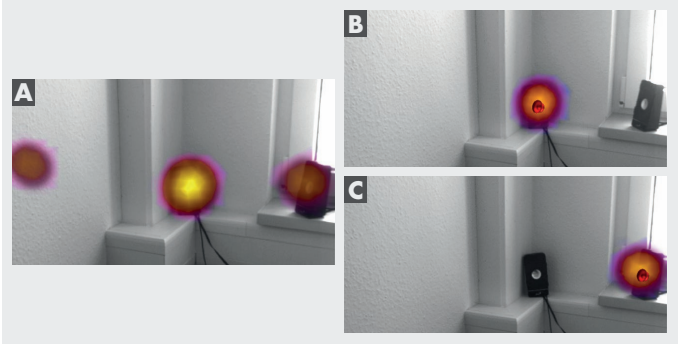
For sound sources interfering with each other, as a first step, the principal component decomposition algorithm is able to decompose the measured total sound into its main emission sources. In the next step, these decomposed individual sound sources can be separated from the total sound and located very precisely.

Coherence Filtering and Amplification

HEAD VISOR calculates the coherence of the array microphones with a reference signal in real time and filters or amplifies the corresponding components. As a reference signal, many devices can be used, such as microphones, accelerometers, laser vibrometers, but also a virtual microphone.

Coherence analysis also enables a differentiation between direct sound and reflections by means of "gated coherence".

Reflections, which are a common interfering phenomenon in beamforming applications, can thus be identified and removed with a simple mouse click.

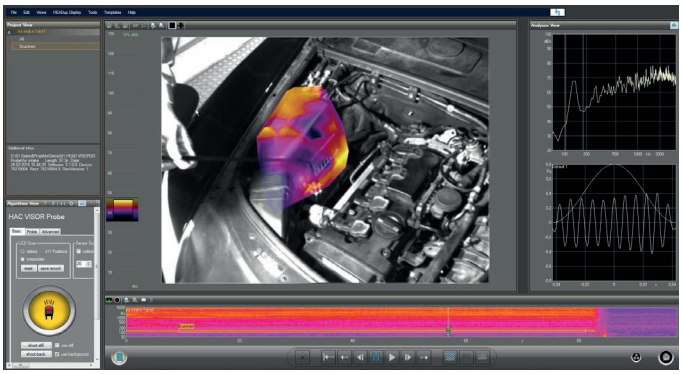


Coherence analysis
A: Two sound sources, one of them with a wall reflection. B: Only the first sound source is shown. C: Only the second sound source is shown without its reflection.

HEAD VISOR TP04

HEAD VISOR PROBE

With HEAD VISOR PROBE, you can measure low-frequency components of a sound source. HEAD VISOR PROBE extends the frequency range to be analyzed down to 20 Hz and is ideal for sound frequencies below 600 Hz. It comes with two microphones and LEDs on the tip and is supplied externally, for example, via a USB connection to VMA V.



Recording of low-frequency emissions of an air filter with HEAD VISOR Probe at 130 Hz. Parallel evaluation with beamforming.

SYSTEM REQUIREMENTS

Operating System	Windows 11 x64 (Pro, Enterprise, Education; version 21H2 or newer; languages: US, Western European), Windows 10 x64 (Pro, Enterprise, Education; version 1809 or newer; languages: US, Western European)
Processor	Quad core processor with 2.5 GHz (recommended: 3 GHz)
RAM	8 GB (16 GB recommended)
Graphics adapter	NVIDIA CUDA capable and DirectX 9.0c-compliant graphics adapter (500 parallel processing cores) with 1 GB (recommended: NVIDIA CUDA 6.1, Pascal architecture, 1000 parallel processing cores)
Graphics driver (min. version)	Quadro-RTX: 553.35 GeForce: 566.36
Display	Display with WXGA resolution (1366x768) (recommended: FHD-resolution (1920x1080))
Sound card	On-board
Network	Dedicated 1000 MBit/s ethernet interface

HEAD acoustics

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