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DATA SHEET

# HEAD VISOR *flex*

Modular array system with a large number of microphones for the HEAD VISOR system for real-time identification of sound sources

## Overview

HEAD VISOR *flex* is a modular array system for real-time sound identification and analysis.

The size and shape of the array and the number of microphones can be freely and flexibly adapted to a wide range of different applications.

Particularly for applications where sounds need to be localized from a great distance or with low frequencies, for example, HEAD VISOR *flex* systems with their large aperture and their large number of microphones are suitable, achieving a very high localization accuracy.

The individual components are easy to transport and can be set up very quickly and mounted in a stable manner.

In spite of its high flexibility and powerful functionality, each HEAD VISOR *flex* system remains an easy-to-use tool.

## Features

Flexibly configurable microphone array system with high resolution and localization accuracy

### A versatile scope of application

- Real-time localization of sounds, particularly with low-frequencies up to below 100 Hz or at great distances, e.g.
  - in a wind tunnel
  - in pass-by measurements
  - for wind power plants
  - for door-slamming sounds

### Modular design

- Flexible combination of front ends, input modules, ICP free-field microphones, etc. into customized systems
- Freely configurable array shape based on rugged panels, fitting every test rig
- Up to several hundreds of microphones in one system
- Inclusion of additional reference channels, such as artificial heads or speed sensors

### MultipleEye technology

- Camera module with MultipleEye technology for automated measuring of the precise distance between the array and the respective sound source

### Powerful software

- Software with an innovative handling concept, a straightforward user interface, and a wide range of functions

### Real-time principle

- Effects of modifications, filtering, or changes of the sound sources can be monitored in real time

### High precision

- Source mapping with a high dynamic range depending on the array shape chosen
- Factory phase matching of all free-field microphones used in a system in order to minimize signal delays between microphones
- Synchronization of all microphone signals by the front end with sample accuracy

### Easy handling

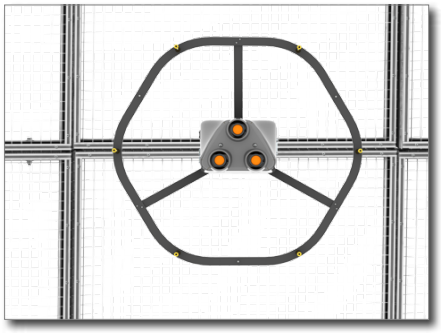
- Quick assembly and disassembly of the array
- Automatic acquisition of microphone positions (no manual entry required)

### High safety

- Mobile base frame with feet for high stability of the array
- Quick and safe mounting to a wall or ceiling

# HEAD VISOR *flex* Components

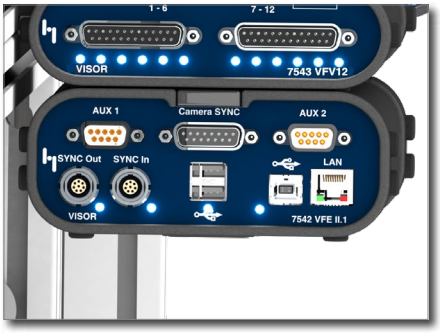
## Camera module VFC I.1



- The VFC I.1 camera module provides the HEAD VISOR software with a live video image, on which a synchronized high-resolution source map is overlaid in real time.

  By means of the unique MultipleEye technology, images from the three calibrated cameras can be used to optically determine the distance to the objects in view.
- Additional specifications:
  - LAN connection to PC
  - Triggering via the VFE II.1 front end
  - Retroactive offline evaluation of the data possible - including distance measurement to individual objects
  - Quick acquisition of the positions of all installed microphones by means of the positioning set VFA I.1 and additional hardware components
  - Easy installation or removal of the camera module in any position on the VFG I.1 grid panel
  - Alternative mounting option for the camera module on the dolly tripod VMT I.1, e.g. for flexible use with test rigs accommodated in a constricted room

## Front end VFE II.1

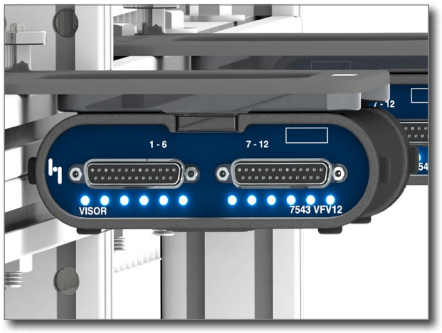



- The VFE II.1 front end is the central connection unit in a HEAD VISOR *flex* system.

  The VFE II.1 handles data aggregation and the synchronization of all connected input modules or microphones and passes the signals to the HEAD VISOR software in real time.

  If additional reference or pulse channels are required, they can be connected via suitable modules, such as artificial heads or pulse sensors.
- Additional specifications:
  - LAN connection to PC
  - Triggering of the VFC I.1 camera module
  - Synchronization and control of up to five VFV12 input modules or other HEAD*lab* input modules with sample accuracy
  - Connection with additional front ends to create larger HEAD VISOR *flex* systems with several hundreds of microphones and sample accuracy
    - Additional VFE II.1 front ends for connecting additional VFV12 input modules
    - Additional *lab*CTRL I.2 controllers for connecting HEAD*lab* input modules for artificial heads, RPM or speed sensors, etc.
  - Easy mounting and safe attachment to the VFG I.1 grid panel
  - Silent operation (fanless), low weight, rugged design

## Input module VFV12




- The VFV12 input module is a low-cost variant of the *lab*V12 HEAD*lab* module, which is designed specifically for the requirements of microphone array technology. Up to twelve VMF I.1 free-field microphones can be connected to each VFV12 unit.

  It is characterized by a high phase accuracy of the 24-bit data and an excellent signal-to-noise ratio. It also ensures that all connected microphones use the same measurement range.

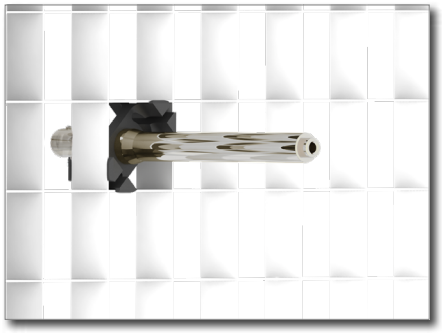
  The modules can be mounted in any position on the back sides of the grid panels, thus allowing a high degree of flexibility for setting up customized HEAD VISOR *flex* systems.

  The wiring between the VFE II.1 front end and the connected input modules uses a star topology.

  The interfaces on the front side of the VFV12 input module are combined into two Sub-D connectors for the breakout cables coming from the VMF I.1 free-field microphones.
- Additional specifications:
  - HEAD*link* connection to the VFE II.1 front end
  - Power supply via the VFE II.1 front end
  - Input impedance: 30.3 kΩ
  - Analog high-pass filter: 2.5 Hz
  - Silent operation (fanless), low weight, rugged design

# HEAD VISOR *flex* Components

## Free-field microphone VMF I.1

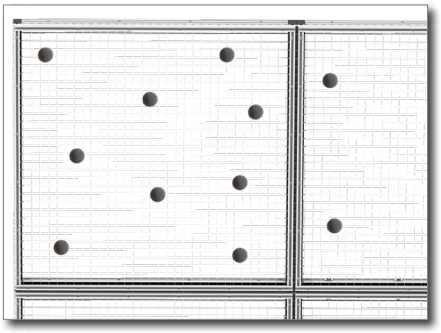


- The ICP free-field microphone VMF I.1 is optimized for operation in an array. The signal phases of each individual free-field microphone of a HEAD VISOR *flex* system are matched at the factory in order to minimize any signal delays between the microphones.

  The microphone socket VFM I.2 makes mounting really easy. It allows the free-field microphone to be easily snapped into any position on the grid panel and to be removed just as easily.

  The positions of the microphones on the VFG I.1 grid panel are determined automatically by the HEAD VISOR software. Using the positioning set VFA I.1 and the excitation speaker HXL, the microphone array of the VFC I.1 camera module measures the exact position of each individual free-field microphone without requiring data to be entered manually by the user.
- Additional specifications:
  - TEDS free-field microphone
  - Phase matching: ±5 °
  - Sensitivity: 17.8 mV/Pa

## Grid panel VFG I.1



- The VFG I.1 grid panel is the base element of the HEAD VISOR *flex* array and serves as a versatile and safe mounting platform for the free-field microphones, the front ends, the input modules, and, if applicable, the camera module.

  The included mounting elements allow any number of grid panels to be quickly and safely connected into a structure of any size and shape, allowing the perfect array to be created for any application.

  The array can be mounted, for example, on a wall, on the floor, on a ceiling, or on a pivot arm. For mobile applications, the mobile chassis VFT I.1 ensures high mobility while keeping the system safely in position.
- Additional specifications:
  - Rugged aluminum profile
  - Fine profile grid for custom positioning of free-field microphones
  - Dimensions (WxHxD): 1000 x 1000 x 86 mm / 3.28 x 3.28 x 0.28 ft
  - Weight: 4 kg / 8.8 lb.

## Mobile chassis for grid panels VFT I.1

- Thanks to the mobile chassis VFT I.1, even a completely mounted array with lengths and heights of several meters can still be freely moved and positioned. The high side arms and the floor cantilevers ensure the necessary safety against overturning.

  To fix it in position, the complete array can be propped up on feet via a pedal mechanism. The rollers are lifted at the same time, so that the height remains unchanged.
- Additional specifications (numbers refer to a single chassis):
  - Height 1.9 m / 6.2 ft
  - Depth: 0.9 m / 3 ft
  - Width: 0.09 m / 0.3 ft
  - Weight: approx. 12 kg / 26.5 lb.

# Hardware - Examples and Security

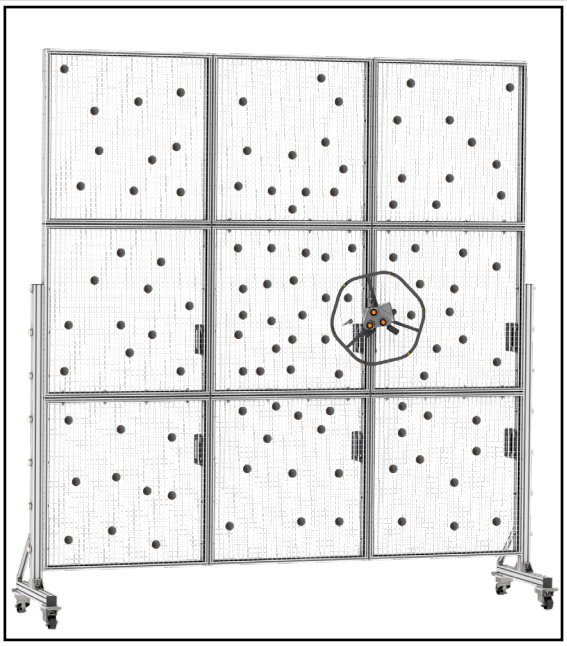
## Example Array

### Basic Components

- 1 x VFE II.1
- 1 x *lab*CTRL I.2
- 10 x VFV12
- 114 x VFM I.1
- 1 x VFC I.1
- 9 x VFG I.1
- n x Mounting Components/Cables/Power Supply

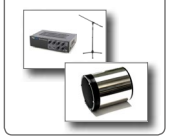
### Optional

- 1 x Additional Front ends
- 2 x Additional Modules
- n x Additional Channels



### Microphone Positioning

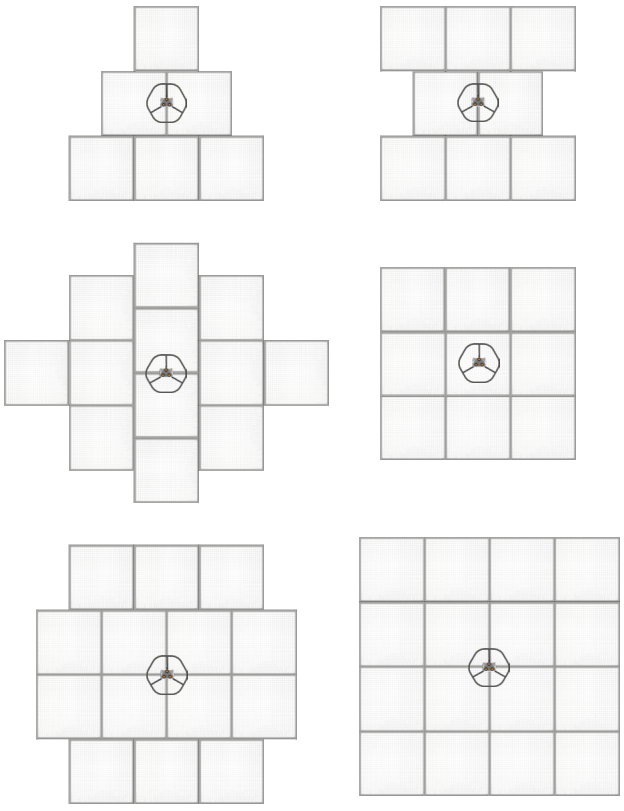
1 x



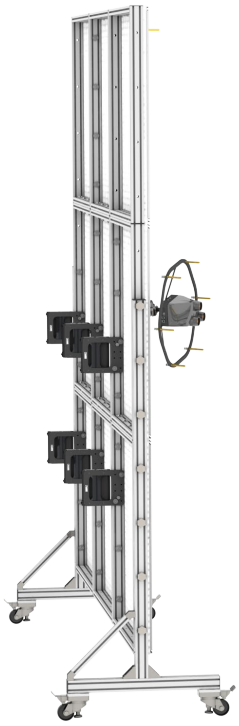
### Optional

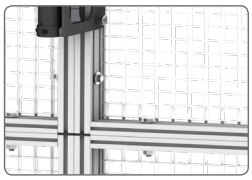
- 1 x VFT I.1
- 1 x VMT I.1

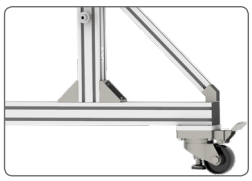
## Example Configurations

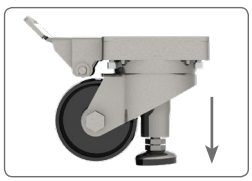


## Array Security



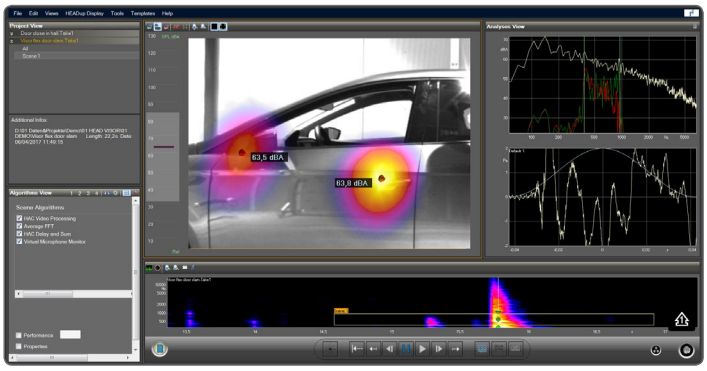






# Software - Overview

## HEAD VISOR Software



A rattle of the handle and the movable outside mirror during a door-slamming.

The innovative HEAD VISOR software for localization of sound sources performs all important work steps in real-time.

After turning the HEAD VISOR software on, the entire measurement system is immediately ready for operation. In spite of its great capabilities, HEAD VISOR remains an easy-to-use software. The user always keeps an overview of all important functions and monitors the influences of modifications, filtering, or changes to the sound sources in real time.

By means of the unique MultipleEye technology, the beamforming is always calculated with the exact distance to the object currently in focus.

The software automatically performs important functions. It is not necessary to manually start a recording. Thanks to the permanently active recording buffer (FreezeBuffer), sound events can easily be analyzed even retroactively.

Various additional functions allow for detailed insights into the acoustics of complex measurement objects and adaptations to a wide range of requirements.

The VISOR software has a modular design. The base version already provides extensive functions for recording, analyzing, and exporting measurements. With individual Tool Packs, special functions can be added.


Emission of intake noise from large distance during an accelerated pass-by.

### Basic Software

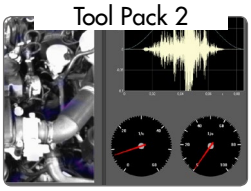
- Beamforming
- Real-time principle
- FreezeBuffer
- Analysis view
- Synchronized Ranges
- Delta Mapper
- HDR function
- Playback
- Export

## HEAD VISOR Tool Packs

### Tool Pack 1

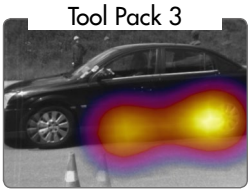
- MultipleEye technology
  - Synchronous video picture in real time
  - Exact distance determination

### Tool Pack 2



- Order detection
- Pulse Gate
- Derotation

### Tool Pack 3

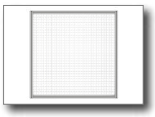


- Coherence filtering and amplification
- Reflections
- Stepping algorithm
- Principal Component Analysis
- Deconvolution algorithm

# Hardware - Overview

## Basic Components

- VFG I.1 (Code 7530)
  Grid panel, 1 x 1 meter, including mounting elements and cable clips



- VFC I.1 (Code 7537)
  Camera module

- VFE II.1 (Code 7542)
  Front end

- VFV12 (Code 7543)
  Input module for connecting free field microphones VMF I.1

- VFM I.1 (Code 7524)
  ICP free field microphone

## Components for Additional Channels

- *lab*CTRL I.2 (Code 3702)
  HEAD*lab* controller

- More HEAD*lab* modules, e. g.,
  *lab*DX (Code 3741)
  Input module for 2 pulse sensors, 2 CAN/OBD-2, 1 FlexRay, 1 artificial head HMS or GPS receiver

## Mounting Components

- VFT I.1 (Code 7582)
  Mobile chassis for grid panels

- VMT I.1 (Code 7580)
  Tripod for camera module VFC I.1

- VFM I.2 (Code 7525)
  *Flex* array microphone holder for array microphone

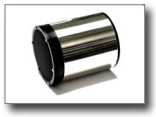
- VFJ I.3 (Code 7536)
  Holder for mounting the camera module VFC I.1 on the grid panel VFG I.1

- VFJ I.2 (Code 7535)
  Holder for front ends and modules

## Components for Microphone Positioning

- VFA I.1 (Code 7538)
  Positioning set for determining the microphone positions, consisting of amplifier, loudspeaker cable, microphone stand

- HXL (Code 2967)
  Excitation loudspeaker



## Software Components

- HEAD VISOR (Code 7500)
  Software for real-time identification of sound sources, basic version

- Tool Pack 01 (Code 7501)
  MultipleEye focus for distance determination

- Tool Pack 02 (Code 7502)
  Order analysis module

- Tool Pack 03 (Code 7503)
  Coherence filtering and enhancement module

# Technical Data

### Camera Module VFC I.1

| | |
|---|---|
| Max. power consumption: | 11 W (without microphones), at 25 °C |
| Input voltage: | 18 V to 36 V, nominal 24 V |
| Industrial-grade cameras<br>Number of cameras:<br>Sampling rate:<br>Resolution: | <br>3<br>23 Hz for the center camera and 6 Hz for the assistance cameras<br>656 x 494 pixels |
| Microphones<br>Number of microphones:<br>Analog signal processing, S/N:<br>Sampling rate:<br>Bandwidth:<br>Dynamic range (data acquisition): | <br>6<br>>100 dB(V)<br>48 kHz<br>20 kHz<br>30 to 130 dB |
| 5-port LAN switch (Gbit ethernet)<br>Data transfer:<br>Connection to:<br>Cable length LAN: | <br>1 Gbit/s<br>3 x camera, 1 x PC, 1 x front end VFE II.1<br>100 m (max.) |
| Camera Sync interface: | Camera triggers for front end VFE II.1 |
| Dimensions:<br>incl. tripod VMT I.1 and rollers: | 797 x 465 x 779 mm (WxDxH)<br>1835 to max. 2096 mm (height) |
| Weight:<br>incl. tripod VMT I.1 and rollers: | 12.25 kg (27 lb)<br>25.65 kg (56.5 lb) |
| Operating temperature: | 5 °C to 40 °C (41 °F to 104 °F), non-condensing |
| Storage temperature: | -10 °C to 70 °C (14 °F to 158 °F), non-condensing |

### Front end VFE II.1

| | |
|---|---|
| Interfaces: | 2 x D-Sub 9-pin, 1 x LEMO 4-pin, 1 x D-Sub 15-pin, 2 x USB host, 12 x LEMO 8-pin (10 x HEAD*link*, 2 x Sync), 1 x USB device, 1 x LAN |
| Resolution: | 24 bit |
| Power consumption: | 8 W, at 25 °C, 10 W (max.) |
| Input voltage: | 18 V to 36 V, nominal 24 V |
| Cooling: | Convection, no fan |
| LAN interface (Gbit Ethernet)<br>Data rate:<br>Net data rate at maximum number of channels:<br>Cable length LAN: | <br>1 Gbit/s<br>100 Mbit/s<br>100 m (max.) (3937“) |
| Sync Interfaces: | Connection and synchronization of several controllers |
| Module interfaces<br>Synchronization of the channels:<br>Sampling frequency: | <br>Sample-accurate<br>48 kHz |
| Camera Sync interface | Camera trigger for camera module VFC I.1 |
| AUX interfaces | For further extensions |
| Dimensions incl. BNC connectors:<br>incl. locking mechanism and rubber pads: | 140 x 180 x 57 mm (WxDxH) (5.5“ x 7.1“ x 2.24“)<br>148 x 180 x 63 mm (WxDxH) (5.8“ x 7.1“ x 2.48“) |
| Weight: | 915 g (2.02 lb) |
| Operating temperature: | -10 °C to 60 °C (14 °F to 140 °F) |
| Storage temperature: | -20 °C to 85 °C (-4 °F to 185 °F) |

# Technical Data

### ICP Free-field Microphone VFM I.1

| | |
|---|---|
| Connection: | BNC |
| Sensitivity: | 17.8 mV/Pa |
| Frequency range: | 50 Hz to 20 kHz |
| Dynamic range (THD 1 %): | 26 dB(A) to 130 dB(A) |
| Inherent noise: | <26 dB(A) |
| Phase matching (100 Hz to 10 kHz): | ±5 ° |
| Power supply: | 18 V to 30 V |
| TEDS: | Yes |
| Operating temperature: | 0 °C to 50 °C (32 °F to 122 °F) |

### Input Module VFV12

| | |
|---|---|
| Number of channels (dual link)<br>(HEAD*link* 1 and HEAD*link* 2 ↔ controller): | 12 (48 kHz) |
| Interfaces: | 2 x D-Sub 25-pin |
| Sampling frequencies ($F_S$): | 48 kHz |
| Coupling: | ICP |
| Power supply: | 18 V to 36 V |
| ICP voltage supply: | 22 V |
| ICP current supply: | 4 mA (±15 %) |
| Electric strength: | Max. ±35 V |
| Resolution: | 24 bit |
| Frequency range: | 2.5 Hz to 20 kHz at $F_S$ = 48 kHz |
| Input impedance: | 10 kΩ |
| Power consumption: | 6 W at 25 °C |
| Range (AC, inputs are TEDS-compliant): | ±1 $V_{PEAK}$ |
| S/N, incl. 2.5 Hz filter: | 107 dB(A) |
| THD+N, incl. 2.5 Hz filter: | -100 dB(A) |
| Crosstalk measurement, termination ≤75 Ω: | >105 dB(A) |
| Frequency response (accuracy final value),<br>20 Hz to 20 kHz incl. 2.5 Hz filter: | ±1 $V_{PEAK}$<br><0.05 dB |
| HP filter (analog): | 10 Hz |
| TEDS: | Yes |
| Maximum cable length to the controller: | 60 m (2362") (with cable CLL X) |
| Cooling: | Convection, no fan |
| Dimensions incl. BNC connectors:<br>incl. locking mechanism and rubber pads: | 140 x 173 x 42 mm (WxDxH) (5.5" x 7.1" x 1.6")<br>148 x 173 x 48 mm (WxDxH) (5.8" x 7.1" x 1.9") |
| Weight: | 502 g (1.17 lb) |
| Operating temperature: | -10 °C to 60 °C (14 °F to 140 °F) |
| Storage temperature: | -20 °C to 70 °C (-4 °F to 158 °F) |