VSE flow measurement

# OPERATING INSTRUCTIONS
# for Flow Meters of the Series
# „VHM with Fibre Optic System“


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## Important basic information

**Dear customer, dear user,**

These installation and operating instructions should provide you with the information you need to properly install and commission the flow meter in potentially explosive hazardous areas according to the regulations. The installation, commissioning, and testing are only to be performed by trained and qualified personnel with knowledge of the relevant national regulations relating to explosion protection. These operating instructions must be read and the instructions followed carefully to ensure proper, trouble-free, and safe operation of the flow meter. VSE is not liable for any damage incurred resulting from not complying with the instructions in these operating instructions. It is not permitted in any case to open the device.

These operating instructions for flow meters in the series "VHM with fibre-optic system" from VSE must be stored so that they can be read at any time by the group of authorized personnel. Chapters may not be taken out of these instructions at any time. A missing operating instructions manual or missing pages in operating instructions must be replaced immediately. VSE can supply you with new operating instructions or you can download the operating instructions from the Internet (www.vse-flow.com). The operating instructions must be given to each subsequent user of this product.

**Legal Information**

This document is not managed by the updating service of the VSE Volumentechnik GmbH.
Changes to this document may be made without notice.

The VSE Volumentechnik GmbH does not provide any implicit guarantees of commercial qualities and suitability for a specific purpose.

If you open or modify the device or incorrectly connect the electrical circuits, the explosion protection warranty is invalidated, and therefore the guarantee of the VSE Volumentechnik GmbH for safe operation in potentially explosive areas is invalidated. The VSE Volumentechnik GmbH is not liable in any way for personal injuries or damage to goods resulting from improper installation or improper operation of the flow meter.

## • Flow meter function description

Flow meters from the VSE Volumentechnik GmbH measure the volumetric flow of fluids using the gear method. The two gears in the meter are put in motion by the fluid flowing through the flow meter. The motion of each tooth of the gear is measured by a dual signal pick-up that is securely mounted to the flow meter. When the gear rotates, each of these signal pick-ups generates a digital output signal when a tooth of the gear passes through the detection area. The output signals from both pick-ups are then added electronically so that two electrical output pulses are generated for each volume of fluid measured. This volume of fluid is enclosed within the gap between the teeth and the housing, and is transported out when the gear rotates. The volume of fluid output by one gap is called the measurement volume V that determines the value of the pulse depending on the size of the flow meter.

**$V_m$ (l/Imp.) = 1/K-factor**

Series "VHM with fibre optic system" are operated in fluid technology applications in difficult environments such as areas subject to electromagnetic interference, high voltages, or an explosion hazard.
The system consists of a dual pick-up unit that sends light pulses over a synthetic fibre optic cable to a receiver unit located outside the difficult or hazardous area. The receiver unit converts these light pulses to electrical pulses that can then be processed by the signal processor. The signal frequency of the output pulse is proportional to the speed of rotation of the gear and the flow rate. The flow rate corresponds to the volume transferred, which is measured continuously by electronically counting the output pulses.

## • Flow Meter Selection

**The right choice (rating) of the type and size of the flow meter is the deciding factor for the trouble-free and safe operation of flow meters. Due to the wide variety of applications and flow meter designs, the technical data provided in the VSE catalogs are of a more general nature. Certain properties of the devices depend in the type, size, and measurement range, as well as on the fluid to be measured. Please contact VSE for exact type and size specifications.**

## • Declaration of Conformity

"VHM with fibre optic system" series flow meters for areas subject to an explosion hazard have been tested for their electromagnetic compatibility and noise emission according to the EMC regulations, and meet the requirements of the applicable, legally mandated EMC directives. They cannot be operated independently. They must be connected to a power source via a cable, and they output digital signals for electronic processing. There is a declaration of conformity available for all flow meters. It can be obtained upon request.
**Since the EM-compatibility of the overall measurement system also depends on how the cables are routed, on proper connection of the shielding, and on every device connected to the system, it must be ensured that all components meet the requirements in the EMC guidelines and that the electromagnetic compatibility of the entire system, machine, or plant is guaranteed.**

All flow meters are tested according to the applicable, legally required EMC directives EN 50081-2 (1994) and EN 50082-2 (1995). "VHM with fibre optic system" flow meters are authorized for use in areas subject to an explosion hazard and fulfill the basic health and safety requirements relating to the design and construction of devices and protective systems according to Appendix II of Directive 94/9/EC.
Due to their fulfillment of the European standards EN 50014 and EN 50020, these devices fulfill the legal health and safety requirements and are certified by accredited certification agencies. You will find an EC Type Examination Certificate on page 23.

The label for EC conformity is the CE symbol which is placed on all flow meters.

## • General requirements for operation

Before installation or operation, you must check the following properties of your system and take the following aspects of the corresponding conditions in your system into account for trouble-free and safe operation of the system.

**1. The medium to be processed**

- ➜ Is the flow meter **suitable for the medium**?
- ➜ Is the medium **viscous or abrasive**?
- ➜ Is the medium **dirty** or is there **contamination** and **suspended particles in the medium**?
- ➜ What is the **size of the particles** of the solid material and could they **block the meter**?
- ➜ Are there any **fillers** or other **additives** in the medium?
- ➜ Is it necessary to install a **hydraulic filter** before the meter?
- ➜ Are the **pipelines clean** and free of scraps left over from the installation such as shavings or weld splatter?
- ➜ IIs the **tank clean** and can **any foreign material** escape from of the tank and into the pipeline system?
- ➜ Is the type of medium changed often and is the system **thoroughly rinsed** after changing?
- ➜ Has all air been completely **bled** from the pipes and the overall system?
- ➜ Which **types of cleaners** are used?
- ➜ Can the **seals** withstand the cleaning agents and medium?
- ➜ Are the **seals suitable** for use with the medium to be measured **(compatible with the seals)**?

2. **Hydraulic properties of the system**
   - ➜ Is the **maximum operating pressure of the system** smaller than the maximum permissible operating pressure of the flow meter?
   - ➜ Is the **maximum pressure drop Δp** (on the flow meter) below the maximum permissible pressure drop?
   - ➜ When at the maximum flow rate (at high viscosities, for example), is there an excessively **large pressure drop Δp** on the flow meter?
   - ➜ Is the **flow rate present** within the flow rate range of the flow meter (depending on the viscosity)?
   - ➜ Note that the flow rate range is reduced at **high viscosities**!
   - ➜ Is the **maximum temperature** of the medium within the temperature range of the flow meter?
   - ➜ Is the pipe **cross-section** large enough and are there any large pressure drops in the system?
   - ➜ Are the **hydraulic connections** (supply and return) correctly connected and sealed?
   - ➜ Does the **pump** have enough power to operate the system?
   - ➜ A blocked flow meter can stop the flow throughout the system. Is there an **overpressure valve / bypass** present in the system?

3. **Electronic signal processing and electrical safety**
   - ➜ Have you selected the best possible flow meter for your application?
   - ➜ Does the **power supply voltage** applied match the voltage required by the flow meter?
   - ➜ Is the power supply voltage for the fibre optic receiver sufficiently **filtered**?
   - ➜ Does the power supply **output** the amount of power required by the fibre optic receiver?
   - ➜ Was the electrical connection wired according to the **connection diagram** provided?
   - ➜ Is the **cable shielding** on the cable to the signal processor connected to the ground conductor?
   - ➜ Is the flow meter securely connected to the **grounded PE conductor** (via the pipe, for example)?
   - ➜ Is the measuring unit of the flow meter **isolated** from the grounded PE conductor (e.g. connected using a sleeve)? If this is the case, then the measuring unit must be connected to the grounded PE conductor!
   - ➜ Are the wires on the **signal processor** connected correctly and properly?
   - ➜ Does the overall system conform to the electromagnetic compatibility (**EMC**) directives as required by law? Does the overall system conform to the electromagnetic compatibility (**EMC**) directives as required by law?
   - ➜ Were the legal **regulations and guidelines** for **explosion protection** followed during the installation of the flow meters and other components in the system?
   - ➜ Systems in which a malfunction or failure can lead to personal injury are to be equipped with **suitable safety equipment**. The function of this safety equipment is to be checked at **regular** intervals.

## • Maximum Operating Pressure

Before installing the flow meter, you must make sure that the **maximum operating pressure** of the system does not exceed the maximum permissible operating pressure of the flow meter. Note also the peak pressures that can arise when operating the system.

**Important:**
**The maximum operating pressure for flow meters in the "VHM" series is 250 bar!**

## • Information about the EU Pressure Equipment Directive 97/23/EC

VSE flow meters of the "RS" series qualify as „pressure equipment" as defined by Section 1, Paragraph 2.1.4. of the directive listed above and as such are affected by the regulations of this directive.

VSE flow meters must therefore meet the technical requirements specified in Section 3, Paragraph 1.4 of the directive. The fluids to be measured are for the most part Group 2 fluids acc. to Section 9, Paragraph 2.2. VSE flow meters do not reach the limit values specified by Section 3, Paragraph 1.1. The technical requirements for VSE flow meters are therefore confined to the criteria specified in Section 3, Paragraph 3. This means that the devices must be designed and manufactured in accordance with the provisions of good engineering practice applicable in a member state. This is hereby confirmed. The section also stipulates that such pressure equipment and components or accessories are not allowed to bear the CE marking in accordance with the Pressure Equipment Directive. This means that a declaration of conformity is not issued for VSE flow meters and the devices are not provided with the CE mark as pertaining to Directive 97/23/EC.

## • Flow rate measurement range

The **flow rate measurement range** ($Q_{min}$ – $Q_{max}$) of the flow meter specified in the data sheet is based on a test medium consisting of hydraulic oil with a viscosity of 21 $mm^2/s$ at a temperature of 20°C. For the measurement range with viscosities > 10 $mm^2/s$, VSE specifies a measuring accuracy of up to 0.5% of the measured value and a repeat accuracy of 0.5%. For viscosities from 1 to 10 $mm^2/s$, a measuring accuracy of up to 1.0% of the measured value and a repeat accuracy of 0.5% is specified.

**Important:**
**Make sure that the maximum permissible operating pressure specified for the flow meter cannot be exceeded in any operating mode of the system. Note the flow rate range of the flow meter, which depends on the viscosity of the medium to be measured.**

## • Installing the flow meter

The flow meter should be installed in a location with easy access so that it can be easily removed to clean the gears. Since flow meters can operate in any mounting position and any direction of flow, you can mount them at any location you want in your system. When installing the flow meter you must make sure that there is always some fluid remaining in the flow meter and that is can never run dry, even when the system is not in operation. For this reason, the outlet of the flow meter should always be under slight pressure since this firmly fixes the measuring unit of the flow meter in the fluid column (the measuring unit is supported in this fashion by the fluid column) and the pipeline cannot drain empty. In critical cases or when the pipe can run dry when the system is on standby or stopped, it is strongly recommended to install an additional non-return valve in the outlet line.

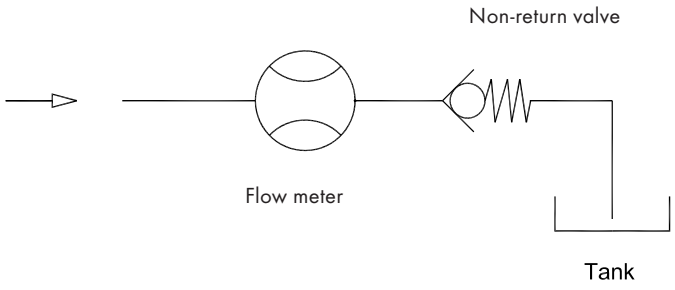



*Figure 1: Flow meter with backpressure*

**Important:**
**Make sure that both the inlet and outlet of the measuring unit of the flow meter are always completely full and that there is some pressure on the outlet. This prevents the creation of gas bubbles and the destruction of the measuring unit when the flow rate suddenly increases rapidly, and it improves the measurement accuracy at the same time.**

Series "VHM" flow meters can be mounted with screws on a mounting plate installed in the pipe. Whenever possible, you should choose large diameter pipes for the piping system and large diameter lines for the hydraulic supply and return. This reduces the effect of a pressure drop and lowers the flow rate in the overall system.

VSE supplies connection plates with various pipe thread sizes and with mounting holes on the side or back for all flow meters in the "VHM" series. Depending on the conditions present, the pipe installed, the diameter of the pipe, or the type of pipe thread, the user can choose the appropriate connection plate and install it in the system or machine without requiring any reduction sleeves.

→ **Block mounting:**
The flow meter is mounted on a connection plate. The connection plate is installed in the pipe and is equipped with all hydraulic connections and mounting holes required for mounting the flow meter.

The flow meter is screwed onto the connection plate using pan head screws. Tighten the screws by hand as tight as they will go first. In special cases, the flow meter can also be mounted directly in the pipe.

**Important:**
**When mounting the flow meter, you must make absolutely sure that the seals are not damaged in any way and are seated correctly in the hydraulic connections of the flow meter. Incorrectly installed or damaged seals can result in leakage and a leaky system, which can have significant consequences in some cases. The yellow plastic stoppers in the hydraulic connections of the flow meter protect the measuring unit from dirt and contamination when the flow meter is placed in storage or for transportation purposes. You must remove these stoppers so that the inlet and outlet are unplugged and open before you mount the flow meter.**

## • Cleaning and rinsing the pipes before operating

Before you operate the flow meter, you must carefully clean and rinse the entire system so that no foreign particles can get into the measuring unit of the flow meter when it is being installed. Foreign particles can block the measuring unit and damage it so badly that the flow meter is unable to supply any valid measurement values any more and must be sent in for repair. After completion of the system or installation of the piping, you must first carefully clean and rinse the entire piping system and the tank. The flow meter must be removed from the piping system to do this. Use a rinsing agent that is compatible with the medium to be used later during operation and will not cause any undesired reactions. You can obtain the corresponding information from your supplier, the manufacturer of the medium, or from VSE.

Flow meters are measuring sensors manufactured to high precision. They have a mechanical measuring unit consisting of two gears and that is fit tightly with small gaps between it and the housing. Even the tiniest amount of damage to the gears or bearings will cause a measurement error. For this reason, you must always make sure that no foreign particles can get into the measuring unit and that the medium being measured is always completely free from contamination.

Once the system has been thoroughly rinsed and there are no foreign particles in the piping system, you can mount the flow meter and start operations.

**Important:**
**Please clean the pipes and the tank thoroughly since foreign particles and residue in the pipes can get into the measuring unit of the flow meter and block it or even destroy it.**

## • Flow meters in environments subject to an explosion hazard

The operation of flow meters in areas with a hazard of explosion is subject to very specific legal regulations. For this reason, **only** flow meters with **certified Ex authorization** are permitted to be used in areas subject to an explosion hazard.

To protect people from harm and equipment from damage, lawmakers have issued **national and international standards** containing regulations that must be followed when using electrical components and systems in explosive atmospheres. In Europe, **CENELEC** – the European Committee for Electrotechnical Standardization – issues harmonized regulations relating to explosion protection for electrical equipment.

A hazard of explosion can arise when handling flammable, meaning oxidizable, substances when these substances are present as gases (e.g. methane, propane), vapors, mist, or dust; their concentration in a mixture with air is within a certain range; and the quantity of the mixture (flammable substance + oxygen) has reached a hazardous level. An explosion would then occur if a suitable source of ignition is present. During an explosion, very high temperatures and high rates of pressure increase often result. An explosion can injure people, damage buildings, destroy parts of the system, or even ignite other flammable substances.

All electrical equipment installed and operated in an explosive atmosphere requires **approval for the corresponding zones** and must be equipped with a special identification plate.

Areas subject to an explosion hazard are divided into zones. The basis for classifying the zones is the probable frequency of occurrence and duration of the explosive atmosphere.

The **division of the areas into zones is done by the company itself**, which means the customer, as an operator, is responsible for the division into zones. The zone definitions can be found in EN 1127-1 in the section on Fundamentals and Methods for explosion protection. Further information on zoning is provided in EN 60079-10 and the collection of examples in the explosion protection rules (Ex-RL). Technical inspectors from professional societies can also be contacted for help. The customer can also always contract explosion protection experts from the TÜV to define the zones. In any case, you must obtain approval from the board of industrial and trade supervisors. The operation of electrical equipment and systems in hazardous areas is subject to very specific legal regulations. For this reason, only flow meters with the corresponding Ex certification and Ex identification plates, in connection with special **certified safety equipment**, are permitted to be used in any areas subject to an explosion hazard.

The "VHM with fibre optic system" flow meters from the VSE GmbH are designed to have the "intrinsic safety" (i) type of protection. The "intrinsic safety" (i) type of protection means that the energy in the circuit is so low that no sparks, arcs, or temperatures can be generated that could cause ignition.

The category i (Intrinsic Safety DIN EN 50020) is subdivided into

- ➜ ia = intrinsically safe when two independent faults occur
- ➜ ib = intrinsically safe when one fault occurs

The European standards basically divide equipment into two different explosion groups. Flow meters belong to Group II (Electrical equipment for hazardous areas). Equipment in Group II is divided further into explosion subgroups and temperature classes.

- ➜ IIA e.g. acetone, ammonia, benzene (pure), methane, propane,
- ➜ IIB e.g. ethylene, city gas (lighting gas), hydrogen sulfide

The most dangerous substances are placed in Group IIC. Devices authorized for Group IIC can also be operated with substances from Group IIA and Group IIB.

The ignition temperature (defined as the temperature at which a mixture self-ignites in a fixed test setup) is directly related to the temperature class.

The temperature class specifies the maximum surface temperature of the electrical equipment and must be lower than the ignition temperature of the flammable substance to prevent ignition. The temperature class specifies the maximum surface temperature of the electrical equipment and must be lower than the ignition temperature of the flammable substance to prevent ignition (see page 22 "Media and ambient temperatures").

## • General information on using devices with intrinsically safe circuits

DIN EN 50014 contains general regulations for the design, construction, and testing of electrical equipment intended for use in explosive atmospheres and specifies the contents of the documentation provided with the devices.
For appropriate operation in explosive atmospheres, the national rules and regulations absolutely must be observed and followed at all times. The following contains some information, in particular information on the basic directives from the European Parliament, 94/9/EC.

For the owner/operator, the most important guidelines for the setup, installation, operation, testing, and maintenance of the system in a hazardous area are, among others, the guidelines ATEX 95, ATEX 137 and the European standards EN1127-1, EN 60079-10, EN 60079-14, and EN 60079-17. These guidelines must be followed.

**Important:**
**Persons assigned or contracted to install, commission, and operate the devices must have appropriate qualifications above and beyond those required for their normal tasks. In particular, they must have knowledge of explosion protection.**

## • VSE "VHM Ex-type with fibre optic system" flow meters

Through the use of fibre optic (FO) technology, there is complete separation of the "VDBI" dual pick-up system (sender) voltages in the hazardous area from the "VUMI" receiver unit voltages in the non-hazardous area since there is absolutely no electrical connection. The circuits in the dual pick-up system are designed to be intrinsically safe and are supplied with power by a separate power supply consisting of lithium batteries. The pulses generated are transmitted to the receiver in the non-hazardous area via fibre optic cables. This ensures the intrinsic safety of the devices in the hazardous area. The receiver and the signal processor must be installed in the non- hazardous area because they do contain non-intrinsically safe circuits.

The fibre optic version of the VSE flow meter is listed in the "ia" category and is permitted for use in Group IIC environments. They can be used in Zone 0, 1, and 2 (for gases and vapors) when the permissible media and ambient temperatures are observed and the installation regulations are followed. The VSE flow meters are **not** authorized for use in areas subject to a dust explosion hazard!

## • Preamplifier for fibre optic cable and fibre optic receiver

Dual signal pick-ups ("VDBI") with fibre optic outputs are used in areas subject to extremely difficult conditions. They are suitable for use in environments subject to heavy electromagnetic interference, in high voltage areas, and in rooms subject to an explosion hazard. They are often used in spray painting systems that operate using electrostatic charges in hazardous areas.

The dual signal pick-up is built into a metal housing functioning as a Faraday cage, which protects the pick-up from electromagnetic radiation. This effectively protects the electronics from extreme external influences so that they will not become defective.

The dual pick-up ("VDBI") is screwed on the flow meter and detects each tooth of the gear using two independently operating carrier frequency oscillators. When the gear rotates, each of these sensors generates a pulse when a tooth of the gear passes through the detector. By detecting the motion with two sensors, you obtain two pulses per tooth. The dual pick-up converts the pulses from both sensors to light pulses and sends them to the receiver ("VUMI") via synthetic fibre optic cables. The receiver then converts the light pulses from the signal pick-up back to electrical pulses and transmits them to the electronic signal processor for further processing. Each output signal from the fibre optic receiver has a resolution of 1/2 of the measured volume per pulse.

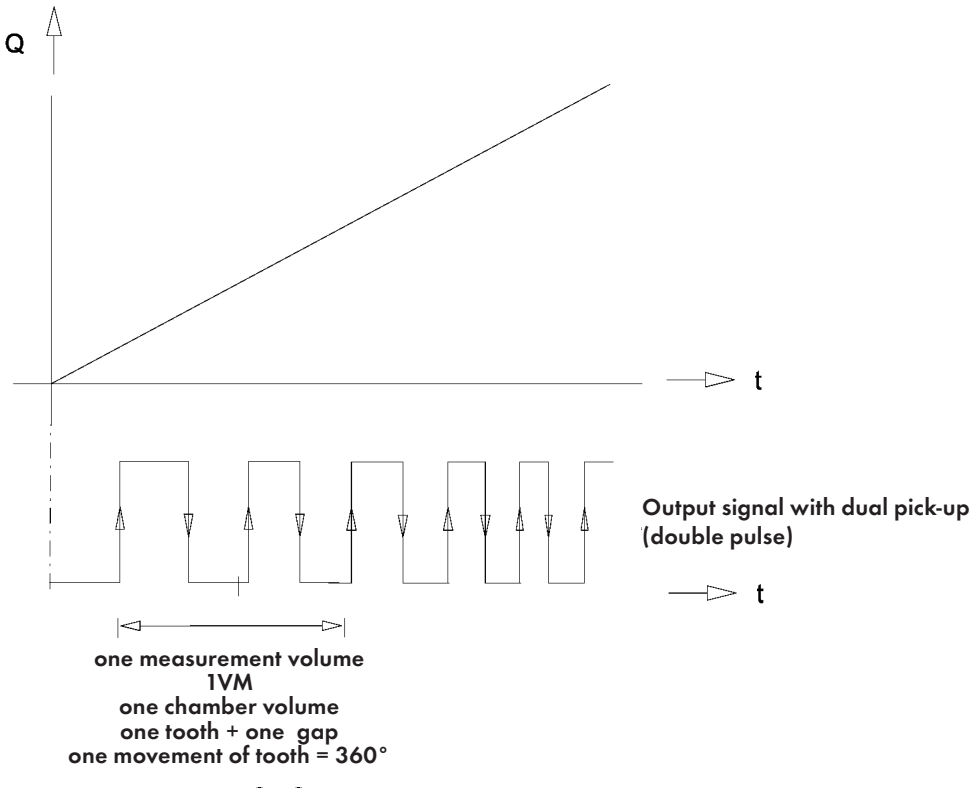



*Figure 2: Signal output*

The fibre optic receiver outputs the output signal and the fault signal as PNP or NPN output signals. The type of output signal desired is easy to select by setting the 2 separate programmable jumpers in the receiver accordingly.

The signal pick-up is supplied with power by the built-in, long-life lithium battery. In the Standby mode, the integrated energy saving circuit switches off some of the electronics to save battery power. Due to the energy saving circuit and the low power consumption of the circuitry, a battery service life of about 1-2 years without a battery change is achieved. The dual pick-up has a built-in battery monitor that automatically detects a weak battery. The signal pick-up informs the fibre optic receiver of the low battery state, and the receiver then outputs a fault signal. The fault signal indicates a weak battery status in the dual pick-up and can be processed in the subsequent signal processor to trigger an alarm or output a signal. The system will continue to operate for a while without any problems after a fault has occurred. However, the lithium battery should be replaced in the near future due to its low charge. The battery is easy to replace as the lithium battery is just pushed into the signal pick-up and connected using a plug connector. Once the battery has been replaced, the system is ready for operation again and the fault signal is switched off.

**Important:**
**Use only original parts from VSE!**

The fibre optic receiver is equipped with a switch to detect if the light signals were correctly transmitted. If communication fails due to a break in the fibre optic cable, improper connection, or a light signal that is too weak, then the receiver outputs a fault signal. This signal can be processed further in the subsequent signal processor. The fault signal is automatically reset once the fault has been eliminated.

The signal processor is informed of all of the types of faults described above using a common fault signal. The fault signal output informs the operator of the system that there is currently a fault in the system. The type of fault is indicated by 2 LEDs built in to the fibre optic receiver. The LEDs indicate the corresponding fault as shown in the following.

**1. LED:** indicates the "Ready to Operate" state of the lithium battery in the dual pick-up

**2. LED:** indicates a fault in the fibre optic communication link

The "VUMI" fibre optic receiver must be installed in the non-hazardous area. It is enclosed by aluminum housing and can be mounted on the wall or in a control cabinet. It is mounted using 2 screws.

## • Installation of VHM flow meters with fibre optic cable

The following figure shows the wiring diagrams for flow meters in the "VHM with fibre optic cable" series. Connect each piece of equipment as shown in the diagram shown. The wiring diagram shows the processed signal from the flow meter. With this measuring system you can measure the flow rate and the volume. However, it is not possible to detect the direction of flow when connected in this manner.

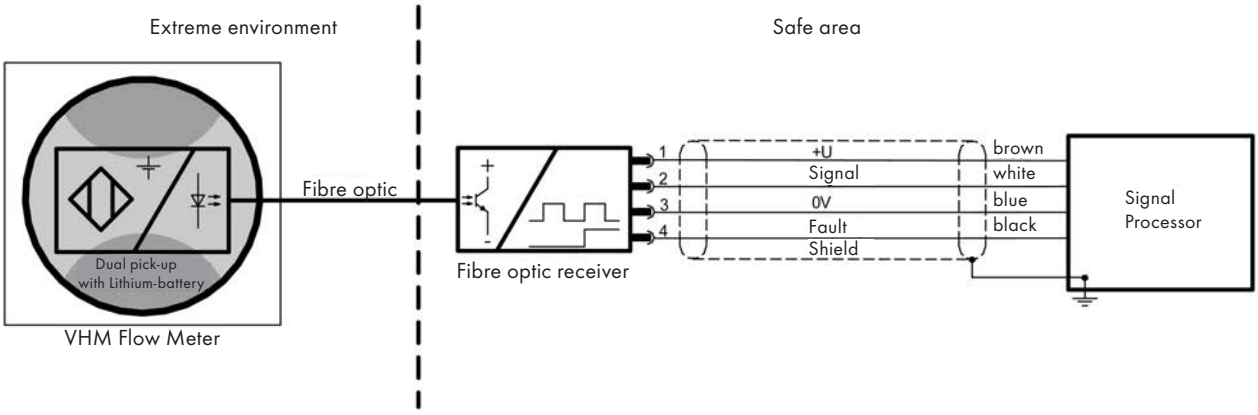



*Figure 3: Wiring diagram for the measuring system*

| Connector No. | Wire color | Description |
|---|---|---|
| **1** | Brown | Power supply voltage U = 9 V ... 30 V |
| **2** | Blue | Power supply voltage 0 V |
| **3** | White | Digital signal output (flow meter pulse) |
| **4** | Black | Digital fault signal output<br>(indicates a fault in the fibre optic connection or a weak battery in the flow meter) |

The synthetic fibre optic cable is to be cut to the desired length. The cut edge must be angled and polished smooth so that the light signal is not attenuated too much. Use the appropriate tools to smooth the cut surfaces (preferably with fine sandpaper). Remove 6 mm of the protective coating from the cut ends of the cable. Now insert the ends of the fibre optic cables in the connection on the dual pick-up on the flow meter an on the receiver. Once the fibre optic cable is inserted until it goes no further, you must tighten the screw so that the fibre optic cable is securely fastened in the device.

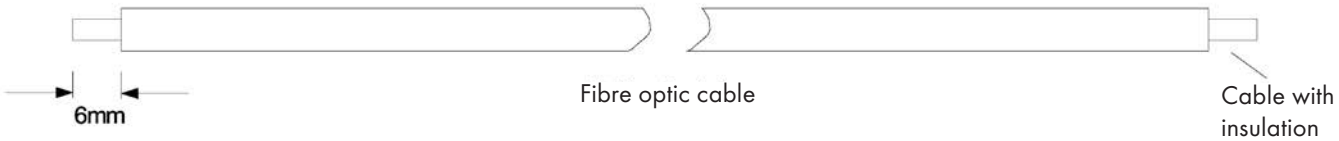



*Figure 4: Fiber optic cable*

Check to see if the fibre optic cable is properly connected using the LEDs in the receiver and the output signals. When the connection is established, the green LED is lit.

When operating the flow meter for the first time, you must connect the lithium battery in the dual pick-up first because it is unplugged for transportation. The receiver also contains non-intrinsically-safe circuits and may not be installed in hazardous areas or in extreme environments. The non-intrinsically-safe circuits are to be installed according to DIN VDE 0100-410.

The output signals from the flow meter and the fault signal can be output by the fibre optic receiver as PNP or NPN signals.

The type of output signal is programmed using the signal output and fault signal output coding jumpers. The codes are described in the figure.

VSE supplies a 4-pin connection cable for EMC-safe operation. One end of the cable there is a polarized VSE standard connector that is plugged into the 4-pin output connector of the fibre optic receiver. The other end is open so you can connect it directly to the signal processor. You must connect the shield at the signal processor end to the grounded PE conductor or ground for EMC-safe operation.

The status of the system is indicated by the red and green LEDs on the fibre optic receiver. The individual operating states are described in the following table.

| Flow meter | Fault signal | LED Grün | LED Rot | Description of the system status | Error in the system |
|---|---|---|---|---|---|
| No signal | No signal | LED off | LED off | No supply voltage present | Power supply failure, broken cable or wire, connector not plugged in, fuse defective |
| Signal | No signal | LED on | LED off | System O.K. and ready for operation Flow meter operating and outputting signals | |
| No signal | No signal | LED on | LED off | System O.K. and ready for operation Flow meter standing still and not outputting signals | |
| No signal | Signal | LED on | LED on | Error during transmission of the optical signal | Fibre optic cable broken, unplugged, or not connected properly |
| No signal | Signal | LED off | LED on | Error during transmission of the optical signal | Fibre optic cable broken, unplugged, or not connected properly |
| Signal | Signal | LED off | LED off | Battery in flow meter is weak Flow meter is operating and outputting signals | Battery in flow meter must be replaced since the voltage has dropped below the minimum voltage |
| No signal | Signal | LED off | LED off | Battery in flow meter is weak Flow meter standing still and not outputting signals | Battery in flow meter must be replaced since the voltage has dropped below the minimum voltage |

## • Control signals of the fibre optic system

### Control when the system is intact

In the Standby mode, the dual pick-up outputs a light pulse every 4 seconds. This light pulse is transmitted by the fibre optic cable to the receiver. When this pulse is received by the receiver, it knows that the communication link is intact and the fibre optic cable was connected properly. No signal is output on the signal or fault signal outputs, and the green LED is lit.

**Signal output = static; Fault signal output = high-impedance; green LED = off; red LED = off**

### Control when there is a fault in the communication link

If the communication link is broken or not connected properly, then the transmission of the signal is disrupted. The dual pick-up will continue to transmit light pulses (in the Standby mode), but they are not received by the receiver (VUMI). The receiver indicates a fault in the communication link when no control pulses are received. It outputs a fault signal, and the red LED is on.

**Signal output = static; Fault signal output = high-impedance; green LED = off; red LED = on**

### Control when the battery is weak

If the lithium battery in the dual pick-up is empty, then you must replace it with a new one. The electronics in the dual pick-up detects the empty battery and sends light pulses with a different width now to the receiver (VUMI). In the receiver the pulses are interpreted as indicating a weak battery in the sender. The fibre optic receiver then outputs a fault signal and the green LED it off.

**Signal output = static; Fault signal output = high-impedance; green LED = off; red LED = off**

## • Energy-saving circuit to extend the life of the lithium battery

The dual pick-up is equipped with an energy saving circuit to reduce the power consumption in the Standby mode.

This circuit reduces the current output of the lithium battery during idle time and increases the lifespan of the battery. The energy saving circuit switches the power supply of one carrier frequency board off, cutting the power consumption in half.

When in the Standby mode, a carrier frequency sensor monitors the flow. When the fluid starts to flow, the sensor detects when a measurement is started and switches the power supply of the second carrier frequency on. Now both carrier frequency sensors are enabled and the measurement starts. The dual pick-up outputs light pulses. About 4.2 minutes after the measurement is finished and the flow rate drops to 0 l/min, the second carrier frequency board is switched off, reducing the power consumption. The battery has an average lifespan of about 1–2 years. If the dual pick-up is in the idle state for long periods of time, then the lifespan increases.

## • Safety instructions for installation and operation in hazardous areas

- Only qualified personnel, meaning authorized persons with special explosion protection training, are permitted to install explosion-protected equipment and systems!
- The qualified personnel must have read and understood the installation regulations and the corresponding type examination certificates and declarations of conformity!
- Work may only be done on the devices when in a de-energized state!
- Before you operate the flow meter, you must carefully clean and rinse the entire system so that no foreign particles from the installation can get into the measuring unit of the flow meter.
- The pipes and the flow meter must always be filled when in operation so that no gas bubbles can form!
- Extremely dirty media or foreign particles in the medium can block, damage, or even destroy the measuring unit. In these cases you should always install a sufficiently large filter before the flow meter so that no foreign particles or substances can get into the measuring unit and damage the flow meter.
- The VSE flow meters are not authorized for use in areas subject to a dust explosion hazard!
- The owner must maintain the system in proper operating condition, operate the system properly, monitor it constantly, perform the necessary maintenance and any related work immediately, and follow the relevant safety regulations when doing so. This procedure, known as continuous monitoring, will eventually be adopted as a new law in Europe!
- When equipment is connected electrically, a "Verification of Intrinsic Safety" must be performed (EN 60+079-14). Even if an intrinsically safe circuit is connected just once to a non- intrinsically safe circuit, then the piece of equipment is not authorized for use anymore as a device with intrinsically safe circuits.
- The permissible ambient and media temperatures in the corresponding temperature class may not be exceeded at any time when operating the flow meter.
- When operating or performing maintenance or repairs on the flow meter, the surface of the flow meter housing must be safely protected from impact or sharp edges, tools, or other items!
- The preamplifier housing is made of die cast aluminum. The generation of impacts and friction, especially between aluminum and steel, must be prevented so that the production of sparks is ruled out!
- When using the flow meters (from the VHM series) in areas requiring Category 1 equipment, the sensor is to be installed so that sparks from impact or friction can be ruled out!
- You may not change or extend the devices in any way if the modifications were not expressly permitted by the manufacturer. If the preamplifier housing is opened, then the explosion protection certification becomes invalid!

## • Maintenance and repairs

**VSE flow meters are basically maintenance-free. However, it is recommended to send the flow meters back to the factory at regular intervals for inspection, particularly in difficult applications, when critical media are used (e.g. when using abrasive, contaminating media or media containing fillers or pigments), when high viscosity media are used, or when very heavy strain is placed on the measuring unit (e.g. when the flow changes often and quickly). In this manner, any minor damage can be detected and eliminated early, before the damage leads to total failure during production, whether the failure is caused by a faulty bearing or a blockage of the gears.**

**The owner is responsible for regular inspections, maintenance, and recalibration. The flow meters may not be used in any case when damage or a fault is detected in the meter!**

**Repairs may only be performed by the manufacturer or by authorized personnel. Any other repairs must be examined by an expert.**

## • Maintenance and repair of devices

To ensure fast and economical repair of the flow meters and other components, it is absolutely necessary to include a precise description of the problem or error with the package you send back to the factory. Furthermore, a safety data sheet must also be enclosed in which it is clearly stated which medium was used with this flow meter and how hazardous the corresponding medium is.

The legal regulations relating to occupational safety (ArbStättV), accident prevention regulations, regulations relating to environmental protection, waste disposal (AbfG), and water resources law (WHG) oblige companies to protect their employees, other persons, and the environment from harmful effects when handling hazardous substances. If additional safety precautions are still required in spite of thorough draining and cleaning of the flow meter, then this information absolutely must be enclosed in the package sent back to the factory.

Note that examination and repair of any flow meters sent to VSE Volumentechnik GmbH will only be performed when the safety data sheet of the medium used is enclosed and the flow meters have been completely clean and rinsed. This serves to protect our employees and makes our job easier.

**When these instructions are not followed, the package will be returned at the sender's expense!**

## • Technical data for the VHM Flow Meter

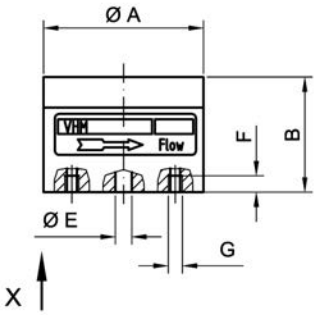
| Size | Measurement Range l/min | Measured volume $V_m$ ml | Frequency Hz | K-Factor imp./liter |
|---|---|---|---|---|
| **VHM 01–1** | 0.01 ... 1 | approx. 0.035 | approx. 5.0 ... 476.0 | approx. 30,000 |
| **VHM 01–2** | 0.01 ... 1 | approx. 0.045 | approx. 5.0 ... 500.0 | approx. 22,000 |
| **VHM 02–1** | 0.05 ... 2 | approx. 0.120 | approx. 6.9 ... 278.0 | approx. 8,800 |
| **VHM 02–2** | 0.10 ... 4 | approx. 0.225 | approx. 7.4 ... 296.0 | approx. 4,400 |
| **VHM 02–3** | 0.40 ... 8 | approx. 0.450 | approx. 14.8 ... 296.0 | approx. 2,200 |
| **VHM 03–2** | 0.50 ... 20 | approx. 1.010 | approx. 8.25 ... 330.0 | approx. 1,000 |

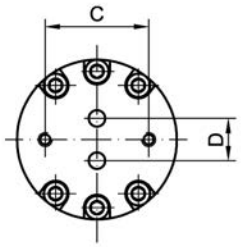
*The exact data can be found in the calibration report!*

| | |
|---|---|
| **Measurement accuracy** | : ±0.5 % of the measured value (at viscosities > 10 $mm^2/s$)<br>±1 % of the measured value (at viscosities 1– 10 $mm^2/s$) |
| **Repeating accuracy** | : ± 0.5 % under the same operating conditions |
| **Materials** | : Gear housing: Stainless steel 1.4404<br>Gears: Stainless steel 1.4462<br>Gear bearings: tungsten carbide<br>Preamplifier housing: Stainless steel 1.4305 or aluminum |
| **Gear bearings** | : Bearing bush, ball bearings (optional) |
| **Seals** | : PTFE with FPM core or PTFE |
| **Max. operating pressure** | :250 bar |
| **Medium temperature (fibre optic system)** | :-20 ... +60°C (-4°F ... 140°F) |
| **Ambient temperature** | :-20 ... +50°C (-4°F ... 122°F) |
| **Viscosity range** | : 1 ... 20,000 $mm^2/s$ |
| **Installation position** | : Any |
| **Direction of flow** | : See the direction of the arrow on the flow meter |
| **Installation** | : On the mounting plate with piping connections or<br>as a piping system (custom version) |

## • Dimensions of the VHM Flow Meter

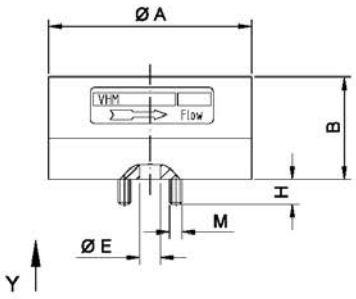
**VHM 01 / 02**

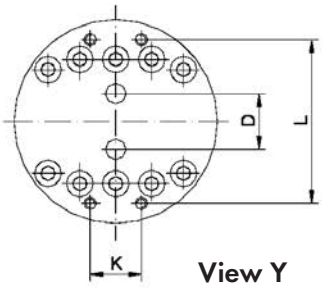



View X

**VHM 03**



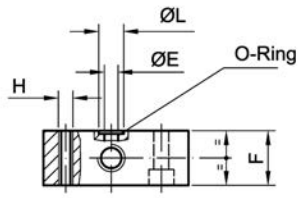

View Y

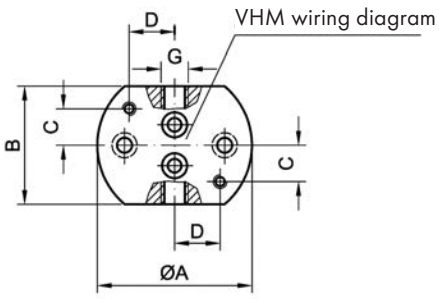
| Typ | øA | B | C | D | øE | F | G | K | L | M | H | Gewicht kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VHM 01–1** | 68 | 29 | 44 | 12 | 4 | 6 | M6 | | | | | 0.760 |
| **VHM 01–2** | 68 | 29 | 44 | 18 | 5 | 6 | M6 | | | | | 0.750 |
| **VHM 02–1** | 68 | 29 | 44 | 18 | 6 | 6 | M6 | | | | | 0.740 |
| **VHM 02–2** | 68 | 34 | 44 | 18 | 6 | 6 | M6 | | | | | 0.860 |
| **VHM 02–3** | 68 | 43 | 44 | 18 | 6 | 6 | M6 | | | | | 1.075 |
| **VHM 03–2** | 99 | 50 | | 27 | 10 | | | 25 | 81 | M6 | 12 | 2.700 |

*The dimensions are given in mm*

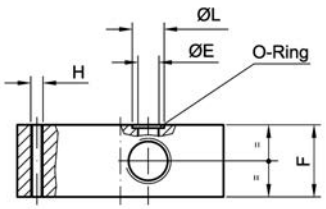
## • Dimensions of the AHM Mounting Plate

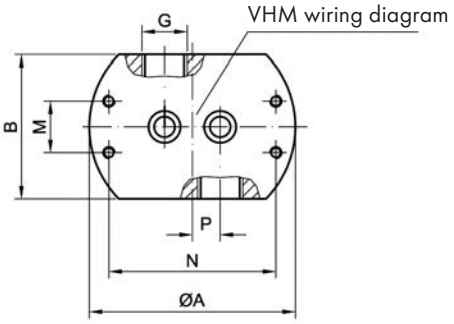
**AHM 01/02** for side mounting



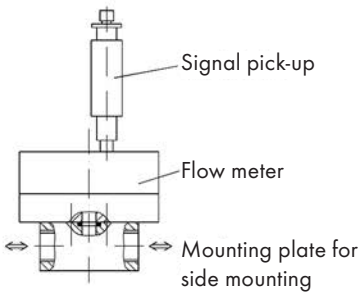




**AHM 03** for side-mounting




Position of the cable connections

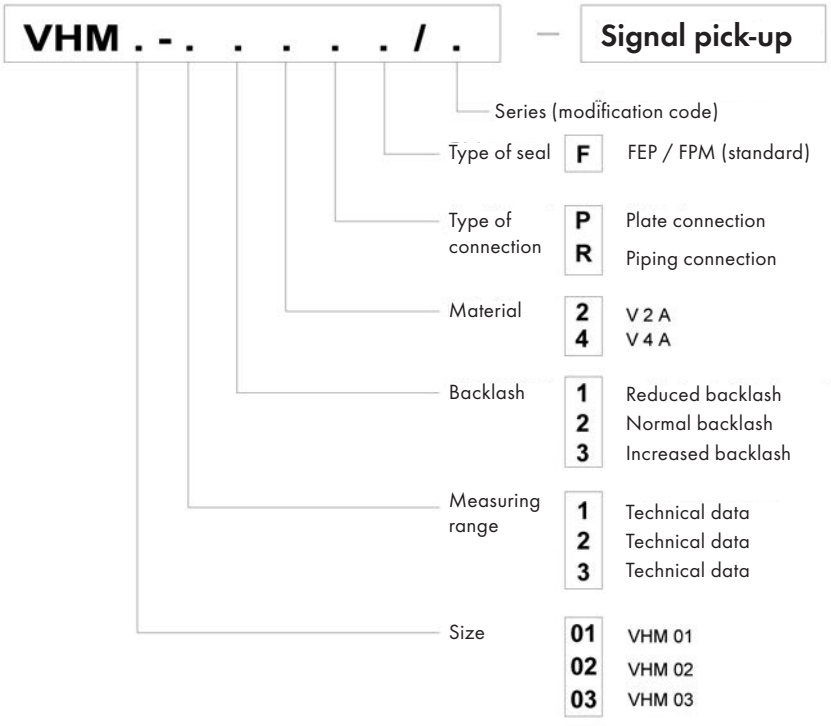


| Permissible size of VHM | G | A | B | C | D | øE | F | H | øL | M | N | P | O-ring |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **01 – 1** | G 1/8" | 68 | 52 | 16 | 20 | 4 | 24 | M6 | 9,4 | | | | 6.07 x 1.78 |
| | G 1/4" | | | | | | | | | | | | |
| **01 – 2**<br>**02 –.** | G 1/8" | 68 | 52 | 16 | 20 | 6 | 24 | M6 | 11 | | | | 7.65 x 1.78 |
| | G 1/4" | | | | | | | | | | | | |
| | 1/8" NPT | | | | | | | | | | | | |
| | 1/4" NPT | | | | | | | | | | | | |
| | G 3/8" | 68 | 52 | 16 | 20 | 6 | 35 | M6 | 11 | | | | |
| | 3/8" NPT | | | | | | | | | | | | |
| **03** | G 3/8" | 100 | 70 | | | 10 | 35 | M6 | 15,5 | 25 | 81 | 13,5 | 12.42 x 1.78 |
| | G 1/2" | | | | | | | | | | | | |
| | 3/8" NPT | | | | | | | | | | | | |
| | 1/2" NPT | | | | | | | | | | | | |

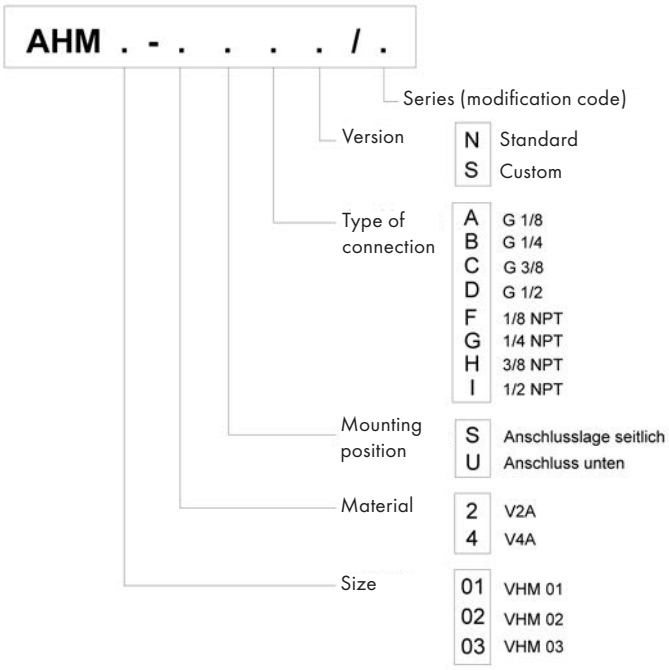
*The dimensions are given in mm*

- **Type Code for VHM, AHM**

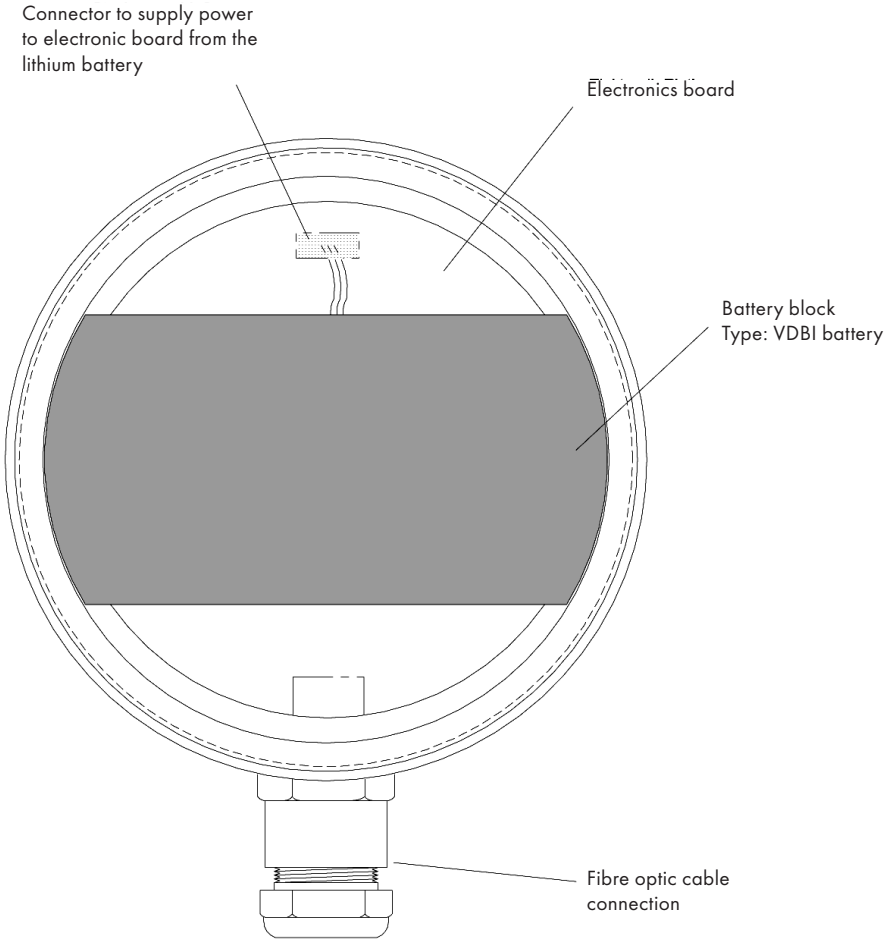
  **VHM Flow Meter**



### AHM Mounting Plate




- **Technical data for dual pick-ups with VDBI fibre optic output**



## Ex-Data

| | |
|---|---|
| Ex-Approval | BVS 12 ATEX E 058 X according to Declaration of Conformity |
| Certification | Ex II 1 G Ex ia op is IIC T4 Ga |

## Electrical Data

| | |
|---|---|
| Power supply | Built-in, encapsulated lithium battery (use only original parts) |
| Lithium battery | 3,6 V / 13,5 Ah with protective circuit, encapsulated |
| Service life | Approx. 1–2 years (integrated energy saving circuit in the Standby mode) |
| Battery monitor | Built-in battery status monitor |
| Battery connection | Polarized plug connector |
| Battery mount | Side-mounted (battery can be pushed into the housing) |
| | |
| Output | Fibre optic output diode |
| Output signal | Digital light signal to the fibre optic receiver (flow meter signals; control signals in the Standby mode; signals from the battery monitor) |
| | |
| Flow meter signals | Pulses with a frequency proportional to the flow rate |
| Monitor signals | Control signal to monitor the light signal communication link and the battery status signal |
| Switching frequency | f = 3 Hz – 1,5 KHz |

## Housing Data

| | |
|---|---|
| Dimensions | ø 78 mm; height 62 mm; total height with sensor 72 mm |
| Fibre optic cable connection | PG 7; length of threaded cable connector 20 mm |
| Material | Anodized aluminum; stainless steel coil holder |
| Media temperature | -20°C (-4°F) ... +60°C (140°F) |
| Ambient temperature | -20°C (-4°F) ... +50°C (122°F) |
| Protection class | IP 54 |
| Weight | 438 g |

## Type Plate

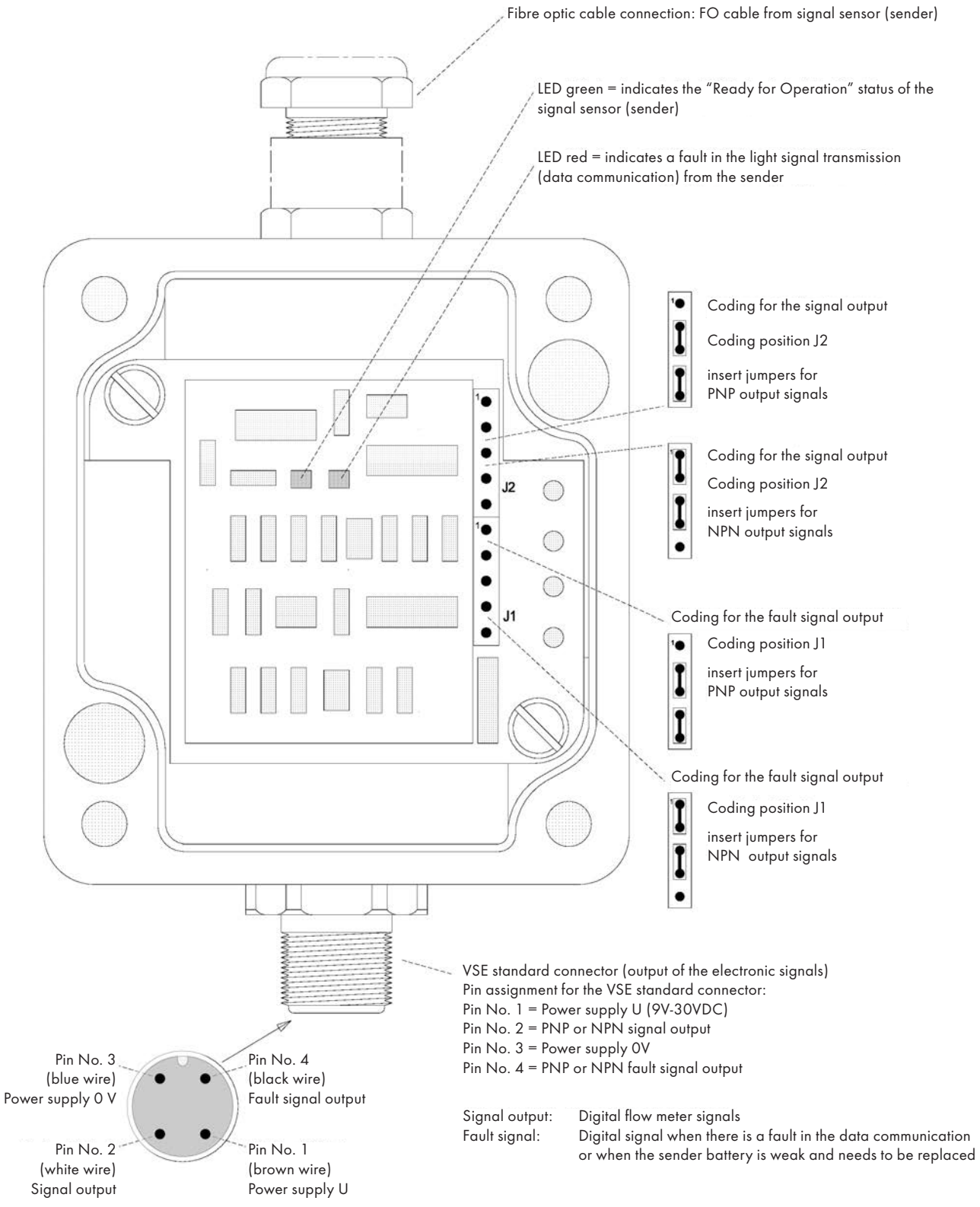

## Fibre optic connection cable

| | |
|---|---|
| Fibre optic cable | Silicon-free synthetic fibre optic cable with two-layer protective sheathing |
| Strain relief | Aramide fibres |
| Outer sheath | Orange polyurethane; flame resistant |
| Outside dimensions | 3,5 mm +/- 0,2 |
| Bending radius | > 70 mm for short periods during installation; > 50 mm long-term |

## List of the types of dual pick-ups with fibre optic output

| | |
|---|---|
| VDBI-1K00/N; VDBI-2K00/N; VDBI-3K00/N | (Fibre optic cable connection) |
| VDBI-1K00/Ex; VDBI-2K00/Ex; VDBI-3K00/Ex | (Fibre optic cable connection) |

## • Technical data for the VUMI fibre optic receiver




Signal output: Digital flow meter signals
Fault signal: Digital signal when there is a fault in the data communication or when the sender battery is weak and needs to be replaced

## Signal input

| | |
|---|---|
| Input | Lichtleiter Eingangs-Transistor |
| Signals | digitale Lichtsignale vom Zweifachaufnehmer (Volumensensorsignale; Kontrollsignale im Standby; Signale von der Batterieüberwachung) |

## Signal output

| | |
|---|---|
| Output circuit | Transistor with series resistor R = 1,2 KΩ |
| Output signal | PNP or NPN output (programmable using two coding jumpers) |
| Signal resolution | ½ of the measured volume per pulse (frequency doubling) |
| Signal voltage | U = 9 – 30 V (depending on the power supply voltage) |
| Signal current | I = 10 mA maximum (for operating voltages > 16 V DC) |

## Fault signal output

| | |
|---|---|
| Output circuit | Transistor with series resistor R = 1,2 KΩ |
| Output signal | PNP- or NPN output (programmable using two coding jumpers) |
| Signal voltage | U = 9 – 30 V (depending on the power supply voltage) |
| Signal current | I = 10 mA maximum (for operating voltages > 16 V DC) |

## LED indicators

| | |
|---|---|
| Ready for operation | green LED |
| Communication fault | red LED |

## Operating values

| | |
|---|---|
| Operating voltage | U = 9 – 30 V DC |
| Power consumption | I = 8 mA |

## Housing Data

| | |
|---|---|
| Overall dimensions | Total length of fibre optic cable and connector 98 mm |
| Housing dimensions | Length 64 mm; Width 58 mm; Height 37 mm; |
| Mounted with | 2 M4 screws |
| Material | Aluminum |
| Color | Gray; RAL 7001 |
| Temperature range | -25°C (-13°F) . . . 60°C (140°C) |
| Protection class | IP 54 |
| Weight | 218 g |

## List of types of fibre optic receivers

| | |
|---|---|
| VUMI-0S00/N | (screw-mounted, plug connection) |

## • Accessories for the fibre optic system

| | |
|---|---|
| VDBI- battery | Encapsulated lithium battery for all dual signal pick-ups |
| FO cable 5 m | Synthetic fibre optic cable, length 5 m |
| FO cable 10 m | Synthetic fibre optic cable, length 10 m |
| FO cable 15 m | Synthetic fibre optic cable, length 15 m |
| FO cable 20 m | Synthetic fibre optic cable, length 20 m |

Other fibre optic cable lengths (max < 20 m) are available upon request

## • Type Codes - Signal Pick-ups

**V . . . - . . 0 . / .**

**Version**

| | |
|---|---|
| N | Standard |
| Ex | intrinsically safe |

**Series**

**Cable entry**

| | |
|---|---|
| S | Plug connector with VSE standard connector (standard) |

**Size**

| | |
|---|---|
| 1 | Flow meter VHM01 |
| 2 | Flow meter VHM02 |
| 3 | Flow meter VHM03 |

**Sensor grounding**

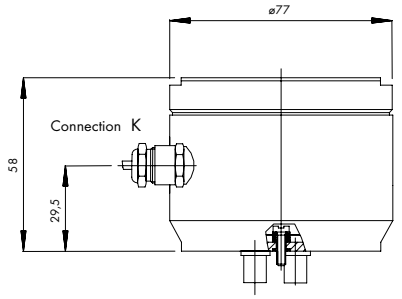
| | |
|---|---|
| I | not grounded to 0V (standard) |

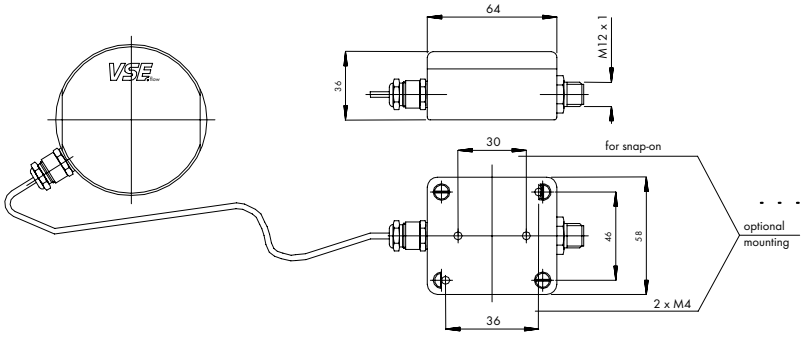
**Connection**

| | |
|---|---|
| B | Supplied by a lithium battery with fiber-optic output |
| M | Input: Light pulses<br>Output: Electrical digital pulses |

**Signal pick-up**

| | |
|---|---|
| D | Two-channel pick-up * (pulse x 2 / pulse x 4) |
| E | Two-channel pick-up * (pulse x 1) |
| U | Converter (fiber-optic receiver and transducer) |




** With the VDB series... (fiber-optic output), the signal can only be doubled (pulse x 2)*

## • Media and ambient temperatures

| | |
|---|---|
| Temperature class | T6 ... T4 |
| Media temperature | -20°C (-4°F) ... max. permissible 60°C (140°F) |
| Ambient temperature | -20°C (-4°F) ... max. permissible 50°C (122°F) |

## • Flow meter labels and certifications

| | |
|---|---|
| Name and address of the manufacturer | **VSE Volumentechnik GmbH<br>Hönnestraße 49<br>58809 Neuenrade / Germany** |
| CE marking | **CE 0158** |
| Type designation for dual pick-ups with fibre optic output | **VDBI- *K**/Ex** |
| Marking according to Directive 94/9/EC | **Ex II 1G Ex ia IIC T6...T4** |
| Type designation for fibre optic receiver | **VUMI-*S**/N** |

- **EC Type Examination Certificate**

## Translation

# (1) EC-Type Examination Certificate

(2) Equipment and protective systems intended for use in potentially explosive atmospheres - Directive 94/9/EC

(3) No. of EC-Type Examination Certificate: **BVS 12 ATEX E 058 X**

(4) Equipment: **Flow meter system type VHM*-*****/* - V*B*-****/Ex**

(5) Manufacturer: **VSE Volumentechnik GmbH**

(6) Address: **Hönnestraße 49**
**58809 Neuenrade, Germany**

(7) The design and construction of this equipment and any acceptable variation thereto are specified in the appendix to this type examination certificate.

(8) The certification body of DEKRA EXAM GmbH, notified body no. 0158 in accordance with Article 9 of the Directive 94/9/EC of the European Parliament and the Council of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive. The examination and test results are recorded in the test and assessment report BVS PP 12.2105 EG.

(9) The Essential Health and Safety Requirements are assured by compliance with:

| | |
|---|---|
| **EN 60079-0:2009** | **General requirements** |
| **EN 60079-11:2012** | **Intrinsic safety 'i'** |
| **EN 60079-26:2007** | **Equipment with equipment protection level (EPL) Ga** |
| **EN 60079-28:2007** | **Protection of equipment and transmission systems using optical radiation** |

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the appendix to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to Directive 94/9/EC.
Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment shall include the following:

**Ex II 1G Ex ia op is IIC T4 Ga**

DEKRA EXAM GmbH
Bochum, dated 02. August 2012

Signed: Dr. Franz Eickhoff — Certification body

Signed: Stephan Ruhnau — Special services unit



DEKRA EXAM GmbH Dinnendahlstrasse 9 44809 Bochum Phone +49.234.3696-105 Fax +49.234.3696-110 zs-exam@dekra.com

(13) Appendix to

(14) **EC-Type Examination Certificate**
**BVS 12 ATEX E 058 X**

(15) 15.1 Subject and type

Flow meter system type VHM*-*****/* - V*B*-****/Ex

Instead of the * in the complete denomination numerals and letters will be inserted which characterize different models.

15.2 Description

The flow meter system type VHM*-*****/* -V*B*-****/Ex consists of the battery-operated pre-amplifier V*B*-****/Ex and the gear tooth flow meter VHM*-*****/*. The motion of the gear teeth is contactless sampled by one or two moulded sampling-coils. Via the pre-amplifier an electronic conversion of the measured values is performed. The converted signal is led to a fibre optic transmission diode and can be transmitted via optical fibres to data processing equipment.

15.3 Parameters

| | | |
|---|---|---|
| Nominal battery voltage | | 3,6 V |
| Max. optical radiation power | | < 35 mW |
| Medium temperature | | -20 °C up to +60 °C |
| Ambient temperature | Ta | -20 °C up to +50 °C |

(16) Test and assessment report

BVS PP 12.2105 EG as of 02.08.2012

(17) Special conditions for safe use

1. The equipment has to be installed in such a way that ignition hazard due to impact or friction can be excluded.

2. The equipment is suited for the following temperature ranges:
   Medium temperature: -20 °C up to +60 °C
   Ambient temperature Ta: -20 °C up to +50 °C

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We confirm the correctness of the translation from the German original.
In the case of arbitration only the German wording shall be valid and binding.

DEKRA EXAM GmbH
44809 Bochum, 02. August 2012
BVS-Le-Schu/Sp A 20120231

Certification body

Special services unit



DEKRA EXAM GmbH Dinnendahlstrasse 9 44809 Bochum Phone +49.234.3696-105 Fax +49.234.3696-110 zs-exam@dekra.com

VSE flow measurement

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