

# OPERATING INSTRUCTIONS for flow meters of the product line "Ex-Type VS"



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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 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 this operating instruction. It is not permitted in any case to open the device.

These operating instructions for flow meters in the series "Ex-Type VS" 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](http://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 an updating service of VSE Volumentechnik GmbH.

Changes to this document may be made without notice.

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

If the device has been opened, modified or incorrectly connected to the electrical circuits, the explosion protection warranty is void, and therefore the guarantee of VSE Volumentechnik GmbH for safe operation in potentially explosive areas is void. 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.

## • Functional description of the flow meter in areas subject to explosion hazards

VS positive displacement flow meters are volume rate measuring sensors, based on the meshing gear principle and are designed for use with liquids. Two precisely matched gear wheels are enclosed in a very accurately machined housing. Gear rotation is sensed by a non-contacting signal pick-up system. Each tooth produces one impulse. The space between the gear teeth, when fully enclosed on both sides by the housing, constitutes measuring chambers. Fluid flow causes the gears to rotate and the incoming flow is separated into discrete volumes within these chambers i. e. the volume of liquid passing through the unit will cause rotation of the gears by exactly

one tooth pitch. This volume is known as the Volume/Impulse ( $V_m$ ) and is stated in cc/Imp. It is used to define the size of a flow meter.

The Ex-Type flow meters of the production series "VS" are used in explosion hazardous areas. The preamplifier of this "Ex-Type" supplies two modulated digital current signals, which are staggered at 90° to one another. The frequency of these signals is proportional to the current flow.

These separate switching currents are digitalized and amplified by two single-channel isolation switching amplifiers.

## • 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. Due to the wide variety of applications and flow meter versions, the technical data provided in the VSE catalogs are of a general nature. Certain

properties of the devices depend on 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

"VS" 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 required 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 the cable routing, 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-directive EN 61000.

"VS" Ex-Type 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 (ATEX95) and NEC/NFPA70.

Due to the fulfillment of the European standards EN 60079-0, EN 60079-11 and EN 60079-26, US-standards FM3600, FM3610 and FM3810. 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 32.

The label for EC-Conformity is the CE-Symbol, which is placed on all flow meters. The FM-Certificate of compliance is on page 38.

## • 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 **pipe lines clean** and free of scraps left over from the installation such as shavings or weld splatter?
- Is the **tank clean** and can **any foreign material** escape from of the tank and into the pipe line 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  $\Delta p$**  (on the flow meter) below the maximum permissible pressure drop?
- Is the **pressure drop  $\Delta p$  excessively large** on the flow meter, when the maximum flow rate (at high viscosities, for example) is reached?
- Does the **present flow rate** within the flow meter correspond to the flow rate range (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 processing and electrical safety

- Have you selected the best possible flow meter and is it equipped with the **proper preamplifier**?
- Does the **power supply voltage** applied match the voltage required by the flow meter?
- Is the supply voltage provided by the power supply or signal processor sufficiently **filtered**?
- Does the power supply **output** the required amount of power?
- Was the electrical connection wired according to the **connection diagram** provided?
- Is the **cable shielding** connected to the ground conductor?
- Is there an equalizing conductor connecting the flow meter to the signal processor to eliminate any **voltage differences** between them?
- Is the flow meter securely connected to the **grounded PE conductor**?
- Is the measuring unit of the flow meter **isolated** from the grounded PE conductor (e.g. connected using a sleeve)? If it is isolated, then the measuring unit must be connected to the grounded PE conductor!
- Is the cable routed to prevent interference and can any **stray pulses** be coupled?
- Is the **4-pin round plug** of the connecting cable screwed tightly to the connector on the flow meter?
- 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?
- Are you following all locally applicable regulations, **applicable rules**, guidelines and basic requirements for **EMC**?
- Are the wires on the **signal processor and the isolated switching amplifiers** connected correctly?
- 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. Also note the peak pressures can arise, when operating the system.

The following operating pressures are permitted depending on flow meter

- Flow meter in grey cast iron version  $p_{\max} = 315 \text{ bar} / 4500 \text{ psi}$
- Flow meter in stainless steel version  $p_{\max} = 450 \text{ bar} / 6500 \text{ psi}$

### Important:

Please consult VSE for all operating pressures > 450 bar / 6500 psi and for special versions.



### • Statement to EU-Directive 97/23/EG, Pressurized devices

VSE flow meters are pressurized devices according to article 1, paragraph 2.1.4. of above mentioned directive. Therefore they are subject to the regulations to this directive.

According to article 3, paragraph 1.4, VSE flow meters have to conform with the technical requirements of the guideline. The fluids to be measured are belonging in most of all cases to the class 2, defined in article 9, paragraph 2.2. VSE flow meter do not reach the limit values as defined in article 3, paragraph 1.1.

The technical requirements for VSE flow meters therefore are limited to the parts indicated in article 3, paragraph 3. It means the devices have to be designed and manufactured in conformity with acknowledged engineering, such as practiced in one of the member states. This is herewith confirmed.

Beside this the paragraph declares that these devices must not have a CE-marking according to Directive 97/23/EG. Therefore we do not issue declarations of CE and our products are not labelled acc. to 97/23/EG.

### • Flow meter range

The flow meter range specified in the flow meter data sheet ( $Q_{\min}$  –  $Q_{\max}$ ) refers to the testing fluid “hydraulic oil” with a viscosity of 21 mm<sup>2</sup>/s at a temperature of 20°C. For this flow meter range, VSE specifies measurement accuracy of up to 0.3% of the measurement value and a repetition accuracy of 0.05%.

For fluids of lower viscosity (< 21 mm<sup>2</sup>/s) measurement accuracy deteriorates, while for fluids of higher viscosity (> 21 mm<sup>2</sup>/s) it can improve. The higher the viscosity, the higher the flow resistance  $\Delta p$ . Also note, however, that the flow meter range is restricted in case of higher viscosity (see flow meter data sheet).

#### 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 measured medium.**



### • 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 it 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 a 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 pipe line 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.

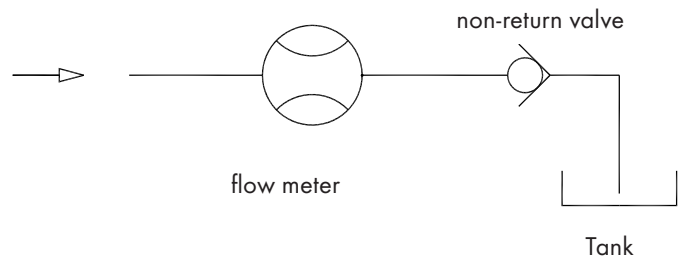


Fig. 1: Flow meter installation with non-return valve

#### Important:

**Make sure that both the inlet and outlet of the flow meter measuring unit is 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 “VS” 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 subplates for all flow meters of the “VS” product line; they have various pipe threads and side or rear-side connection (see subplates data sheet). Depending on the provided conditions, the installed pipe line, the pipe cross section or pipe thread, the operator can choose the suitable subplate and incorporate this into the system or machine without additional reductions.

The flow meter is screwed onto the block or subplate with four DIN 912 cheese head screws. The screws are to be pretensed crosswise evenly with the following torques.

#### → Block mounting:

The flow meter is mounted on a subplate. The subplate is installed in the pipe and is equipped with all hydraulic connections and mounting holes required for mounting the flow meter.

Table 1: Torque of fastening screws

Flow meter, size (cast iron and 1.4305)	Torque
VS 0.02; VS 0.04; VS 0.1; VS 0.2	15 Nm
VS 0.4; VS 1; VS 2	35 Nm
VS 4	120 Nm
VS 10	250 Nm

Please note the special instructions for mounting sizes VS 4 and VS 10 (see appendix)

**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 can have significant consequences in certain 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 operation**

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 carefully clean and rinse the entire piping system and the tank first. The flow meter must be removed from the piping system to do this. You have to mount a diversion plate onto the block or subplate instead of the flow meter, so that the fluid can flow through the diversion plate and all extraneous material can be flushed out without obstruction.

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.

VSE supplies bypass-plates, which are corresponding for all "VS"-flow meter sizes. Flow meters are measuring sensors manufactured to high precision. They have a mechanical measuring unit consisting of two gears and that are fit tightly with small gaps between them and the housing. Even the least 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 and block it or even destroy it.**



• **Filtering of liquid**

Heavily contaminated fluid or extraneous material in the fluid can block, damage or even destroy the flow meter. In such cases, always install a sufficiently large filter in front of the flow meter to prevent damage to the flow meter. The necessary filtering depends on size, bearing system and model of flow meter.

**Table 2: Pre-switched filters**

Flow meter size	Filter size for ball bearings
VS 0.02 / 0.04 / 0.1	10 µm
VS 0.2 / 0.4	20 µm
VS 1 / 2 / 4 / 10	50 µm

*For information on filter size for flow meters with plain bearings, in special version, or with specially adjusted meter tolerances, please consult VSE.*

**Important:**

**A blocked flow meter can stop the whole flow. You have to provide a control valve/ bypass for the system.**





## • 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. In the U.S. the regulations are issued by the **ANSI** (American National Standard Institute). 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. An explosion often causes very high temperatures and high rates of pressure. They can injure people and damage buildings, or destroy parts of the system, or even ignite other flammable substances.

All electrical equipment installed and operated in an explosive atmosphere require **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. In Europe 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). For U.S. the NEC/NFPA70, NEC500 and NEC505 supplies to the divisions. Technical inspectors from professional societies can also be contacted for help. The customer can also always contract explosion protection experts from an association for technical inspection 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 **Ex-Type flow meters** from **VSE GmbH** are designed to have the “intrinsic safety” type of protection and are operated with isolated switching amplifiers. The amplifiers must guarantee the intrinsic safety of the signal circuit according to specific criteria and parameters and their limit values may not **exceed** the highest permitted input value of the device.

A single channel isolated switching amplifier is required to operate the Ex-version of the flow meters in the “VS” series.

The **“intrinsic safety” (i/IS) 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. When installing intrinsically safe circuits, detailed regulations must be observed. Strict requirements are placed on the isolation to prevent the voltage from creeping into the Ex-range due to parasitic voltages. For this reason, intrinsically safe and non-intrinsically safe circuits must always be routed separately. It is not permitted to install both types together when routing, bundling, or harnessing cables.

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 are 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
- IIC, e.g. carbon disulfide, acetylene, hydrogen

The American standards basically determine in **classes** and **divisions** on the properties of the flammable substance and its likelihood that a flammable concentration is present. The flow meters belong to the Class 1, Division 1. The equipment is also identified for a specific gas or vapor with a grouping and temperature classes. The flow meters are permitted for the Groups:

- A (e.g. acetylene),
- B (e.g. hydrogen),
- C (e.g. ethylene),
- D (e.g. propane).

The most dangerous substances are placed in **Group IIC (Atex) or Class 1, Division 1 (FM)**. Devices authorized for Group IIC (Atex) or Class 1, Division 1 (FM) can also be operated with substances from Group IIA and Group IIB (Atex) or Class 1, Division 2 (FM).

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 **ambient temperatures** and **media temperatures** permitted for the Ex-Type flow meters are classified according to the corresponding temperature classes, and these temperatures **absolutely must be observed** (see page 30 “Maximum ambient and media temperatures”).

The Ex-versions of the VSE flow meters are listed with European standards in the “ia” (intrinsically safe, when two independent errors occur) category and are 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 FM-approved ambient and media temperature for Ex-Type flow meters are determined in the corresponding temperature classes and must be strictly maintained.

The Ex-Type of the VSE flow meter is evaluated by the American standards of the FM as intrinsically safe “IS” for operating in Class 1, Division 1, Groups A,B,C,D and temperature classes T4...T6 (see page 33).

**The VSE flow meters are not authorized for use in areas subject to a dust explosion hazard!**



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

DIN EN 60079-0 and FM3600 contain general regulations for the design, construction and testing of electrical equipment intended for use in explosive, hazardous atmospheres and specifies the contents of the documentation provided with the devices.

For **appropriate operation** in explosive atmospheres, the **national rules and regulations must absolutely 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 (ATEX95) and of the U.S. standard NEC/NFPA70. Intrinsically safe electrical equipment can be connected to the intrinsically safe connections on the isolated switching amplifier. All equipment must meet the requirements for operation in the zone specifying the present explosive atmosphere.

When equipment is connected electrically, a "Verification of Intrinsic Safety" must be performed (EN 60079-14; NEC504). 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. This applies to the isolated switching amplifiers as well as the flow meters.

The relevant, applicable regulations apply to the installation of intrinsically safe circuits, the mounting of external connectors, and the properties and routing of lines and cables. Cables and terminals with intrinsically safe circuits must be labeled accordingly and must be safely isolated from non-intrinsically safe circuits.

The **prescribed distance** between the intrinsically safe connections of the isolated switching amplifier and the grounded components and connections of other devices must be maintained. If not specified expressly in the manual for the specific device, the opening of the device for repairs or modifications to the device not performed by qualified experts or the manufacturer will result in the invalidation of the Ex-authorization.

Visible changes to the device housing of the isolated switching amplifier (e.g. black or brown discoloration due to heat or any holes and dents) indicate a serious error and the device should be switched off immediately in this case. In addition, the connected flow meter must be inspected.

**Note that the inspection of the device in terms of its explosion protection properties can only be performed by a qualified expert or the manufacturer.**

Operation of the isolated switching amplifier is only permitted within the authorized limits printed on the housing. You must make sure that the applicable regulations, guidelines, directives and general conditions for operation are observed every time before operating the device or changing its connections, the conditions for appropriate operation and the safety regulations are met.

### **Important:**

**The installation and connection of the isolated switching amplifier and the flow meter are only to be performed by trained and qualified personnel (authorized personnel) with knowledge of the relevant national regulations relating to explosion protection.**



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 EN 1127-1, EN 60079-10, EN 60079-14, and EN 60079-17 and the American standards NEC/NFPA70 articles 504, 505 and ANSI/ISA-RP12.06.01. These guidelines must be followed.

## • VSE "Ex-Type VS" flow meters

The VSE flow meters in the "Ex-Type VS" series from VSE are authorized for use in hazardous areas and are always operated together with an isolated switching amplifier. They provide the required explosion protection safety. On the type plate you will find the specifications, labels

and safety-related and electrical data required according to DIN EN 60079-0 and FM3600 (see page 29 "Labeling of the flow meters"). VSE supplies the flow meters with isolated switching amplifier models MK 13-P-Ex0/24 V DC/K15.

## • Isolated switching amplifier MK 13-P-Ex0/24 V DC/K15

The isolated switching amplifier MK 13-P-Ex0/24 V DC/K15 allows binary switching states to be transmitted, while electrically isolated. It has an intrinsically safe circuit and is certified according to II (1) GD [EE ia] IIC for the EU. For the U.S. it is suitable for CL1; Div 2; GRPS A, B, C, D hazardous locations with IS Entity connections to CL1; Div 1; GRPS A, B, C, D. The input circuit and output circuit are electrically isolated from each other and from the supply voltage. An isolated switching amplifier is

required to operate the Ex-version flow meters in the "VS" series. The input circuit can be monitored for open circuits and short circuits (the monitor can be disabled using a wire jumper). An error in the input circuit will block the signal output, but will not be output as an error message. Two positively switching (PNP-outputs), short circuit-proof transistor outputs, output the antivalent digital signal.



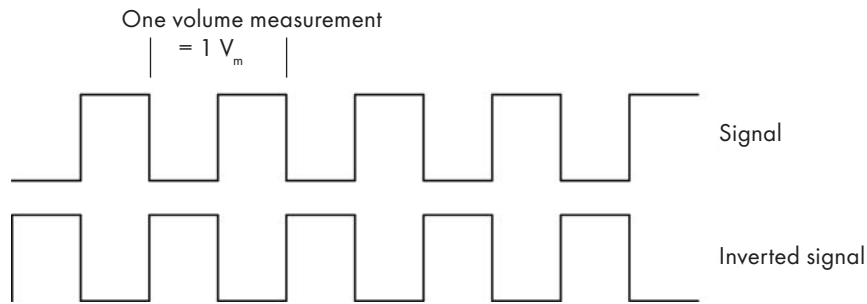


Figure 4: Signal output of the isolated switching amplifier

## Note:

**Note that the signal output of the isolated switching amplifier is a PNP-signal (low signal = open output; high signal =  $U_b$ ). Problems may arise, when the signal processor has high impedance inputs, especially in the higher range of flow rates. The signal edges become rounded, and the signal processor cannot detect the digital signal any more. In this case, insert a pull-down resistor with a resistance of approx. 2.2 – 4.7 k $\Omega$  parallel to the input of the signal processor (see figure 3; Resistor R).**



## • Technical data for the isolated switching amplifier MK 13-P-Ex0/24 V DC/K15

<b>Manufacturer</b>	Werner Turck GmbH & Co. KG	External inductances/capacitances and inductances $L_0/C_0$	
<b>Type designation</b>	MK13-P-Ex0/24 V DC/K15	- [EEx ia] IIB	2/10/20mH / 5/3.5/3 $\mu$ F (ATEX)
<b>Operating voltage</b>	10 ... 30 V DC	- [EEx ia] IIC	1/5/10mH / 1.1/0.75/0.65 $\mu$ F (ATEX)
Residual ripple WSS	$\leq 10\%$	- Group A/B/IIC	82 mH; 3.6 $\mu$ F (FM)
Current consumption	approx. 20 mA	- Group C/IIB	296 mH; 26 $\mu$ F (FM)
Galvanic isolation	Input circuit to output circuit and supply voltage for 250 V <sub>eff</sub> Test voltage 2.5k V <sub>eff</sub>	- Group D/IIA	700 mH; 210 $\mu$ F (FM)
		Temperature range T <sub>U</sub>	-25°C ... +70°C -13°F ... +158°F
		Device label	II (1) GD [EEx ia] IIC (ATEX)
<b>Input circuit</b>			ASSOCIATED EQUIPMENT
Operating values			Suitable for CL1; Div 2; GRPS A, B, C, D hazardous locations with IS entity connections to CL 1; Div 1; GRPS A, B, C, D (FM)
- No-load voltage $U_0$	8.2 V	<b>LED indicators</b>	
- No-load current $I_0$	16.4 mA	- Switching state/error message	yellow/red (two-color LED)
- Internal resistance $R_i$	$\leq 500 \Omega$	- Ready for operation	green
Switch points	2.9 ... 3.5 mA ( $\pm 0.2$ mA)		
Open circuit threshold	$\leq 0.16$ mA	<b>Terminal box</b>	
Short-circuit threshold	$\leq 12.4$ mA		8-pin, polycarbonate/ABS
<b>Output circuit</b>	Two transistor outputs, short-circuit proof, positive switching		Flammability class V-0 according to UL94
Voltage drop	$\leq 2.5$ V		can be clipped on the top hat rail (DIN 50022) or clip-on on mounting plate
Switching current per output	$\leq 100$ mA		Height: 89 mm, Length: 70 mm, Width: 18 mm
Switching frequency	$\leq 3$ kHz		Flat terminals with self-lifting pressure plates
<b>Ex-certified according to Conformity certificate</b>			$\leq 2 \times 2.5$ mm <sup>2</sup> or $2 \times 1.5$ mm <sup>2</sup> with wire end ferrules
Maximum values	PTB 06 ATEX 2025   FM-ID. 3026923	Dimensions	
- No-load voltage $U_0$	$\leq 9.9$ V	Connection	
- Short-circuit current $I_0$	$\leq 22$ mA	Connection cross-section	
- Power $P_0$	$\leq 54$ mW	Type of protection (IEC 60529 / EN60529)	IP 20
		Operating temperature range	-25°C ... +70°C -13°F ... +158°F

## • Control Drawings

### Hazardous (Classified) Location

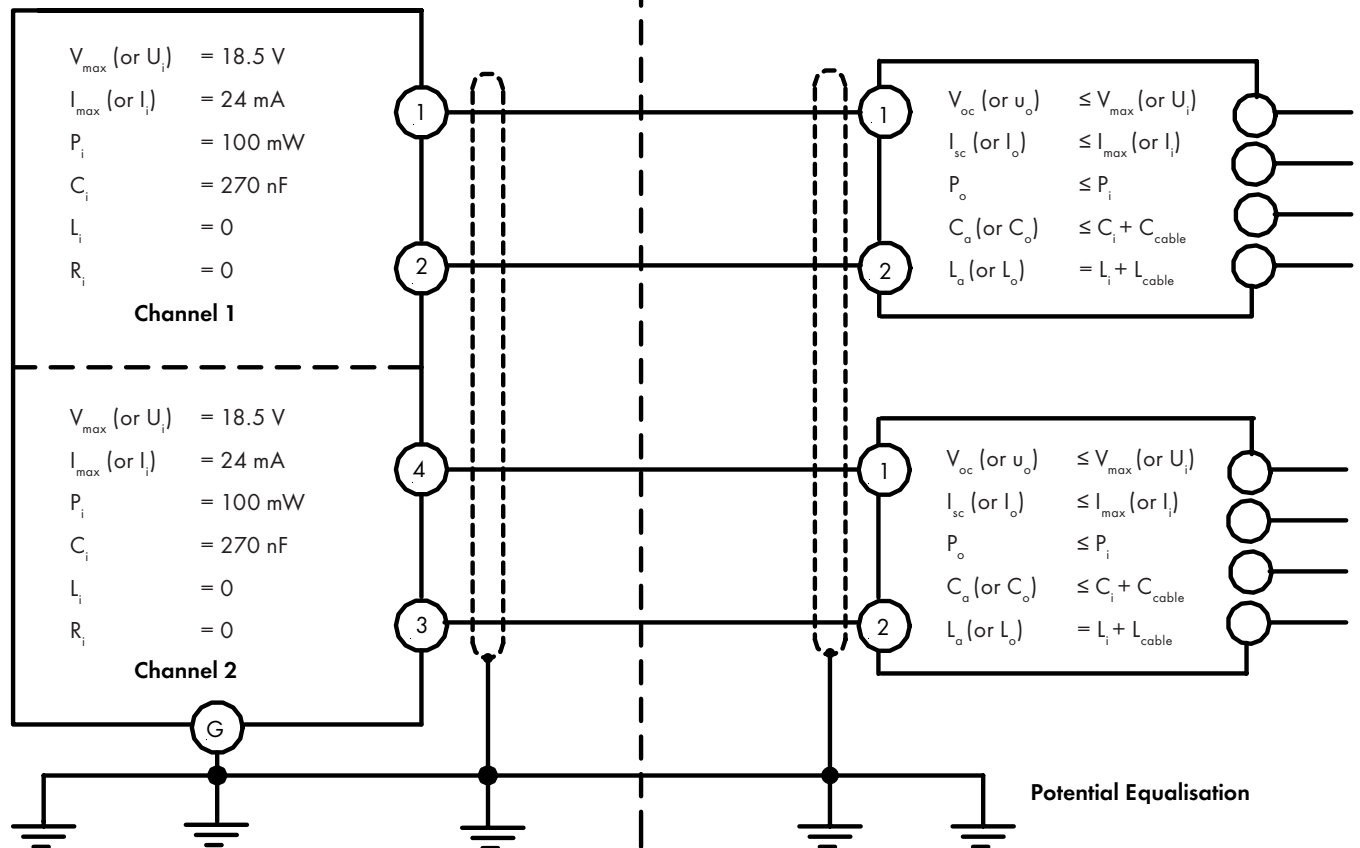
Class I; Division 1; Groups A, B, C & D T4 ... T6

Note: T4 Temperature code based on 80°C (176°F)  
T5 Temperature code based on 70°C (158°F)  
T6 Temperature code based on 55°C (131°F)

### Flow Meter System Series

VS\*\* \*\*\*\*\*-32Q1\*/\*

EF\*\* Q\*\*\*\*\*/\*



1. The installation must be in accordance with the National Electrical Code, NFPA 70, Articles 504 and 505 and ANSI/ISA-RP12.06.01.

2. The flow meter systems series VS\*\* \*\*\*\*\*-32Q1\*/\* and EF\*\* Q\*\*\*\*\*/\* are suitable for use in Class I, Division 1 and Zone 0 (AEx ia) applications. If connected to associated apparatus the flow meter systems VS\*\* \*\*\*\*\*-32Q1\*/\* and EF\*\* Q\*\*\*\*\*/\* may be used in areas classified as zones. If connected to AEx [ib] associated apparatus, the flow meter system may only be used in Zone 1 or 2 Hazardous (Classified) Locations.

3. In order to suppress inductive interference, a connecting cable with the shield bearing on the coupling nut of the four-pole circular plug-in connect or must be used during the installation of the flow meter. In explosion-hazardous areas the flow meter is connected to the ground potential. The greatest care must be taken to ensure that between each end of the electrical circuit (i.e. between the explosive area and the non-explosive area) potential equalisation exists.

Drawing No. V 06 606 4

Date 15<sup>th</sup> November 2006

## Hazardous (Classified) Location

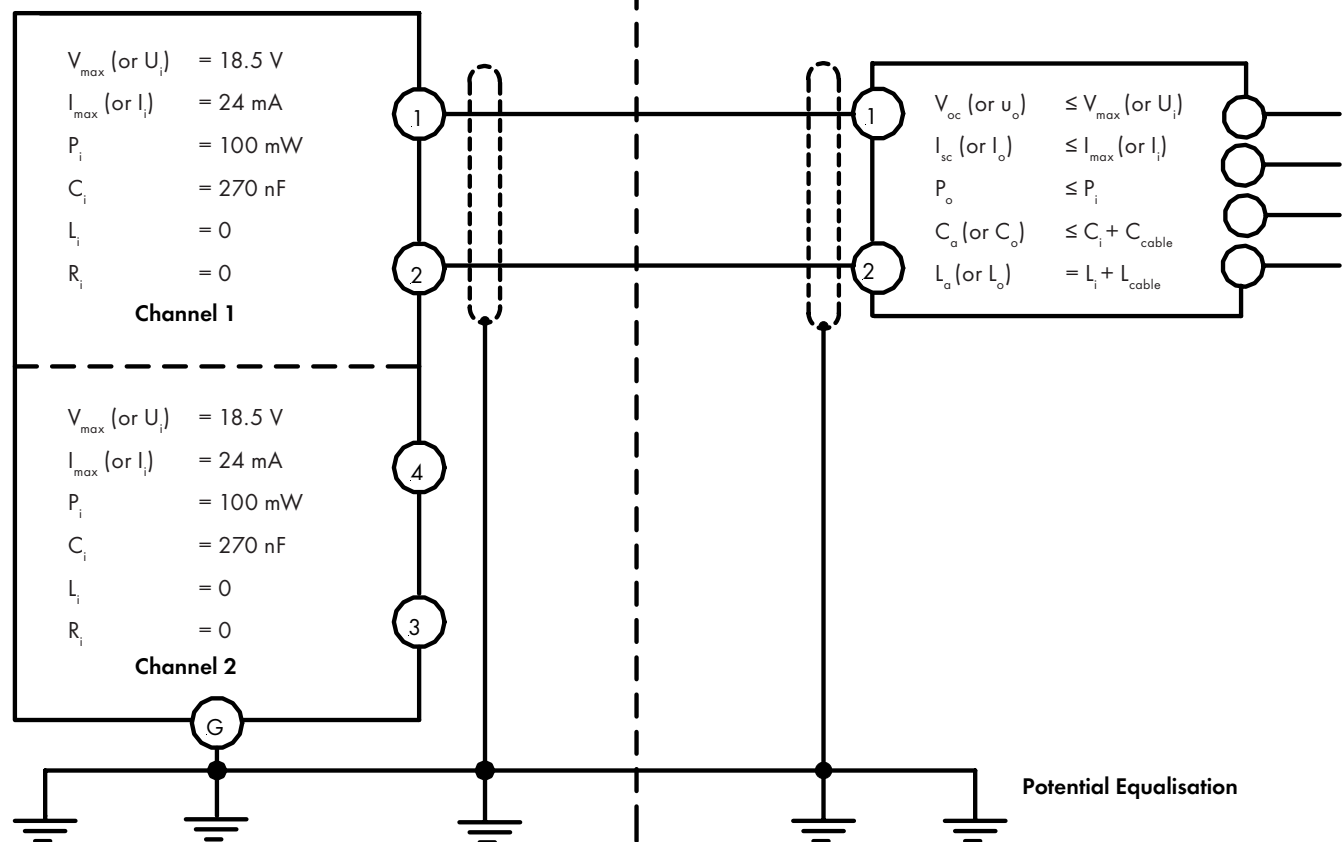
Class I; Division 1; Groups A, B, C & D T4 ... T6

Note: T4 Temperature code based on 80°C (176°F)  
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Drawing No. V 06 60 74

Date 15<sup>th</sup> November 2006

## Hazardous (Classified) Location

Class I; Division 1; Groups A, B, C & D T4 ... T6

Note: T4 Temperature code based on 80°C (176°F)  
T5 Temperature code based on 70°C (158°F)  
T6 Temperature code based on 55°C (131°F)

### Flow Meter System Series

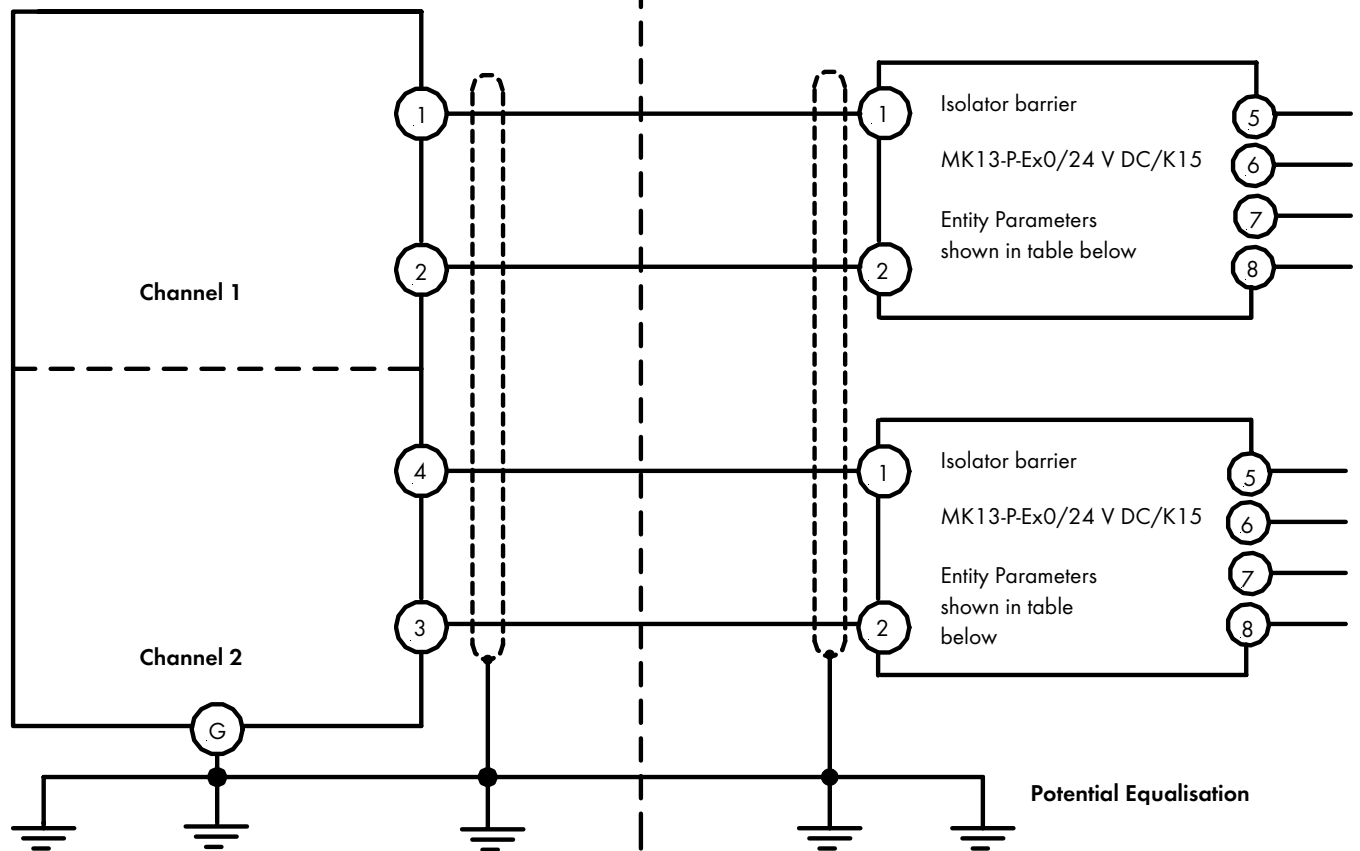
VS\*\* \*\*\*\*\*-32Q1\*/\*

EF\*\* Q\*\*\*\*\*-\*/\*

## Unclassified Location

### ASSOCIATED APPARATUS

Isolator barrier MK13-P-Ex0/24 V DC/K15 (TURCK)



Terminals	Group	C <sub>cable</sub> (μF)	L <sub>cable</sub> (mH)
1-2	A/B/IIC	3.3	82
1-2	C/IIB	25.7	296
1-2	D/IIA	209.7	700

Power supply: 24 V DC

The isolator barrier shall be installed in a tool secured enclosure in compliance with the mounting, spacing and segregation requirements of the ultimate application.

1. The installation must be in accordance with the National Electrical Code, NFPA 70, Articles 504 and 505 and ANSI/ISA-RP12.06.01.

2. In order to suppress inductive interference, a connecting cable with the shield bearing on the coupling nut of the four-pole circular plug-in connect or must be used during the installation of the flow meter. In explosion-hazardous areas the flow meter is connected to the ground potential. The greatest care must be taken to ensure that between each end of the electrical circuit (i.e. between the explosive area and the non-explosive area) potential equalisation exists.

### Hazardous (Classified) Location

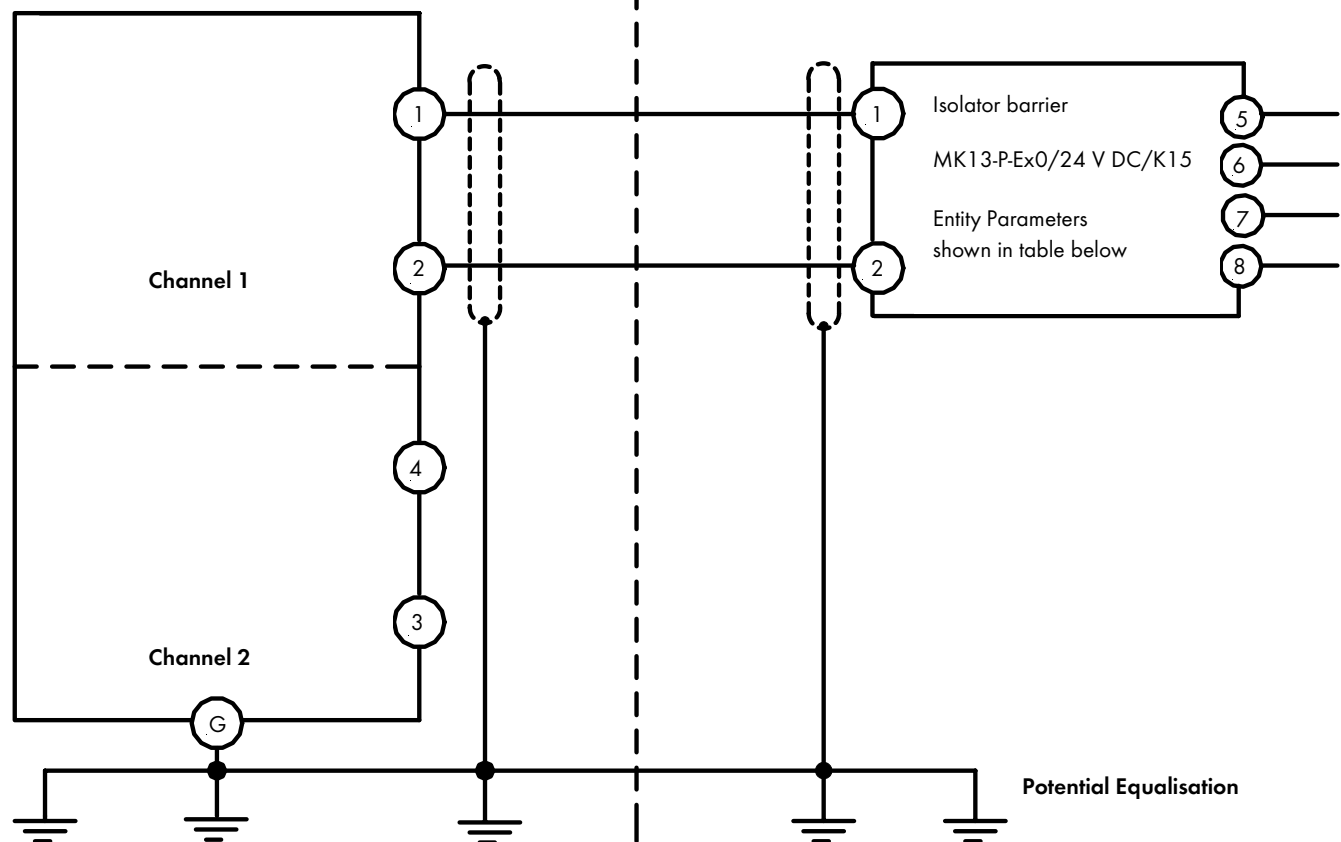
Class I; Division 1; Groups A, B, C & D T4 ... T6

Note: T4 Temperature code based on 80 °C (176 °F)  
T5 Temperature code based on 70 °C (158 °F)  
T6 Temperature code based on 55 °C (131 °F)

Flow Meter System Series  
VS\*\* \*-32Q1\*/\*  
EF\*\* Q\*\*\*/\*

### Unclassified Location

ASSOCIATED APPARATUS  
Isolator barrier MK13-P-Ex0/24 V DC/K15  
(TURCK)



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# FM Approved Isolator Barriers

## Discrete Input Devices with Intrinsically Safe Field Circuits

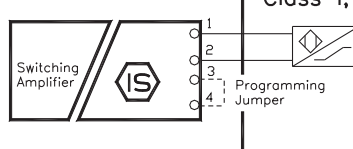


NON-HAZARDOUS LOCATION, OR  
Class I, Division 2, Groups A,B,C,D

HAZARDOUS (CLASSIFIED) LOCATION

Class I, Div. 1, Groups A,B,C,D; Class II, Div. 1, Groups E,F,G; Class III, Div. 1  
or  
Class I, Zone 0, 1 or 2, Group IIC, IIB, or IIA

MK13-R-Ex0/24VDC  
MK13-R-Ex0/12VDC  
MK13-R-Ex0  
MK13-PF-Ex0/24VDC  
MK13-NF-Ex0/24VDC  
MK13-PN-Ex0/24VDC  
MK13-P-Ex0/24VDC  
MK13-P-Ex0/24VDC/K15  
MK13-N-Ex0/24VDC



Entity Parameters: Class I, Division 1; Class II, Division 1; Class III, Division 1

Model	Terminals	V <sub>oc</sub> (V)	I <sub>sc</sub> (mA)	P <sub>0</sub> (mW)	C <sub>0</sub> (uF) AB/CE/DFG	L <sub>0</sub> (mH) AB/CE/DFG
MK13-R-Ex0/..VDC	1-2	9.6	19.4	46.6	3.6/26/210	82/296/700
MK13-PF-Ex0/24VDC						
MK13-NF-Ex0/24VDC						
MK13-PN-Ex0/24VDC						
MK13-P-Ex0/24VDC						
MK13-N-Ex0/24VDC						
MK13-R-Ex0						
MK13-P-Ex0/24VDC/K15						

Entity Parameters: Class I, Zone 0, 1, or 2

Model	Terminals	U <sub>0</sub> (V)	I <sub>0</sub> (mA)	P <sub>0</sub> (mW)	C <sub>0</sub> (uF) IIC/IIB/IIA	L <sub>0</sub> (mH) IIC/IIB/IIA
MK13-R-Ex0/..VDC	1-2	9.6	19.4	46.6	3.6/26/210	82/296/700
MK13-PF-Ex0/24VDC						
MK13-NF-Ex0/24VDC						
MK13-PN-Ex0/24VDC						
MK13-P-Ex0/24VDC						
MK13-N-Ex0/24VDC						
MK13-R-Ex0						
MK13-P-Ex0/24VDC/K15						

### Notes:

1. The symbol designates any of the following:

- For US jurisdictions - Any FM approved intrinsically safe apparatus with Entity Concept parameters, or any simple apparatus.
- For Canadian jurisdictions - Any Canadian certified intrinsically safe apparatus with Entity Concept parameters, or any simple apparatus.

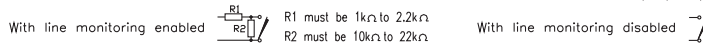
The Entity concept allows interconnection of intrinsically safe apparatus and associated apparatus not specifically examined in such combination as a system when the conditions above are met.

$$V_{max} \geq V_{oc} \text{ or } V_t \quad I_{max} \geq I_{sc} \text{ or } I_t \quad U_i \geq U_0 \quad I \geq I_0 \quad P_i \geq P_0$$

$$C_i + C_{cable} \leq C_0 \quad L_i + L_{cable} \leq L_0 \quad C_i + C_{cable} \leq C_0 \quad L_i + L_{cable} \leq L_0$$

A simple apparatus is defined as an electrical component or combination of components of simple construction with well-defined electrical parameters that does not generate more than 1.5V, 100mA, and 25mW, or a passive component that does not dissipate more than 1.3W and is compatible with the intrinsic safety of the circuit in which it is used.

2. When the field device is a contact closure, the connection should be made as shown below for proper performance.



3. Wiring methods must be in accordance with:

For US jurisdictions - the National Electrical Code, ANSI/NFPA 70, Article 504 (for Division 1 or 2 installations) or Article 505 (for Zone 0, 1 or 2 applications), and ANSI/ISA RP12.06.01.

For Canadian jurisdictions - the Canadian Electrical Code, CSA 22.1, for Division 1 or 2 or Zone 1 or 2 installations.

4. Associated apparatus must not be connected to any device that uses or generates in excess of 250Vrms unless it has been determined that the voltage is adequately isolated from the associated apparatus.

5. If the electrical parameters of the cable are unknown, the following values may be used:

Capacitance - 60pF/foot  
Inductance - 0.2uH/foot

Drawing No.:

IS-1.110

**TURCK**

3000 Campus Drive  
Plymouth, MN 55441  
Phone: (763) 553-7300

Title: Control Drawing for MK13-R-, MK13-P-, MK13-N-, MK13-PN-, MK13-PF-, and MK13-NF- with I/S (Entity) Field Circuits

Scale: NONE

Sheet 1 of 1

A	Release	BVL	1/11/06
Rev	Description	Drft	Date

## • Installation of VSE flow meters in explosion hazardous areas

The following figures show the wiring diagrams for flow meters in the "VS" series for use in areas subject to an explosion hazard. Connect each piece of equipment as shown in the diagram. Isolated switching amplifiers also contain non-intrinsically-safe circuits and may not be installed in hazardous areas. The non-intrinsically-safe circuits are to be installed according to IEC 60364-4-4\*.

Flow meters in hazardous areas are to be connected to a grounding system grounded according to the applicable regulations. VSE supplies connection cables for EMC-safe operation in which the shield is seated on the union nut of the four-pin circular connector. It is not necessary for EMC-safe operation, but it is recommended to connect the shield to a ground connection at the other end of the connection cable, i.e. in the non-hazardous area.

You must always make sure that the grounded conductor "PE" is correctly connected with the flow meter and that no voltage differences can arise between the grounded conductor PE connections (flow meter » isolated switching amplifier » electronic signal processor). To accomplish this, always install an extra wire connection (about Ø 4 ... Ø 6 mm<sup>2</sup>) between each of the pieces of equipment (see the PE arrows in the following figures) or connect every single PE connection point in a star configuration to a specific location on the grounded conductor PE. There is a terminal for this on the measuring unit housing. A conductor with a minimum diameter of 4 mm<sup>2</sup> can be connected here.

### Important:

**Mounting and installation must always be performed according to the locally applicable regulations and the owner of the measuring unit is responsible for abiding by these regulations. All installations are to be performed to ensure EM-compatibility. You must make sure that no voltage differences can arise between the pieces of equipment and must install potential equalization!**



The wiring diagram in figure 5 shows the processed signal of one channel from the flow meter. With this measuring system you can measure the flow rate and the volume, but it is not possible to detect the direction of flow, when connected in this manner.

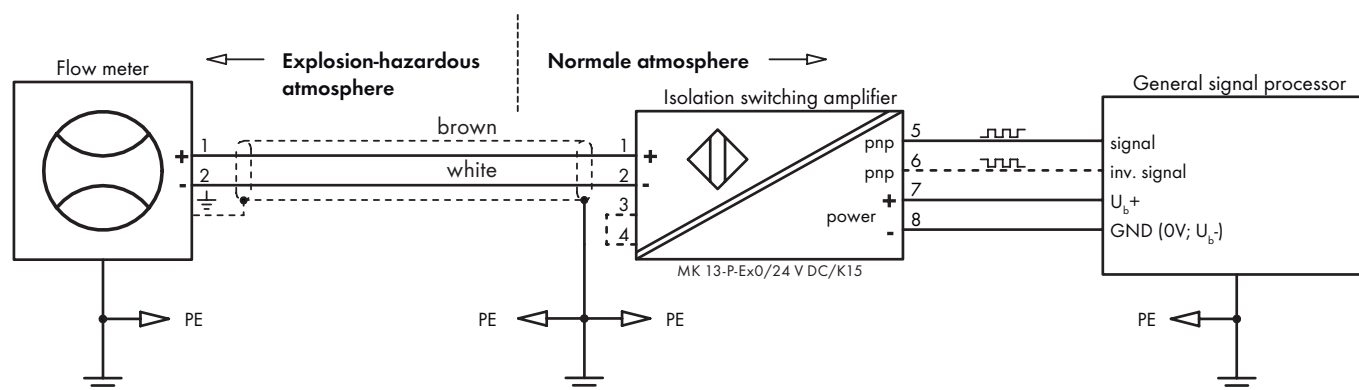


Figure 5: Evaluation of one channel

### Important:

**This processing unit can be used, when it is ensured that the flow volume can flow in only one direction. When the flow direction changes (also short term), the receiver does not perceive this return flow, and a measurement error occurs.**



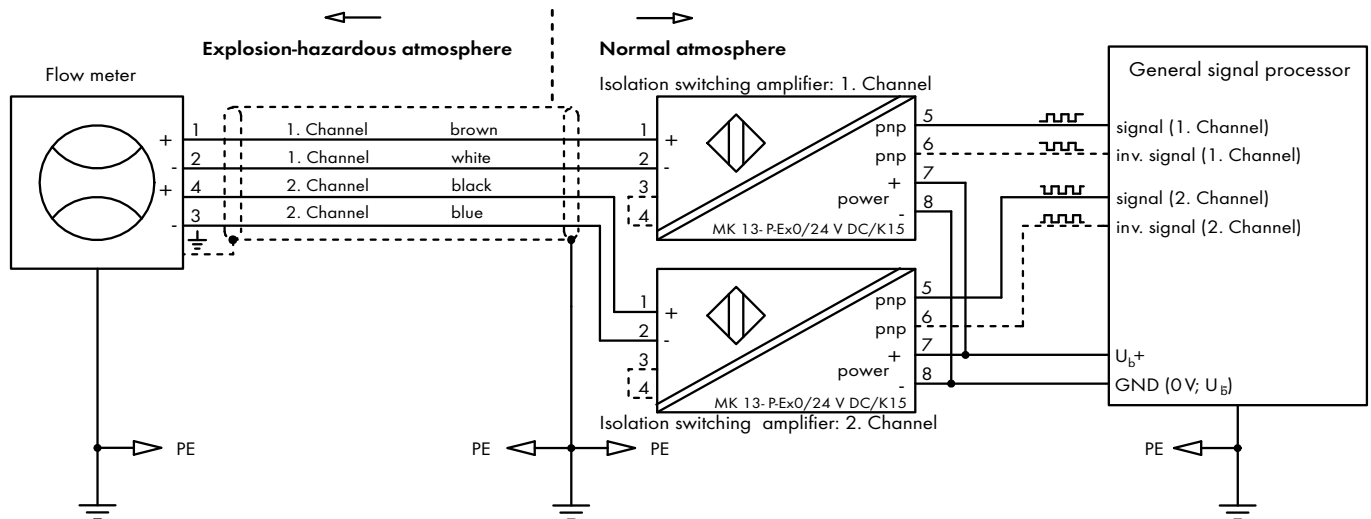


Figure 6: Evaluation of two channels (standard circuit)

As a rule, this circuit is used as the standard. The electronic processing unit processes the digital signals from channels 1 and 2 and supplies the current. The inverted signals of the channels are not required for the evaluation so that they are omitted and you only need a four-strand cable.

With the figure 7 circuit, you can create two autarchic functioning signal systems. This type of flow meter has two galvanic isolated circuits, which operate

separately, thus allowing a separate processing of the signals (channel 1 and channel 2). As you can see in figure 7, the signals are transmitted through isolation switching amplifiers, which operate separately. The two systems are fed by two sources of power. Since the two signal systems are galvanically isolated from one another and operate independently, this type is used in equipment and systems, which operate redundantly. Even if one of the signal systems fails, the other continues to function.

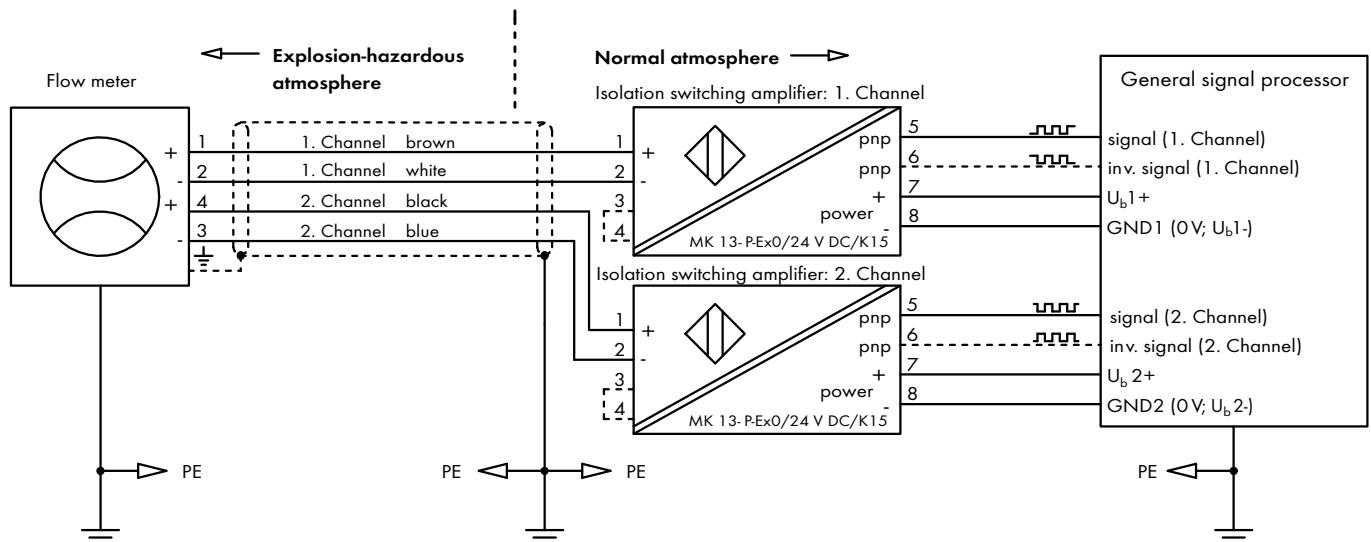


Figure 7: Galvanic isolation between the channels through separate power supply

### Important:

**The isolation switching amplifier MK13-P-Ex0/24 V DC/K15 is manufactured by the WERNER TURCK GmbH & Co. KG exclusively for the Ex-Type flow meters of the VSE Volumentechnik GmbH!**



The connection diagram in figure 6 shows the processing of two channels of the flow meter. With this measuring system, you can measure the flow rate and volume in both directions of flow.

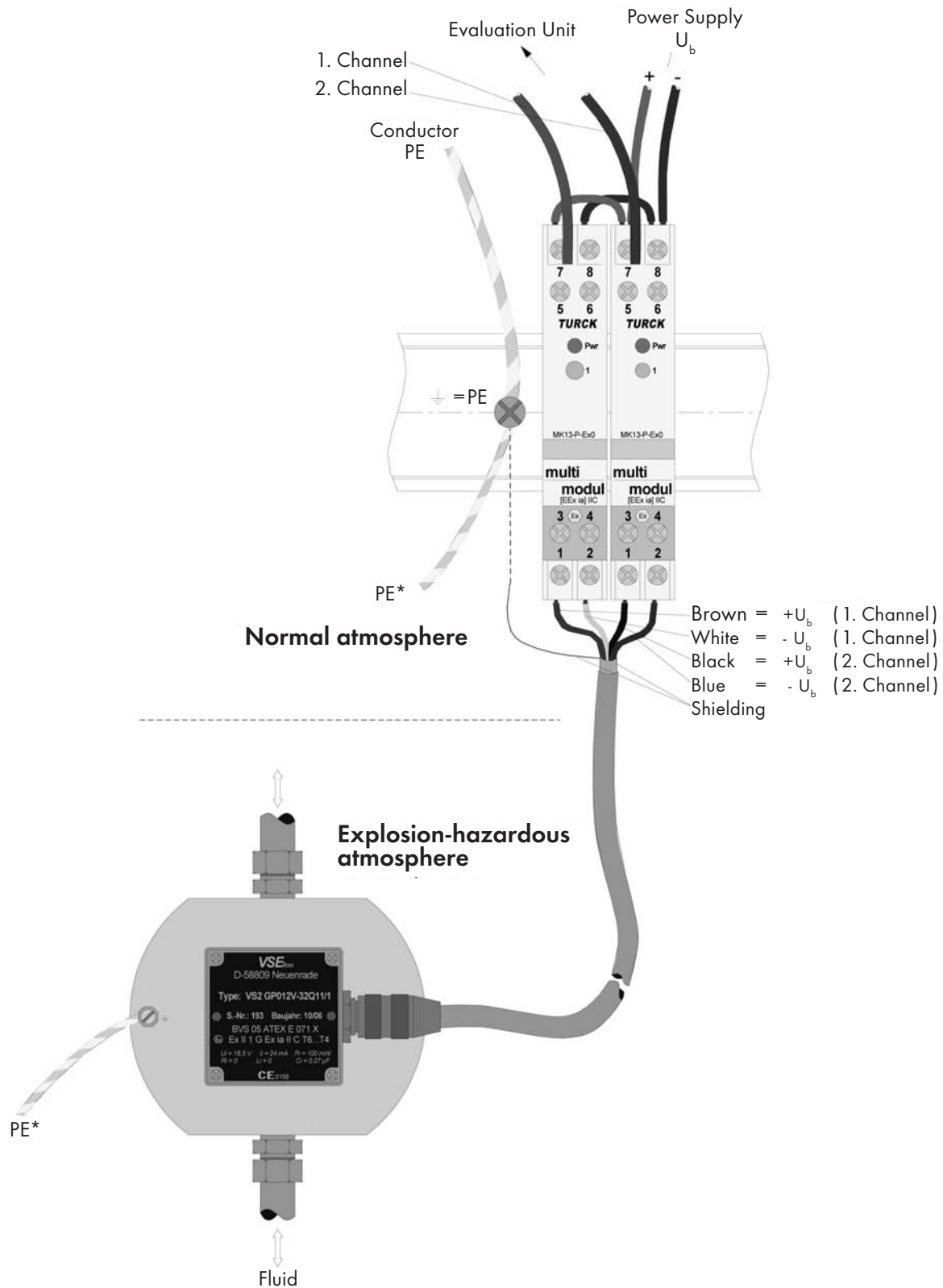


Figure 8: Connection of flow meter and isolated switching amplifier

**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.**



## • 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 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 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 rated 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!
- To suppress inductive interference, you must use the connection cable in which the shield is seated on the union nut of the four-pin circular connector, when installing the flow meter. In hazardous areas, the flow meter is connected to a ground potential. You must be extremely certain that there is an equalization of potential between each end of the circuit (i.e. between the hazardous and non-hazardous areas). The potential equalization of the ground conductor PE must be present throughout the entire area.
- 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!
- VSE supplies special flow meters from the "VS" series, when the flow meter is to be operated in a hazardous area. These flow meters are authorized for use in hazardous areas and must always be operated in conjunction with isolated switching amplifiers that guarantee intrinsic safety and are Ex-certified. They are marked in blue and offer the safety level required for explosion protection!
- The isolated switching amplifiers must guarantee the "ia" level (DIN EN 60079-11) of intrinsic safety of the signal circuit, and their limit values may not exceed the highest permitted input value of the flow meter.
- When equipment is connected electrically, a "Verification of Intrinsic Safety" must be performed (EN 60079-14; FM 3600). 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. This applies to the isolated switching amplifiers as well as the flow meters. The relevant, applicable regulations apply to the installation of intrinsically safe circuits, the mounting of external connectors, the properties and routing of lines and cables. Cables and terminals with intrinsically safe circuits must be labeled accordingly and must be isolated from non-intrinsically safe circuits or be equipped with the appropriate isolation (EN 60079-14; FM 3600)!
- The sum of the maximum effective capacitance  $C_i$  and inductivity  $L_i$  of the flow meter and the four-pin connection cable may not exceed the maximum values  $C_0$  ( $C_0$ ) and  $L_0$  ( $L_0$ ) of the corresponding isolated switching amplifier. Pay attention to the manufacturer's specifications for the connection cable and to the lengths of the cables used.
- It must be especially observed that the radial thickness of the insulation of a conductor for conventional insulation materials e.g. polyurethane, have a minimum thickness of 0.2 mm. The diameter of a finely stranded conductor must not be smaller than 0.1 mm. The ends of the conductor have to be protected against fanning out, e.g. by ferrules.  
In addition to this the sheath insulation must be tested in respect of electrostatic charge to ensure a safe use in the intrinsically safe area. The VSE-Ex-cable corresponds to these requirements.
- It must be especially observed that for the use of devices with two channels there exist two intrinsically safe power circuits in a cable. Here please observe chapter 12.2.2.7/8 of EN60079-14. An installation firm and protected against damages is always necessary for this kind of operation.
- 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 (Ex-Type VS) in hazardous areas requiring category 1 equipment, the sensor is to be installed so that sparks from impact or friction can be ruled out! Furthermore the operator has to judge the suitability of the device for special application.
- 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. We advise to a yearly control and recalibration.**

**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 VSE.

Furthermore, a safety data sheet must also be enclosed in which it is clearly stated, which medium was used with this flow meter and any potential hazards the corresponding medium may attribute.

The legal regulations relating to occupational safety, accident prevention regulations, regulations relating to environmental protection, waste disposal and water resources law oblige companies, their employees and 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 VSE.

Note that examination and repair of any flow meters sent to VSE Volumen-technik GmbH will only be performed, when the safety data sheet of the medium used is enclosed and the flow meters have been completely cleaned 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 specifications VS 0.02 – VS 4**

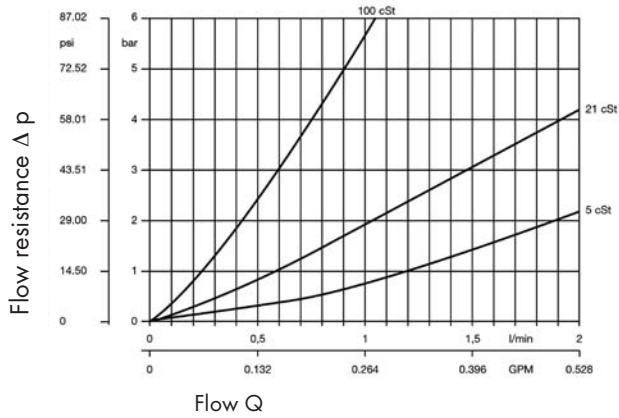
Size	Measuring range l/min	Frequency Hz	Pulse value cm <sup>3</sup> /pulse	K-factor pulse/litre
VS 0.02	0.002 ... 2	1.667 ... 1666.67	0.02	50 000
VS 0.04	0.004 ... 4	1.667 ... 1666.67	0.04	25 000
VS 0.1	0.01 ... 10	1.667 ... 1666.67	0.1	10 000
VS 0.2	0.02 ... 18	1.667 ... 1500.00	0.2	5 000
VS 0.4	0.03 ... 40	1.250 ... 1666.67	0.4	2 500
VS 1	0.05 ... 80	0.833 ... 1333.33	1	1 000
VS 2	0.1 ... 120	0.833 ... 1000.00	2	500
VS 4	1.0 ... 250	4.167 ... 1041.67	4	250

Measurement accuracy	: up to 0.3% of measurement value (with viscosity > 20 mm <sup>2</sup> /s)	
Repeating accuracy	: ± 0.05% under the same operating conditions	
Materials	: Cast iron EN-GJS-400-15 (EN 1563) or stainless steel 1.4305	
Gear bearing	: Ball bearings or steel plain bearings (medium-dependent)	
Seals	: FPM (standard), NBR, PTFE or EPDM	
Max. operating pressure	: Cast iron EN-GJS-400-15 (EN 1563)	315 bar/ 4500 psi
	: stainless steel 1.4305	450 bar/ 6500 psi
Viscosity range	: 1 ... 100 000 mm <sup>2</sup> /s	
Installation position	: unrestricted	
Direction of flow	: unrestricted	
Running noise	: max. 72 db(A)	
Channel offset	: 90° ± 30° max.	
Pulse-width repetition rate	: 1/1 ± 15° max.	
Preamplifier housing	: Aluminum	
Protection type	: IP 65	

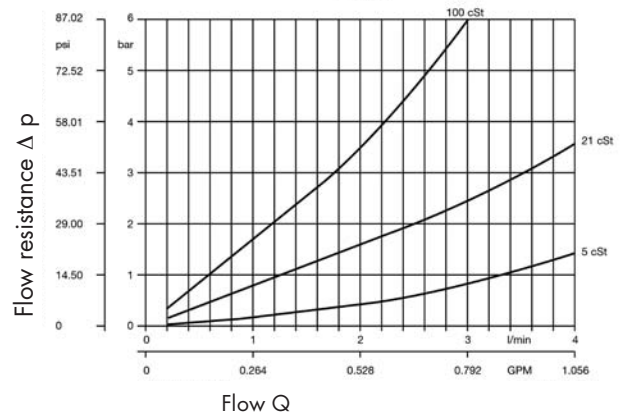


• Flow response curves VS 0.02 – VS 4

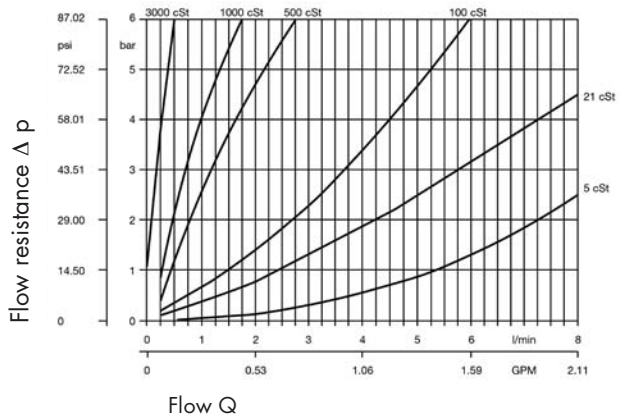
**VS 0.02**



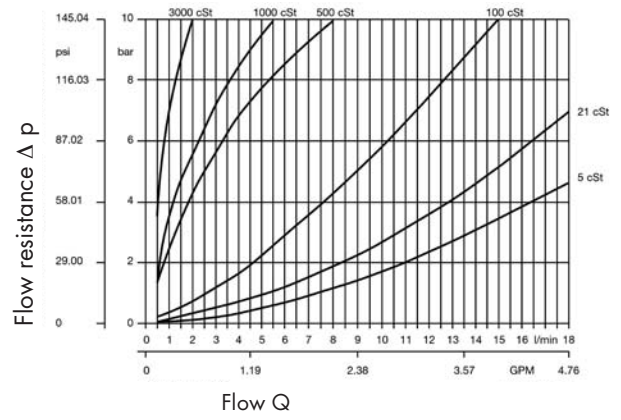
**VS 0.04**



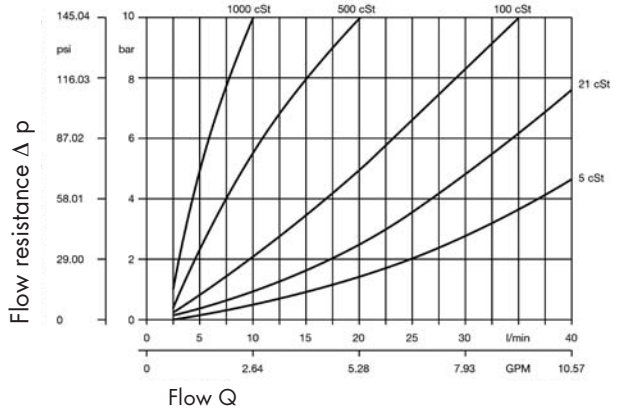
**VS 0.1**



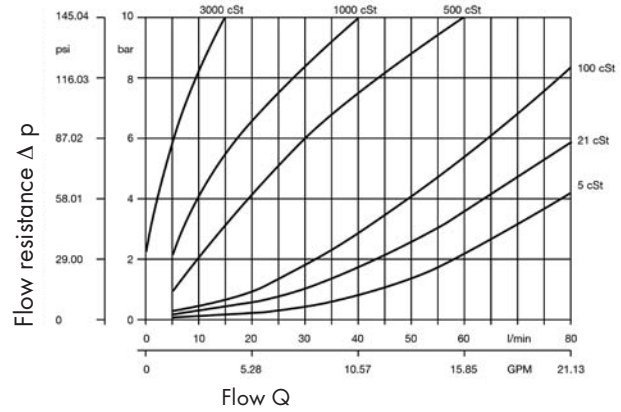
**VS 0.2**



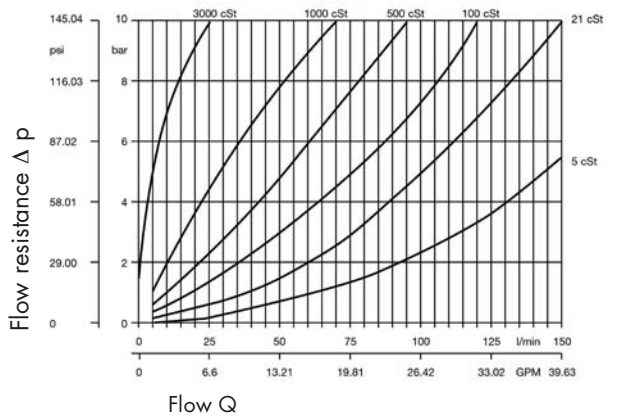
**VS 0.4**



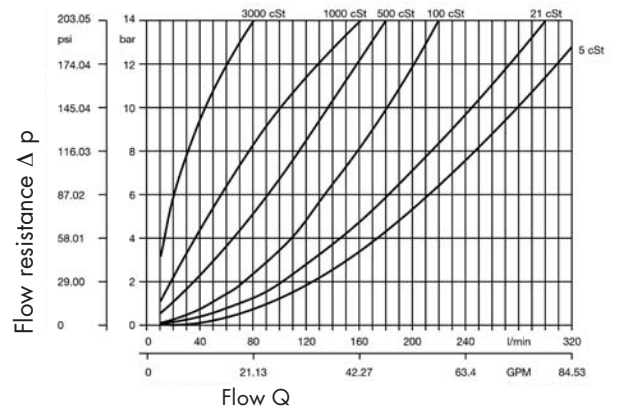
**VS 1**



**VS 2**

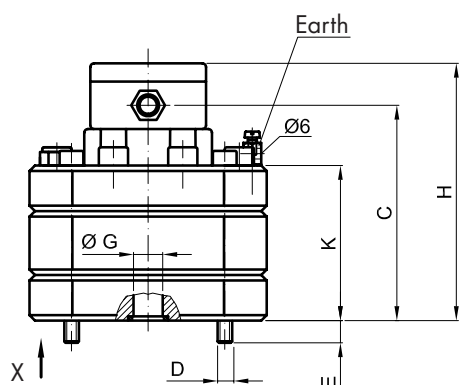


**VS 4**



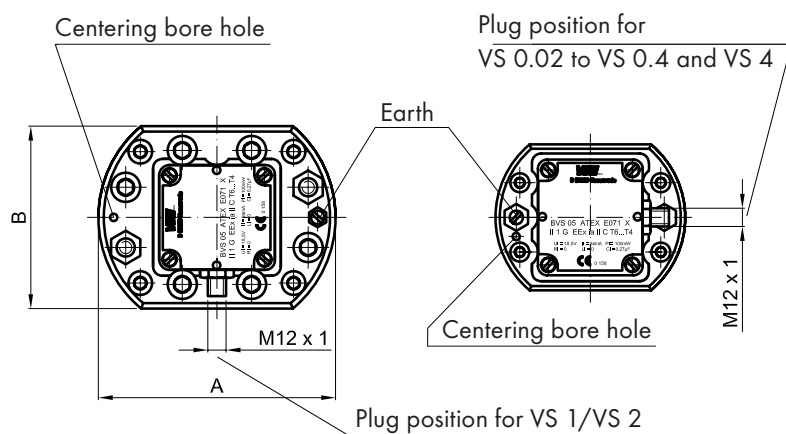
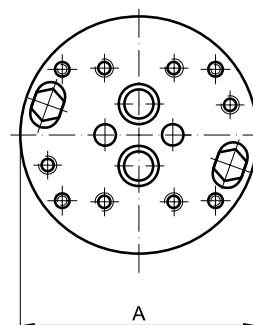
## • Dimensions VS 0.02 – VS 4

Cast iron version



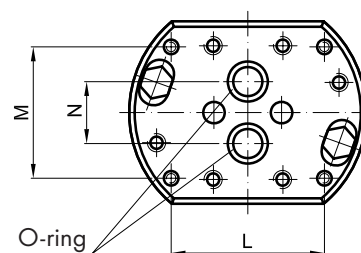
View X

Stainless steel version  
Connection diagram  
Housing without milled edge



View X

Cast iron version  
Connection diagram

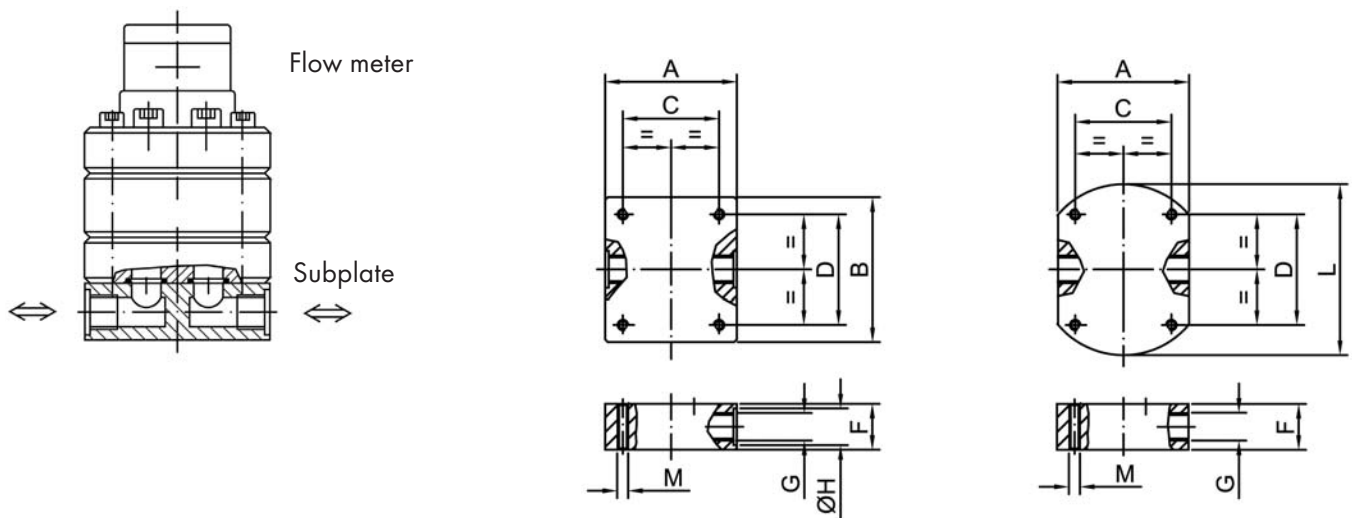


Size	A	B	C	D	E	øG	H	K	L	M	N	O-ring	weight GCI kg	E kg
<b>VS</b>														
<b>0.02</b>	100	80	91	M6	12.5	9	114	58	70	40	20	11 x 2	2.8	3.4
<b>0.04</b>	100	80	92	M6	11.5	9	115	59	70	40	20	11 x 2	2.8	3.4
<b>0.1</b>	100	80	94	M6	9	9	117	61	70	40	20	11 x 2	2.8	3.4
<b>0.2</b>	100	80	94	M6	9.5	9	117	61	70	40	20	11 x 2	3.0	3.7
<b>0.4</b>	115	90	96.5	M8	11.5	16	120	63.5	80	38	34	17.96 x 2.62	4.0	5.0
<b>1</b>	130	100	101	M8	12.5	16	124	68	84	72	34	17.96 x 2.62	5.3	6.8
<b>2</b>	130	100	118	M8	15	16	141	85	84	72	34	17.96 x 2.62	6.7	8.4
<b>4</b>	180	140	145	M12	20	30	168	110	46	95	45	36.17 x 2.62	14.7	18.4

The dimensions are specified in mm

• **Dimensions, subplates AP. 02 - 4**

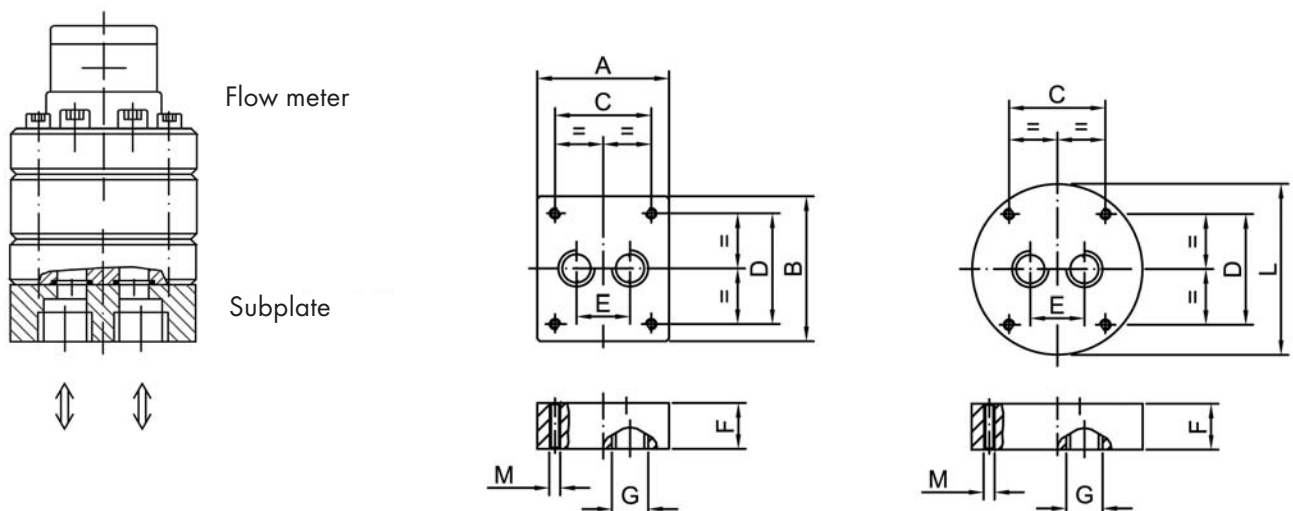
**Connection position, side**



Size	Connection thread	F	øH	A	B	C	D	E	L	Thread /depth	weight
VS	G									M	kg
0.02	G 1/4"	35	20	80	90	40	70	26	100	M6 / 12	1.8
0.04	G 3/8"		23					30			
0.1	G 1/2"		28					38			
0.2											
0.4	G 1/2"	35	28	90	100	38	80	46	115	M8 /15	2.7
	G 3/4"	40	33					52			
1 2	G 1/2"	35	28	100	110	72	84	46	130	M8 /15	3.6
	G 3/4"	40	33					52			
	G 1"	55	41					55			
4	G 1 1/4"	70	51	120	130	100	110	60		M8 /15	7.4
	*G 1 1/2"	70	56				120	72			
	G 1 1/2"	80		140			110				180

\*only for AP. 4 U...

**Connection position below**

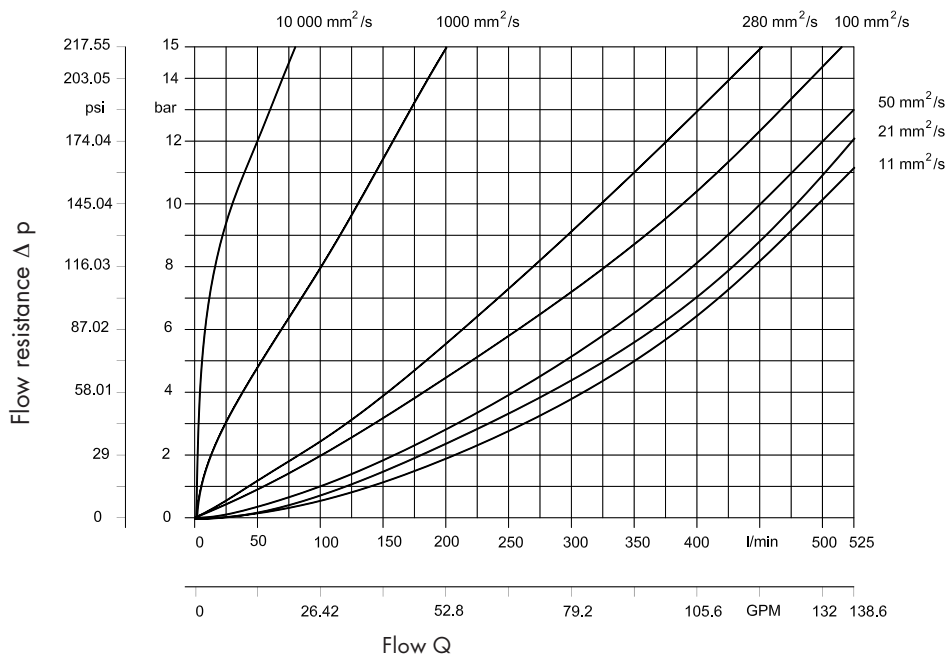


## • Technical specifications VS 10

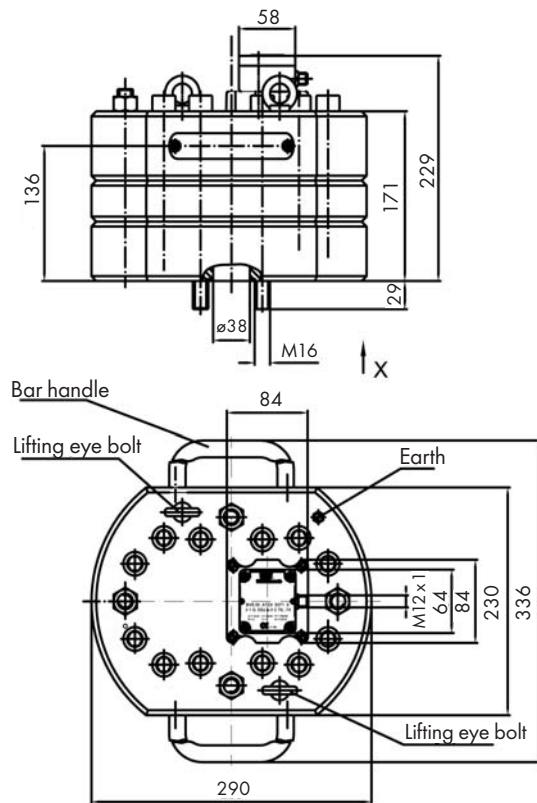
Size	Measuring range l/min	Frequency Hz	Pulse value cm <sup>3</sup> /pulse	K-factor pulse/litre
VS 10	1.5 ... 525	7.50 ... 2625.00	3.333	300

Measurement accuracy	: up to 0.3% of measurement value (with viscosity > 20 mm <sup>2</sup> /s)
Repeating accuracy	: ± 0.05% under the same operating conditions
Materials	: Cast iron EN-GJS-600-3 (EN 1563)
Gear bearing	: Ball bearings or steel plain bearings (medium-dependent)
Weight	: 70 kg without subplate
Seals	: FPM (standard), NBR, PTFE or EPDM
Max. operating pressure	: 420 bar / 6000 psi
Viscosity range	: 5 ... 100 000 mm <sup>2</sup> /s
Installation position	: unrestricted
Direction of flow	: unrestricted
Running noise	: < 80 db(A)
Channel offset	: 90° ± 30° max.
Pulse-width repetition rate	: 1/1 ± 15° max.
Preamplifier housing	: Aluminum
Protection type	: IP 65

## • Flow response curves VS 10

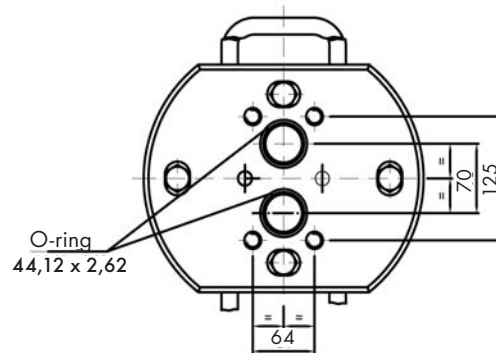


• **Dimensions VS 10**



View X

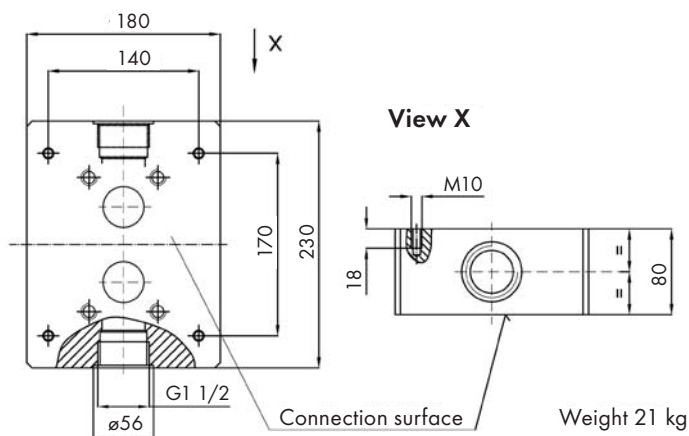
Connection diagram



Weight 70 kg

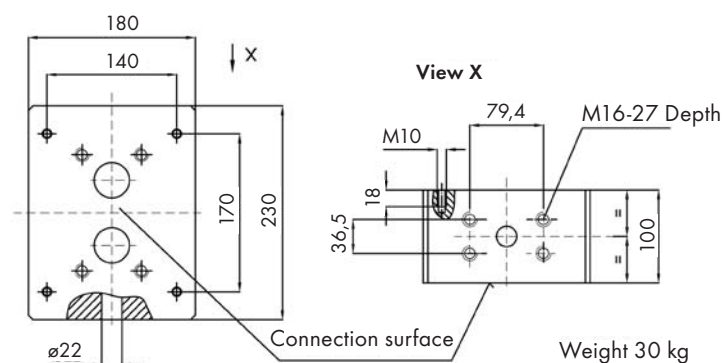
The dimensions are specified in mm

• **Dimensions, subplate APG 10**  
APG 10 SG0N / 1



View X

APG 10 SW0N / 1



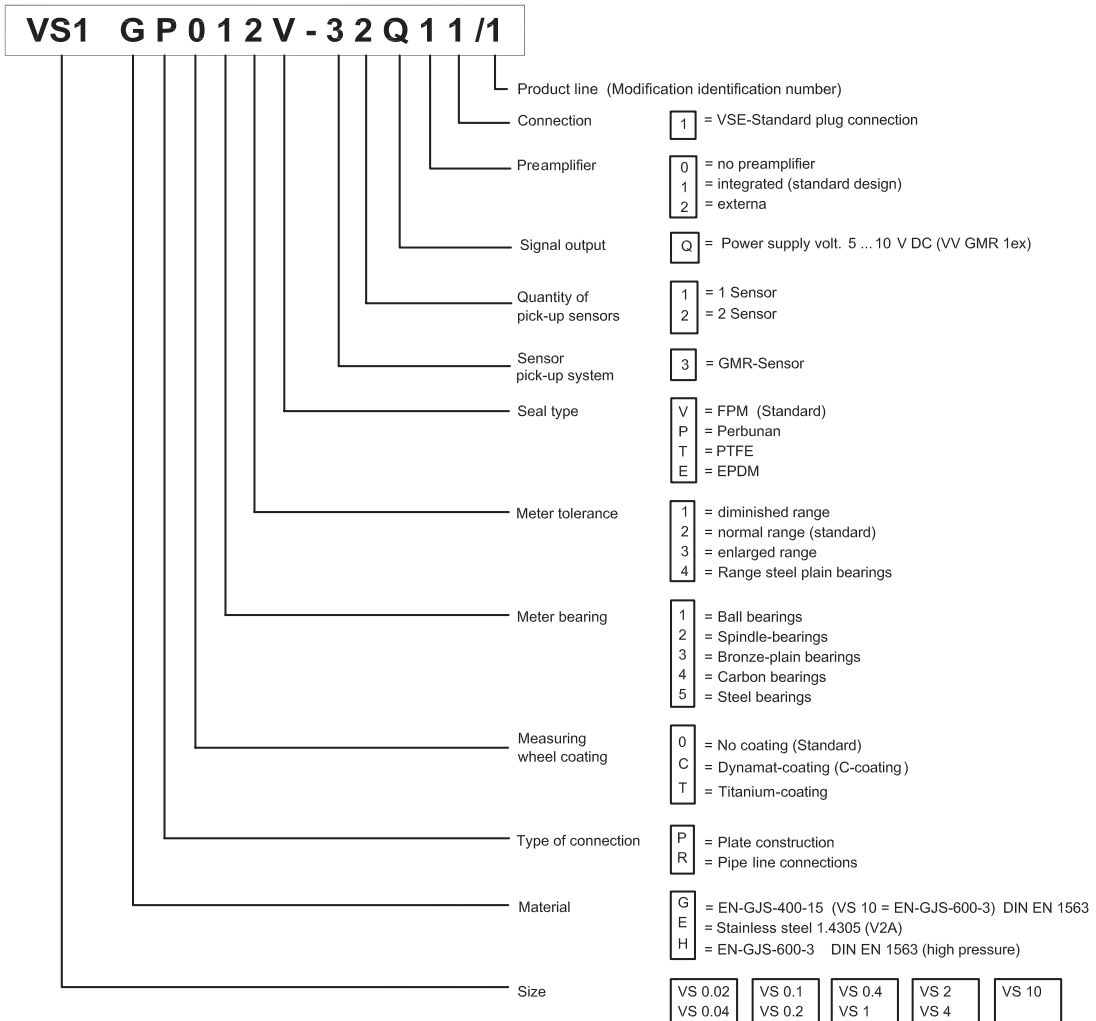
View X

The dimensions are specified in mm

## • Type key

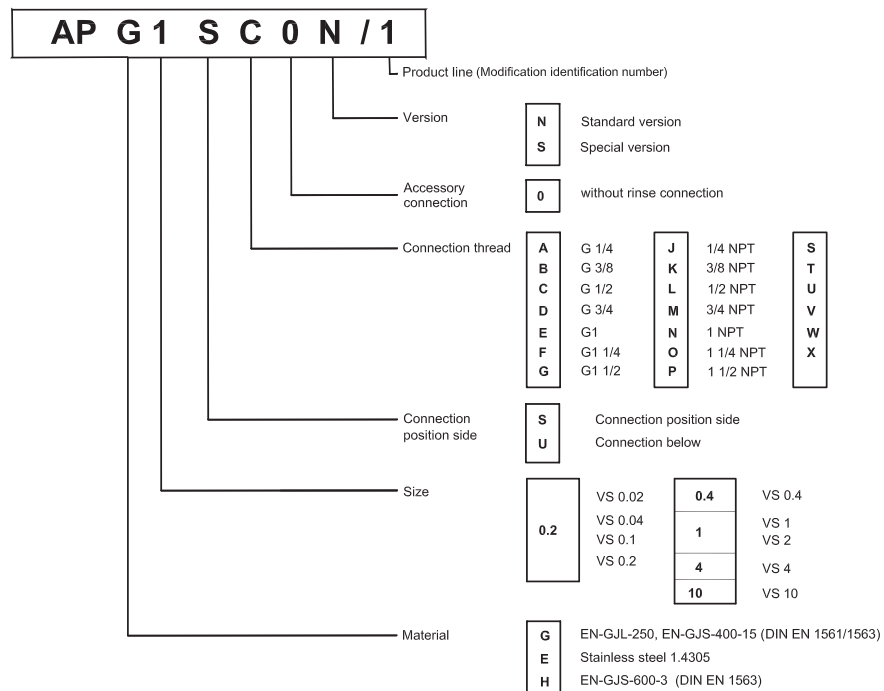
### Flow meters VS Ex-Type

Example:



### Subplates AP

Example:



## • Labeling of the flow meters

Name and address of the manufacturer

VSE Volumentechnik GmbH  
Hönnestraße 49  
58809 Neuenrade / Germany

CE label



Type designation

VS \*\*\* \*\*\*\*\*-32Q1\*/\*

Compliance with directive 94/9/EC compliance



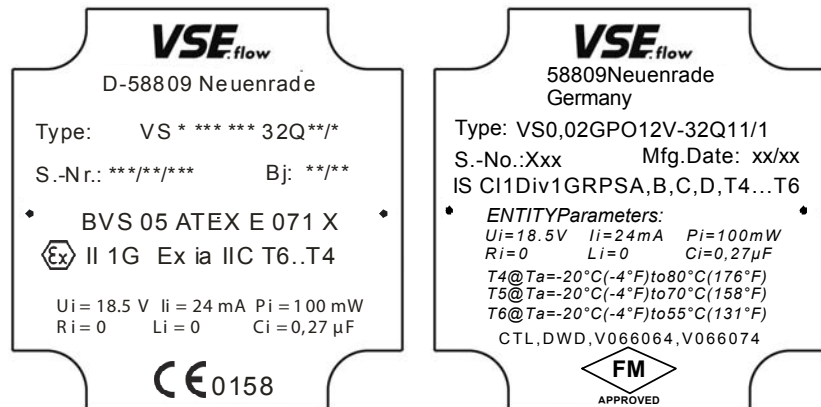
II 1G Ex ia IIC T6...T4

Compliance with NEC/NFPA 70



IS CL1 Div. GRPS A, B, C, D T4...T6

Type plates



## • Safety data for flow meter type VS \*\*\* \*\*\*\*\*-32Q1 \*/\*

### Nominal values:

Nominal voltage  $V_{CC1,2} = 5 \dots 10 \text{ V}$   
Switching current  $I_{Low1,2} < 2.7 \text{ mA}$  ( $I_{Low min1,2} > 2.0 \text{ mA}$ )  
 $I_{High1,2} > 3.7 \text{ mA}$  ( $I_{high max1,2} < 4.5 \text{ mA}$ )

### Maximum values

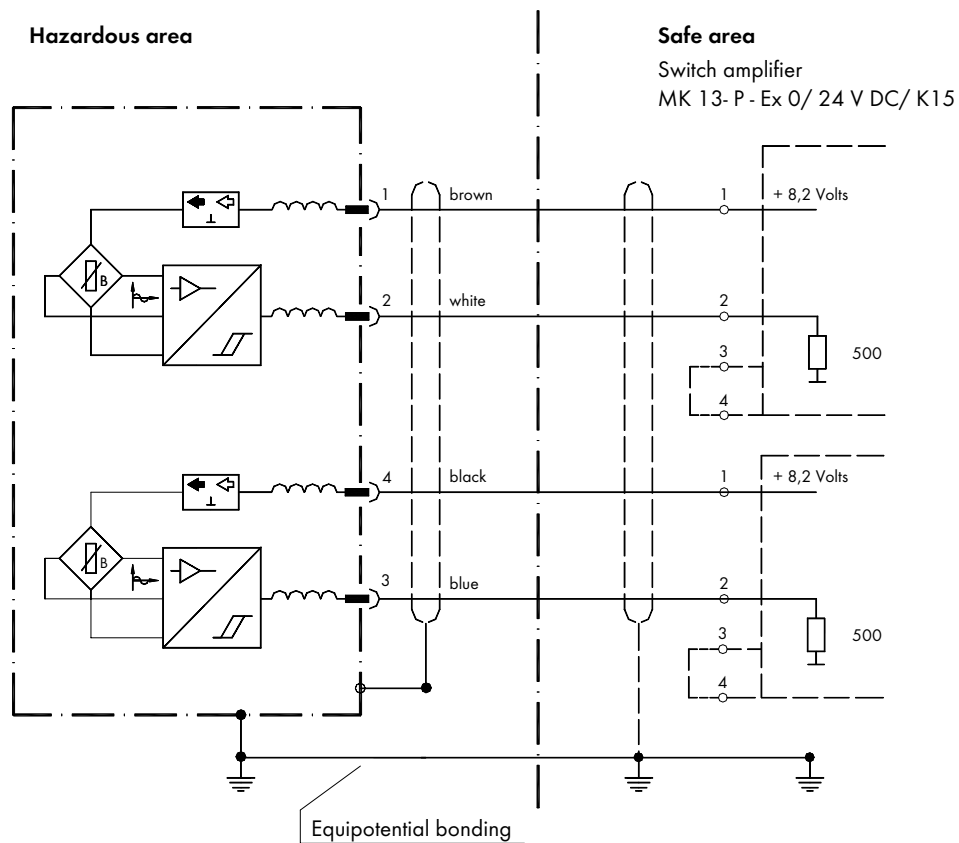
$U_i = 18.5 \text{ V}$   $C_i = 0.27 \mu\text{F}$   
 $I_i = 24 \text{ mA}$   $L_i = 0$   
 $P_i = 100 \text{ mW}$   $R_i = 0$





• **Maximum ambient and media temperatures**

Temperature class	T4	T5	T6
ATEX	T4	T5	T6
Ambient temperature	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{amb}} \leq 95^{\circ}\text{C} (203^{\circ}\text{F})$	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{amb}} \leq 70^{\circ}\text{C} (158^{\circ}\text{F})$	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{amb}} \leq 55^{\circ}\text{C} (131^{\circ}\text{F})$
Media temperature	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{Med}} \leq 100^{\circ}\text{C} (212^{\circ}\text{F})$	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{Med}} \leq 75^{\circ}\text{C} (167^{\circ}\text{F})$	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{Med}} \leq 60^{\circ}\text{C} (140^{\circ}\text{F})$
FM	T4	T5	T6
Ambient temperature	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{amb}} \leq 80^{\circ}\text{C} (176^{\circ}\text{F})$	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{amb}} \leq 70^{\circ}\text{C} (158^{\circ}\text{F})$	$-20^{\circ}\text{C} (-4^{\circ}\text{F}) \leq T_{\text{amb}} \leq 55^{\circ}\text{C} (131^{\circ}\text{F})$

• **Preamplifier-block wiring diagram**



# • Summary of the safety-related technical data

Flow meter	VSE connecting cable, blue RAL 5015	Switching amplifier
<b>Type: VS *** *****-32Q1*/*</b>	<b>shielded; 4 x 0.34 mm<sup>2</sup></b>	<b>Type: MK13-P-Ex0/24 V DC/K15</b>
BVS 05 ATEX E 071 X FM-ID3026920	PUR	PTB 06 ATEX 2025 FM-ID3026920
 II 1G EEx ia IIC T4-T6 IS CL1 Div. 1 GRPS A, B, C, D T4...T6		 II (1) G [EEx ia] IIC Hazardous Locations CL1 Div. 2 GRPS A, B, C, D IS Entity Connections to CL1 Div. 1 GRPS A, B, C, D
$U_i = 18.5 \text{ V}$	$R = 0.053 \text{ } \Omega/\text{m}$	$U_o = 9.9 \text{ V (ATEX)}$ $V_{oc} = 9.6 \text{ V}$
$I_i = 24 \text{ mA}$	$L = 0.85 \text{ } \mu\text{H}/\text{m}$ (x)	$I_o = 22 \text{ mA (ATEX)}$ $I_{sc} = 19.4 \text{ mA}$
$P_i = 100 \text{ mW}$	$C_{A-A} = 55 \text{ pF}/\text{m}$ (x)	$P_o = 54 \text{ mW (ATEX)}$ $P_o = 46.6 \text{ mW}$
$R_i = 0$	$C_{A-S} = 105 \text{ pF}/\text{m}$ (x)	
$L_i = 0$	[(x) = measured at 1000 Hz]	
$C_i = 0.27 \text{ } \mu\text{F}$		

	ATEX		IIC		IIB	
$L_o/\text{mH}$	1	5	10	2	10	20
$C_o/\mu\text{F}$	1.1	0.75	0.65	5	3.5	3

FM	A/BIIC	C/IIB	D/IIA
$L_o/\text{mH}$	82	296	700
$C_o/\mu\text{F}$	3.6	26	210

Temperature class	T4	T5	T6
<b>ATEX</b>	<b>T4</b>	<b>T5</b>	<b>T6</b>
Ambient temperature	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{amb} \leq 95^\circ\text{C} (203^\circ\text{F})$	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{amb} \leq 70^\circ\text{C} (158^\circ\text{F})$	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{amb} \leq 55^\circ\text{C} (131^\circ\text{F})$
Media temperature	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{Med} \leq 100^\circ\text{C} (212^\circ\text{F})$	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{Med} \leq 75^\circ\text{C} (167^\circ\text{F})$	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{Med} \leq 60^\circ\text{C} (140^\circ\text{F})$
<b>FM</b>	<b>T4</b>	<b>T5</b>	<b>T6</b>
Ambient temperature	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{amb} \leq 80^\circ\text{C} (176^\circ\text{F})$	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{amb} \leq 70^\circ\text{C} (158^\circ\text{F})$	$-20^\circ\text{C} (-4^\circ\text{F}) \leq T_{amb} \leq 55^\circ\text{C} (131^\circ\text{F})$



Translation

**EC-Type Examination Certificate**

(1)

(2)

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

(3)

**BVS 05 ATEX E 071 X**

(4) **Equipment:** Volume sensor type VS \*\*\* \*\*\*\*\*-32Q1\*/\*\*and Typ EF \*\*\* Q\*\*\*\*\*\_\*/\*\*

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

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

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

(8) The certification body of EXAM BBG Prüf- und Zertifizier 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 05.2049 EG.

(9) The Essential Health and Safety Requirements are assured by compliance with:  
EN 50014:1997+A1-A2 General requirements  
EN 50020:2002 Intrinsic safety 'i'  
EN 50284:1999 Equipment Group II Category 1G

(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 schedule 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:

 **II 1G EEx ia IIC T4 – T6**

**EXAM BBG Prüf- und Zertifizier GmbH**

Bochum, dated 11. May 2005

Signed: Dr. Jockers

Certification body

Signed: Dr. Eickhoff

Special services unit

Page 1 of 3 to BVS 05 ATEX E 071 X

This certificate may only be reproduced in its entirety and without change  
Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 234/3696-105 Fax +49 234/3696-110



(13) Appendix to

(14) **EC-Type Examination Certificate**

**BVS 05 ATEX E 071 X**

(15) 15.1 Subject and type

Volume sensor type VS \*\*\* \*-32Q1\*/\* and type EF \*\*\* Q\*\*\*\*\*-\*/\*

Instead of the \*\*\* in the complete denomination letters and numerals will be inserted, which characterize modifications without influence on explosion protection.

15.2 Description

The volume sensor is used for measurement of flow or mass flow of liquids.

The electrical components of the sensor are mounted inside an aluminium (EF \*\*\* Q\*\*\*\*\*-\*/\*) or a cast iron or stainless steel enclosure (Typ VS \*\*\* \*-32Q1\*/\*).

The electrical connection is done by a connector.

15.3 Parameters

each channel

Voltage	Ui	DC	18,5	V
Current	Ii		24	mA
Power	Pi		100	mW
Effective internal capacitance	Ci		0,27	µF
Effective internal inductance	Li		negligible	

The temperature class will be defined depending on the ambient temperature range and the medium temperature in accordance with the following table:

Temperature class	T4	T5	T6
Ambient temperature range	-20 °C up to 95 °C	-20 °C up to 70 °C	-20 °C up to 55 °C
max. medium temperature	100 °C	75 °C	60 °C

(16) Test and assessment report

BVS PP 05.2049 EG as of 11.05.2005

(17) Special conditions for safe use

The use of volume sensors type EF \*\*\* Q\*\*\*\*\*-\*/\* in areas, where Category 1-equipment is necessary, the sensor has to be mounted in such a way that sparks by operational friction or impact are not possible.





**Translation**

**1st Supplement**

(Supplement in accordance with Directive 94/9/EC Annex III number 6)

**to the EC-Type Examination Certificate  
BVS 05 ATEX E 071 X**

**Equipment:** Volume sensor type VS \*\*\* -32Q1\*\* and type EF \*\*\* Q\*\*\*\*\*-/\*\*  
**Manufacturer:** VSE Volumenteknik GmbH  
**Address:** 58809 Neuenrade, Germany

Description

The sensor can be modified according to the descriptive documents as mentioned in the pertinent test and assessment report.

The Essential Health and Safety Requirements of the modified equipment are assured by compliance with:  
EN 50014:1997+A1-A2 General requirements  
EN 50020:2002 Intrinsic safety 'i'  
EN 50284:1999 Equipment Group II Category 1G

The marking of the equipment shall include the following:

 II 1G EEx ia IIC T4 – T6

Special conditions for safe use

The use of volume sensors type EF \*\*\* Q\*\*\*\*\*-/\*\* in areas, where Category 1-equipment is necessary, the sensor has to be mounted in such a way that sparks by operational friction or impact are not possible.

Test and assessment report

BVS PP 05.2049 EG as of 31.05.2006

**EXAM BBG Prüf- und Zertifizier GmbH**

Bochum, dated 31. May 2006

Signed: Dr. Jockers

Certification body

Signed: Dr. Eickhoff

Special services unit



## 2nd Supplement

(Supplement in accordance with Directive 94/9/EC Annex III number 6)

### to the EC-Type Examination Certificate BVS 05 ATEX E 071 X

**Equipment:** Volume sensor type VS \*\*\* \*-32Q1\*/\* and type EF \*\*\* Q\*\*\*\*\*-\*/\*  
**Manufacturer:** VSE Vumenttechnik GmbH  
**Address:** 58809 Neuenrade, Germany

#### Description

The flow sensor has been tested in acc. with EN 60079-\*\* and an additional version (with permanently connected cable) is possible.

The Essential Health and Safety Requirements of the modified equipment are assured by compliance with:

EN 60079-0:2006 General requirements  
EN 60079-11:2007 Intrinsic safety 'i'  
EN 60079-26:2004 Equipment Group II Category 1G

The marking of the equipment shall include the following:

**Ex II 1G Ex ia IIC T4-T6**

#### Parameters

each channel				
Voltage	Ui	DC	18.5	V
Current	Ii		24	mA
Power	Pi		100	mW
Effective internal capacitance	Ci		0.27	µF
Effective internal inductance	Li	negligible		

The temperature class will be defined depending on the ambient temperature range and the medium temperature in accordance with the following table:

Temperature class	T4	T5	T6
Ambient temperature range with connector	-20 °C up to +95 °C	-20 °C up to +70 °C	-20 °C up to +55 °C
Ambient temperature range with permanently connected cable	-40 °C up to +95 °C	-40 °C up to +70 °C	-40 °C up to +55 °C
max. medium temperature	100 °C	75 °C	60 °C

Page 1 of 2 to BVS 05 ATEX E 071 X / N2

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DEKRA EXAM GmbH Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 234/3696-105 Fax +49 234/3696-110 E-mail zs-exam@dekra.com  
(until 31.03.2007 EXAM BBG Prüf- und Zertifizier GmbH)



Special conditions for safe use

The volume sensor has to be mounted in such a way that sparks by operational friction or impact are not possible.

Test and assessment report

BVS PP 05.2049 EG as of 29.07.2009

**DEKRA EXAM GmbH**

Bochum, dated 29. July 2009

Signed: Simanski  
Certification body

Signed: Dr. Eickhoff  
Special services unit

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.

44809 Bochum, 29. July 2009  
BVS-Schu / Her A 20090571

**DEKRA EXAM GmbH**

  
Certification body

  
Special services unit





Member of the FM Global Group

FM Approvals  
1151 Boston-Providence Turnpike  
P.O. Box 9102 Norwood, MA 02062 USA  
T: 781 762 4300 F: 781 762 9375 www.fmglobal.com

## CERTIFICATE OF COMPLIANCE

### HAZARDOUS (CLASSIFIED) LOCATION ELECTRICAL EQUIPMENT

This certificate is issued for the following equipment:

**Type VS\*\*\* a\*\*\*\*\*-32QI\*\* and Type EF \*\*\* Q\*\*\*\*\*-\*/. Volume Sensors**

IS/I/1/ABCD/T4 @ Ta = -20 °C – 80 °C (-4 °F – 176 °F); T5 @ Ta = -20 °C - 70°C (-4 °F – 158 °F); T6 @ Ta = -20 °C – 55 °C (-4 °F – 131 °F); Entity

Entity Parameters:

$V_{Max} = 18.5 \text{ V}$ ,  $I_{Max} = 24 \text{ mA}$ ,  $P_{Max} = 100 \text{ mW}$ ,  $C_i = 0.27 \mu\text{F}$ ,  $L_i = 0 \text{ mH}$ .

a = Housing: E = 303 Stainless Steel (1.4305); G = Grey Cast Iron (GGG40).

The EF-Type consists of aluminum.

The preamplifier housing AK 061 consists of aluminum.

\* = Options not affecting safety, any single digit letter or number referring to non-electrical properties as product associates, language, delivery packing, documentation, etc.



**Equipment Ratings:**

Intrinsically Safe with Entity Parameters for Class I, Division 1, Groups A, B, C & D hazardous (classified) locations

**FM Approved for:**

VSE Vumentechnik GmbH  
Hönnestrasse 47  
58809 Neuenrade  
Germany



This certifies that the equipment described has been found to comply with the following Approval Standards and other documents:

Class 3600	1998
Class 3610	1999
Class 3810	2005

Original Project ID: 3026920

Approval Granted: *SEPTEMBER 17, 2007*

Subsequent Revision Reports / Date Approval Amended

Report Number	Date	Report Number	Date
---------------	------	---------------	------

FM Approvals LLC

  
Robert L. Martell, Jr.  
Assistant Vice President

  
Date



VSE Volumentechnik GmbH  
Hönnestraße 49  
58809 Neuenrade / Germany  
Phone + 49 (0)23 94/616 30  
Fax + 49 (0)23 94/616 33  
E-Mail [info@vse-flow.com](mailto:info@vse-flow.com)  
Internet [www.vse-flow.com](http://www.vse-flow.com)