VSE flow®

Solutions for Fluid Technology

# VS + VSI

## GEAR FLOW METERS

# VS POSITIVE DISPLACEMENT FLOW METERS

## VS FLOW METER

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.

## EXPLANATIONS FOR PREAMPLIFIER OF SIGNAL PICK-UP SYSTEM

The non-contact pick-up sensors consist of two differential magneto resistors, which are circumferentially offset from one another by 1/4 of a tooth pitch. The signals of both pick-up sensors are digitised with two signal amplifiers and amplified via followed short circuit proof push-pull output stages.
The square wave output signals are bidirectional and may be simply processed by any external electronics, plc control or computer. The processing of the 90° phase angle between signals enables recognition of flow direction and impulse rate conversion with a factor of 1, 2 and 4.

The signal frequency is proportional to the momentary flow rate (volume rate) dependent on the particular flow meter size. The frequency range extends from 0 – 2000 Hz. The preamplifier is protected against reverse polarity and incorrect connection. For medium temperatures between -40°C and 120°C (-22°F and 248°F) the unit is mounted directly on the flow meter cover.

## SENSOR SYSTEMS FOR EXTENDED TEMPERATURE RANGE

For liquid temperatures from -40°C up to 210°C a special pick up system is available.

## VSI HIGH DEFINITION PREAMPLIFIER

The VSI High Definition Preamplifier supplies digital signals with a higher resolution of the measured value. The resolution can be programmed between 4 and 64 angle steps and it enables a frequency multiplication up to factor 16. The K-factor of the flow meter can be increased up to factor 64. The maximum frequency at full flow can be 26 kHz.

## EX-TYPES

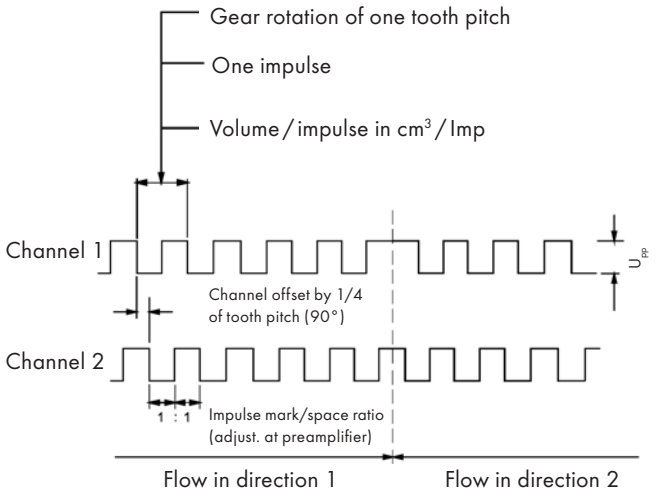
Intrinsically safe models, with approval code Ⓔx I 1G Ex ia IIC T4–T6, are supplied for applications in potentially explosion-hazardous areas. VSE delivers these types with isolation switch amplifier models MK 13 P Ex 0/24 VDC/K15.

## VS FLOW METER SELECTION

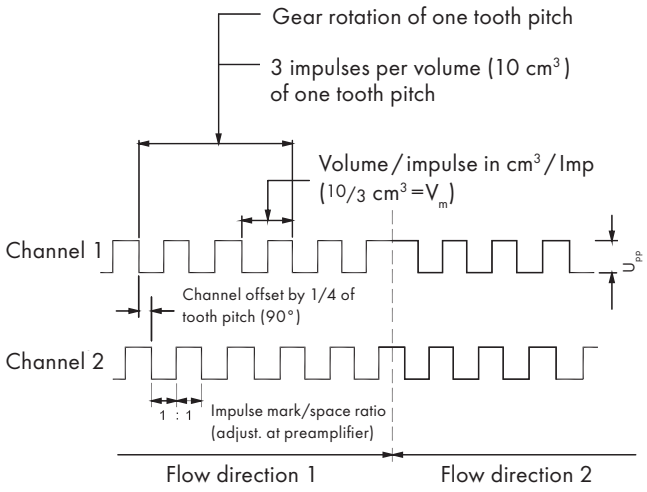
For trouble-free and safe operation of the flow meters the correct selection of type and size is decisive. Due to the great number of different applications and flow meter versions, the technical data in the VSE catalogues are of general character.
Certain characteristics of the devices depend on type, size and measuring range as well as on the medium to be measured. For exact flow meter selection please contact VSE.

# OUTPUT SIGNALS OF PREAMPLIFIER

## FLOW METER VS 0.02... VS 4




## FLOW METER VS 10




## VOLTAGE RANGES

Supply voltages: $U_v$ = 10 ... 28 V DC
Impulse voltages: $U_{pp} = U_v$ – 1 V

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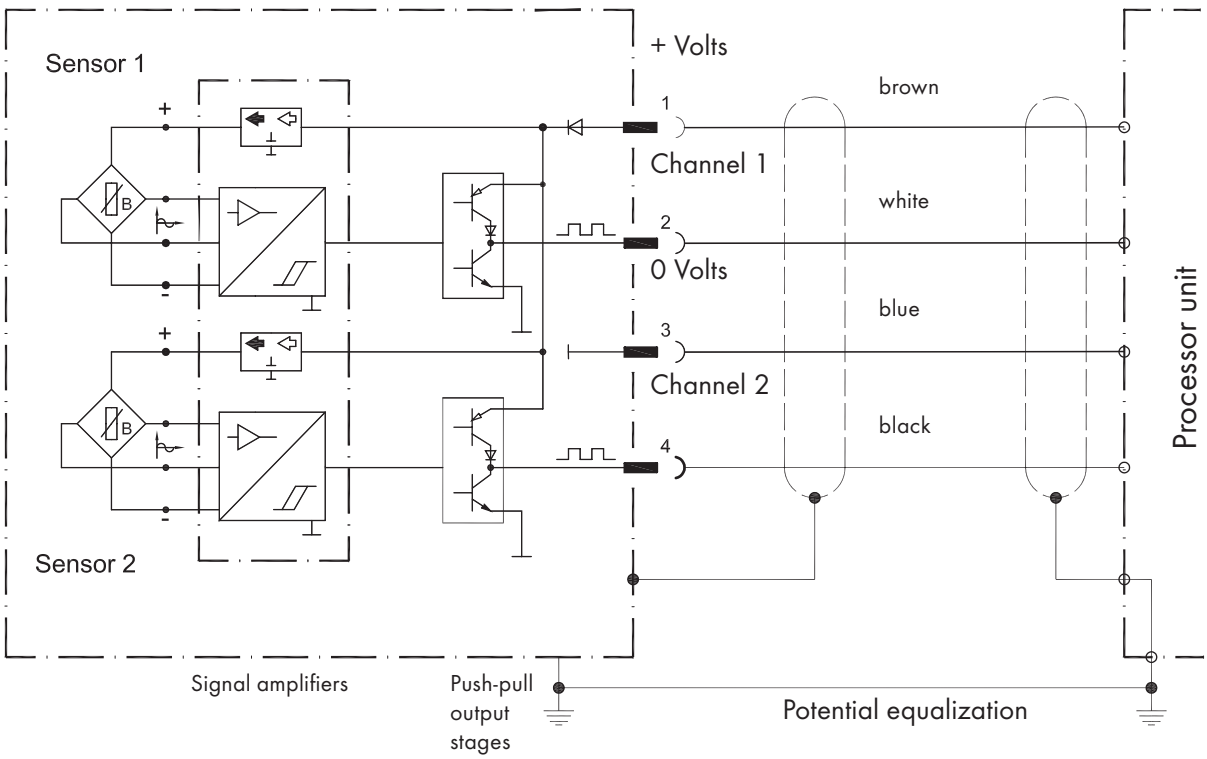
## BLOCK DIAGRAM



# RANGES OF APPLICATIONS

## APPLICATIONS

All liquids that can be pumped and have known lubrication properties can be measured, for example: paraffin, kerosene, benzine, diesel, Skydrol, mineral oils, hydraulic oils including fire resistant fluids, inks, dyes and paints, greases, polyurethane, polyol and isocyanates, Araldite, glues, pastes and creams, resins, waxes and many others.

## RANGES OF APPLICATIONS IN THE AUTOMOTIVE INDUSTRY

Braking system test stands

Fuel consumption measurement

Polyurethane foams for steering wheels, fascia, seats etc.

Paint spraying systems

Steering systems

Batching and filling of motor oils, brake fluids, anti-freeze, corrosion preventatives, waxes etc.

Adhesive coatings for windscreens, headlights, engine housings etc.

## HYDRAULICS

Volume and flow rate measurement

Leakage and rupture monitoring

Cylinder speed and position measurement

Positioning and step control

Measurement, control and regulation of flow rates and volumes

Test stands for pumps, motors, valves, proportionals and servo-valves

Synchronised multi-cylinder monitoring

Filling and additive blending

## DYES AND PAINTS

Paint spraying systems

Batching and filling

Volume, flow rate and consumption

Monitoring of mixing ratios

## PLASTICS TECHNOLOGY

Mixing, moulding and batching systems for single and multicomponent fluid plastics

Consumption measurement of e.g.:
Epoxy adhesives and potting compounds (resins and hardeners) for transformers, coils, relays, condensers, armatures, initiators, auto-electronics

Measuring, control and regulation of single components and mixing ratios

Silicon potting compounds

Polyurethane foams (polyol and isocyanate) for steering wheels, seals, shoes, soles, surf boards, furniture, computer casings, isolation etc.

Hot adhesive

## CHEMICAL INDUSTRY

Flow rate and volume measurement in process plants and plant systems

Dosing and filling of chemical products such as liquid plastics, adhesives, resins, hardeners, potting compounds, solvents, fuels, foams, plasticisers, dyes and paints, oils and synthetic products etc., application in laboratories and manufacturing plants (in normal and explosion-hazardous areas)

Control and regulation of single components, mixing ratios and consumption of various components

Leakage measurement and leakage monitoring on plants

Measurement, indication and logging of data for product quality assurance

Special designs on request

# TECHNICAL DATA OVERVIEW

| Size | Flow range* | Flow range* | K-factor | K-factor |
|---|---|---|---|---|
| | l / min | GPM | Imp./l | Imp./Gal. |
| VS 0.02 | 0.002 ... 2 | 0.0005 ... 0.53 | 50,000 | 189,272.00 |
| VS 0.04 | 0.004 ... 4 | 0.0011 ... 1.06 | 25,000 | 94,636.00 |
| VS 0.1 | 0.01 ... 10 | 0.0026 ... 2.64 | 10,000 | 37,854.40 |
| VS 0.2 | 0.02 ... 18 | 0.0053 ... 4.76 | 5,000 | 18,927.20 |
| VS 0.4 | 0.03 ... 40 | 0.0079 ... 10.57 | 2,500 | 9,463.60 |
| VS 1 | 0.05 ... 80 | 0.0132 ... 21.13 | 1,000 | 3,785.44 |
| VS 2 | 0.1 ... 120 | 0.0264 ... 31.70 | 500 | 1,892.72 |
| VS 4 | 1 ... 250 | 0.2642 ... 66.00 | 250 | 946.36 |
| VS 10 | 1.5 ... 525 | 0.39 ... 138.00 | 300 | 1,135.63 |
| | *at 21 cSt | *at 21 cSt | | |

## CALCULATION FACTOR

1 litre = 0.26417 U.S. Gallon
1 U.S. Gallon = 3.78544 litre
1 bar = 14.503684 psi
1 psi = 0.068948 bar

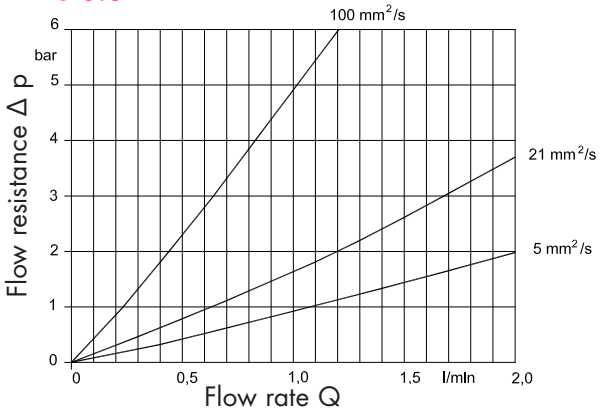
$°C = \frac{5 \times (°F - 32)}{9}$ psi = pound-weight per square inch

$°F = \frac{9 \times °C}{5} + 32$ GPM = U.S.Gallon per minute

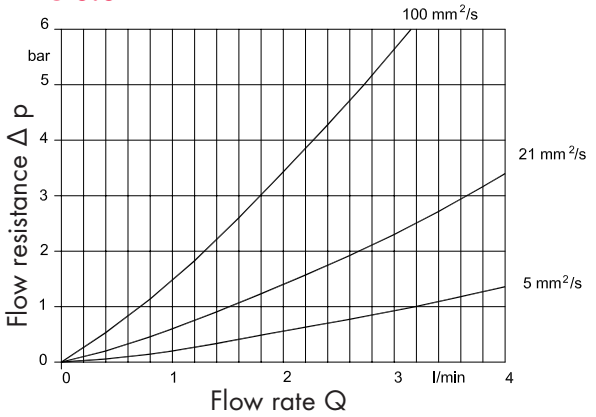
| | | | |
|---|---|---|---|
| **Accuracy** | ± 0.3 % of measured value at viscosity > 20 cSt (< 20 cSt reduced accuracy) | | |
| **Repeatability** | ± 0.05 % under same operating conditions | | |
| **Materials** | **Body**<br>EN-GJS-400-15 (EN 1563)<br>Stainless Steel 1.4305 | **Bearings**<br>Ball / Plain / Plain (Copper-free) depend on liquid | **Seals**<br>FPM (standard)<br>NBR, PTFE, EPDM |
| **Max. operating pressures** | **Cast iron**<br>315 bar/4,568 psi | **Stainless steel**<br>450 bar / 6,526 psi | |
| **Medium temperature** | Standard<br>Ex-design<br>High temperature | –40 ≤ ... 120° C<br>–20 ≤ ... 100° C<br>–40 ≤ ... 210° C | |
| **Viscosity ranges** | 1...100,000 cSt | | |
| **Mounting positions** | Unrestricted, on subplate with side or bottom connections | | |
| **Filtering for ball bearing type** | VS 0.02/0.04/0.1 10 µm<br>VS 0.2/0.4 20 µm<br>VS 1/2 50 µm<br>VS 4 50 µm | **Exceptions**<br>Flow meters with special clearance on request. | |
| **Noise level** | Max. 72 dB(A) | | |
| **Preamplifier** | 10 to 28 Volt (DC) | | |

# FLOW RESPONSE CURVES

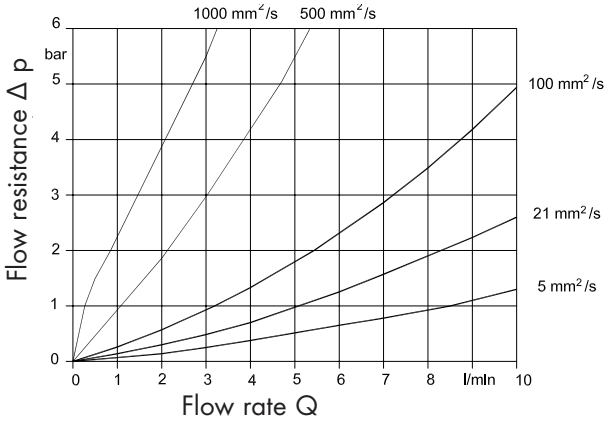
## VS 0.02



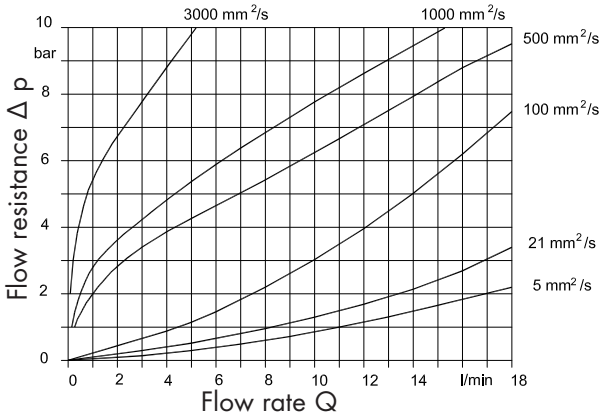

## VS 0.04



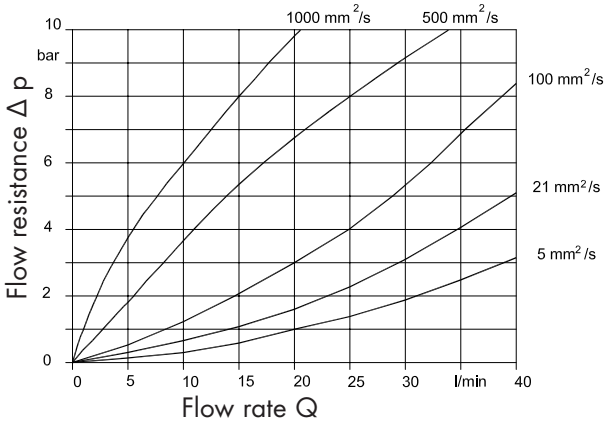

## VS 0.1



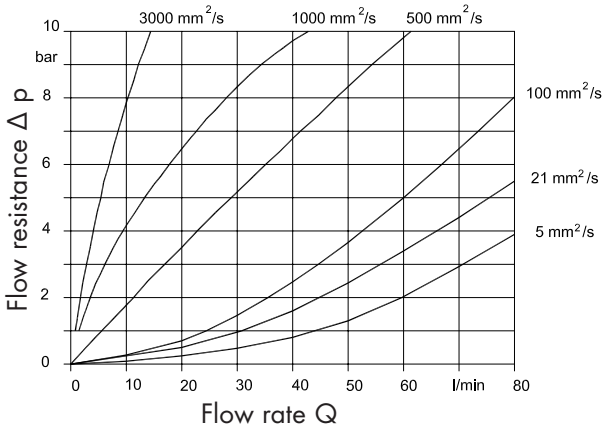

## VS 0.2



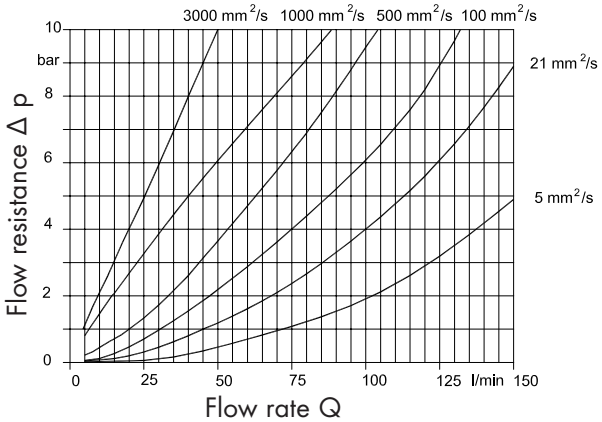

## VS 0.4



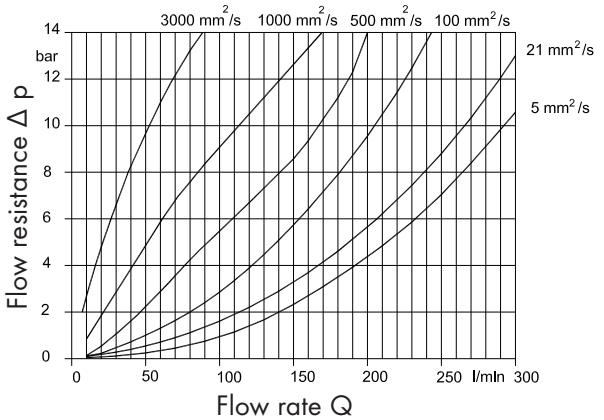

## VS 1




## VS 2



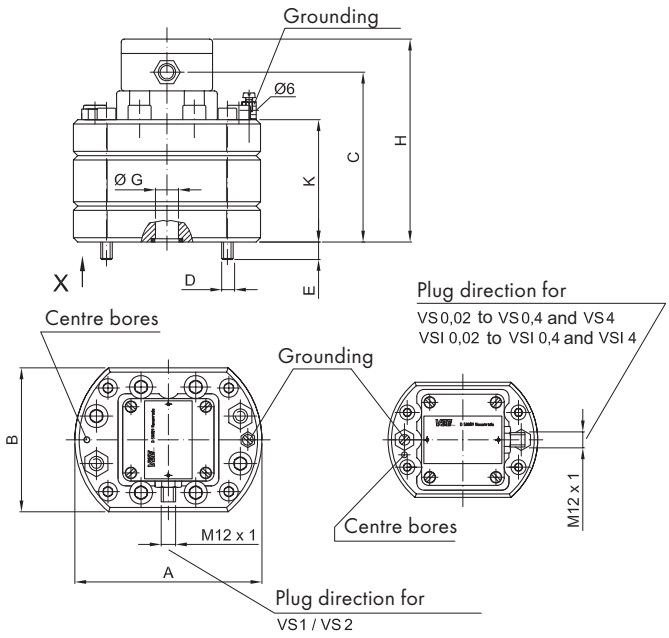

## VS 4



# VS FLOW METER DIMENSIONS

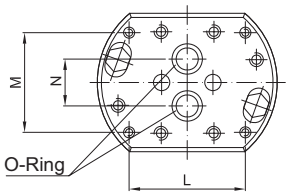
## CAST IRON VERSION

Housing curve mill cutted




## CAST IRON VERSION CONNECTION DRAWING

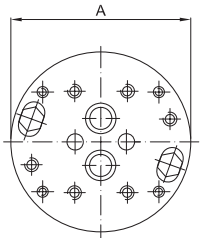
View X




## STAINLESS STEEL VERSION CONNECTION DRAWING

Housing not mill cutted

View X

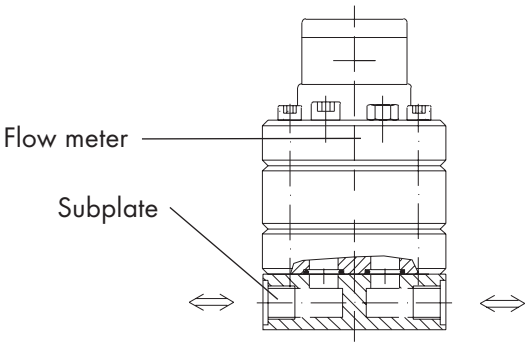



| Size VS / VSI | A | B | C | D | E | ø G | H | K | L | M | N | O-Ring | Weight GG* kg | Weight E** kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0.02** | 100 | 80 | 91 | M 6 | 12 | ø 9 | 114 | 58 | 70 | 40 | 20 | 11 x 2 | 2.8 | 3.4 |
| **0.04** | 100 | 80 | 91.5 | M 6 | 11.5 | ø 9 | 114.5 | 58.5 | 70 | 40 | 20 | 11 x 2 | 2.8 | 3.4 |
| **0.1** | 100 | 80 | 94 | M 6 | 9 | ø 9 | 117 | 61 | 70 | 40 | 20 | 11 x 2 | 2.8 | 3.4 |
| **0.2** | 100 | 80 | 93.5 | M 6 | 9.5 | ø 9 | 116.5 | 60.5 | 70 | 40 | 20 | 11 x 2 | 3.0 | 3.7 |
| **0.4** | 115 | 90 | 96.5 | M 8 | 11.5 | ø 16 | 119.5 | 63.5 | 80 | 38 | 34 | 17.96 x 2.62 | 4.0 | 5.0 |
| **1** | 130 | 100 | 101 | M 8 | 12 | ø 16 | 124 | 68 | 84 | 72 | 34 | 17.96 x 2.62 | 5.3 | 6.8 |
| **2** | 130 | 100 | 118 | M 8 | 15 | ø 16 | 141 | 85 | 84 | 72 | 34 | 17.96 x 2.62 | 6.7 | 8.4 |
| **4** | 180 | 140 | 143 | M 12 | 20 | ø 30 | 166 | 110 | 46 | 95 | 45 | 36.17 x 2.62 | 14.7 | 18.4 |

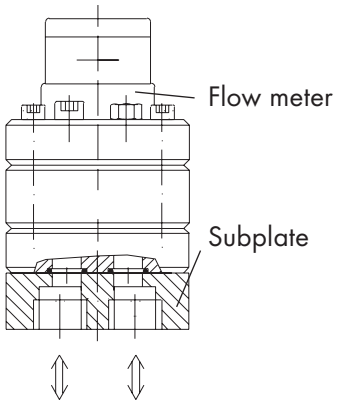
*GG= Cast Iron EN-GJS-400-15 (EN 1563)
Dimensions are specified in mm

** E = Stainless Steel 1.4305

## SIDE PORTS

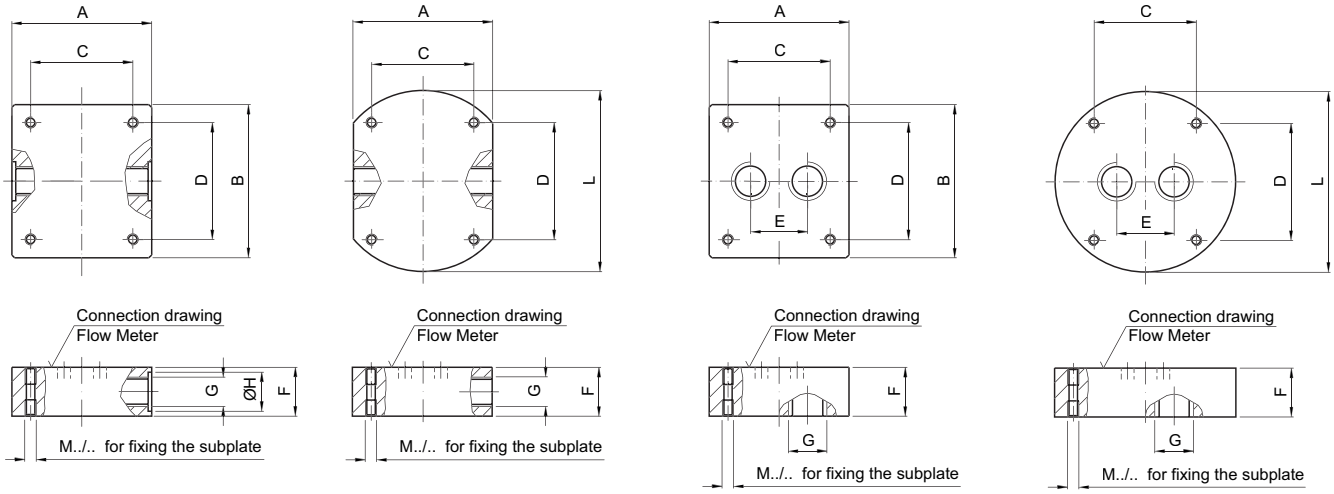



## BOTTOM PORTS



# AP SUBPLATE DIMENSIONS

| Side ports | | Bottom ports* | |
|---|---|---|---|
| Cast iron / APG.S.../. | Stainless steel / APE.S.../. | Cast iron / APG.U.../. | Stainless steel / APE.U.../. |




* Both bottom ports (G) for size APG 4 U and APE 4 U have a displacement of 90° to the shown drawings.

| | VS / VSI | | G | F | ø H | E ① |
|---|---|---|---|---|---|---|
| Affiliated size | 0.02 / 0.04<br>0.1 / 0.2 | G pipe thread classification | G 1/4 | 35 | ø 20 | 26 |
| | 0.02 / 0.04<br>0.1 / 0.2 | | G 3/8 | 35 | ø 23 | 30 |
| | 0.02 / 0.04<br>0.1 / 0.2 | | G 1/2 | 35 | ø 28 | 38 |
| | 0.4 / 1 / 2 | | G 1/2 | 35 | ø 28 | 46 |
| | 0.4 / 1 / 2 | | G 3/4 | 40 | ø 33 | 52 |
| | 1 / 2 | | G 1 | 55 | ø 41 | 55 |
| | 4 | | G 1 1/4 | 70 | ø 51 | 60 |
| | 4 | | G 1 1/2 | AP..U=70 | ø 56 | 72 |
| | 4 | | G 1 1/2 | AP..S=80 | ø 56 | 72 |

| Size | | | | | | | Depth | Weight |
|---|---|---|---|---|---|---|---|---|
| VS / VSI | AP | A | B | C | D | L ② | M | kg |
| **0.02 / 0.04<br>0.1 / 0.2** | AP.02 | 80 | 90 | 40 | 70 | 100 | M6/12 | 1.8 |
| **0.4** | AP.04 | 90 | 100 | 38 | 80 | 115 | M8/15 | 2.7 |
| **1 / 2** | AP.1 | 100 | 110 | 72 | 84 | 130 | M8/15 | 3.6 |
| **4** | APG4 | 120 | 130 | 100 | 110 | – | M8/15 | 7.4 |
| | APG4 UG | 140 | 120 | 120 | 100 | – | M8/15 | 7.4 |
| | APE.4 | 140 | – | 100 | 110 | 180 | M8/15 | 12 |

① Only for APG.U .../. ; APE.U .../.
② Only for APE.S .../. ; APE.U .../.

Special designs on request

# VS 10 FLOW METER

## TECHNICAL DATA

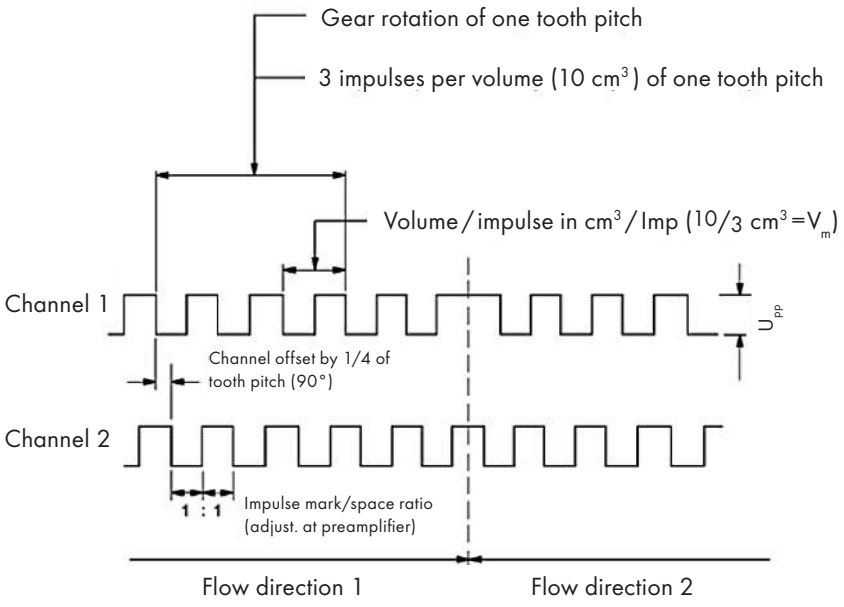
| Size | Flow range l/min | GPM | K-Factor Imp./l | Imp./Gal. |
|---|---|---|---|---|
| VS 10 | 1.5 ... 525 | 0.3963 ... 138.69 | 300 | 1,135.63 |

| | | | |
|---|---|---|---|
| **Accuracy** | ± 0.3 % of measured value at viscosity > 20 cSt<br>(< 20 cSt reduced accuracy) | | |
| **Repeatability** | ± 0.05 % under same operating conditions | | |
| **Materials** | **Body** | **Bearings** | **Seals** |
| | EN-GJS-600-3<br>EN 1563 | Ball / Plain gearings<br>depend on liquid | FPM (Standard)<br>NBR, PTFE, EPDM |
| **Max. operating pressure** | 400 bar / 6,000 psi | | |
| **Medium temperature** | Standard<br>Ex-design<br>High temperature | –40 ≤ ... 120° C<br>–20 ≤ ... 100° C<br>not available | |
| **Viscosity range** | 1 ... 100,000 $mm^2/s$ | | |
| **Mounting positions** | Unrestricted, on subplate with side or bottom connections | | |
| **Filtering** | 50 µm | | |
| **Preamplifier** | Short circuit proof and reverse polarity proof 10 ... 28 V DC / 45 mA,<br>additional current on signal output max. 20 mA | | |

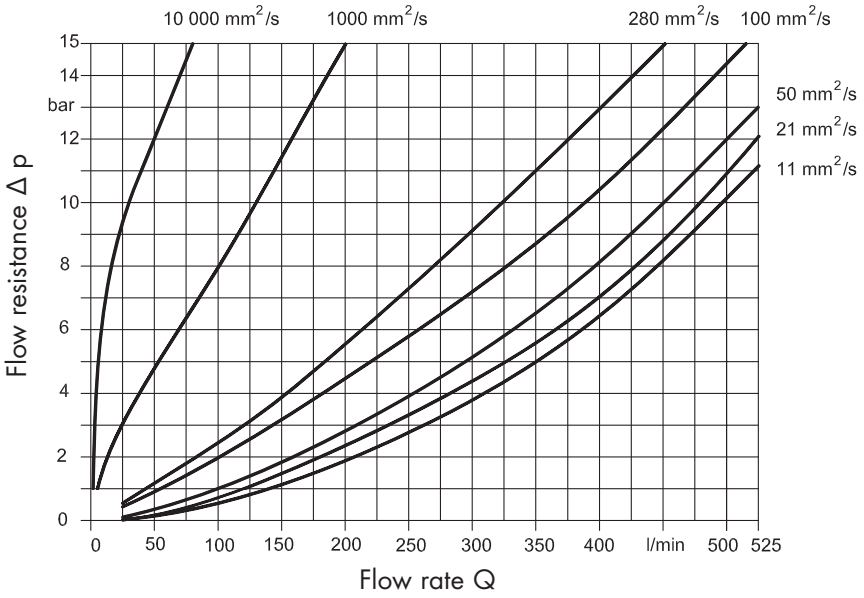
## OUTPUT SIGNALS OF PREAMPLIFIER

### VOLTAGE RANGES

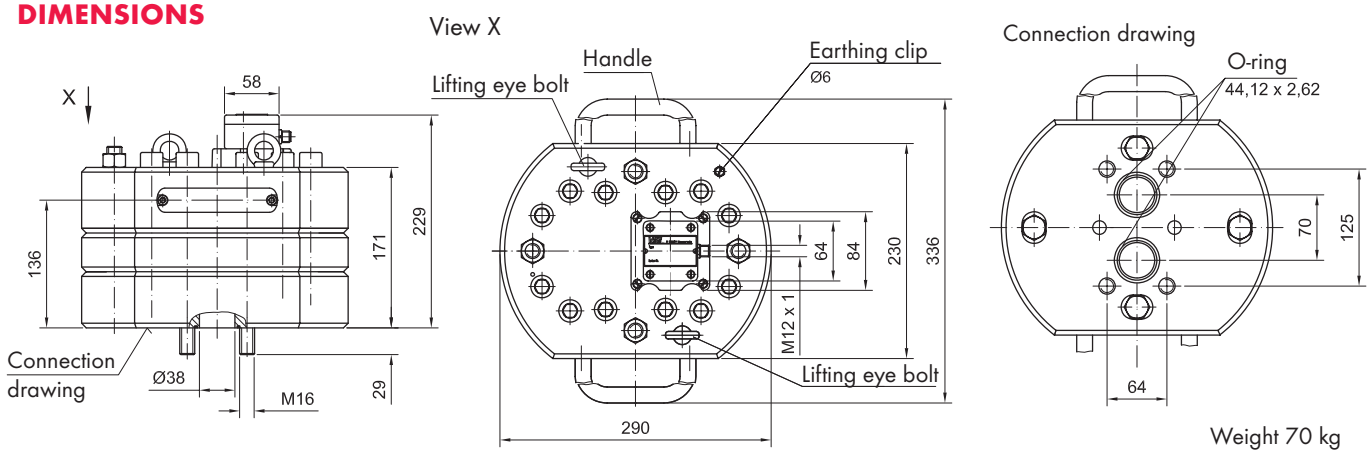
Supply voltages: $U_v$ = 10 ... 28 V
Impulse voltages: $U_{pp} = U_v - 1$ V



## FLOW RESPONSE CURVES

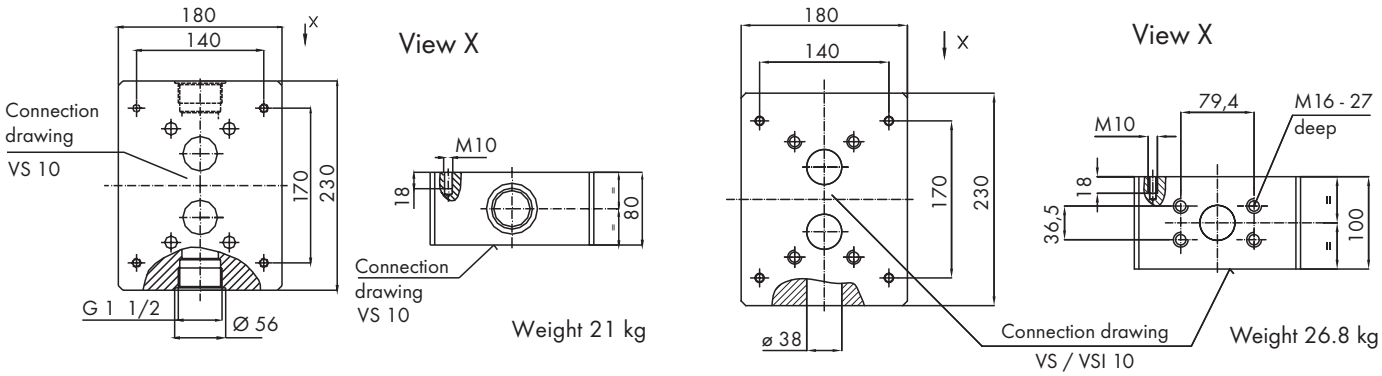



## DIMENSIONS



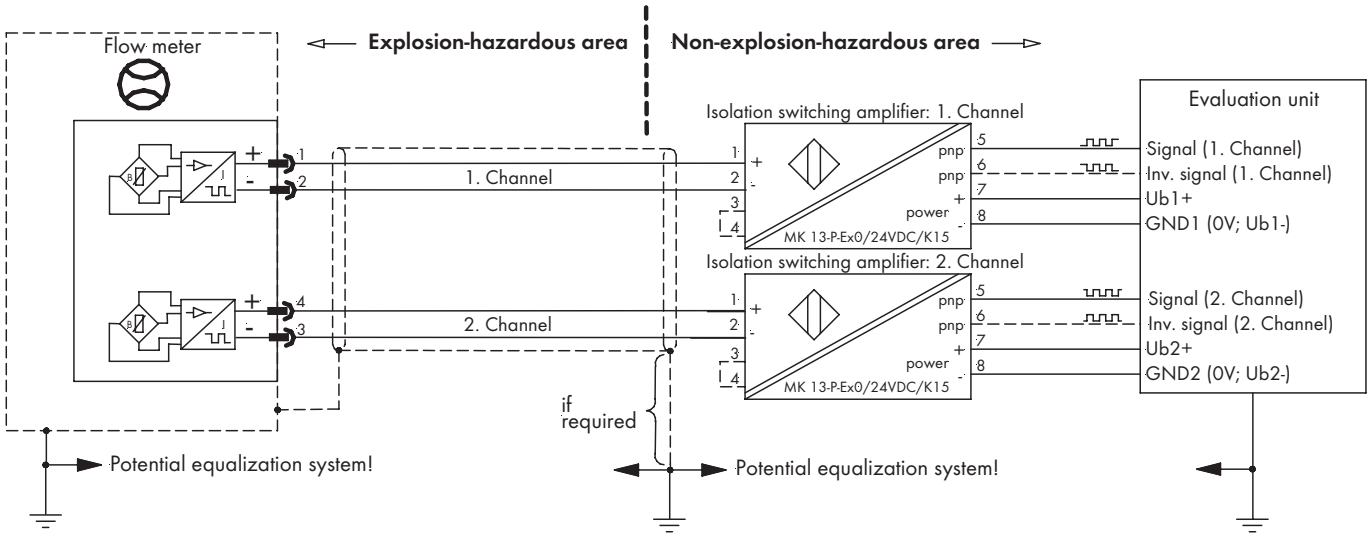

## SUBPLATE DIMENSIONS

APG 10 S GON / 1




Dimensions are specified in mm

# VSE FLOW METERS IN EX-DESIGN / THE BARRIER AMPLIFIER




## VSE FLOW METERS IN EX-DESIGN

The VSE flow meters of the VS series in Ex-design are approved for applications in potentially explosion-hazardous areas and are always operated in conjunction with one or two barrier amplifiers. They have blue markings and offer the necessary Ex-protection security. The type plate shows the necessary description according to DIN EN 50014, the type key and the safety-related and electric data. VSE can supply the flow meters with the barrier amplifiers type MK 13-P-Ex 0/24 VDC/K15.

## THE BARRIER AMPLIFIER MK 13-P-EX 0/24 VDC/K15

The barrier amplifier MK 13-P-Ex 0/24 VDC/K15 enables a galvanic isolated transmission of binary switching status. It has an intrinsically safe control circuit and is certified according to ⟨Ex⟩ II(1) GD [EEx ia] II C.

There is a galvanic separation from the control circuit to the output circuit and to the power supply. For the transmission of two channels, two barrier amplifiers of this version are necessary. The control circuit can be monitored concerning wire breaking and short circuit (the monitoring can be switched off via a wire jumper).

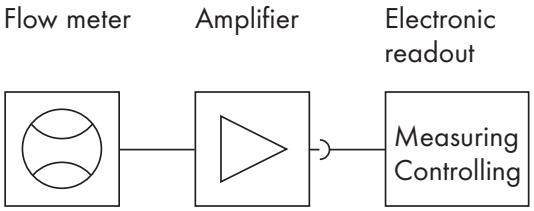
An error in the control circuit stops the signal output but is not displayed as an error message. Two plus-switching short circuit proof transistor outputs (PNP-outputs) display the digital signal of a channel antivalently.

| Flow meter | VSE connection cable, blue | Barrier amplifier |
|---|---|---|
| **Type VS****–32 Q1* / *** | **Shielded; 4 x 0.34 mm²** | **Type MK 13-P-Ex 0/24 VDC/K15** |
| BVS 05 ATEX E 071 X | PUR | PTB 06ATEX 2025 |
| ⟨Ex⟩ II 1G Ex ia II C T4-T6 | | ⟨Ex⟩ II (1) GD [EEx ia] II C |
| $U_i$ = 18.5 V | R = 0.053 Ω/m | $U_o$ = 9,9 V |
| $I_i$ = 24 mA | L = 0.85 µH/m (x) | $I_o$ = 22 mA |
| $P_i$ = 100 mW | $C_{A-A}$ = 55 pF/m (x) | $P_o$ = 54 mW |
| $R_i$ = 0 | $C_{A-S}$ = 105 pF/m (x) | |
| $L_i$ = 0 | [(x) = Measured at 1000 Hz] | |
| $C_i$ = 0.27 µF | | |

| | IIC | | | IIB | | |
|---|---|---|---|---|---|---|
| Lo/mH | 1 | 5 | 10 | 2 | 10 | 20 |
| Co/µF | 1.1 | 0.75 | 0.65 | 5 | 3.5 | 3 |

| Temperature class | T4 | T5 | T6 |
|---|---|---|---|
| Ambient temperature | - 20°C ≤ $T_{amb}$ ≤ 95°C | - 20°C ≤ $T_{amb}$ ≤ 70°C | - 20°C ≤ $T_{amb}$ ≤ 55°C |
| Liquid temperature | - 20°C ≤ $T_{Med}$ ≤ 100°C | - 20°C ≤ $T_{Med}$ ≤ 75°C | - 20°C ≤ $T_{Med}$ ≤ 60°C |

# PICK-UP SYSTEM FOR HIGH TEMPERATURE RANGES



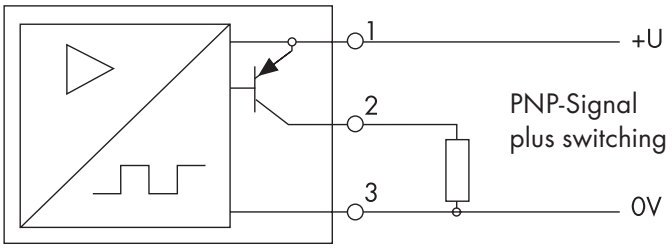

## OPTION FOR STAINLESS STEEL FLOW METERS VS 0.04 ... VS 4

The pick-up system consists of one or two sensor units, which are screwed into the cover of the VS flow meter and of a downstream switched amplifier. This amplifier is connected with the flow meter by means of a temperature resistant cable and has to be installed outside the high temperature area, where the ambient temperature should not exceed 50 °C.

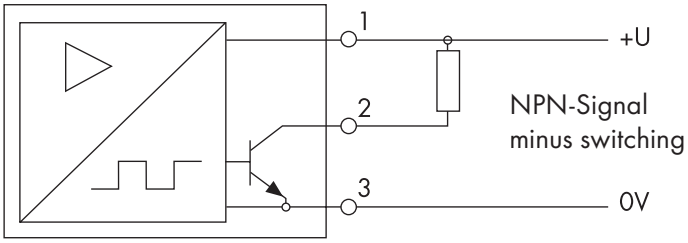
Depending on the amplifier version, the digital signals are output as PNP or NPN switching signals. The following pictures show the respective connection of the electronic readout:

For long cable lengths and high input impedance of the readout, it is recommended to use shielded cables and a pull-down (PNP-signal) or a pull-up (NPN-signal) resistor.

## CONNECTION: PNP-SWITCHING




## CONNECTION: NPN-SWITCHING



# TECHNICAL DATA / FLOW METER DIMENSIONS

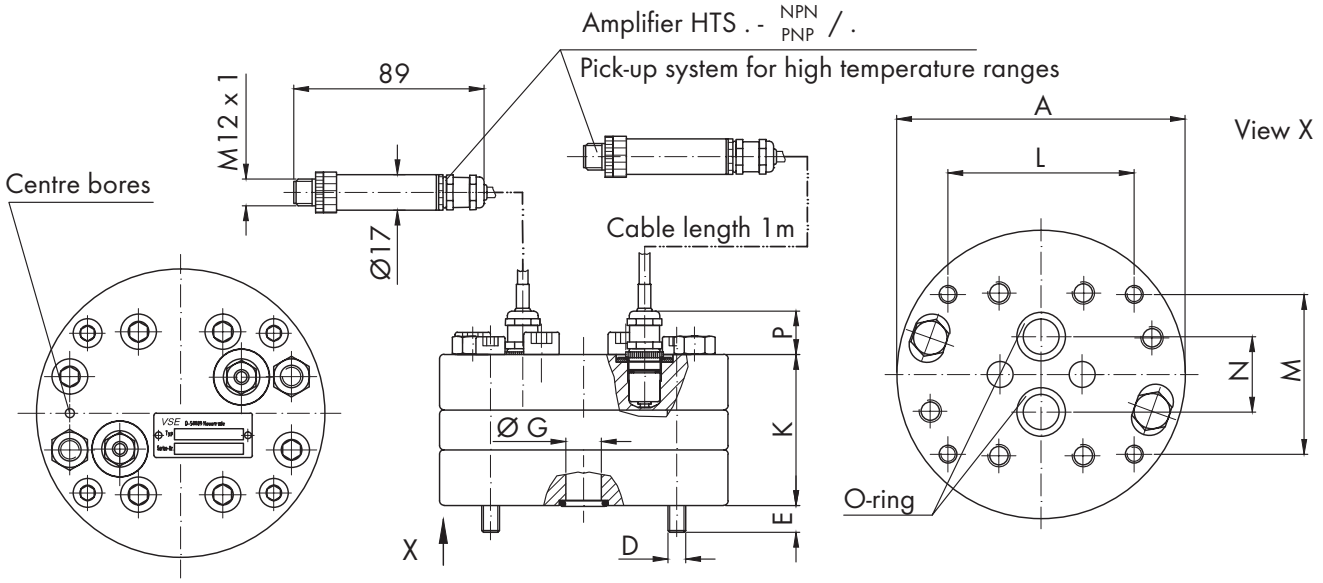
## TECHNICAL DATA: SENSOR UNIT

| | |
|---|---|
| **Medium temperature** | -40° C ... 210° C |
| **Number of pick-ups** | 1 or 2 pick-ups |
| **Pick-up** | Magnetoresistive |
| **Electrical connection** | PG- cable fitting |
| **Isolation protection** | IP 64 |

## TECHNICAL DATA: AMPLIFIER

| | |
|---|---|
| **Supply voltage** | $U_b$ = 10 ... 30 V DC +/-10% |
| **Current consumption** | $I_b$ = approx. 15 mA (idle motion, without load) |
| **Signal output PNP** | High sign: $-U_s = U_b$ -1 V, $I_s$ = 25 mA max. |
| **Signal output NPN** | Low sign: $-U_s$ = 0V, $I_s$ = 25 mA max. |
| **Electrical connection** | 4-pole round plug M 12 |
| **Max. ambient temperature** | 50° C |
| **Protection class** | IP 64 |
| **Pull-down resistor** | 4.7 ... 10 KΩ |
| **Pull-up resistor** | 4.7 ... 10 KΩ |

## FLOW METER DIMENSIONS




| Size | A | D | E | ø G | K | L | M | N | P | O-Ring | Weight kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VS 0.04* | 100 | M 6 | 11.5 | ø 9 | 58.5 | 70 | 40 | 20 | 22 | 11 x 2 | 3.5 |
| VS 0.1 | 100 | M 6 | 9 | ø 9 | 61 | 70 | 40 | 20 | 22 | 11 x 2 | 3.3 |
| VS 0.2 | 100 | M 6 | 9.5 | ø 9 | 60.5 | 70 | 40 | 20 | 22 | 11 x 2 | 3.6 |
| VS 0.4 | 115 | M 8 | 11.5 | ø 16 | 63.5 | 80 | 38 | 34 | 22 | 17.96 x 2.62 | 4.9 |
| VS 1 | 130 | M 8 | 12 | ø 16 | 68 | 84 | 72 | 34 | 22 | 17.96 x 2.62 | 6.7 |
| VS 2 | 130 | M 8 | 15 | ø 16 | 85 | 84 | 72 | 34 | 22 | 17.96 x 2.62 | 8.3 |
| VS 4 | 180 | M 12 | 20 | ø 30 | 110 | 46 | 95 | 45 | 12 | 36.17 x 2.62 | 18.3 |

*Attention: 0.04 with one (1) channel only

# TYPE KEY

## TYPE KEY FLOW METERS VS

### EXAMPLE

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | H | T | | | | | | Pick-up system for high temperature ranges (...210°C) signal output PNP or NPN |
| - | H | T | | | | / | X | |

| VS 1 | G | P | 0 | 1 | 2 | V | - | 3 | 2 | N | 1 | 1 | / | X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | Series |
| | | | | | | | | | | | | | | X: No. factory preset |
| | | | | | | | | | | | | Connection | | 1: VSE 4 pole plug connection (Standard design) |
| | | | | | | | | | | | Pre-amplifier | | | 0: Non pre-amplifier<br>1: Integrated<br>2: External |
| | | | | | | | | | | Signal out-put | | | | N: Supply voltage 10 ... 28 V DC (Standard)<br>Q: Supply voltage 5 ... 10 V DC (Ex-design) |
| | | | | | | | | | Quantity of pick-up | | | | | 1: 1 pick-up<br>2: 2 pick-up |
| | | | | | | | | Pick-up system | | | | | | 3: GMR- Sensor |
| | | | | | | | Type of seal | | | | | | | V: FPM (Viton) Standard<br>P: NBR (Perbunan)<br>T: PTFE<br>E: EPDM<br>B: EPDM-41B8<br>S: Silicone |
| | | | | | | Factory preset to the application<br>Instrument tolerance | | | | | | | | 1: Reduced tolerance<br>2: Normal tolerance (Standard)<br>3: Increased tolerance<br>4: Tolerance steel plain bearing |
| | | | | | Factory preset to the application<br>Instruments bearing | | | | | | | | | 1: Ball bearing<br>2: Spindle bearing<br>3: Bronze plain bearing<br>4: Carbon plain bearing<br>5: Steel plain bearing |
| | | | | Gear coating | | | | | | | | | | O: No coating (Standard)<br>C: Dynamat coating (C-surface coating)<br>T: Titanium coating |
| | | | Type of connection | | | | | | | | | | | P: Plate construction<br>R: Pipeline connections |
| | | Material | | | | | | | | | | | | G: EN-GJS-400-15 (VS10 = EN-GJS-600-3) DIN EN 1563<br>E: Stainless steel 1.4305 (V2A)<br>H: EN-GJS-600-3 (High pressure) DIN EN 1563 |
| Size | | | | | | | | | | | | | | |
| VS 0.02<br>VS 0.04<br>VS 0.1<br>VS 0.2<br>VS 0.4<br>VS 1<br>VS 2<br>VS 4<br>VS 10 | | | | | | | | | | | | | | |

## SUBPLATES AP

### EXAMPLE

| A P | G | 1 | - | S | C | 0 | N | / | X |
|---|---|---|---|---|---|---|---|---|---|

**Subplate**

**Material**

| | |
|---|---|
| **G** | EN-GJL-250, EN-GJS-400-15 DIN EN 1561/ 1563 |
| **E** | Stainless steel 1.4305 |
| **H** | EN-GJS-600-3 DIN EN 1563 (high pressure) |

**Size**

| | |
|---|---|
| **0,2** | VS 0,02 to VS 0,2 / VSI 0,02 to VSI 0,2 |
| **0,4** | VS 0,4 / VSI 0,4 |
| **1** | VS 1 / VS 2 / VSI 1 / VSI 2 |
| **4** | VS 4 / VSI 4 |
| **10** | VS 10 / VSI 10 |

**Side connection**

| | |
|---|---|
| **S** | Side connection |
| **U** | Bottom connection |

**Connection thread**

| | |
|---|---|
| **A** | G 1/4 |
| **B** | G 3/8 |
| **C** | G 1/2 |
| **D** | G 3/4 |
| **E** | G 1 |
| **F** | G 1 1/4 |
| **G** | G 1 1/2 |
| | |
| **J** | 1/4 NPT |
| **K** | 3/8 NPT |
| **L** | 1/2 NPT |
| **M** | 3/4 NPT |
| **N** | 1 NPT |
| **O** | 1 1/4 NPT |
| **P** | 1 1/2 NPT |
| | |
| **S** | SAE 1/2 |
| **T** | SAE 3/4 |
| **U** | SAE 1 |
| **V** | SAE 1 1/4 |
| **W** | SAE 1 1/2 |
| **X** | SAE 2 |

**Accessory connection**

| | |
|---|---|
| **0** | Without rinse connection |

**Version**

| | |
|---|---|
| **N** | Standard version |
| **S** | Special version |

**Product line**

| | |
|---|---|
| **X** | Modification Id. No. |

# FLOW METERS WITH HIGH DEFINITION PREAMPLIFIER

## FLOW METERS WITH HIGH DEFINITION FLOW RATE

The preamplifiers of the standard version for VS flow meters output one pulse per tooth gap volume $V_Z$, which corresponds to the volume measurement $V_m$ ($V_m = V_Z$ / pulse). This occurs in two channels, so that a maximum resolution of 1/4 $V_Z$ for the evaluation of all flanks can be attained. A higher resolution is not possible with these preamplifiers.

As a very high resolution is necessary for precise and exact flow measurements, the volume measurement $V_m$ must be resolved even more than with conventional preamplifiers. VSE has therefore developed the preamplifier with interpolation, with which a selectable resolution of up to 64 flanks (16 pulses) per period can be attained. This means, that you can resolve the volume measurement $V_m$ with this preamplifier to a maximum of 1/64 $V_m$. This means for the evaluation that a part volume of 1/64 $V_m$ from pulse flank to pulse flank (for quadruple evaluation or flank count) is measured, or a full signal pulse is counted as part volume of 1/16 $V_m$ (pulse count) (interpolation $V_m$/16).

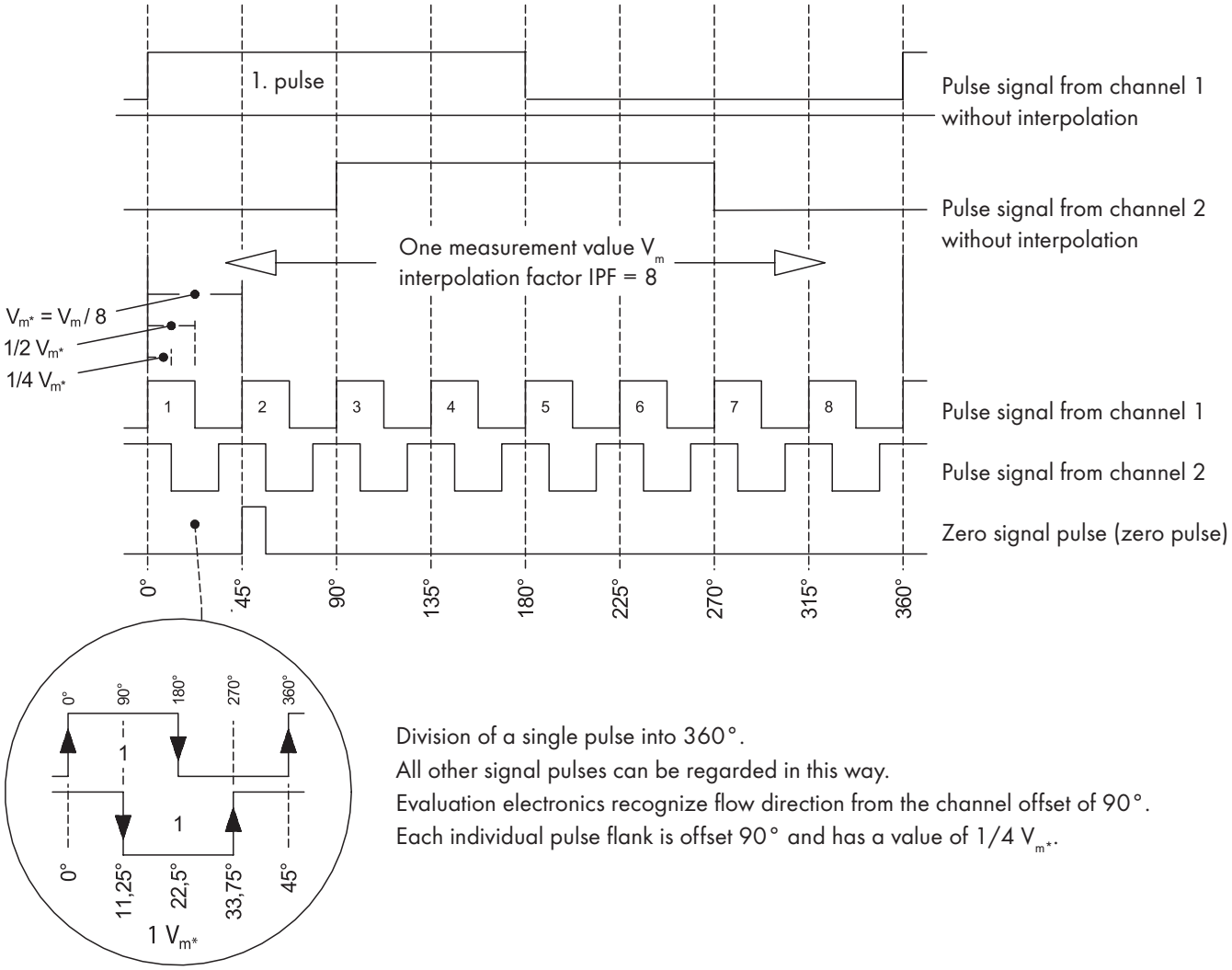
This individually programmed high resolution enables you to set the volume measurement $V_m$ optimally for each provided case of application. Furthermore, new applications can be availed with the higher resolution

- Measuring, controlling and regulating in lower flow ranges
- Measuring, controlling and regulating in zero flow
- Measuring, controlling and regulating in both flow directions
- Measuring, controlling, dosing and filling of small volumes

Flow meters with interpolation electronics (VSI) output two digital signals with programmable high resolution that are phase-offset at 90°. In addition to the signal emission, a zero signal emission is provided, which emits a zero signal at each fully registered volume measurement $V_m$.

## SIGNAL EMISSION OF THE PREAMPLIFIER WITH INTERPOLATION

The figure shows the resolution of the volume measurement $V_m$ with an interpolation factor of 8. This resolves each volume measurement into eight individual part volumes. A pulse on the signal output of channel 1 or channel 2 thus has a value of $V_{m^*} = V_m / 8 = 1/8\ V_m$ per pulse. In double evaluation (flank evaluation of one channel) this results in a value of $1/2\ V_{m^*} = V_m / 16 = 1/16\ V_m$ and for quadruple evaluation (flank evaluation of both channels) the result is a value of $1/4\ V_{m^*} = V_m / 32 = 1/32\ V_m$ per flank. Evaluation electronics can recognize flow direction from signals offset at 90°. The preamplifier of the VSI product line has a programmed interpolation factor (IPF) with which you can program new, different resolutions. Hence, you can program a resolution of 4 to 64 angular steps (see figure 4) per volume measurement $V_m$. The frequency multiplication "f*" is between 1 and 16 (see table page 18).




Division of a single pulse into 360°.
All other signal pulses can be regarded in this way.
Evaluation electronics recognize flow direction from the channel offset of 90°.
Each individual pulse flank is offset 90° and has a value of $1/4\ V_{m^*}$.

# INTERPOLATION FACTOR AND RESOLUTION

| Interpolation factor | Imp/$V_m$ | Max. resolution (evaluation of signal flanks) | Resolution $V_{m^*}$ (volume measurement $V_{m^*}$) [ml] | Max. resolution (angle degrees) | Frequency $f_{max^*}$ |
|---|---|---|---|---|---|
| 1 | 1 | 4 (quadrupling) | $V_m$ / 4 | 90° | $f_{max}$ x 1 |
| 2 | 2 | 8 | $V_m$ / 8 | 45° | $f_{max}$ x 2 |
| 3 | 3 | 12 | $V_m$ /12 | 30° | $f_{max}$ x 3 |
| 4 | 4 | 16 | $V_m$ /16 | 22.5° | $f_{max}$ x 4 |
| 5 | 5 | 20 | $V_m$ /20 | 18° | $f_{max}$ x 5 |
| 8 | 8 | 32 | $V_m$ /32 | 11.25° | $f_{max}$ x 8 |
| 10 | 10 | 40 | $V_m$ /40 | 9° | $f_{max}$ x 10 |
| 12 | 12 | 48 | $V_m$ /48 | 7.5° | $f_{max}$ x 12 |
| 16 | 16 | 64 | $V_m$ /64 | 5.625° | $f_{max}$ x 16 |

Column 1: Programmable interpolation factor IPF (programming is done in the factory)
Column 2: Pulses per volume measurement $V_m$
Column 3: Maximum resolution of the signal flanks. The signal flanks channels 1 and 2 are evaluated
Column 4: Volume measurement $V_{m^*}$ resulting from the maximum resolution of the signal flanks
Column 5: Maximum resolution in angle degrees at resolution of signal flanks
Column 6: Maximum frequency $f_{max^*}$ at maximum flow $Q_{max}$ and programmed interpolation factor IPF

In practice the maximum flow $Q_{max}$ of the flow meter is seldom run so that a lower frequency can be calculated. The maximum frequency is then calculated according to the following formula:

$$f_{max^*} = \frac{(Q_{max})^*IPF}{V_m}$$ formula 1

| | |
|---|---|
| $f_{max^*}$ | Maximum frequency of the flow meter signals |
| $Q_{max}$ | Maximum flow attained in the case of application described here |
| IPF | Programmed interpolation factor |
| $V_m$ | Volume measurement of the flow meter |

**Example** Flow meter VSI 1/10... max. flow rate of the system at maximum capacity

$Q_{max}$ = 40 l/min = 666.667 ml/sec; IPF = 10;
$V_m$ = 1 ml/pulse; $f_{max^*}$ = 6666.67 Hz
= 6.66667 kHz

At max. flow $_{max^*}$ = 40 l/min, the flow meter VSI 1/10... outputs a frequency of

$f_{max^*}$ = 6666.67 Hz.

# TYPE KEY

## TYPE KEY FLOW METERS VSI

### EXAMPLE

| VSI 1 | / | 4 | | G | P | O | 1 | 2 | V | - | 3 | 2 | W | 1 | 5 | / | X | . . |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Size**

| | |
|---|---|
| VSI 0.02 | $V_z$ = 0.02 ml |
| VSI 0.04 | $V_z$ = 0.04 ml |
| VSI 0.1 | $V_z$ = 0.1 ml |
| VSI 0.2 | $V_z$ = 0.2 ml |
| VSI 0.4 | $V_z$ = 0.4 ml |
| VSI 1 | $V_z$ = 1 ml |
| VSI 2 | $V_z$ = 2 ml |
| VSI 4 | $V_z$ = 4 ml |
| VSI 10 | $V_z$ = 10 ml |

**Interpolation** (for VSI 0.02 to VSI 4)

| | | |
|---|---|---|
| 1 | 1 Imp. pro $V_z$ | $V_m$ = $V_z$ pro Imp |
| 2 | 2 Imp. pro $V_z$ | $V_m$ = $V_z$ / 2 pro Imp. |
| 3 | 3 Imp. pro $V_z$ | $V_m$ = $V_z$ / 3 pro Imp. |
| 4 | 4 Imp. pro $V_z$ | $V_m$ = $V_z$ / 4 pro Imp. |
| 5 | 5 Imp. pro $V_z$ | $V_m$ = $V_z$ / 5 pro Imp. |
| 8 | 8 Imp. pro $V_z$ | $V_m$ = $V_z$ / 8 pro Imp. |
| 10 | 10 Imp. pro $V_z$ | $V_m$ = $V_z$ /10 pro Imp. |
| 12 | 12 Imp. pro $V_z$ | $V_m$ = $V_z$ /12 pro Imp. |
| 16 | 16 Imp. pro $V_z$ | $V_m$ = $V_z$ /16 pro Imp. |

**Interpolation** (for VSI 10)

| | | |
|---|---|---|
| 1 | 3 Imp. pro $V_z$ | $V_m$ = 10/ 3 pro Imp |
| 2 | 6 Imp. pro $V_z$ | $V_m$ = 10/ 6 pro Imp. |
| 3 | 9 Imp. pro $V_z$ | $V_m$ = 10/ 9 pro Imp. |
| 4 | 12 Imp. pro $V_z$ | $V_m$ = 10/12 pro Imp. |
| 5 | 15 Imp. pro $V_z$ | $V_m$ = 10/15 pro Imp. |
| 8 | 24 Imp. pro $V_z$ | $V_m$ = 10/24 pro Imp. |
| 10 | 30 Imp. pro $V_z$ | $V_m$ = 10/30 pro Imp. |
| 12 | 36 Imp. pro $V_z$ | $V_m$ = 10/36 pro Imp. |
| 16 | 48 Imp. pro $V_z$ | $V_m$ = 10/48 pro Imp. |

**Material**

| | |
|---|---|
| G | EN-GJS-400-15 (VSI10 = EN-GJS-600-3) DIN EN 1563 |
| E | Stainless steel 1.4305 (V2A) |
| H | EN-GJS-600-3 (High pressure) DIN EN 1563 |

**Type of connection**

| | |
|---|---|
| P | Plate construction |
| R | Pipeline connections |

**Measuring wheel coating**

| | |
|---|---|
| O | No coating (standard) |
| C | Dynamat coating (C-coating) |
| T | Titanium coating |

**Instrument bearing**

| | |
|---|---|
| 1 | Ball bearings |
| 2 | Spindle bearings |
| 3 | Bronze plain bearings |
| 4 | Carbon bearings |
| 5 | Steel bearings |

**Factory preset to the application** (Instrument tolerance)

| | |
|---|---|
| 1 | Reduced tolerance |
| 2 | Normal tolerance (standard) |
| 3 | Increased tolerance |
| 4 | Tolerance steel plain bearing |

**Factory preset to the application** (Seal type)

| | |
|---|---|
| V | FPM (Viton) standard |
| P | NBR (Perbunan) |
| T | PTFE |
| E | EPDM |
| B | EPDM - 41B8 |
| S | Silicone |

**Sensor pick-up system**

| | |
|---|---|
| 3 | GMR- Sensor |

**Quantity of pick-up sensors**

| | |
|---|---|
| 2 | 2 Sensors |

**Signal output**

| | |
|---|---|
| W | VV int. WE (power supply volt. 10 ... 28 V DC) |

**Pre-amplifier**

| | |
|---|---|
| 1 | Integrated (standard design) |

**Connection**

| | |
|---|---|
| 1 | VSE norm connection (4-pole) |
| 5 | 5-pole plug connection |

**Product line**

| | |
|---|---|
| X | Modification id. No. |

**Power supply voltage**

| | |
|---|---|
| 10 ... 28 V | Power supply volt. |

$V_m$ = Volume ($cm^3$)

$V_z$ = the volume between the gear teeth

# ELECTRONIC EVALUATION UNITS

## FLOW RATE MEASURING INSTRUMENT MF1 FOR 2-CHANNEL FLOW SENSOR


Flow direction indication with switching output (0 V / 5 V)

2 optocoupler limit value outputs, limit values are individually programmable

Analogue output with flow rate direction dependent voltage-/current-polarity is available
0 ... (±) 10 V
0 ... (±) 20 mA
4 ... 20 mA

A power supply for flow sensor is integrated
24 Volt DC / 50 mA

## FLOW RATE AND VOLUME MEASURING INSTRUMENT PAXI FOR 1- OR 2-CHANNEL FLOW SENSOR


Flow rate- or volume display programmable, with linearizer function

12 Bit analogue output
0 ... 10 V
0 ... 20 mA
4 ... 20 mA

2 limit value-relay outputs

PC-Interface RS 232

A power supply for flow sensor is integrated
12 Volt / 100 mA

## UNIVERSAL MEASURING INSTRUMENT VFM 320 FOR DYNAMIC PROCESS MEASUREMENTS AND CLOSED LOOP CONTROLS


Flow rate, volume and ratio measurements as well as measurement and control of volume-shots or mass-shots in 2-component mixing systems

Signal processing of 2 flow sensors with 2-channel signal outputs

2 independent dynamic analogue outputs with 16 Bit digital-analogue converter D/A-converter:

< 3ms (0 Hz → 2 kHz → 0 Hz)

The flow rate and volume values are direction dependent

(0 V ← Flow in direction 2 — 5 V — Flow in direction 1 → 10 V)

or direction independent

(10 V ← Flow in direction 2 — 0 V — Flow in direction 1 → 10 V)

Real time output of analogue and digital measurement values

PC-Interface 1 x RS 232, 2 x RS 485

Special designs on request

## FLOW RATE MEASURING INSTRUMENT A341-28

2 independent flow measurements

Ratio measurement, sum measurement or differential measurement etc. programmable

Linearization function for each flow measurement

5 separate parameter data sets can be pre-set

14 Bit analogue output
(accuracy 0.1%, response time <1msec)
-10 V ... +10 V  4 ... 20 mA
0 ... +10 V  0 ... 20 mA

4 pre-set limit values with transistor switching outputs

Programmable via RS232 interface

Integrated power supply 2 x 24 VDC / 120 mA

## FREQUENCY ANALOGUE CONVERTER FU252

Conversion time only 1msec with f >3kHz

14 Bit resolution (accuracy 0.1%)

Voltage output: -10 V ... +10 V  0 ... +10 V

Current output:  4 ... 20 mA  0 ... 20 mA

Suitable for conversion of quadrature signals as well as single-channel signals

Converts ratio, product, sum or difference of two frequencies or flow rates

Programmable linearization function and digital filter

Programmable with PC via RS232 interface

Teach function

# INSTRUMENTS FOR IMPULSE CONDITIONING

## FREQUENCY-/ANALOGUE CONVERTER DIGFU 1

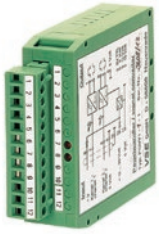
Converter output signal for operation with 1-channel flow sensor
0 ... 10 V
0 ... 20 mA
4 ... 20 mA

Converter output signal with flow direction polarity for operation with 2-channel flow sensor
0 ... ± 10 V
0 ... ± 20 mA

Evaluation of flow direction via digital output signal possible if a 2-channel flow sensor is connected

Proportional to flow frequency a digital output frequency signal with multiplier factor is adjustable

## SIGNAL CONVERTER PGW-1 FOR 2- OR 1- CHANNEL FLOW SENSORS TO CONVERT FLOW SENSOR OUTPUT SIGNALS INTO OTHER VOLTAGE LEVELS



For example: for chart recorder with impulse input, forward-/reversecounter, computer, PC- and PLC controls

Available output voltages:
TTL 5 V, 8 V, 12 V, CMOS 15 V

Power supply/current consumption:
10 ... 30 V DC, 20 mA without flow sensor

Inverted and non-inverted output signal for both channels integrated among other things for connection on differential count inputs to achieve a distortion-free signal transmission over long cable distances

## BARRIER AMPLIFIER MK-13

Economical interfaces with galvanic isolation between intrinsically safe and non-intrinsically safe circuits

Must be installed in the safe area

Are used to limit the electrical power into an intrinsically safe circuit in such a way that neither sparks nor thermal effects (hot surfaces) can cause an ignition

Connection diagram and exact type no. see page 11.

# PRODUCT OVERVIEW

**RS SERIES** 0 – 3,000 l/min


**VHM SERIES** 0.01 – 20 l/min

**EF ECOFLOW SERIES** 0.05 – 150 l/min

**VTR SERIES** 110 l/h – 4,500 m³/h

**SPECIAL OPTIONS**

distributed by

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