FLOW MEASUREMENT TECHNOLOGY

VS SERIES
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, constitute 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 (Vm) and is stated in cc/Imp. It is used to define the size of a flow meter.

EXPLANATIONS TO PREAMPLIFIER OF SIGNAL PICK-UP SYSTEM

• The non-contacting sensors consist of two differential magnetoresistors which are circumferentially offset from one another by 1/4 of a tooth pitch. The signals of both pick-up sensors are digitized 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 -30°C and 120°C (-22°F and 248°F) the unit is mounted directly on the flow meter cover.

• For liquid temperatures up to 210°C (410°F) 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 I1G EEx ia IIC T4-T6, are supplied for applications in potentially hazardous areas. VSE delivers these types with isolation switch amplifier models MK 13 P ExEx 0/21 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 characteristic 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**

- Gear rotation of one tooth pitch
- One impulse
- Volume / impulse in cm³ / Imp

Channel 1

Channel 2

Flow in direction 1

Flow in direction 2

* VOLTAGE RANGES
  - supply voltage: $U_{V} = 10 \ldots 28$ V DC
  - impulse voltage: $U_{pp} = U_{V} - 1$ V

**FLOW METER VS 10**

- Gear rotation of one gear tooth pitch
- 3 Impulse per volume (10 cm³) of one tooth pitch

Channel 1

Channel 2

Flow in direction 1

Flow in direction 2

* VOLTAGE RANGES
  - supply voltage: $U_{V} = 10 \ldots 28$ V DC
  - impulse voltage: $U_{pp} = U_{V} - 1$ V

**BLOCK DIAGRAM**

- + Volts
- brown
- white
- blue
- black

Processor Unit

Signal Amplifiers

Push-pull output stages

Potential equalization
APPLICATIONS
• All liquids that can be pumped and have known lubrication properties can be measured, for example: Petrol, parafin, kerosene, diesel; Skydrol, mineral oils, hydraulic oils including fire resistant fluids; inks, dyes and paints; greases; polyurethane, polyal 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, rust 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 fluidplastics
• 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, surfboards, furniture, computer casings, isolation etc.
• hot adhesive

CHEMICAL INDUSTRY
• Flow rate and volume measurement in process plant and plant systems
• Blending and filling chemical products such as liquid plastics adhesives, resins, hardeners, potting, compounds, solvents, fuels, foames plasticisers, dyes and paints, oils and synthetic products etc. application in laboratories and manufacturing plants (in normal and hazardous areas)
• Control and regulation of single components, mixing ratios and consumption of various components
• Leakage measurement and leakage monitor on plant
• Measurement, indication and logging of data for product quality assurance

SPECIAL DESIGNS ON REQUEST
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Revision: 09/2007
### TECHNICAL DATA OVERVIEW

<table>
<thead>
<tr>
<th>Size</th>
<th>Flow Range*</th>
<th>Flow Range*</th>
<th>K-Factor</th>
<th>K-Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>l/min</td>
<td>GPM</td>
<td>l/min</td>
<td>Imp./Gal.</td>
</tr>
<tr>
<td>VS 0.02</td>
<td>0.002 ...... 2</td>
<td>0.0005 ...... 0.53</td>
<td>50000</td>
<td>189272</td>
</tr>
<tr>
<td>VS 0.04</td>
<td>0.004 ...... 4</td>
<td>0.0011 ...... 1.06</td>
<td>25000</td>
<td>94636</td>
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<tr>
<td>VS 0.1</td>
<td>0.01 ...... 10</td>
<td>0.0026 ...... 2.64</td>
<td>20000</td>
<td>37854.4</td>
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<td>VS 0.2</td>
<td>0.02 ...... 18</td>
<td>0.0053 ...... 4.76</td>
<td>5000</td>
<td>18927.2</td>
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<td>VS 0.4</td>
<td>0.03 ...... 40</td>
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<td>2500</td>
<td>9463.6</td>
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<tr>
<td>VS 1</td>
<td>0.05 ...... 80</td>
<td>0.0132 ...... 21.13</td>
<td>1000</td>
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<tr>
<td>VS 2</td>
<td>0.1 ...... 120</td>
<td>0.0264 ...... 31.70</td>
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<tr>
<td>VS 4</td>
<td>1 ...... 250</td>
<td>0.2642 ...... 66.00</td>
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<tr>
<td>VS 10**</td>
<td>1.5 ...... 525</td>
<td>0.39 ...... 138.00</td>
<td>300</td>
<td>1135</td>
</tr>
</tbody>
</table>

*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

\[
°C = \frac{5 \times (°F - 32)}{9}
\]

\[
°F = \frac{9 \times °C + 32}{5}
\]

- psi = pound-weight per square inch

### Materials

- **Body**: EN-GJS-400-15 (EN 1563), Stainless Steel 1.4305
- **Bearings**: Ball/Plain/Plain (Copper-free) depend on liquid.
- **Seals**: FPM (Standard), NBR, PTFE, EPDM

### Max. Operating Pressures

- **Cast Iron**: 315 bar/4568 psi
- **Stainless Steel**: 450 bar / 6526 psi

### Medium Temperature

- **Standard**: -30 ≤ ... 120° C
- **Ex-design**: -20 ≤ ... 100° C
- **High temperature**: -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
- VS 0.2/0.4: 20 µm
- VS 1/2: 50 µm
- VS 4: 50 µm

### Noise Level

Max. 72 dB(A)

### Preamplifier

10 to 28 Volt (DC)

### Accuracy

± 0.3 % of measured value at viscosity > 20 cSt (< 20 cSt reduced accuracy)

### Repeatability

± 0.05 % under same operating conditions

### Exceptions

Flow meter with special clearance on request.
FLOW RESPONSE CURVES

VS 0.02

VS 0.1

VS 0.4

VS 0.2

VS 1

VS 2

VS 4
# VS Flow Meter Dimensions

### CAST IRON VERSION
- Housing curve mill cutted

![Diagram of CAST IRON VERSION](image1)

### STAINLESS STEEL VERSION
- Housing not mill cutted
- View X

![Diagram of STAINLESS STEEL VERSION](image2)

### Table: VS Flow Meter Dimensions

<table>
<thead>
<tr>
<th>Size VS / VSI</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>G</th>
<th>H</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O-ring</th>
<th>Weight GG kg</th>
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<tbody>
<tr>
<td>0.02</td>
<td>100</td>
<td>80</td>
<td>91</td>
<td>M 6</td>
<td>12.5</td>
<td>9</td>
<td>114</td>
<td>58</td>
<td>70</td>
<td>40</td>
<td>20</td>
<td>11 x 2</td>
<td>2.8</td>
</tr>
<tr>
<td>0.04</td>
<td>100</td>
<td>80</td>
<td>91.5</td>
<td>M 6</td>
<td>11.5</td>
<td>9</td>
<td>114.5</td>
<td>58.5</td>
<td>70</td>
<td>40</td>
<td>20</td>
<td>11 x 2</td>
<td>2.8</td>
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<tr>
<td>0.1</td>
<td>100</td>
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<td>20</td>
<td>11 x 2</td>
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<tr>
<td>0.2</td>
<td>100</td>
<td>80</td>
<td>93.5</td>
<td>M 6</td>
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<td>9</td>
<td>116.5</td>
<td>60.5</td>
<td>70</td>
<td>40</td>
<td>20</td>
<td>11 x 2</td>
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<tr>
<td>0.4</td>
<td>115</td>
<td>90</td>
<td>96.5</td>
<td>M 8</td>
<td>11.5</td>
<td>16</td>
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<td>34</td>
<td>1796 x 2.62</td>
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<tr>
<td>1</td>
<td>130</td>
<td>100</td>
<td>101</td>
<td>M 8</td>
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<td>2</td>
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<td>100</td>
<td>118</td>
<td>M 8</td>
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<td>4</td>
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<td>30</td>
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<td>46</td>
<td>95</td>
<td>45</td>
<td>3617 x 2.62</td>
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</table>

- **GG** = Cast Iron EN-GJS-400-15 (EN 1563)
- **E** = Stainless Steel 1.4305
- Dimensions are specified in mm

---

**SIDE PORTS**

- Flow meter
- Subplate

**BOTTOM PORTS**

- Flow meter
- Subplate
## AP SUBPLATE DIMENSIONS

### SIDE PORTS

| Cast Iron / AP.G.S.../ | Stainless Steel / APE.S.../ |

### BOTTOM PORTS *

| Cast Iron / AP.G.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.

### G PIPE THREAD CLASSIFICATION

<table>
<thead>
<tr>
<th>AFFILIATED SIZE</th>
<th>VS / VS1</th>
<th>G</th>
<th>F</th>
<th>ø H</th>
<th>E</th>
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<tbody>
<tr>
<td>0.02 / 0.04</td>
<td>0.2</td>
<td>G1 / 4</td>
<td>35</td>
<td>ø 20</td>
<td>26</td>
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<tr>
<td>0.1 / 0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.02 / 0.04</td>
<td>0.2</td>
<td>G3 / 8</td>
<td>35</td>
<td>ø 23</td>
<td>30</td>
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<tr>
<td>0.1 / 0.2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.02 / 0.04</td>
<td>0.2</td>
<td>G1 / 2</td>
<td>35</td>
<td>ø 28</td>
<td>38</td>
</tr>
<tr>
<td>0.1 / 0.2</td>
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<td></td>
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<tr>
<td>0.02 / 0.04</td>
<td>0.1</td>
<td>G1 / 2</td>
<td>35</td>
<td>ø 28</td>
<td>46</td>
</tr>
<tr>
<td>0.1 / 0.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>0.02 / 0.04</td>
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<td>G3 / 4</td>
<td>40</td>
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<td>0.1 / 2</td>
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<td></td>
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<td>0.02 / 0.04</td>
<td>1 / 2</td>
<td>G1*</td>
<td>55</td>
<td>ø 41</td>
<td>55</td>
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<tr>
<td>0.1 / 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.02 / 0.04</td>
<td>1 / 2</td>
<td>G1 1 / 4</td>
<td>70</td>
<td>ø 51</td>
<td>60</td>
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<tr>
<td>0.1 / 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.02 / 0.04</td>
<td>1 / 2</td>
<td>G1 1 / 2</td>
<td>AP.U=70</td>
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<td>72</td>
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<td>0.1 / 2</td>
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<td></td>
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<tr>
<td>0.02 / 0.04</td>
<td>1 / 2</td>
<td>G1 1 / 2</td>
<td>AP.S=80</td>
<td>ø 56</td>
<td>72</td>
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### Size

<table>
<thead>
<tr>
<th>VS / VS1</th>
<th>AP</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>L</th>
<th>M</th>
<th>Weight</th>
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<tbody>
<tr>
<td>0.02 / 0.04</td>
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<td>110</td>
<td>72</td>
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<td>100</td>
<td>110</td>
<td>180</td>
<td>M8/15</td>
<td>7.4</td>
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<td></td>
<td>APG4 UG</td>
<td>140</td>
<td>120</td>
<td>120</td>
<td>100</td>
<td>100</td>
<td>M8/15</td>
<td>7.4</td>
</tr>
<tr>
<td></td>
<td>APE.U</td>
<td>140</td>
<td>-</td>
<td>100</td>
<td>110</td>
<td>180</td>
<td>M8/15</td>
<td>12</td>
</tr>
</tbody>
</table>

Special designs on request

1. Only for APG.U.../; APE.U.../
2. Only for APE.S.../; APE.U.../
VS 10 FLOW METER

TECHNICAL DATA

<table>
<thead>
<tr>
<th>Size</th>
<th>Flow range l/min</th>
<th>GPM</th>
<th>K-Factor</th>
<th>Imp./l</th>
<th>Imp./Gal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS 10</td>
<td>1.5 ... 525</td>
<td>0.3963 ... 138.69</td>
<td>300</td>
<td>1135.63</td>
<td></td>
</tr>
</tbody>
</table>

Accuracy
± 0.3 % of measured value at viscosity > 20 cSt (< 20 cSt reduced accuracy)

Repeatability
± 0.05 % under same operating conditions

Materials
<table>
<thead>
<tr>
<th>Body</th>
<th>Bearings</th>
<th>Seals</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN-GJS-600-3</td>
<td>Ball/Plain gearings</td>
<td>FPM (Standard)</td>
</tr>
<tr>
<td>EN 1563</td>
<td>depend on liquid.</td>
<td>NBR, PTFE, EPDM</td>
</tr>
</tbody>
</table>

Max. Operating Pressure
400 bar / 6000 psi

Medium Temperature
<table>
<thead>
<tr>
<th>Standard</th>
<th>Ex-design</th>
<th>High temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>–30 ≤ ... 120 °C</td>
<td>–20 ≤ ... 100 °C</td>
<td>not available</td>
</tr>
</tbody>
</table>

Viscosity Range
1 ... 100,000 mm² / 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, additional current on signal output max. 20 mA

OUTPUT SIGNALS OF PREAMPLIFIER

VOLTAGE RANGES
Supply voltages: \( U_s = 10 \ldots 28 \text{ V DC} \)
Impulse voltages: \( U_i = U_s - 1 \text{ V} \)

---

Gear rotation of one gear tooth pitch
3 Impulse pro volume (10 cm³) of one tooth pitch

Volume / Impulse in cm³ / Imp (\( 10 / 3 \text{ cm}^3 \) = Vm)

Channel 1

Channel offset by 1/4 of tooth pitch (90°)

Impulse mark / space ratio (adjust at preamplifier)

Flow direction 1

Flow direction 2
FLOW RESPONSE CURVES

![Flow response curves graph]

DIMENSIONS

![Dimensions diagram]

Dimensions are specified in mm

SUBPLATE DIMENSIONS

APG 10 S GON / 1

![APG 10 S GON / 1 diagram]

Dimensions are specified in mm
VSE FLOW METERS IN EX-DESIGN

The VSE flow meters of the VS-series in ex-design are approved for applications in potentially 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 makes a galvanic isolated transmission of binary switching status possible. It has an intrinsically safe control circuit and is certified according to II(1) GD [EEExial] IIC.

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 (PNP-outputs) short circuit proof transistor outputs display the digital signal of a channel antivalently.

<table>
<thead>
<tr>
<th>Flow meter</th>
<th>VSE connection cable, blue, PUR,</th>
<th>Barrier amplifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typ VSE**∗∗∗∗–32 Q1∗∗ / ∗</td>
<td>shielded; 4 x 0,34 mm²</td>
<td>Typ MK 13-P-Ex 0/24 VDC/K15</td>
</tr>
<tr>
<td>BVS 05 ATEX E 071 X</td>
<td>PUR</td>
<td>PTB 06ATEX 2025</td>
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<tr>
<td>II 1G EEx ia II C T4-T6</td>
<td></td>
<td>II (1) G [EEExia] II C</td>
</tr>
<tr>
<td>U_i = 18,5 V</td>
<td>R = 0,053 Ω/m</td>
<td>U_o = 9,9 V</td>
</tr>
<tr>
<td>I_i = 24 mA</td>
<td>L = 0,85 μH/m</td>
<td>I_o = 22 mA</td>
</tr>
<tr>
<td>P_i = 100 mW</td>
<td>C_{A,A} = 55 pF/m</td>
<td>P_o = 54 mW</td>
</tr>
<tr>
<td>R = 0</td>
<td>C_{A,3} = 105 pF/m</td>
<td></td>
</tr>
<tr>
<td>L = 0</td>
<td>([x] = measured at 1000 Hz)</td>
<td></td>
</tr>
<tr>
<td>C_i = 0,27 μF</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IIC

| Lo / mH | 1 | 5 | 10 | 20 |
| 1,5 | 0,75 | 0,65 | 5 | 3,5 | 3 |

IIIB

| Co / μF | 1,5 | 0,75 | 0,65 | 5 | 3,5 | 3 |

<table>
<thead>
<tr>
<th>temperature class</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>ambient temperature</td>
<td>-20 °C ≤ T_{amb} ≤ 95 °C</td>
<td>-20 °C ≤ T_{amb} ≤ 70 °C</td>
<td>-20 °C ≤ T_{amb} ≤ 55 °C</td>
</tr>
<tr>
<td>liquid temperature</td>
<td>-20 °C ≤ T_{med} ≤ 100 °C</td>
<td>-20 °C ≤ T_{med} ≤ 75 °C</td>
<td>-20 °C ≤ T_{med} ≤ 60 °C</td>
</tr>
</tbody>
</table>
**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 (122°F).

- 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 read out it is recommended to use shielded cables and a pull-down (PNP-signal) or a pull-up (NPN-signal) resistors.

**CONNECTION: PNP-SWITCHING**

![PNP-Switching Connection Diagram]

**CONNECTION: NPN-SWITCHING**

![NPN-Switching Connection Diagram]
TECHNICAL DATA: SENSOR UNIT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Temperature</td>
<td>-40° C ... 210° C</td>
</tr>
<tr>
<td>Number of pick-ups</td>
<td>1 or 2 pick-ups</td>
</tr>
<tr>
<td>Pick-up</td>
<td>Magnetoresistive</td>
</tr>
<tr>
<td>Electrical Connection</td>
<td>PG - cable fitting</td>
</tr>
<tr>
<td>Isolation-Protection</td>
<td>IP 64</td>
</tr>
</tbody>
</table>

TECHNICAL DATA: AMPLIFIER

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>( U_b = 10 \ldots 30 \text{ V} \text{ DC +/–10%} )</td>
</tr>
<tr>
<td>Current Consumption</td>
<td>( I_b = \text{ca.} 15 \text{ mA (idle motion, without load)} )</td>
</tr>
<tr>
<td>Signal Output PNP</td>
<td>High Sign: (-U_s = U_b - 1 \text{ V}, I_s = 25 \text{ mA max.})</td>
</tr>
<tr>
<td>Signal Output NPN</td>
<td>Low Sign: (-U_s = 0 \text{ V}, I_s = 25 \text{ mA max.})</td>
</tr>
<tr>
<td>Electrical Connection</td>
<td>4-pole round plug M 12</td>
</tr>
<tr>
<td>Max. Ambient Temperature</td>
<td>50° C</td>
</tr>
<tr>
<td>Protection-class</td>
<td>IP 64</td>
</tr>
<tr>
<td>Pull-down Resistor</td>
<td>4.7 \ldots 10 KΩ</td>
</tr>
<tr>
<td>Pull-up Resistor</td>
<td>4.7 \ldots 10 KΩ</td>
</tr>
</tbody>
</table>

FLOW METER DIMENSIONS

**VIEW X**

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>D</th>
<th>E</th>
<th>( \varnothing ) G</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>P</th>
<th>O-ring</th>
<th>Weight kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS 0.04*</td>
<td>100</td>
<td>M 6</td>
<td>11.5</td>
<td>( \varnothing ) 9</td>
<td>58.5</td>
<td>70</td>
<td>40</td>
<td>20</td>
<td>22</td>
<td>11 ( \times 2 )</td>
<td>3.5</td>
</tr>
<tr>
<td>VS 0.1</td>
<td>100</td>
<td>M 6</td>
<td>9</td>
<td>( \varnothing ) 9</td>
<td>61</td>
<td>70</td>
<td>40</td>
<td>20</td>
<td>22</td>
<td>11 ( \times 2 )</td>
<td>3.3</td>
</tr>
<tr>
<td>VS 0.2</td>
<td>100</td>
<td>M 6</td>
<td>9</td>
<td>( \varnothing ) 9</td>
<td>60.5</td>
<td>70</td>
<td>40</td>
<td>20</td>
<td>22</td>
<td>11 ( \times 2 )</td>
<td>3.6</td>
</tr>
<tr>
<td>VS 0.4</td>
<td>115</td>
<td>M 8</td>
<td>11.5</td>
<td>( \varnothing ) 16</td>
<td>63.5</td>
<td>80</td>
<td>38</td>
<td>34</td>
<td>22</td>
<td>17.96 ( \times 2.62 )</td>
<td>4.9</td>
</tr>
<tr>
<td>VS 1</td>
<td>130</td>
<td>M 8</td>
<td>15</td>
<td>( \varnothing ) 16</td>
<td>68</td>
<td>84</td>
<td>72</td>
<td>34</td>
<td>22</td>
<td>17.96 ( \times 2.62 )</td>
<td>6.7</td>
</tr>
<tr>
<td>VS 2</td>
<td>130</td>
<td>M 8</td>
<td>12</td>
<td>( \varnothing ) 16</td>
<td>85</td>
<td>84</td>
<td>72</td>
<td>34</td>
<td>22</td>
<td>17.96 ( \times 2.62 )</td>
<td>8.3</td>
</tr>
<tr>
<td>VS 4</td>
<td>180</td>
<td>M 12</td>
<td>20</td>
<td>( \varnothing ) 30</td>
<td>110</td>
<td>46</td>
<td>95</td>
<td>45</td>
<td>12</td>
<td>36.17 ( \times 2.62 )</td>
<td>18.3</td>
</tr>
</tbody>
</table>

*Attention: * 0.04 with one (1) channel only
## TYPE KEY FLOW METERS VS

### EXAMPLE

<table>
<thead>
<tr>
<th>H</th>
<th>T</th>
<th>Pick-up system for high temperature ranges (..210°C) signal output PNP or NPN</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>H</td>
<td>/ X</td>
</tr>
</tbody>
</table>

| VS  | G | P | 0 | 1 | 2 | V | - | 3 | 2 | N | 1 | 1 | / | X |
|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| V   | FPM (Viton) Standard |
| P   | NBR (Perbunan)       |
| T   | PTFE                 |
| E   | EPDM                 |
| 1   | Reduced tolerance    |
| 2   | Normal tolerance     |
| 3   | Increased tolerance  |
| 4   | Tolerance steel - plain bearing |

<table>
<thead>
<tr>
<th>OCT</th>
<th>No coating (Standard)</th>
<th>Dynamat - coating (C - surface coating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>Plate coating</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P</th>
<th>Pipe - line connections</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>E</th>
<th>EN-GJS-400-15 (V610) - EN-GJS-600-3) DIN EN 1563</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Stainless steel 1.4305 (V2A)</td>
</tr>
<tr>
<td></td>
<td>EN-GJS-600-3 (High pressure) DIN EN 1563</td>
</tr>
</tbody>
</table>

VS 0.02  VS 0.64  VS 0.16  VS 0.1  VS 0.4  VS 1  VS 2  VS 4  VS 10
FLOW METERS WITH HIGH DEFINITION FLOW RATE

The preamplifiers of the standard version for flow meters of the “VS” product line output one pulse per tooth-gap volume \( V_Z \), which corresponds to the volume measurement \( V_m = V_Z / \text{pulse} \). 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. But since as high a resolution as possible is necessary for precise and exact flow and volume measurements, the volume measurement \( V_m \) must be resolved even more than is the case 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 \( 1/64 V_m \). Evaluation electronics can recognize flow direction from signals offset 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 Fig. 4) per volume measurement \( V_m \). The frequency multiplication \( f^* \) lies between 1 and 16 (see table).

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

FIGURE SIGNAL EMISSION OF THE PREAMPLIFIER WITH INTERPOLATION

Fig. 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 \( V_m^* = V_m / 8 \). In double evaluation (flank evaluation of one channel) this results in a value of \( 1/2 V_m^* = V_m / 16 \) and for quadruple evaluation (flank evaluation of both channels) the result is a value of \( 1/4 V_m^* = V_m / 32 \). Evaluation electronics can recognize flow direction from signals offset 90°.
## INTERPOLATION FACTOR AND RESOLUTION

<table>
<thead>
<tr>
<th>Interpolation factor</th>
<th>Imp/Vₘ</th>
<th>Max. resolution (evaluation of signal flanks)</th>
<th>Resolution Vₘₖ* (volume measurement Vₘ*) [ml]</th>
<th>Max. resolution (angle degrees)</th>
<th>Frequency fₘ₃₉*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>4 [quadrupling]</td>
<td>Vₘ / 4</td>
<td>90°</td>
<td>fₘ₃₉ x 1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>8</td>
<td>Vₘ / 8</td>
<td>45°</td>
<td>fₘ₃₉ x 2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>12</td>
<td>Vₘ /12</td>
<td>30°</td>
<td>fₘ₃₉ x 3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>16</td>
<td>Vₘ /16</td>
<td>22.5°</td>
<td>fₘ₃₉ x 4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>20</td>
<td>Vₘ /20</td>
<td>18°</td>
<td>fₘ₃₉ x 5</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>32</td>
<td>Vₘ /32</td>
<td>11.25°</td>
<td>fₘ₃₉ x 8</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>40</td>
<td>Vₘ /40</td>
<td>9°</td>
<td>fₘ₃₉ x 10</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>48</td>
<td>Vₘ /48</td>
<td>7.5°</td>
<td>fₘ₃₉ x 12</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>64</td>
<td>Vₘ /64</td>
<td>5.625°</td>
<td>fₘ₃₉ x 16</td>
</tr>
</tbody>
</table>

Column 1: programmable interpolation factor IPF (programming is done in the factory)
Column 2: Pulses per volume measurement Vₘ
Column 3: maximum resolution of the signal flanks. The signal flanks channels 1 and 2 are evaluated.
Column 4: Volume measurement Vₘₖ* 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 fₘ₃₉ at maximum flow Qₘ₃₉ and programmed interpolation factor IPF

In practice, the maximum flow Qₘ₃₉ 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:

\[ fₘ₃₉ = \frac{(Qₘ₃₉) * IPF}{Vₘ} \]  

fₘ₃₉ = Maximum frequency of the flow meter signals
Qₘ₃₉ = Maximum flow attained in the case of application described here
IPF = Programmed interpolation factor
Vₘ = Volume measurement of the flow meter

**Example:** Flow meter VSI 1/10… max. flow rate of the system at maximum capacity
Qₘ₃₉ = 40 l/min = 666.667 ml/sec; IPF = 10;
Vₘ = 1 ml/pulse; fₘ₃₉ = 6666.67 Hz = 6.66667 kHz

At max. flow max₃₉ = 40 l/min, the flow meter VSI 1/10… outputs a frequency of
fₘ₃₉ = 6666.67 Hz.
## TYPE KEY FLOW METERS VSI

### Example

<table>
<thead>
<tr>
<th>VSI 1</th>
<th>/</th>
<th>4</th>
<th>G</th>
<th>P</th>
<th>O</th>
<th>1</th>
<th>2</th>
<th>V</th>
<th>-</th>
<th>3</th>
<th>2</th>
<th>W</th>
<th>1</th>
<th>5</th>
<th>/</th>
<th>X</th>
<th>. .</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Type Key

- **V**: FPM (Viton) standard
- **P**: NBR (Perbunan)
- **T**: PTFE
- **E**: EPDM

### Gear Bearing

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

### Measuring Wheel Coating

- 1: Stainless steel
- 2: Titanium coating

### Connection

- **V**: 10...30 V Power supply volt.
- **X**: Modification id. no.
- **W**: VV int. WE (power supply volt, 10...30V DC)
- **1**: Integrated (standard design)
- **5**: 5 pole plug connection

### Material

- **G**: EN-GJS-400-15 (VSI10 = EN-GJS-600-3) EN1563
- **E**: Stainless steel 1.4305 (V2A)
- **H**: EN-GJS-600-3 EN1563 (high pressure)

### Size

- Vz = 0.004ml
- Vz = 0.04ml
- Vz = 0.1 ml
- Vz = 0.2 ml
- Vz = 0.4 ml
- Vz = 1 ml
- Vz = 2 ml
- Vz = 4 ml
- Vz = 10 ml

\[ V_{m} = \text{Volume (cm}^{3}\text{)} \]

\[ V_{z} = \text{the volume between the gear teeth} \]
**ELECTRONIC DISPLAYS WITH ANALOGUE OUTPUT**

**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 value 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 MEASURING INSTRUMENT DPZ-F FOR 2-OR 1-CHANNEL FLOW SENSOR**
- Flow meter type selectable by menu
- Flow meter direction indicator
- 16 Bit-analogue output
  - 0 ... ± 10 V
  - 0 ... ± 20 mA
  - 0/4 ... 20 mA
- 2 limit value outputs
- Semiconductor
- PC-Interface RS 232 or RS 485
- A power supply for flow sensor is integrated 24 Volt DC / 100mA

**FLOW RATE AND VOLUME MEASURING INSTRUMENT PAXI FOR 1- OR 2-CHANNEL FLOW SENSOR**
- Flow rate- or volumedisplay 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 / 100mA

**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 → 5 V → 10 V]
  - [10 V → 0 V → 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
ELECTRONIC DISPLAYS WITHOUT ANALOGUE OUTPUT

VOLUME-PRESETCOUNTER AND BATCH-COUNTER GEL 103 FOR 2-OR 1-CHANNEL FLOW SENSOR

- Display values for actual volume value and 2 volume preset values will be displayed simultaneously
- 2 limited value relay and transistor outputs, 1 transistor output for batch preset control
- Phase discriminator for 2-channel flow rate sensor with single, double or quadruple volume impulse edge evaluation programmable
- A power supply for flow sensor is integrated 24 V DC ± 10%, max. 60 mA

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 VOLTAGES LEVELS

- For example: 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 without galvanic isolation between intrinsically safe and nonintrinsically safe circuits
- They must be installed in the safe area
- They 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 order nos. see page 11.
ACCESSORIES / CUSTOMER SPECIFIC SOLUTIONS

CUSTOMER SPECIFIC

• Customer specific solutions can be realized for prices in line with market requirements in the shortest time. We develop your solutions in all current materials such as steel, stainless steel, titanium and aluminium as well as bronze materials.

PROCESS CONTROL

• Dyes, paints, (hot-) adhesives or epoxy or PUR-materials also with fillers can be reliably measured. Pressures up to 700 bar and temperatures up to 210°C are included in our standard product range.

AUTOMOBILE INDUSTRY

• Whether for installation in vehicles or in climatic exposure test cabinets, we have a solution for almost every measuring application. High reliability, low space requirements and highest measurement accuracy, also difficult media or aggressive atmospheres distinguish our products.

ACCESSORIES

• Connection blocks also heatable, sandwich plates with integrated ball valves and heating jackets for all current flow meters. Additional measuring connections for pressure and temperature can be supplied from stock.

REPAIR / CALIBRATION SERVICE

• Inhouse calibrations from 0.002 l/min ... 600 l/min, traceable to a DKD normal. We are pleased to provide you with loan units for the time of repair/calibration. Repair and calibration also of external brands as well as electronics displays.
WORLDWIDE SERVICE / PRODUCTS

QUALIFIED ADVICE THROUGH LONGSTANDING COOPERATION PARTNERS

• personal
• competent
• efficient

PRODUCTS

• Precision gear type flow meters for general industrial applications
• Stainless steel gear type flow meters for special applications
• Turbine flow meters
• Standardized and individual electronic readouts
• Electronic devices for special solutions in measurement, control and regulation technology
• Repair / calibration service