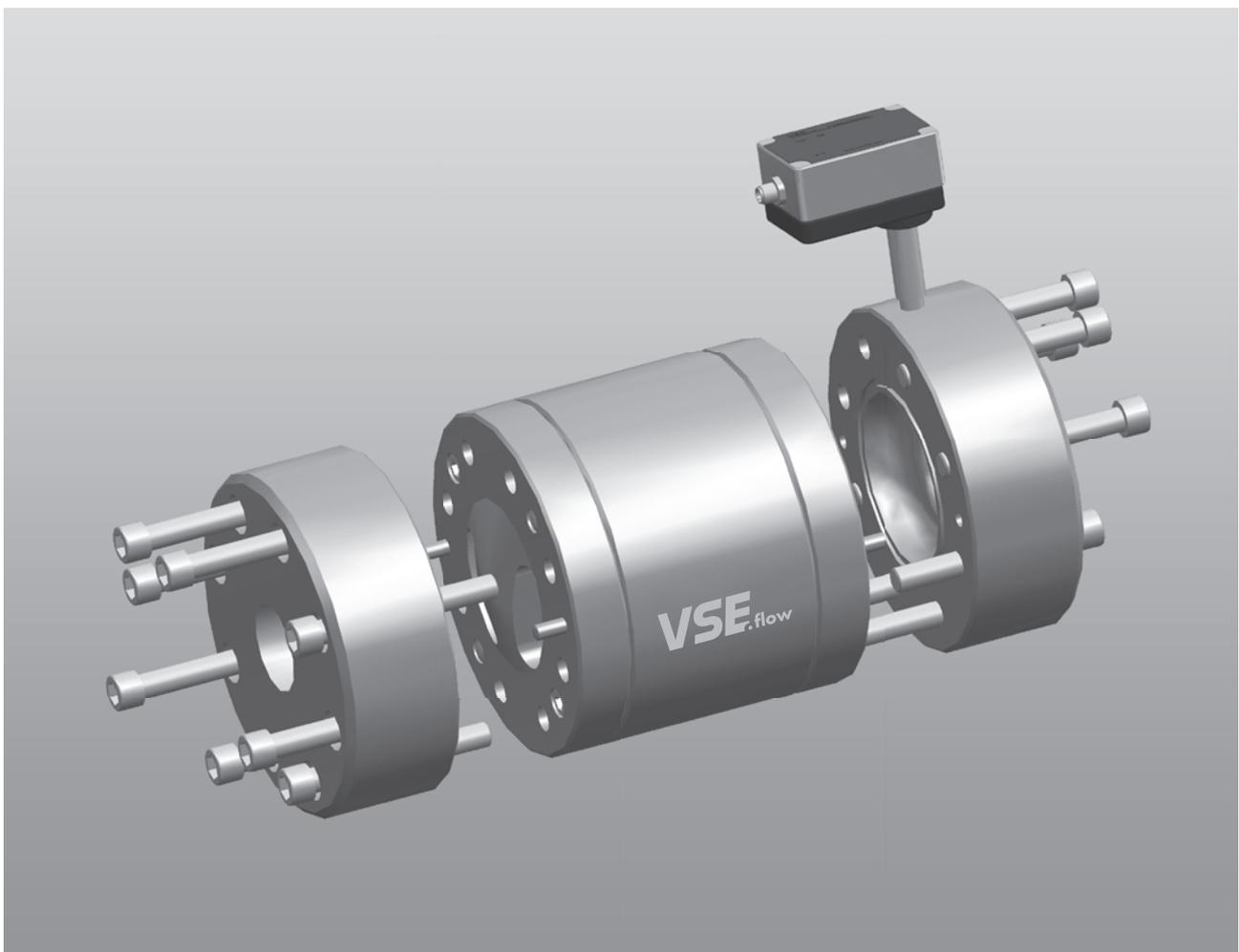


Solutions for Fluid Technology



OPERATING INSTRUCTIONS

For Flow Meters of the Product Series "RS"

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IMPORTANT INFORMATION AND LEGAL NOTICES

Dear customer, dear user,

This operating instruction for volume sensors of the “**RS**” series by VSE Volumentechnik GmbH (VSE) contains information required to properly install and commission the flow meter for the intended purpose.

Any installation, commissioning, operation, maintenance and testing may only be carried out by trained and authorized personnel. The operating instructions must be read and followed carefully to ensure a trouble-free, proper and safe operation of the flow meter. In particular, the safety instructions are essential.

These operating instructions must be kept safe and accessible for the authorized personnel at all times. At no time should contents of the operating instructions be removed. A missing manual or missing pages must be replaced immediately if lost. The operating instructions can be requested at any time from VSE or downloaded from our website www.vse-flow.com. The operating instructions must be passed on to each subsequent user of the flow meter.

This operating instruction is not subject to any modification service by VSE. VSE reserves the right to make technical changes at any time without notice.

VSE makes no warranties, express or implied, with respect to commercial qualities and suitability for a particular purpose.

VSE accepts no liability for damage and malfunctions resulting from operating errors, failure to observe these operating instructions, improper installation, commissioning or maintenance as well as improper use of the flow meter.

The opening of the flow meter is absolutely not permitted. After an unauthorized opening or rebuilding as well as after a single, incorrect connection of the flow circuits of the flow meter, the warranty as well as the product liability by VSE expire.

FUNCTION DESCRIPTION OF THE RS FLOW METERS

RS flow meters measure the flow rate based on the screw pump principle. A pair of rotors fitted precisely into the housing constitutes the measuring element. An integrated gear and non-contact signal pick-up system detects the rotations of the measuring element and converts them to digital pulses.

Together with the housing walls, the rotor edges form closed measuring chambers in which the fluid is transported from the inlet to the outlet side.

The fluid volume put through within one main rotor rotation is the rotation volume, which is divided by the sensing gear and digitised, processed and output in the sensor module.

Advantages

- High degree of precision that is mostly independent of viscosity
- Pulsation-free measurement
- Lowest pressure losses
- Short response time due to innovative rotor profile and reduced mass
- Highest functionality due to intelligent sensor technology
- Gentle fluid measurements

GENERAL DESCRIPTION

Please follow all instructions in this manual to ensure the trouble-free operation of the RS flow meters. VSE does not assume responsibility or liability for damages resulting from noncompliance with these instruc-

RS FLOW METER SELECTION

For the trouble-free, safe, and reliable operation of the flow meters, selecting the correct type and size is critical. Because of the wide variety of applications and flow meter designs, the technical data in the VSE catalogue are general in nature. Certain properties of the devices are

DECLARATION OF CONFORMITY

Flow meters of the "RS" series have been tested for their electromagnetic compatibility and interference emissions as outlined by the EMC Directive and are in compliance with the applicable statutory EMC Directives.

They cannot be operated independently, are connected by cable to a power source, and provide digital electrical signals for electronic evaluation. All flow meters have a declaration of conformity, which can be requested if necessary.

Sensor System Explanation

The non-contact pick-up system consists of two GMR bridges (sin/cos), which are located in a sensor unit in cartridge design. It detects the movement of the sensing gear and routes the sin/cos signals to the preamplifier electronics.

The preamplifier electronics digitise and amplify the sensor signals and multiply them by a high-resolution interpolator using adjustable settings. The square wave signals are bidirectional and can be utilised by any evaluating instrument as well as computers and PLC controls.

The resolution is selectable in steps from factor 1 to 128.

In case of a 1-channel evaluation, a separate directional signal is available.

An adjustable pulse filter can offset and suppress negative flows (e.g. generated by vibrations) while still in the device.

The frequency of the output signals is proportional to the flow (volume flow) and depends on the respective flow meter size. The frequency range is from 0 to 100 kHz. The preamplifier is protected against reverse polarity and incorrect connection. It is designed for media temperatures of -30°C to +120°C and is mounted directly on the RS flow meter.

tions. The device may only be opened within the warranty period after consultation and approval by VSE.

dependent on type, size and measuring range, as well as the liquid to be measured. Please contact VSE or one of our sales and service representatives for detailed information about the appropriate flow meter for your particular application.

Since the electromagnetic compatibility of the entire measuring system is also dependent on the installation of the cables, the correct connection of the shield, and each individual connected device, all components must comply with the EMC Directive, and the electromagnetic compatibility of the entire system, machine, or system must be ensured as well.

All flow meters have been tested in accordance with the applicable statutory EMC Directives and are CE certified. The EC conformity marking is the CE mark affixed to all flow meters.

GENERAL OPERATING REQUIREMENTS

Before assembly or putting into operation (commissioning), check and verify the following properties and aspects of the respective circumstances of your system to ensure operation is trouble-free, safe, and reliable.

1. The Fluid to be Processed

- Is the flow meter **suitable for the fluid**?
- Is the fluid **viscous** or **abrasive**?
- Is the fluid **dirty** or does it contain **contaminants/pollutants** and **solid particles**?
- Which **grain sizes** do these solids have and could they **block the measuring** element?
- Does the fluid have **fillers** or other **additives**?
- Is it necessary to install an upstream **hydraulic filter**?
- Are **tubes and pipes clean** and free of assembly residues such as chips, weld spatter?
- Is the **tank clean** and is it impossible for impurities or **foreign substances** to reach the pipeline or tubing system from the tank?
- Is a different fluid used frequently and is the system sufficiently flushed and **rinsed** in between?
- Are pipelines/tubes and the entire system completely **deaerated**?
- Which **cleaning agent** is being used?
- Are fluid and cleaning agent compatible with the **seals**?
- Are the **seals suitable** for the fluid to be measured (**compatibilities of seals**)?

2. Hydraulic Properties of the System

- Is the **max. operating pressure** of the system less than the max. permissible operating pressure of the flow meter?
- Is the **max. pressure drop Δp** (at flow meter) below the max. permissible pressure drop?
- Is the **pressure drop Δp** not excessive with max. flow (e.g. high viscosity)?
- Does the flow range of the flow meter (dependent on the viscosity) correspond with the **present flow**?
- Please note that the flow range is less with **higher viscosity!**
- Does the temperature range of the flow meter correspond with **the present max. temperature** of the fluid?
- Is the **cross-section** of the pipelines/tubes large enough and are there no overly large pressure drops in the system?
- Is the **hydraulic connection** (inlet/outlet) connected corrected and sealed properly?
- Does the **pump** have enough power to operate the system?
- A blocked flow meter can stop the entire flow. Does the system feature an **overpressure / bypass** valve? This valve must be checked and maintained at regular intervals.

3. Electronic Evaluation and Electrical Safety

- Have you selected the optimal flow sensor and is this equipped with the **appropriate preamplifier**?
- Does the **supply voltage** of the flow meter match the available power supply?
- Is the supply voltage to the power supply adapter or the evaluating device sufficiently **filtered**?
- Does the **output** of the supply voltage correspond with the required output?
- Is the electrical connection established based on the enclosed **wiring plan**?
- Is the cable protected by a shield?
- Is a **connection** of the cable shielding installed via the housing of the round pin plug to the flow meter?
- Is there a **potential difference** between the PE on the flow meter and the PE at the evaluating device?
- Is a compensation line to eliminate the **potential difference** needed between the flow meter and the evaluating device?
- Is the flow meter permanently attached to the **protective earth conductor (PE)** (e.g. via the pipelines)?
- Is the flow meter **insulated** to the protective earth conductor (PE) (e.g. connection via pipes/tubes)? If this applies, the protective earth conductor (PE) must be connected to the flow meter!
- Is the cable installed free of interference and is it impossible to couple **interfering impulses**?
- Is the **round pin plug** of the connection cable firmly attached to the plug of the flow meter?
- Are the wires at the **evaluating** device connected correctly?
- Does the entire system meet the legal rules and regulations concerning electromagnetic compatibility (**EMC**)?
- Is compliance with all local rule and regulations, **applicable rules**, guidelines and basic conditions of the **EMC** ensured?
- Systems where a malfunction or failure may lead to personal injuries must be equipped with **suitable safety mechanisms**. The function of these safety mechanisms must be checked at regular intervals.

MAXIMUM OPERATING PRESSURE

Before installing the flow meter, you must check whether the max. operating pressure of the system does not exceed the max. permissible

operating pressure of 450 bar of the flow meter. Make sure to keep in mind that peak pressures may occur when operating the system.

Important:

Please contact VSE with all operating pressures > 450 bar and in case of special models.



INFORMATION ON EU DIRECTIVE 2014/68/EU ON PRESSURE EQUIPMENT

In terms of Article 2, No. 5 of the directive named above, VSE volume sensors are so-called „pressuremaintaining components“ and this directive thereby relates to them.

VSE volume sensors must thereby comply with the technical requirements named in Section 4 of the directive in accordance with Article 4, Paragraph (1) d, Piping according to Paragraph (1) c.

Typically, the fluids measured fall into Group 2 in accordance with Article 13, Paragraph 1, b. The volume sensors sold by VSE do not comply with the limit values defined under Article 4, Paragraph 1, a.

The technical requirements on volume sensors from VSE are therefore limited to the criteria defined in Article 4, Paragraph 3. That means that the devices must be designed and manufactured in accordance with the good engineering practices prevailing in the member state. We hereby confirm this. The paragraph also states that these units may not bear the CE label named in Article 18.

A CE declaration of conformity is therefore not issued in accordance with 2014/68/EU.

The CE label of our volume sensors refers to Directive 2014/30/EU.

FLOW RATE MEASURING RANGE

The **flow rate** measuring range specified in the data sheet (Q_{\min} – Q_{\max}) of the flow meter refers to the test fluid ‚hydraulic oil‘ with a viscosity of 21 mm²/s at a temperature of 20°C. For this measuring range, VSE specifies accuracy up to 0.3% of the measured value and a repeatability of 0.05%.

In fluids with low viscosity (< 21 mm²/s), the measurement accuracy degrades while it may improve with fluid with a high viscosity (> 21 mm²/s). Note also that the flow measuring range is limited at higher viscosity (see „RS flow meter technical data“). The characteristic pressure loss curves are listed in Section 23.

Important:

Verify that the specified maximum permissible operating pressure of the flow meter can never be exceeded in any operating mode of the system. Also pay attention to the flow measuring range, which is dependent on the viscosity of the fluid to be measured.



MOUNTING THE FLOW METER

The flow meter should be mounted in an easily accessible location so that disassembly to clean the measuring elements is easy. Since flow meters operate in any installation position and flow direction, you can mount it anywhere in your system. When installing the flow meter, make sure that liquid remains in the flow meter even at standstill of the system and that the flow meter can never run dry. The outlet of the flow meter should always have a certain backpressure since this fixes the measuring element of the flow meter in the liquid column and the pipeline cannot empty itself (the measuring element uses to support itself on the liquid column). In critical cases, or if the pipeline can run empty in standstill or standby mode, it is always advisable to install an additional non-return check valve in the outlet line.

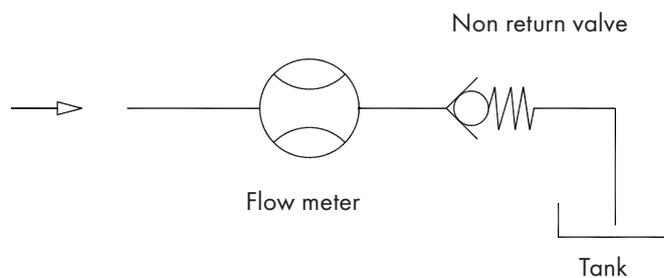


Fig. 1: Flow meter with backpressure

Important:

Make sure that the flow meter measuring elements are always completely filled both in inlet and outlet and that the outlet has a little backpressure. This prevents the measuring elements from being damaged by a sudden and steep increase of flow and at the same time improves measurement accuracy.



Flow meters of the "RS" series can be installed in the pipeline. Always select large cross-sections (if possible) for the hydraulic inlet and outlet or the entire pipeline system. This reduces the pressure drop and the flow rate throughout the system.

Installation Notes

Installation Position

Any, note arrow indicating preferred direction if necessary (calibration arrow). Mount the device in such a way that the preamplifier is turned away from any potential heat source.

Straight pipe sections are **not** required in inlet/outlet.

Connecting Units

If the connecting units (mounting flanges) are to be installed on-site, compliance with the specified torque is required.

Pipe Thread

Please comply with the screw-in depths and sealing systems. Teflon tape or liquid sealants such as adhesives are not permitted!

Fastening

The devices must be installed stress-free into the pipeline. This is accomplished with fastening screws located at the face sides in the connecting units. For stress-free assembly, the compressive strength may be limited!

Table 1: Starting torque of the connection units

RS Flow Meter Size	Torque
RS 40	35 Nm
RS 100	70 Nm
RS 400	120 Nm
RS 800	280 Nm
RS 2500	180 Nm

CLEANING AND FLUSHING OF PIPELINE BEFORE INITIAL START-UP

Before initial start-up of the flow meter, you must flush and clean the whole system to prevent contaminants from reaching the measuring elements during the assembly and installation. Foreign matter or contaminants may block the flow meter or severely damage it so that the flow meter readings are no longer valid and the device must be returned for repairs. After completion of the installation or piping, you must first flush the entire pipeline system and carefully clean and flush the tank. This requires that the flow sensor is removed from the fluid circuit to flush out all foreign matter or contaminants (e.g. chips, metal parts) without problems. Use a rinsing fluid that is compatible with the subsequent used fluid and will not cause adverse reactions. Such information can

be obtained from the supplier or manufacturer of the fluid or from VSE. Flow meters are sensors manufactured with a high degree of precision. They have mechanical measuring elements consisting of two rotors fitted into the housing with narrow gaps. Even the smallest damage to the rotors causes a measuring error. Always make sure that foreign matter or contaminants cannot reach the measuring elements and that the fluid flowing through the flow meter is always free of pollutants and particles. Once the system is thoroughly flushed and no extraneous material is in the piping system, you can mount the flow meter into the fluid circuit and start the actual initial startup process.

FLUID FILTERING

Heavily contaminated fluids or foreign matter in the fluid can block, damage, and even destroy the flow meter. In these cases, always install a sufficiently large filter in front of the flow meter so that foreign particles

and solids are prevented from entering the measuring elements, thus preventing damage to the flow meter. The required filtering depends on the size, bearing, and design of the flow meter.

Table 2: Upstream filters

Flow meter size	Filter size for ball bearing
RS 40	100 µm
RS 100	250 µm
RS 400	250 µm
RS 800	500 µm
RS 2500	500 µm

The filter size for flow meters with slide bearings, in special designs, or with specially adapted measuring element tolerances can be obtained from VSE GmbH upon request.

Important:

**A blocked flow meter is capable of stopping the entire flow.
An overpressure / bypass valve must be installed in the system side.**



SENSOR ELECTRONICS FUNCTION

The liquid to be measured flows through the rotor chambers in axial direction, resulting in an even rotation of the screw spindles.

This is done especially gentle and with very low resistance for the fluid to be measured as well as pulsation-free and almost free of leaks due to the specially designed fluidic profile geometry.

A magnet wheel permanently affixed to the rotors is scanned without contact with a sensor module. The non-contact pick-up system consists of two GMR bridges (sin/cos), which are located in a sensor unit in cartridge design. It detects every movement of the sensing gear and routes the sin/cos signals to the preamplifier electronics. The preamplifier electronics digitise and amplify the sensor signals and multiply them by a high-resolution interpolator using adjustable settings. The square wave signals phase-shifted by 90° are bidirectional and can be utilised by any evaluating device as well as computers and PLC controls.

The flow is proportional to the edges/pulse count and the flow rate is proportional to the frequency. The adjustable interpolator can be used to adjust the resolution explicitly to the downstream connected evaluating unit for obtaining highly precise measuring results of the entire system. This applies to the following application cases, for example:

- Measuring, controlling, and regulating high viscosity fluids
- Measuring, controlling, and regulating in lower flow ranges
- Measuring, controlling, and regulating when passing through zero
- Measuring, controlling, and regulating in both flow directions
- Measuring, controlling, metering, and filling of small volumes

The resolution is selectable in steps from factor 1 to 128. The frequency range is from 0 to 100 kHz.

In case of a 1-channel evaluation, a separate directional signal is available.

The preamplifier is protected against reverse polarity and incorrect connection. It is designed for fluid temperatures of -30°C up to +120°C and is mounted directly on the RS flow meter.

The fluid volume passed through by one gear division of the sensing wheel within the measuring element is divided by the set interpolation factor.

This forms the measurement volume per pulse (V_m) with the defined unit [cm³/pulse].

The frequency of the output signals can be calculated as follows:

Formula 1: Calculation of the output frequency with Q in l/min

$$f = \frac{Q}{V_m} \times \frac{1000}{60}$$

Table 2, Formula 2, and the subsequent diagrams can be used to determine the corresponding resolution or the corresponding IPF for the respective application.

Adjustable interpolation factors IPF: 1, 2, 5, 10, 25, 32, 50, 64, 100, 128

Table 3: Measurement volumes and K-factors

RS 40				
Interpolation factor (IPF)	Measurement volume V_m [cm ³ /Imp]	K-Factor [Imp/l]	K-Factor [Imp/gal.]	
1	0.31	3226	12212	
2	0.155	6452	24423	
5	0.062	16129	61055	
10	0.031	32258	122110	
25	0.0124	80645	305275	
32	0.0097	103226	390753	
50	0.0062	161290	610549	
64	0.0048	206452	781506	
100	0.0031	322581	1221102	
128	0,0024	412903	1563008	

RS 100				
Interpolation factor (IPF)	Switch position S3	Measurement volume V_m [cm ³ /Imp]	K-Factor [Imp/l]	K-Factor [Imp/gal.]
1	0	0.5649	1770	6700
2	1	0.2825	3540	13400
5	2	0.1130	8851	31700
10	3	0.0565	17702	67009
25	4	0.0226	44256	167527
32	5	0.0177	56647	214432
50	6	0.0113	88511	335050
64	7	0.0088	113294	428864
100	8	0.0056	177022	670101
128	9	0.0044	226589	857732

RS 400				
Interpolation factor (IPF)	Switch position S3	Measurement volume V_m [cm ³ /Imp]	K-Factor [Imp/l]	K-Factor [Imp/gal.]
1	0	3.138	319	1206
2	1	1.569	637	2413
5	2	0.6276	1593	6032
10	3	0.3138	3187	12063
25	4	0.12552	7967	30158
32	5	0.09806	10198	38603
50	6	0.06276	15934	60316
64	7	0.04903	20396	77207
100	8	0.03138	31867	120632
128	9	0.02452	40783	154382

RS 800				
Interpolation factor (IPF)	Switch position S3	Measurement volume V_m [cm ³ /Imp]	K-Factor [Imp/l]	K-Factor [Imp/gal.]
1	0	10.00000	100	379
2	1	5.00000	200	757
5	2	2.00000	500	1893
10	3	1.00000	1000	3785
25	4	0.40000	2500	9464
32	5	0.31200	3200	12113
50	6	0.20000	5000	18927
64	7	0.15625	6400	24227
100	8	0.10000	10000	37854
128	9	0.07813	12799	48451

RS 2500				
Interpolation factor (IPF)	Switch position S3	Measurement volume V_m [cm ³ /Imp]	K-Factor [Imp/l]	K-Factor [Imp/gal.]
1	0	37.00000	27	102
2	1	18.50000	54	204
5	2	7.40000	135	511
10	3	3.70000	270	1022
25	4	1.48000	675	2555
32	5	1.15625	864	3270
50	6	0.74000	1350	5110
64	7	0.57813	1728	6540
100	8	0.37000	2700	10220
128	9	0.28906	3456	13081

Formula 2: Calculating the max. IPF

$$IPF \approx \frac{f_{max} \times V_{mIPF1} \times 60}{Q_{max} \times 1000}$$

The set IPF may not be larger than the calculated IPF!

IPF Interpolation factor

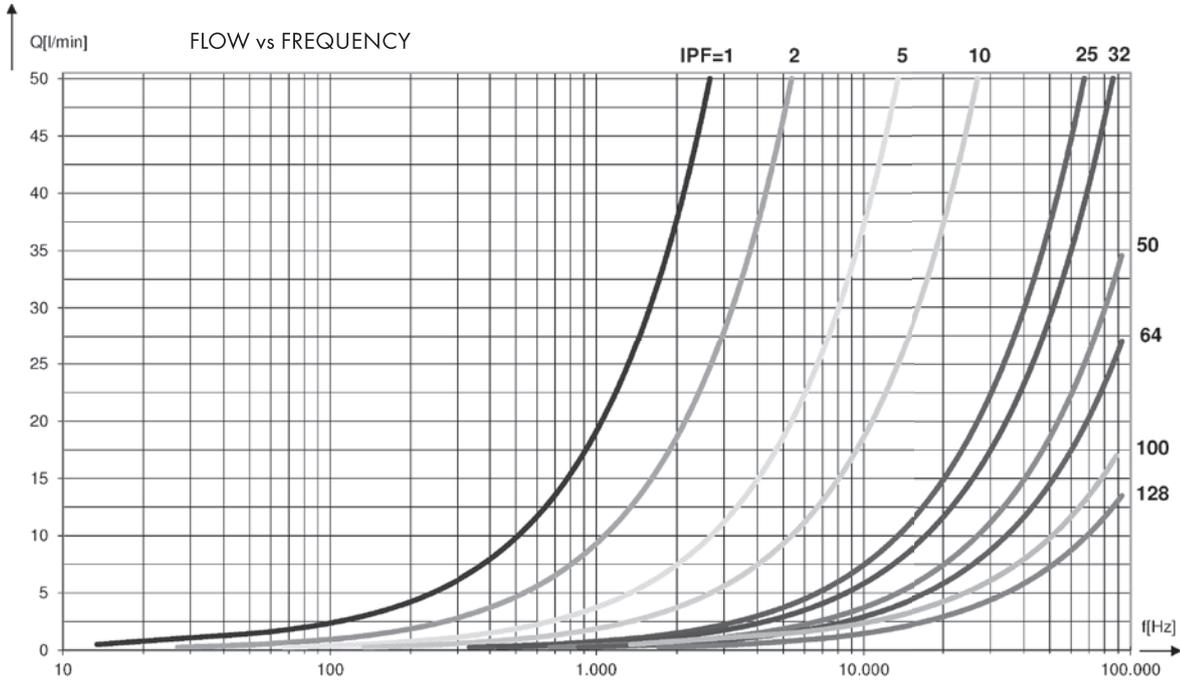
f_{max} Max. processable input frequency

V_{mIPF1} Measurement volume with IPF = 1 (volume of a gear structure of the sensing wheel)

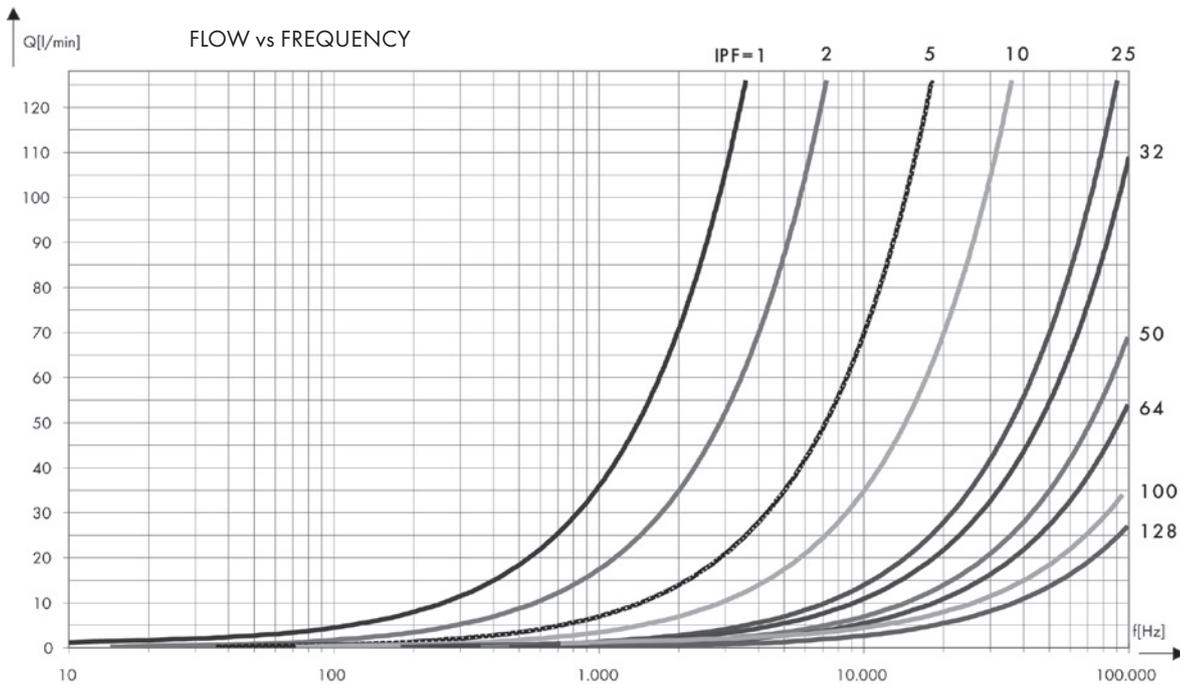
Q_{max} Max. operating flow in l/min

FLOW DIAGRAMS VS FREQUENCY

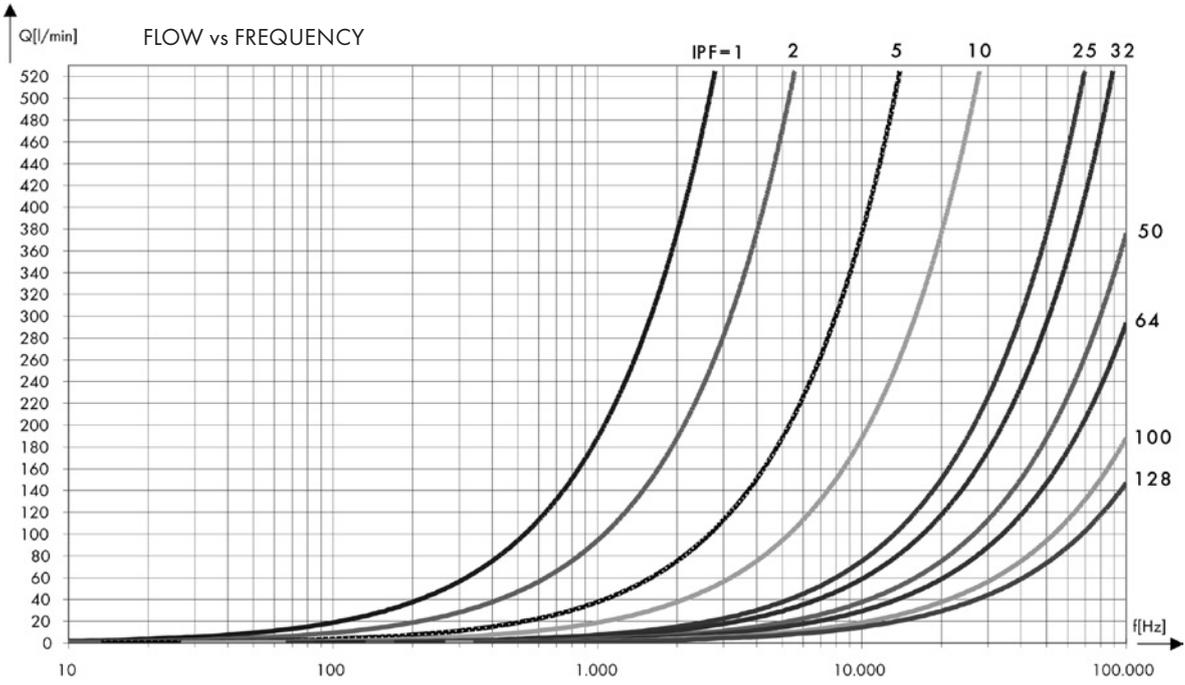
RS 40



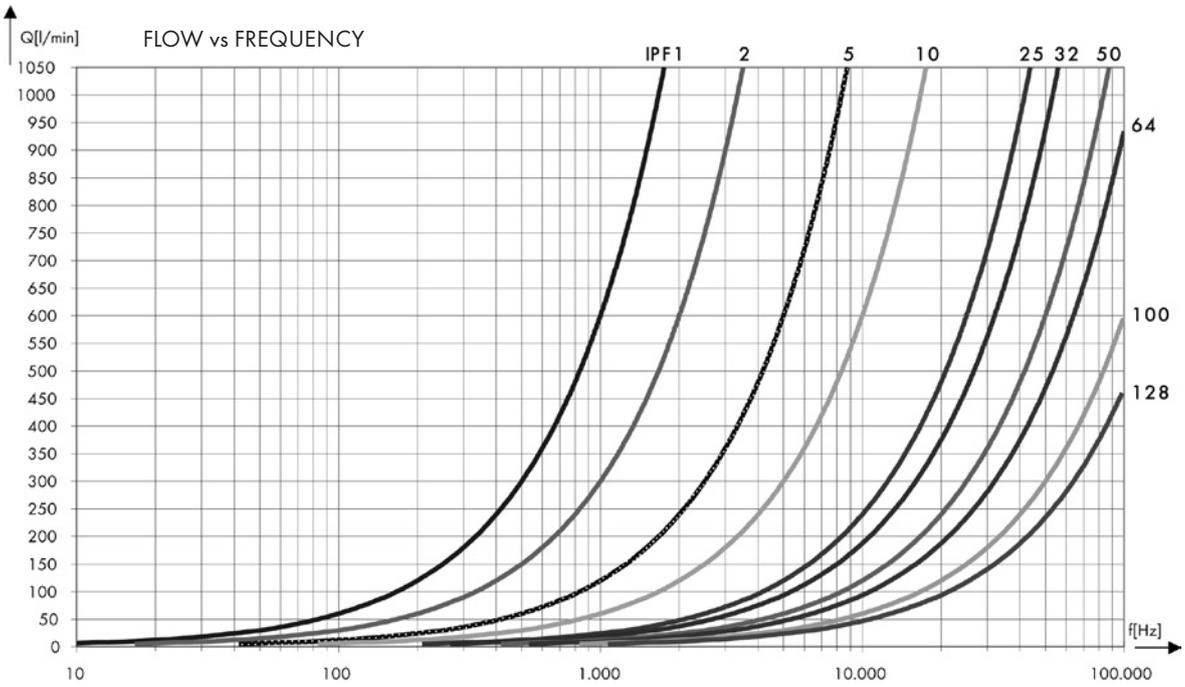
RS 100



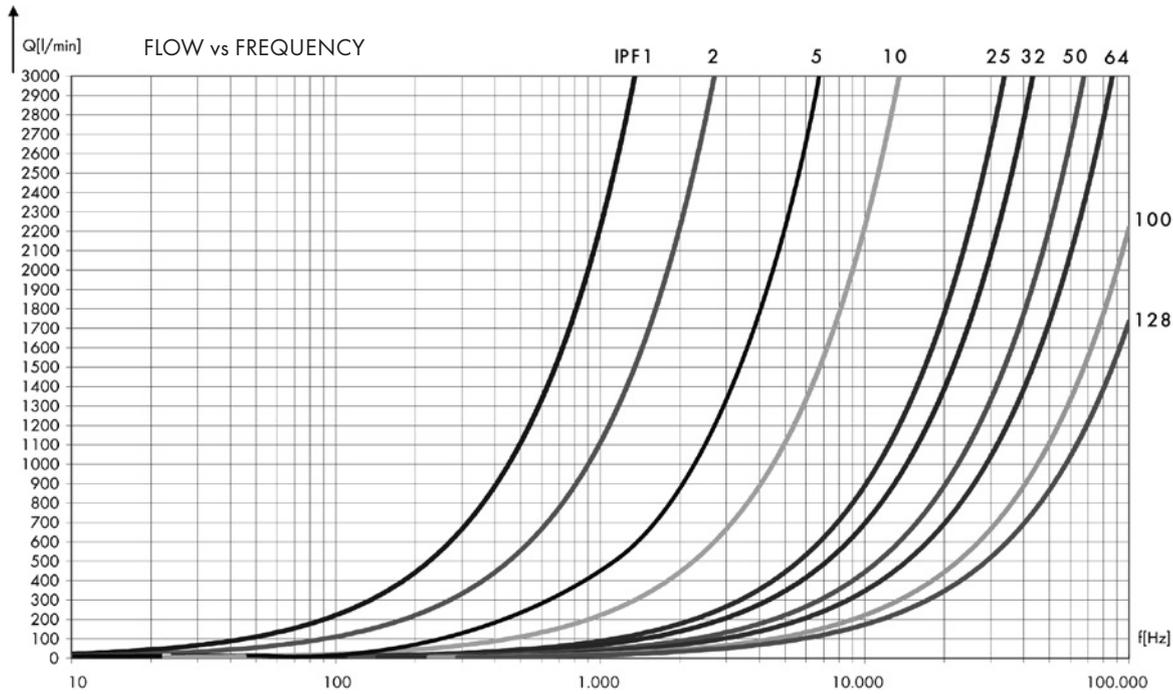
RS 400



RS 800



RS 2500

**Example**

Flow meter: RS 400

Max processable input frequency of the downstream evaluating unit: 20 kHz

Max. operating flow: 140 l/min

Path 1: The diagram yields an IPF of 25

Path 2:

$$IPF \approx \frac{f_{\max} \times V_{m_{IPF1}} \times 60}{Q_{\max} \times 1000} = \frac{20,000 \frac{1}{s} \times 3.138 \text{ ml}}{140} \times \frac{60 \text{ s}}{1000 \text{ ml}} = 26.9 \approx 25$$

PULSE FILTERING

Oscillations in fluid systems manifest themselves through constant forward and backward movements of the liquid column, which is also detected by the rotor sensors and converted into proportional electronic pulses or edge sequences. Depending on the application, oscillations or vibrations can occur during the flow rest phases or discontinuous flows. The pulses generated during the oscillation phase can be incorrectly interpreted by the downstream evaluating unit or controller, which can be very distracting for the respective operating process.

The signal filtering function of the internal electronics continuously offsets these generated edges during the rapid forward and backward move-

ments of the rotor measuring unit. The signals at the channel outputs are also suppressed at the same time until the internal offset is equalized or the initial position of the rotor measuring unit has been reached again (see Fig. 3).

The user is able to set the degree of filtering in the form of partial volumes using rotary coding switches.

Adjustable pulse filtering: 0Z, 0.25Z, 0.5Z, 0.75Z, 1.0Z, 1.25Z, 1.5Z, 1.75Z, 2.0Z, 2.25Z, 2.5Z, 2.75Z, 3.0Z, 3.25Z, 3.5Z, 3.75Z (Z: gear unit)

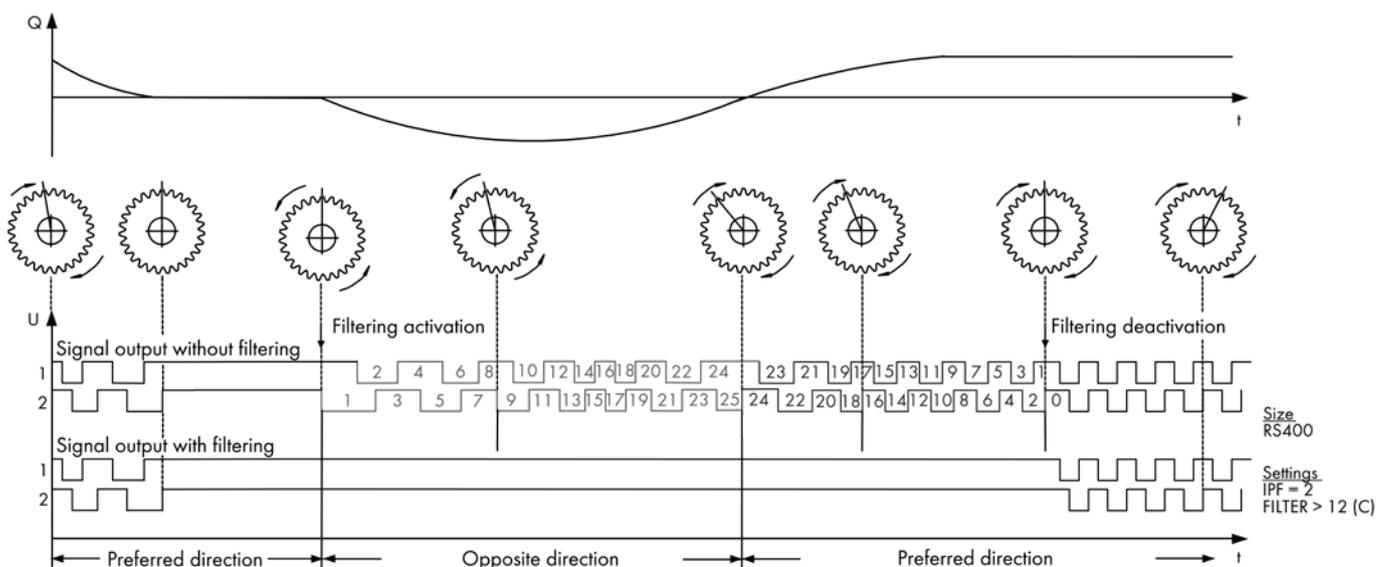


Fig. 3: Pulse filtering principle

Table 4: Suppressed volume with pulse filtering activation [ml]

Filter position	RS 40X	RS 100X	RS 400X	RS 800X	RS 2500X
0	0	0	0	0	0
1	0.0775	0.145375	0.7845	2.5	9.25
2	0.155	0.29075	1.569	5.0	18.50
3	0.2325	0.436125	2.3535	7.5	27.75
4	0.31	0.5815	3.138	10.0	37.00
5	0.3875	0.726875	3.9225	12.5	46.25
6	0.465	0.87225	4.707	15.0	55.50
7	0.5425	1.017625	5.4915	17.5	64.75
8	0.62	1.163	6.276	20.0	74.00
9	0.6975	1.308375	7.0605	22.5	83.25
10 (A)	0.775	1.45375	7.845	25.0	92.50
11 (B)	0.8525	1.599125	8.6295	27.5	101.75
12 (C)	0.93	1.7445	9.414	30.0	111.00
13 (D)	1.0075	1.889875	10.1985	32.5	120.25
14 (E)	1.085	2.03525	10.983	35.0	129.50
15 (F)	1.1625	2.180625	11.7675	37.5	138.75

PROGRAMMING THE PREAMPLIFIER ELECTRONICS

The electronics elements are quickly and easily set. There are two rotary coding switches on the electronics (S3, S4), a jumper (B2), a switch (S1) and a key (S2). With the rotary coding switches, the IPF and the degree of filtering are programmed.

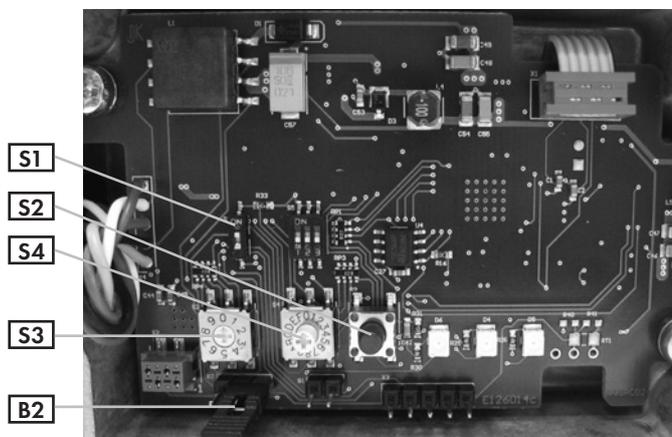


Fig. 4: Preamplifier electronics

During initial startup, the switch S1 must first be set to the corresponding preferred direction of the flow. The positive flow direction of the RS flow meter system is specified in the top view of the 5-pin M12 connector. In this case, the switch S1 must be set to ON. For the opposite negative direction, the switch position is to be down and thus set to OFF. This setting ensures that the pulse filtering is activated in the right direction from the very beginning after switching on the supply voltage.

Pin 5 of the M12 connector is either used for the separate direction signal or an error signal. This is set accordingly with the bridge B2. The figure above depicts the bridge attached to the middle and right pin of the 3-pin row of pins, which routes the separate zero signal to the third output. If the bridge is on the left and middle pin, the error signal in case of a fault is output. A description of the error states is found in the "Alarm and Warning Messages" chapter.

Ten different interpolation factors can be set with the coding switch S3. The corresponding interpolation factors for the respective switch positions are listed in Table 3. This setting can be changed at any time while the system is running. Simply use a small screwdriver to adjust the rotary coding switch and then briefly press the S2 key for the acknowledgment. The new pulse rate is enabled once.

The rotary coding switch for the pulse filtering has 16 switch settings. The degree of filtering is determined with quarter gear division increments. The corresponding suppressed partial volumes of the respective size are listed in Table 4. Changes can also be performed during operation and become active after pressing the S2 key.

The electronics is sensitive to electrostatic discharges. People making adjustments to the electronics must first discharge their electrostatic charges using a grounded object.

Important:

People making adjustments to the electronics must first discharge their electrostatic charges using a grounded object.

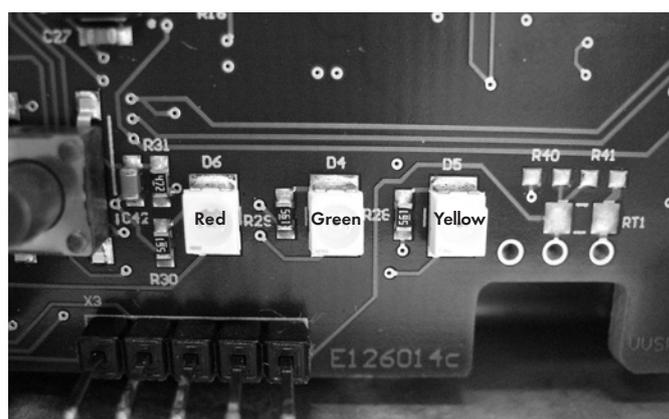


SIGNALING LEDs

The signaling LEDs provide information about the corresponding status of the electronics. These include certain operating and fault states (see Figure 5).

The three LEDs have a different combination of states for each signal. The LEDs signal either operating modes or alarms and warnings. Operating mode messages signal the respective mode that has been set. Alarm and warning signals provide explicit information about overload, conditions that can negatively affect the measurement, or component errors of the measuring system.

Fig. 5: Signaling LEDs of the preamplifier electronics



OPERATING MODE MESSAGES

Table 5: Operating mode messages

Mode	Yellow LED	Green LED	Red LED	Error output
Normal operation	off	on	off	off
Offset mode	off	flashes	off	off

ALARM AND WARNING MESSAGES

The electronics of the RS flow meters can detect five events that could lead to measurement errors. In case of serious errors, the third output has a "high" signal or a "pulse" signal if activated with the bridge B2. The different error causes can be determined with the states of the three

LEDs. The red LED is linked with the error output. Each active state of this LED or the error output signals an event that has negative effects on the measurements.

Table 6: Alarm and warning messages

Warning	Yellow LED	Green LED	Red LED	Error output
1. Offset adjustment necessary	flashes	on	off	off

Alarm	Yellow LED	Green LED	Red LED	Error output
2. Interpolator electronics errors	flashes	off	flashes	pulse
3. Error at pick-up	off	on/off	on	on
4. Flow overload	on	off	on	on
5. max. frequency range exceeded (>100 kHz)	on	on	flashes	pulse

Description of the Error Messages

1. Offset adjustment necessary: The sensor and/or the preamplifier electronics were replaced. A different size was set.
2. Electronics errors: Defective component in interpolator circuit, unable to determine internal configuration values
3. Pick-up errors: The sensor is defective or quit working. The distance between the sensor and the magnet wheel has changed = mechanical damage
4. Overload: The maximum permissible flow range was exceeded
5. Frequency errors: The max. output frequency of 100,000 Hz was exceeded. The IPF is dimensioned too high for the respective flow

PREAMPLIFIER TECHNICAL DATA

Scanning sensor	2 x GMR sensors
Resolution	programmable via rotary coding switch 1, 2, 5, 10, 25, 32, 50, 64, 100, 128
Adjustable pulse filtering	0Z, 0.25Z, 0.5Z, 0.75Z, 1.0Z, 1.25Z, 1.5Z, 1.75Z, 2.0Z, 2.25Z, 2.5Z, 2.75, 3.0Z, 3.25Z, 3.5Z, 3.75Z (Z: gear unit)
Frequency	up to 100 kHz
Output signals	Channel A, channel B, directional signal DIREC (high: positive, low: negative) or error signal ERROR (high or pulse: error)
Channel A and B	two signal outputs for outputting the digital flow sensor signals, a channel offset of 90° between channel A and channel B; Low signal level: 0.7 ... 1 V High signal level: $U_b - 1$ V
Flow direction	Detection of flow direction from the channel offset of the signals from channel A to channel B or via the separate directional signal.
Outputs	Three current-limited and short-circuit-proof power amplifiers (channel A, channel B, DIREC/ERROR); driver current approx. 300 mA at supply of 24 V
Error messages	Electronics fault, sensor errors, offset adjustment necessary, overload (flow peaks), frequency error (> 100 kHz)
Operating voltage	$V_b = 10 \dots 28$ VDC
Current consumption	$I_{\text{no load}} = \text{approx. } 65 \text{ mA}$, at 24 VDC unloaded

PREAMPLIFIER TECHNICAL DATA

Fig. 6 depicts the pin assignment of the preamplifier. This plug has five pins. Two pins are for the power supply (pin 1 and 3), two for the signal output of channel 1, 2 (pins 2 and 4) and a separate output for error or direction detection (pin 5).

However, please note that the cable shield at the plug side is on the metal housing of the plug. The cable shield should always be continuous to the flow meter and not separated by distribution boxes or junction boxes. Route the connection cable as directly as possible from the eva-

luating device to the flow meter since interruptions are always potential sources of error. The flow meter must be connected electrically with the protective earth conductor (PE). This is generally ensured with the grounded pipelines.

If potential differences exist between the preamplifier housing and the protective conductor (PE) of the evaluating device, you must provide equalization.

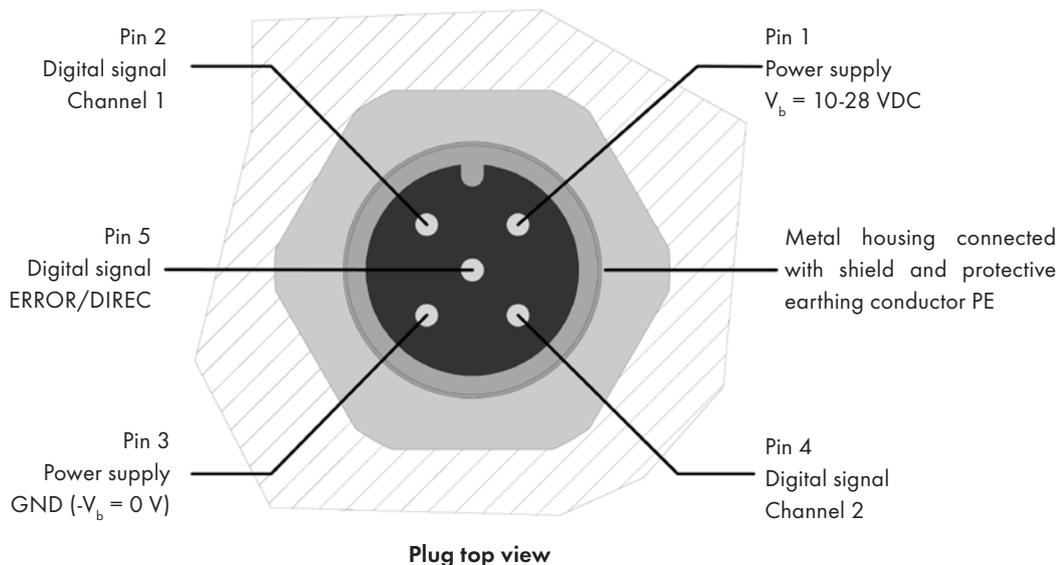


Figure 6: Flange plug of the preamplifier housing

Important:

Use only well shielded connection cables with a wire cross-section of ≥ 4 to 5×0.25 mm². Please note that the housing of the round pin plug is metallic, has a connection for the shield and that the potential of the PE is connected to the flow meter.



Important:

Please make sure that no additional inductors such as contactors, relays, valves, etc. are connected to the power supply of the flow meter. These components are potential sources of interference which produce high interference pulses during the switching, and may disrupt the function of the flow meter even though it complies with the EMC directives (especially if the inductors are not provided with adequate protective circuits).



MAINTENANCE

Depending on the operating conditions, the service life and thus the specific characteristics of the equipment are limited due to wear, corrosion, deposits, or aging. The operator is responsible for carrying out periodic inspections, maintenance, and re-calibrations. Each observation of a malfunction or damage makes it necessary to stop operation. We can loan a device for the duration of the overhaul if requested. We recommend an annual inspection and recalibration.



Safety note:

Seals are not covered by the warranty, as they are parts that are subject to wear and tear. Over the course of time, the nature of plastics such as elastomer seals can change, in respect of flexibility, strength and toughness. Operating conditions have a decisive effect on the durability and lifespan of seals. Therefore, they should be checked, and if necessary, replaced, at regular intervals.



RETURNING FOR REPAIRS AND SAMPLE DEVICES

Repairs on the flow meter and other components can be carried out quickly and efficiently only if you include detailed information about the claim or defect when returning the device. In addition, a safety sheet must be enclosed, clearly indicating what fluid has been used with the flow meter and how hazardous this fluid is.

Compliance with the laws on occupational safety, such as Workplace Regulations (ArbStättV), Accident Prevention Regulations and Regulations on Environmental Protection, Waste Law (AbfG) and Water Act (WHG), require that businesses protect their employees and other people as well as the environment from harmful effects when handling

hazardous substances. If additional precautions are required despite careful draining and cleaning of the flow meter, the associated required information must be included when returning the device. Please note that inspection and repair is only performed on flow meters returned to VSE GmbH if the safety sheet of the used fluid is enclosed and if the flow meter has been completely cleaned and flushed. This is to protect our employees and makes our work easier.

In case of noncompliance with this rule, the devices are returned to the sender without attaching postage to the package.

RS FLOW METER TECHNICAL DATA

Overall size	Measuring range ($Q_{max.}$) l/min.	RV ccm/rev.	VE ccm/Imp.	K – Factor Imp./l min.	K – Factor Imp./l max.	P max. bar	Filtering μm
RS 40	0.04 – 40 (50)	8.37	0.31	3,226	413,000	450	100
RS 100	0.50 – 100 (120)	15.7	0.5815	1,720	220,000	450	250
RS 400	1.00 – 400 (525)	56.5	3.138	318	40,800	450	250
RS 800	4.00 – 800 (1000)	180.0	10	100	12,800	450	500
RS 2500	10.00 – 2500 (3000)	666.0	37	27	3,459	40	500

Frequency range	0 ... 100 kHz, adjustable
Measuring accuracy	$\pm 0.5\%$, 1%* of measured value at viscosity of 21 cSt
Repeatability	$\pm 0.05\%$ with same operating conditions

Materials

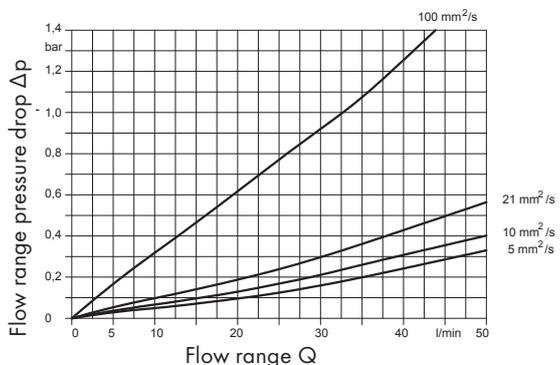
Gray cast iron version	EN-GJS – 400 – 15 (EN 1563) / 16 Mn Cr 5 or 1,4112
Stainless steel version	Stainless steel 1.4305/1.4112, additional available upon request
Bearing	Fluid-dependent as anti-friction bearing or SSIC/wolfram carbide friction bearing
Seals	FPM (standard) PTFE, NBR, EPDM upon request, EPDM-41B8
Fluid temperature	-30°C ... +120°C
Viscosity range	1 ... 1,000,000 cSt
Installation position	Any using selectable connection units, also customer specific
Supply voltage	10 ... 28 VDC
Current consumption	65 mA at 24 VDC unloaded
Delay time	$\leq 8 \mu\text{s}$
Protection type	IP 65

*RS 2500

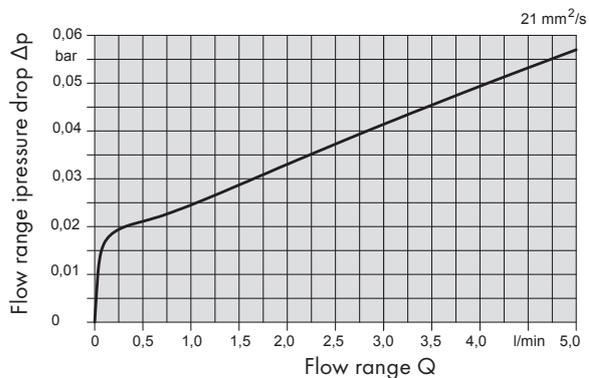
RS FLOW METER FLOW CHARACTERISTICS

Size 40

Flow range 0 up to 50 l/min

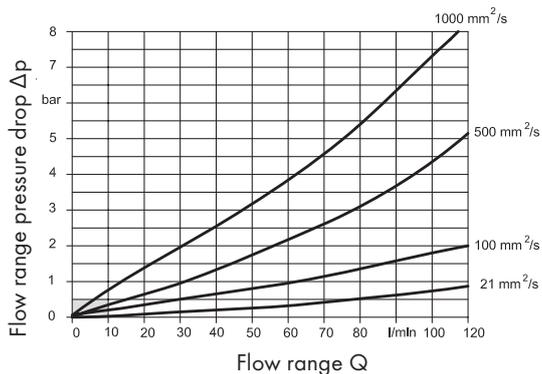


Flow range 0 up to 5 l/min

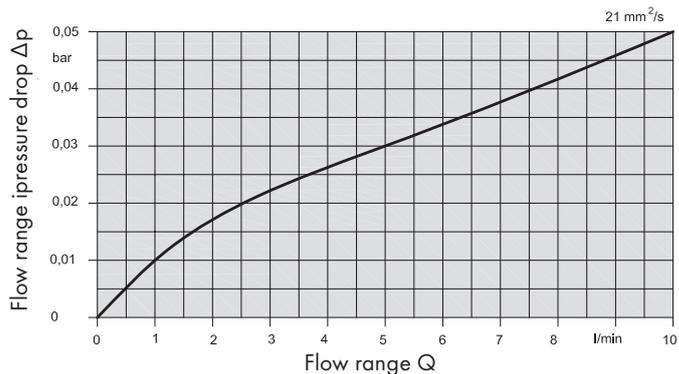


Size 100

Flow range 0 up to 120 l/min

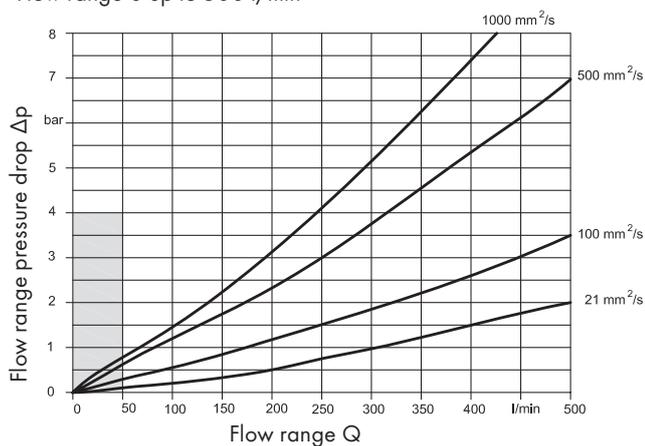


Flow range 0 up to 10 l/min

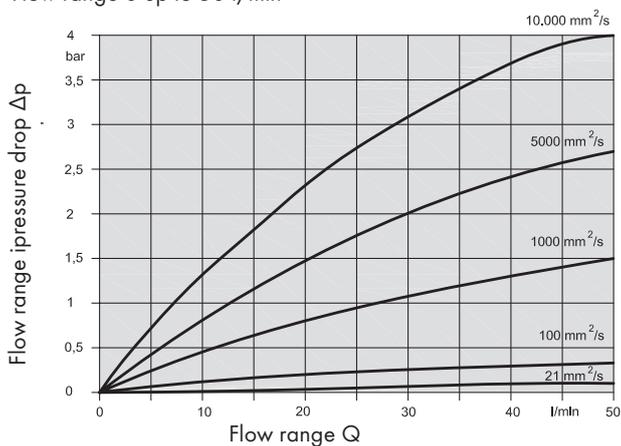


Size 400

Flow range 0 up to 500 l/min

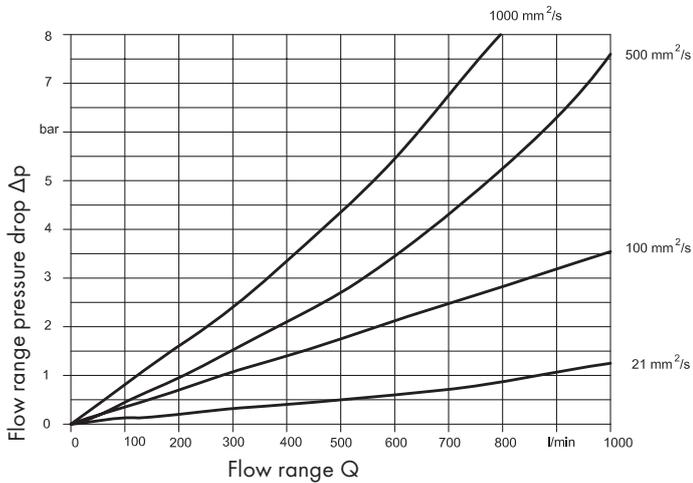


Flow range 0 up to 50 l/min



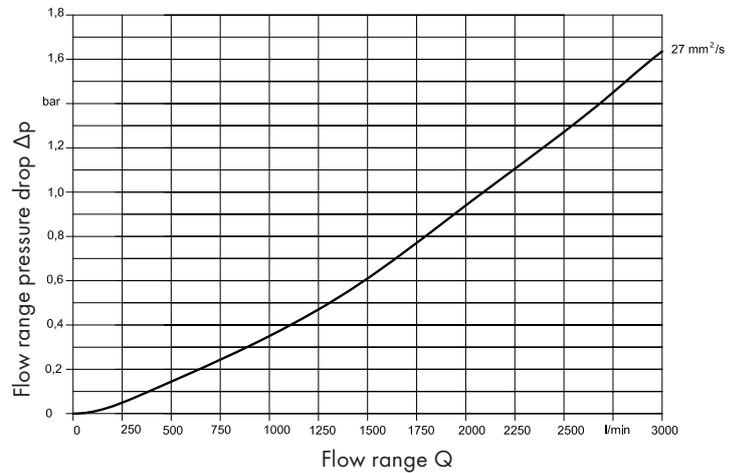
Size 800

Flow range 0 up to 1,000 l/min



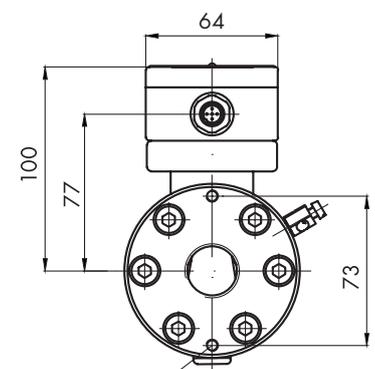
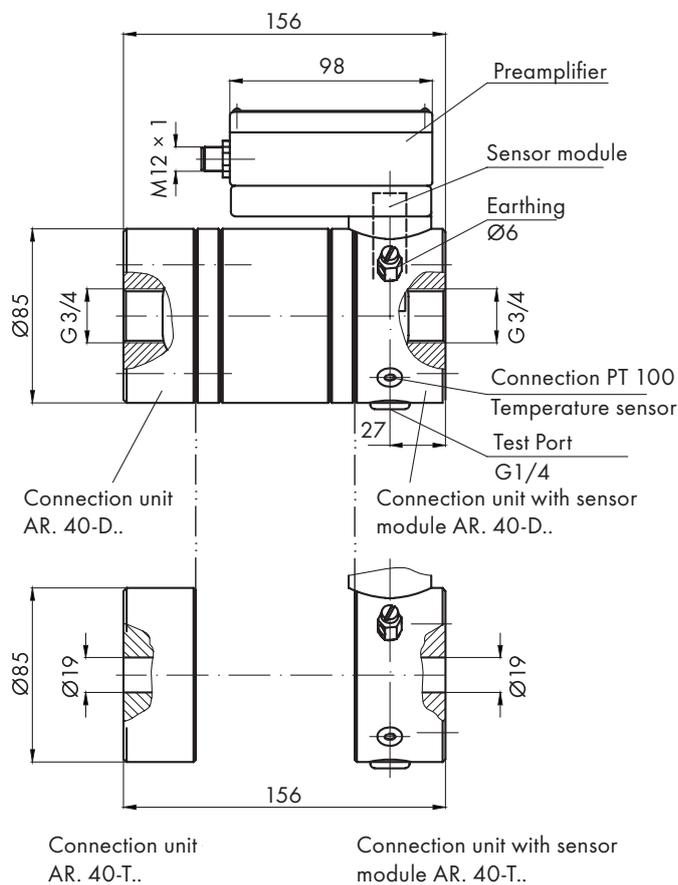
Size 2500

Flow range 0 up to 3,000 l/min

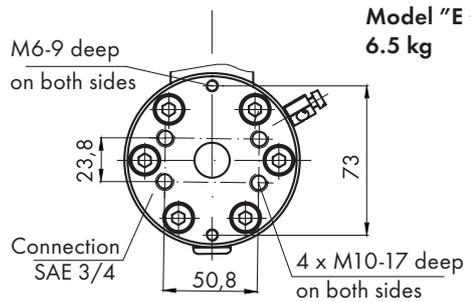


RS FLOW METER DIMENSIONS

RS 40

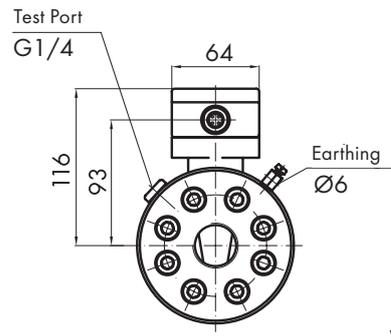
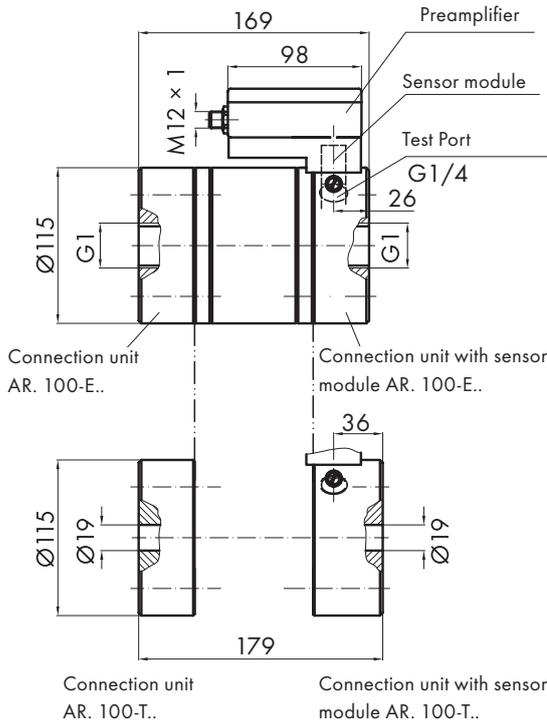


M6-9 deep on both sides
Weight
Model "G"
6.0 kg

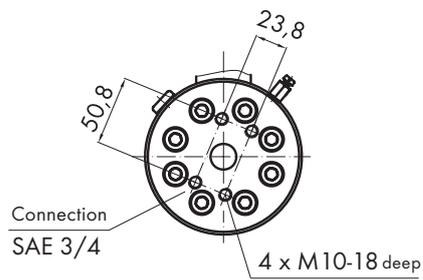


M6-9 deep on both sides
 Connection SAE 3/4
 4 x M10-17 deep on both sides

RS 100

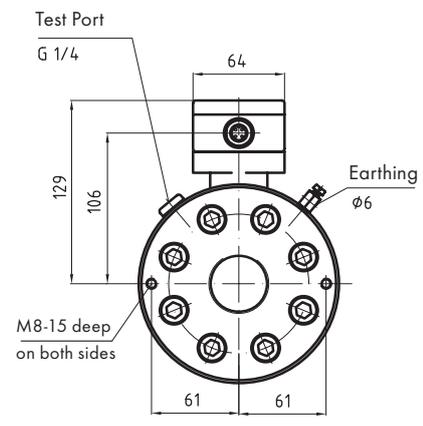
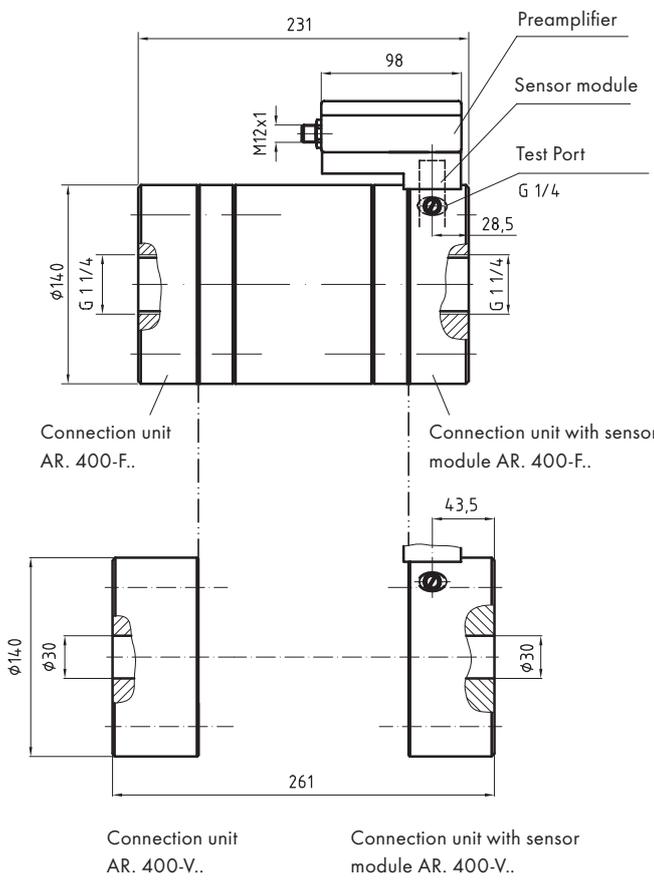


Weight 12 kg

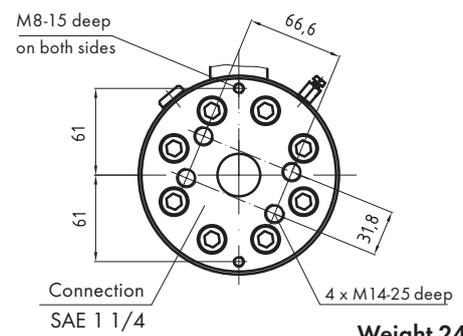


Weight 12.7 kg

RS 400



Weight 22 kg

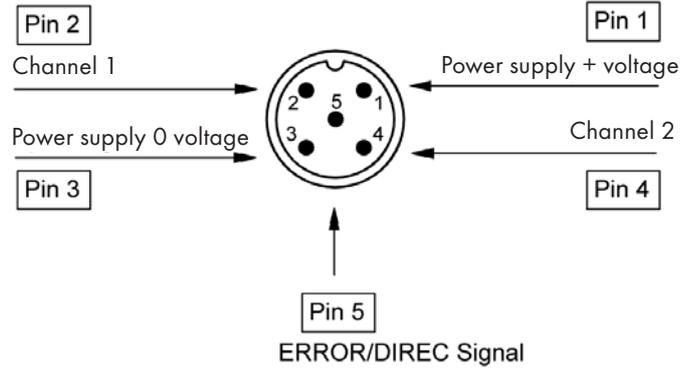
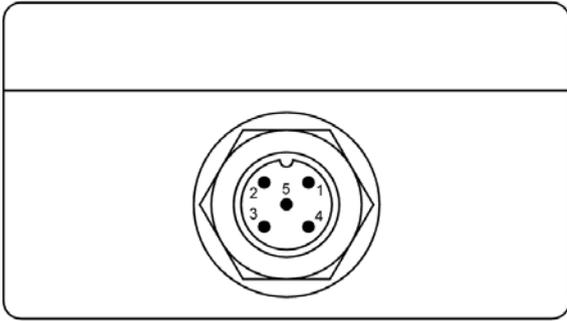


Weight 24.8 kg

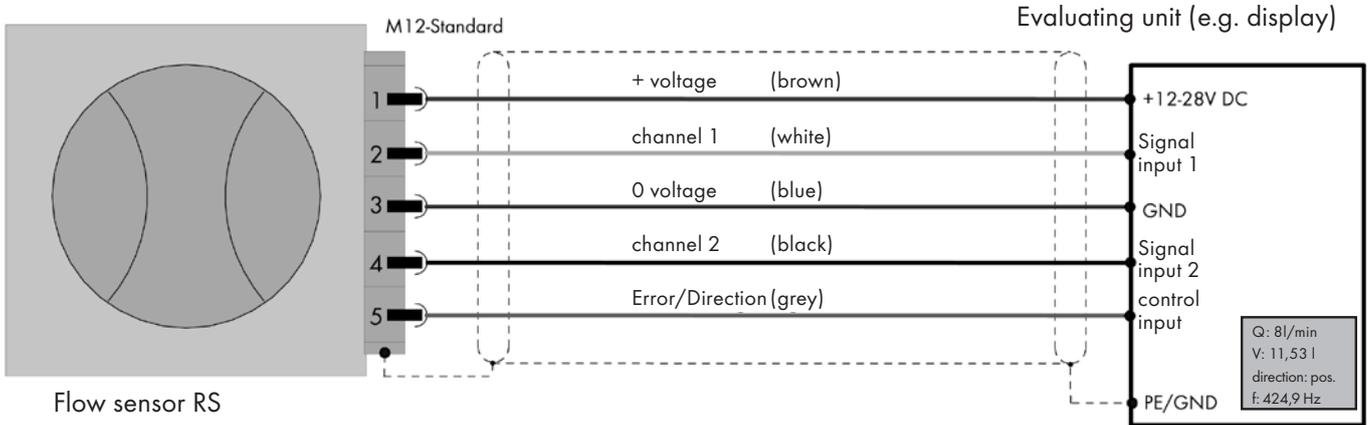
RS FLOW METER TYPE CODE

RS 25	In preparation													
RS 40														
RS 100														
RS 400														
RS 800														
RS 2500														
Size	Interpolation	1 2 5 10 25 32 50 64 100 128	Selectable interpolations factor											
		G	EN-GJS-400-15 (DIN EN 1563)											
		F	Stainless steel 1.4305 (V2A)											
		X	Stainless steel 1.4571 (V4A)											
		R	Pipeline connection											
		0	Standard											
		1 6 7	Ball bearing											
			Hard metal sleeve bearing											
			Angular contact ball bearing											
		2	Standard											
V P T E B	FPM (Viton) Standard													
	NBR (Perbunan)													
	PTFE													
	EPDM													
X	EPDM - 41B8													
	Modification figure factory-provided													
X	Modification figure factory-provided													
			Flow Sensor											
RS 800	/	50	G R 0 1 2 V / X											
Example														
AR	G	800	- G V 1 1 0 N / X											
Connection unit														
Connection unit	Material	Size	AR	G	800	-	G	V	1	1	0	N	/	X
			Connection for temperature sensor	N	Standard									
			Special design	X	Modification figure factory-provided									
			Construction range	X	Modification figure factory-provided									
			Test port	0	Without connection for PT 100									
			1	With connection for PT 100										
			Sensor module	0	Without test port G 1/4									
			1	With one test port G 1/4										
			2	With two test port G 1/4										
			Sealing type	1	Sensor module GSM 01 no longer valid									
2	Sensor module GSM 02													
V P T E B	FPM (Viton) Standard													
	NBR (Perbunan)													
	PTFE													
	EPDM													
D E F G	G 3/4													
	G 1													
H I R	G 2													
	DN 100 P16													
T V X Y	SAE 3/4													
	SAE 1 1/4													
Z Q Q1 Q2	SAE 4													
	DN 50 PN40													
		DN 80 PN40												
		DN 100 PN10												
Material	40	RS 40												
	100	RS 100												
	400	RS 400												
	800	RS 800												
	2500	RS 2500												
Material	G	EN-GJS-400-15 (DIN EN 1563)												
	F	Stainless steel 1.4305 (V2A)												
	X	Stainless steel 1.4571 (V4A)												

PIN ASSIGNMENT



CONNECTION DIAGRAM



VSE.flow®

VSE Volumentechnik GmbH
Hönnestraße 49
58809 Neuenrade / Germany

VSE Volumentechnik GmbH
Postfach / P.O.Box 1229
58804 Neuenrade / Germany

Phone +49 (0) 23 94 / 616-30
Fax +49 (0) 23 94 / 616-33
info@vse-flow.com
www.vse-flow.com

e.holding
FLUID TECHNOLOGY GROUP
www.e-holding.de