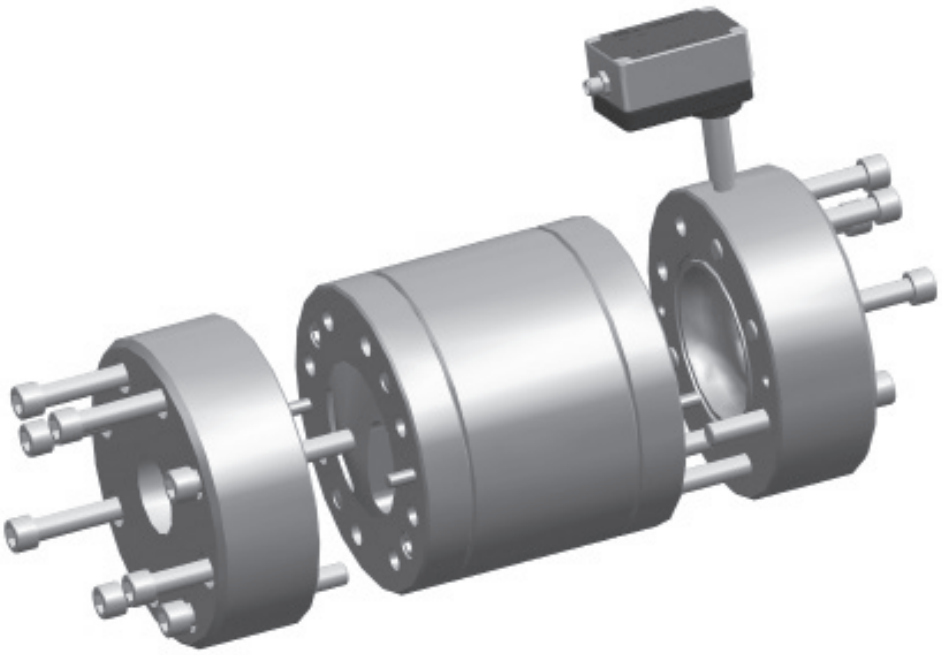
User's Guide



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FHG FLOW METERS

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OPERATING INSTRUCTIONS
For FHG Series Flow Meters

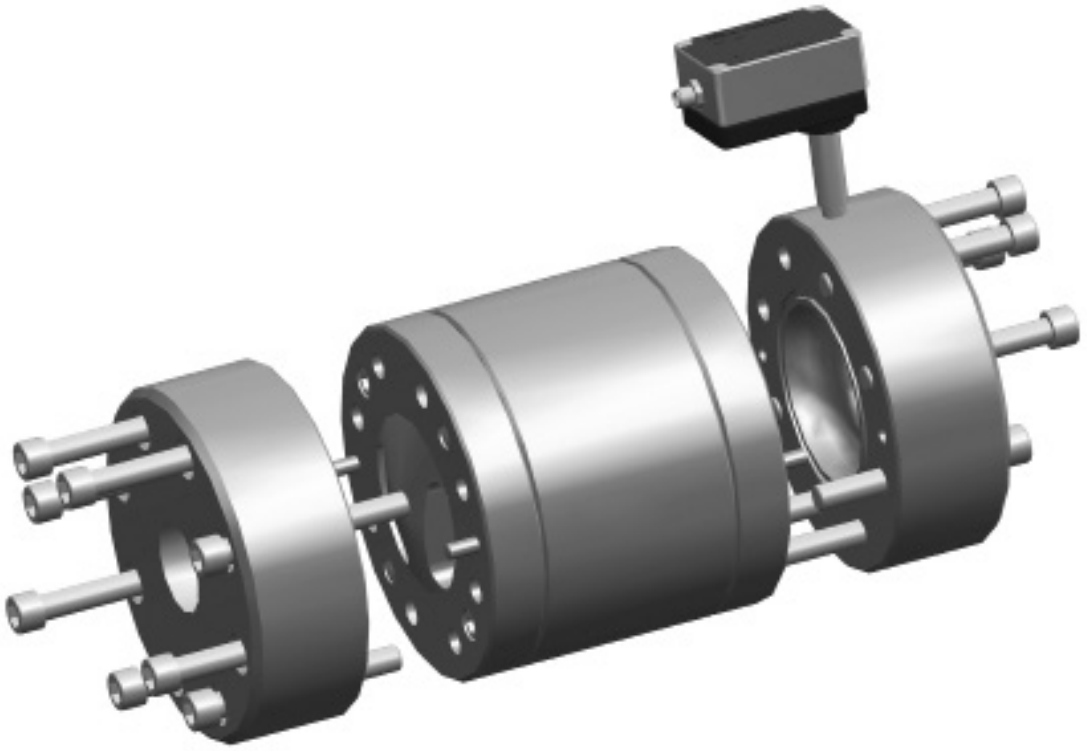
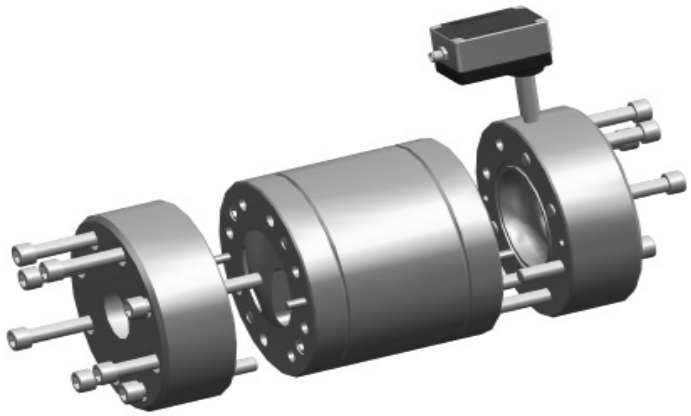


Table of Contents

Important basic information

These installation and operating instructions should provide you with the information you need to properly install and commission the flow meter. Installation, commissioning and testing are to be performed by trained and qualified personnel only. These operating instructions must be read and applied carefully to ensure proper, trouble-free and safe operation of the flow meter. Omega is not liable for any damage incurred resulting from not complying with the instructions in this operating instruction. It is not permitted in any case to open the device.



1. Function Description of the FHG Flow Meters

FHG 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
- Highest functionality due to intelligent sensor technology
- Gentle fluid measurements

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 FHG flow meter.

2. General Description

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

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

3. FHG 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 Omega catalog are general in nature. Certain properties of the devices are dependent on type, size and measuring range, as well as the liquid to be measured. Please contact Omega or one of our sales and service representatives for detailed information about the appropriate flow meter for your particular application.

4. Declaration of Conformity

Flow meters of the "FHG" 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.

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 of EN 61000-6 and are CE certified. The EC conformity marking is the CE mark affixed to all flow meters.

5. General Operating Requirements

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

1. The Fluid to be Processed

- Are the flow meter seals and materials **compatible with for the fluid and any cleaning agents that will be used**?
- Is the fluid **viscous** or **abrasive**? Have you properly sized the meter and selected appropriate bearing materials?
- Is the fluid **dirty** or does it contain **contaminants/pollutants** and **solid particles** that may require filtration?
- Does the fluid have **fillers** or other **additives**? What grain sizes do these solids have, and could they **block the measuring element**?
- Is it necessary to install an upstream **hydraulic filter** (see filtering requirements in section 22 of this document)?
- 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 (**the system should be slowly filled with fluid before operation at full flow to avoid hydraulic shock on the mechanical components**)**?

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?
- Note: 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

- 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** (see page 19)?
- Is the **cable shield** correctly grounded on both sides to a clean common ground (PE)?
- Is there a **potential difference** between the ground on the flow meter and at the evaluating device?
- Is the flow meter permanently **grounded (PE)** (e.g. via the pipelines)?
- If the measuring element of the flow meter is **insulated** from ground (PE), the meter must be grounded with a cable!!
- Is the **4-pin to 5-pin 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.

6. 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 Omega with all operating pressures > 450 bar and in case of special models.

7. Information about the EU Pressure Equipment Directive 97/23/EC

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

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

8. 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, Omega 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 data sheet of the flow meter). 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.

9. 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 (the measuring element uses to support itself on the liquid column) and the pipeline cannot empty itself. 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.

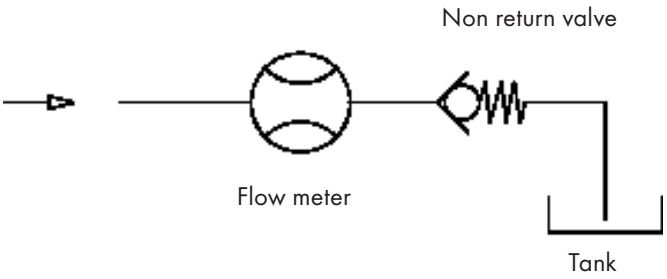


Fig. 1: Flow meter with backpressure

Important:
Make sure that the flow meter measuring elements are always completely filled both in inflow and outflow and that the outflow 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 "FHG" 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. PTFE 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

FHG Flow Meter Size	Torque
FHG 1xx2	70 Nm
FHG 1xx4	120 Nm
FHG 1xx5	240 Nm
FHG 1xx7	160 Nm

10. 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 Omega.

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.

11. 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
FHG 1xx2	250 µm
FHG 1xx4	250 µm
FHG 1xx5	500 µm
FHG 1xx7	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 Omega 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.

12. 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 FHG 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 [cm^3/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

FHG 100				
Interpolation factor (IPF)	Switch position S3	Measurement volume V_m [cm^3/Imp]	K-Factor [Imp/l]	K-Factor [Imp/gal.]
1	0	0,5815	1720	6510
2	1	0,29075	3439	13020
5	2	0,11630	8598	32549
10	3	0,05815	17197	65098
25	4	0,02326	42992	162745
32	5	0,01817	55036	208335
50	6	0,01163	85985	325489
64	7	0,00909	110011	416440
100	8	0,00582	171821	650419
128	9	0,00454	220264	833797

FHG 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

FHG 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

FHG 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

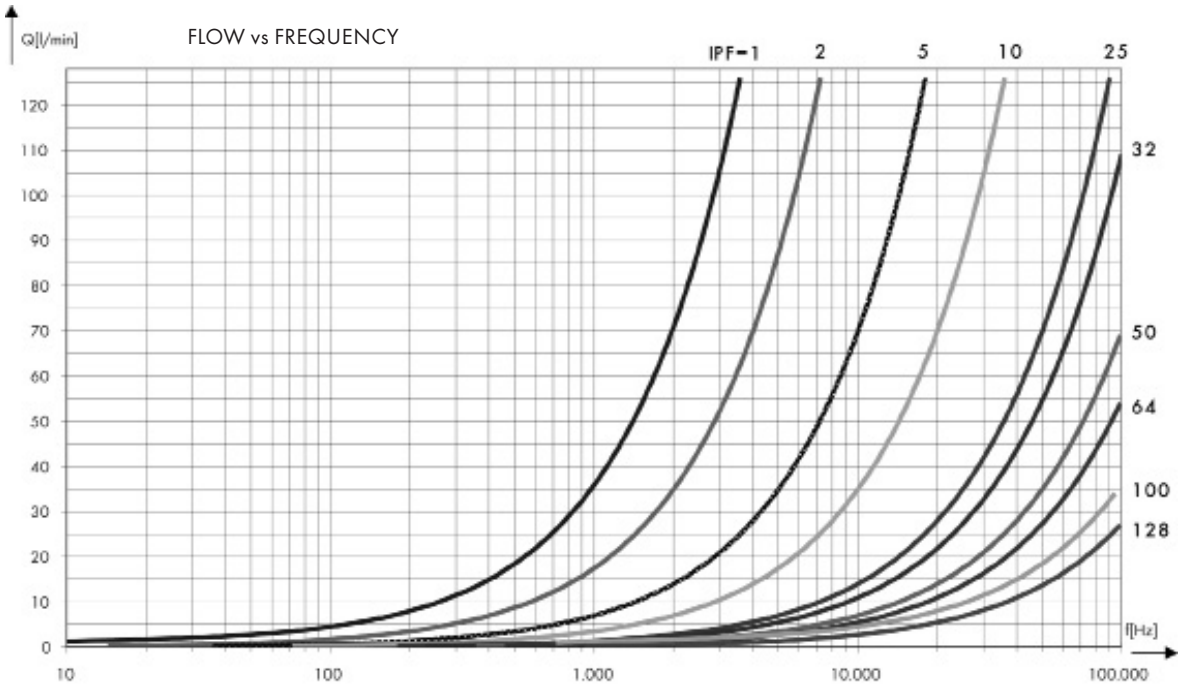
$$IPF \approx \frac{f_{max} \times Vm_{IPF1} \times 60}{Q_{max} \times 1000}$$

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

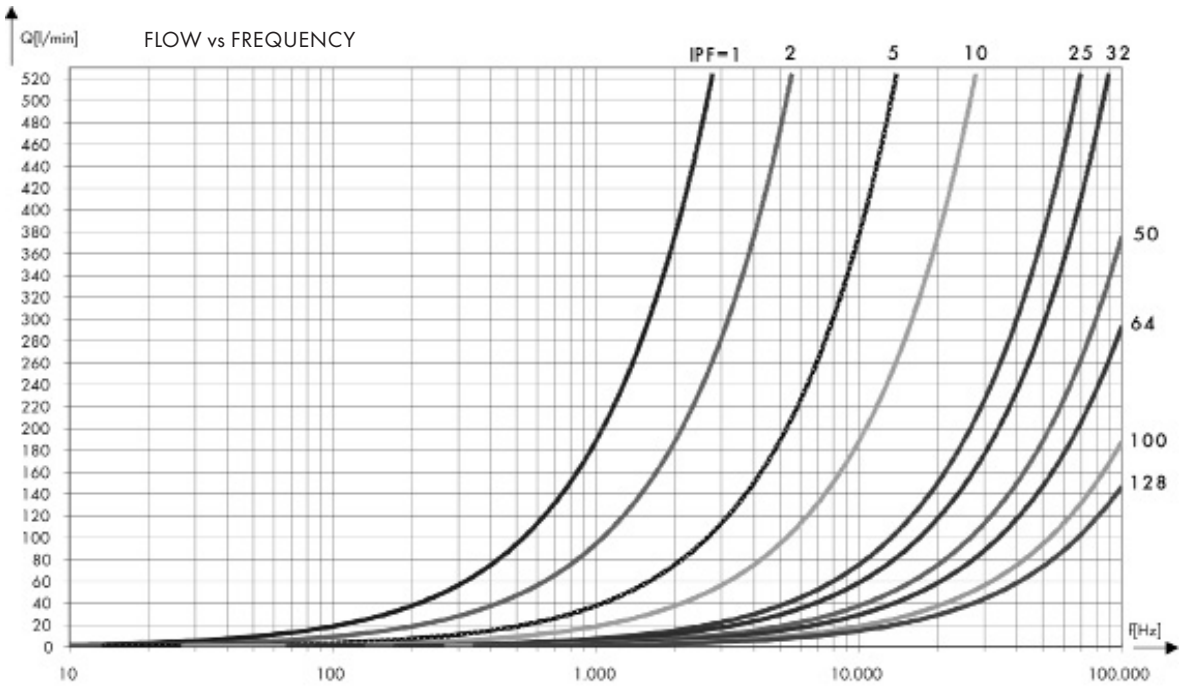
IPF Interpolation factor
f_{max} Max. processable input frequency
V_{mIPF1} Measurement volume with IPF = 1 (volume of a gear structure of the sensing wheel)
Q_{max} Max. operating flow in l/min

Flow diagrams vs frequency

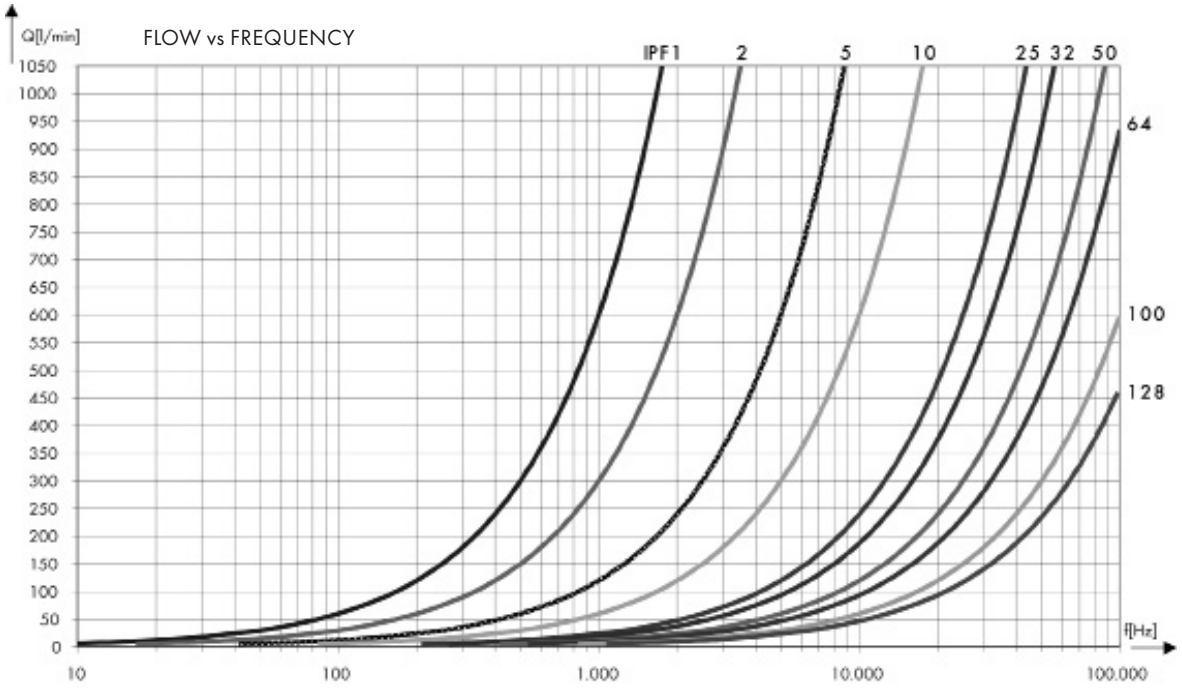
FHG 1xx2



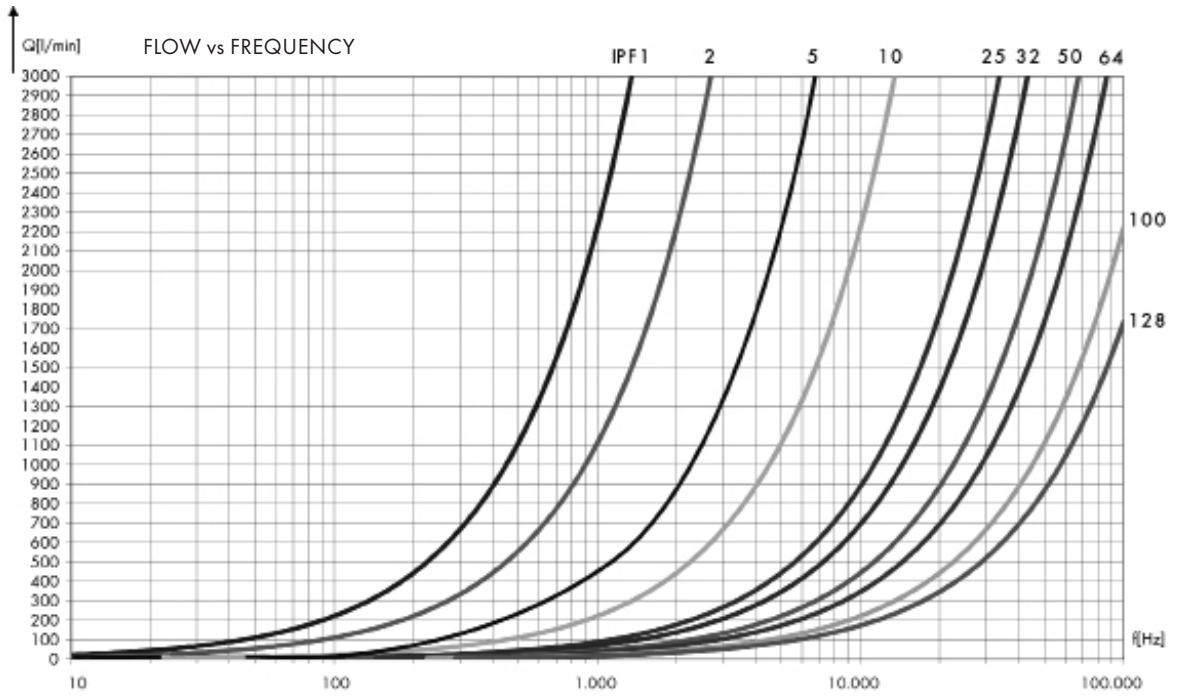
FHG 1xx4



FHG 1xx5



FHG 1xx7



Example
Flow meter: FHG 1xx4
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:

$$IPF \approx \frac{f_{max} \times Vm_{IPF1} \times 60}{Q_{max} \times 1000} = \frac{20.000\,\frac{1}{s} \times 3{,}138\ ml}{140} \times \frac{60\ s}{1000\ ml} = 26{,}9 \approx 25$$

13. 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 osciallation 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 movements 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, 2.75, 3.0Z, 3.25Z, 3.5Z, 3.75Z (Z: gear unit)

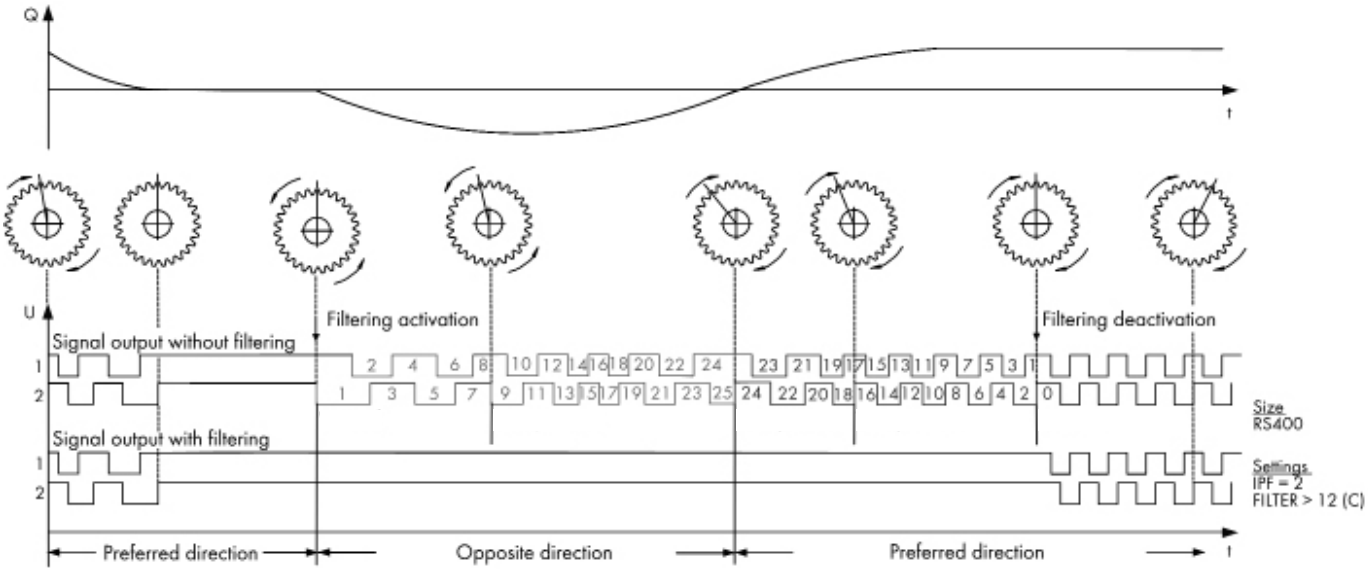


Fig. 3: Pulse filtering principle

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

Filter position	FHG 1xx2	FHG 1xx4	FHG 1xx5	FHG 1xx7
0	0	0	0	0
1	0.145375	0.7845	2.5	9.25
2	0.29075	1.569	5.0	18.50
3	0.436120	2.3535	7.5	27.75
4	0.5815	3.138	10.0	37.00
5	0.726875	3.9225	12.5	46.25
6	0.87225	4.707	15.0	55.5
7	1.017625	5.4915	17.5	64.75
8	1.163	6.276	20.0	74.00
9	1.308375	7.0605	22.5	83.25
10 (A)	1.45375	7.845	25.0	92.50
11 (B)	1.599120	8.6295	27.5	101.75
12 (C)	1.7445	9.414	30.0	111.00
13 (D)	1.889875	10.1985	32.5	120.25
14 (E)	2.03525	10.983	35.0	129.50
15 (F)	2.180625	11.7675	37.5	138.75

14. 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 (S2) and a key (S2). With the rotary coding switches, the IPF and the degree of filtering are programmed.

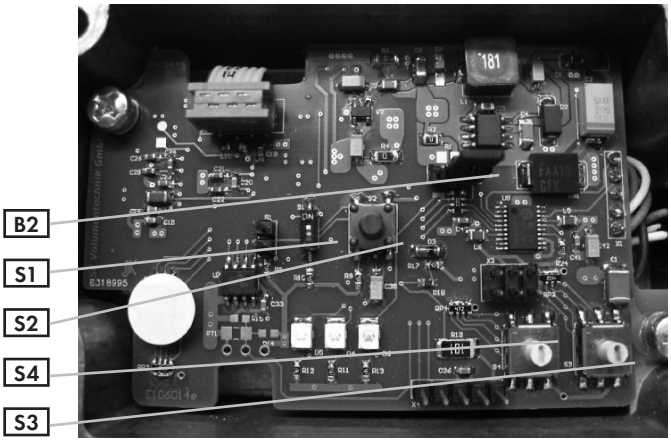


Fig. 4: Preamplifier electronics

During initial startup, the switch S2 must first be set to the corresponding preferred direction of the flow. The positive flow direction of the FHG 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 a 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.

15. 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.

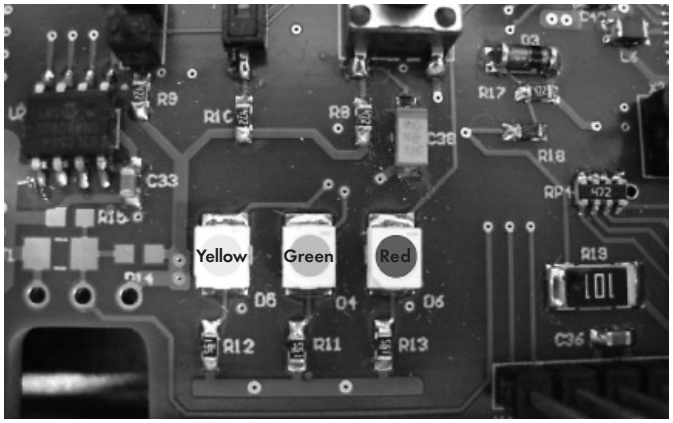


Fig. 5: Signaling LEDs of the preamplifier electronics

16. 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

17. Alarm and Warning Messages

The electronics of the FHG 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 B1. 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
Offset adjustment necessary 1	Flashes	on	off	off

Alarm	Yellow LED	Green LED	Red LED	Error output
Interpolator electronics errors 2	Flashes	off	Flashes	Pulse
Error at pick-up 3	off	on / off	on	on
Flow overload	on	off	on	on
max. frequency range exceeded (>100 kHz) 4	on	on	Flashes	Pulse
Fluid temperature > 120°C 5	Flashes	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
6. Temperature errors: The temperature of the fluid is too high (> 120°C) and may result in flawed or incorrect measurements

18. Preamplifier Technical Data

Scanning sensor 2 x GMR sensors in a bridge circuit (sin/cos)

Adjustment automatic offset adjustment

Resolution programmable 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;

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); integrated adjustment to a characteristic impedance of 75 Ω; driver current approx. 300 mA at supply of 24 V; small saturation voltage of up to 30 mA load current, short switching times, integrated freewheeling diodes against V_b and GND, thermal shutdown with hysteresis; in case of error, the outputs are high impedance;

The 24 V line drivers are designed for control applications with cable adjustment

Error messages Electronics fault (e.g. faulty interpolator), sensor errors (e.g. sensor failure), offset adjustment necessary, overload (flow peaks), frequency error (> 100 kHz), temperature error (> 120°C)

Operating voltage V_b = 10 ... 28 VDC

Current consumption I_{noload} = approx. 40 mA, total current consumption depends on output load

19. 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 connection cable shield must be applied on both sides. The shield is used to connect the PE from the evaluation electronics to the preamplifier housing and the measuring element of the flow meter. 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 evaluating device to the flow meter since interruptions are always potential sources of error. The measuring elements of 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.

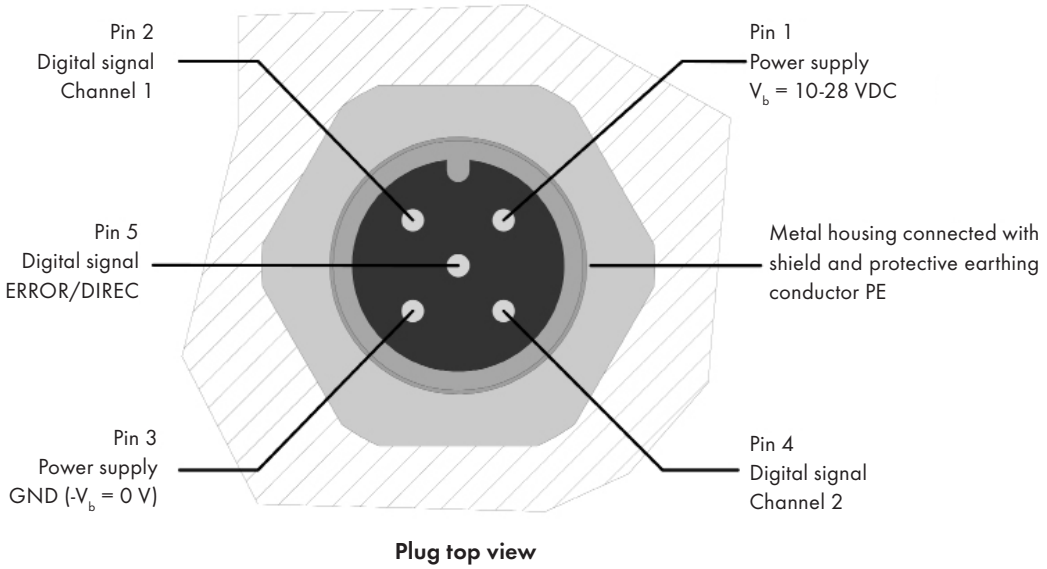


Figure 6: Flange plug of the preamplifier housing

Important:
Use only well shielded connection cables with a wire cross-section of ≥ 4 to 5 x 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 cable shield and the housing of the preamplifier.

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 (especially if the inductors are not provided with adequate protective circuits), produce high interference pulses during the switching, and may disrupt the function of the flow meter even though it complies with the EMC directives.

20. 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.

21. 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 Omega 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.

22. FHG 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
FHG 1xx2	0.50 – 100 (120)	15.7	0.5815	1,720	220,000	450	250
FHG 1xx4	1.00 – 400 (525)	56.5	3.138	318	40,800	450	250
FHG 1xx5	4.00 – 800 (1,000)	180.0	10	100	12,800	450	500
FHG 1xx7	10.00 – 2,500 (3,000)	666.0	37	27	3,459	40	500

Frequency range 0 ... 100 kHz, adjustable

Measuring accuracy ± 0.3% [0.5%]*, [1%]** of measured value at viscosity of 21 cSt
*FHG 1xx5, **FHG 1xx7

Repeatability ± 0.05% with same operating conditions

Materials

Gray cast iron version EN-GJS – 400 – 15 (EN 1563) / 100 Cr 6

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

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 9 ... 28 VDC

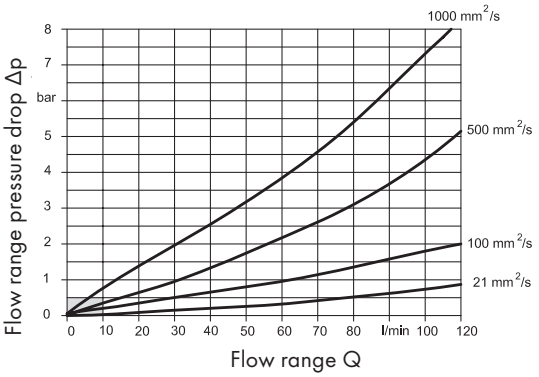
Current consumption 65 mA at 24 VDC unloaded

Delay time ≤ 8 mµs

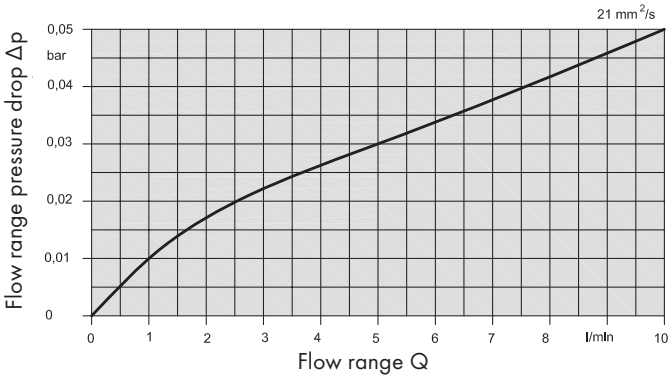
Protection type IP 65

Size 1xx2

Flow range 0 up to 120 l/min

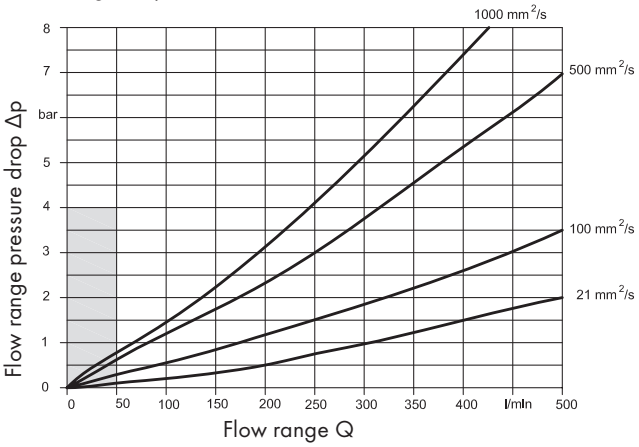


Flow range 0 up to 10 l/min

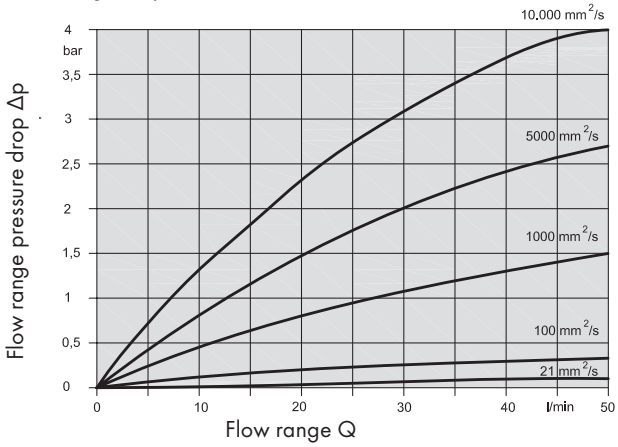


Size 1xx4

Flow range 0 up to 500 l/min

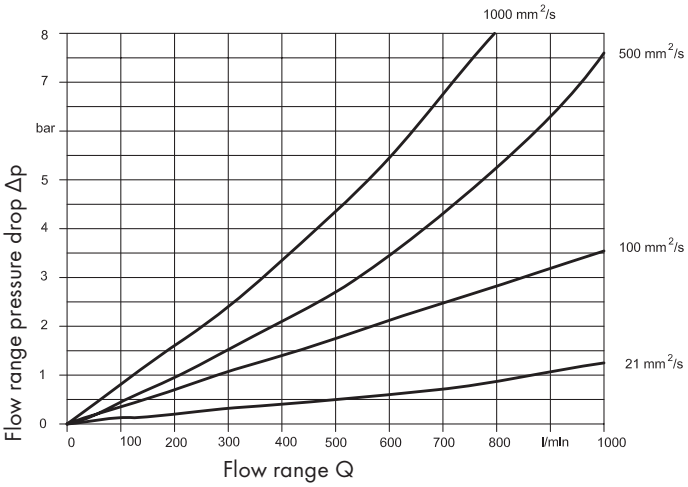


Flow range 0 up to 50 l/min



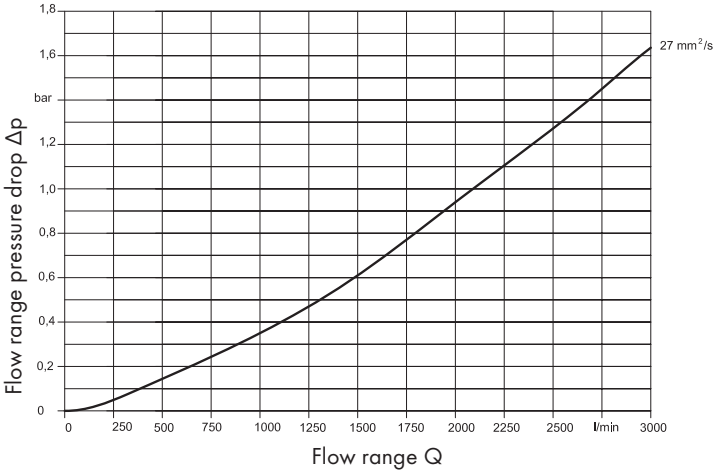
Size 1xx5

Flow range 0 up to 1,000 l/min

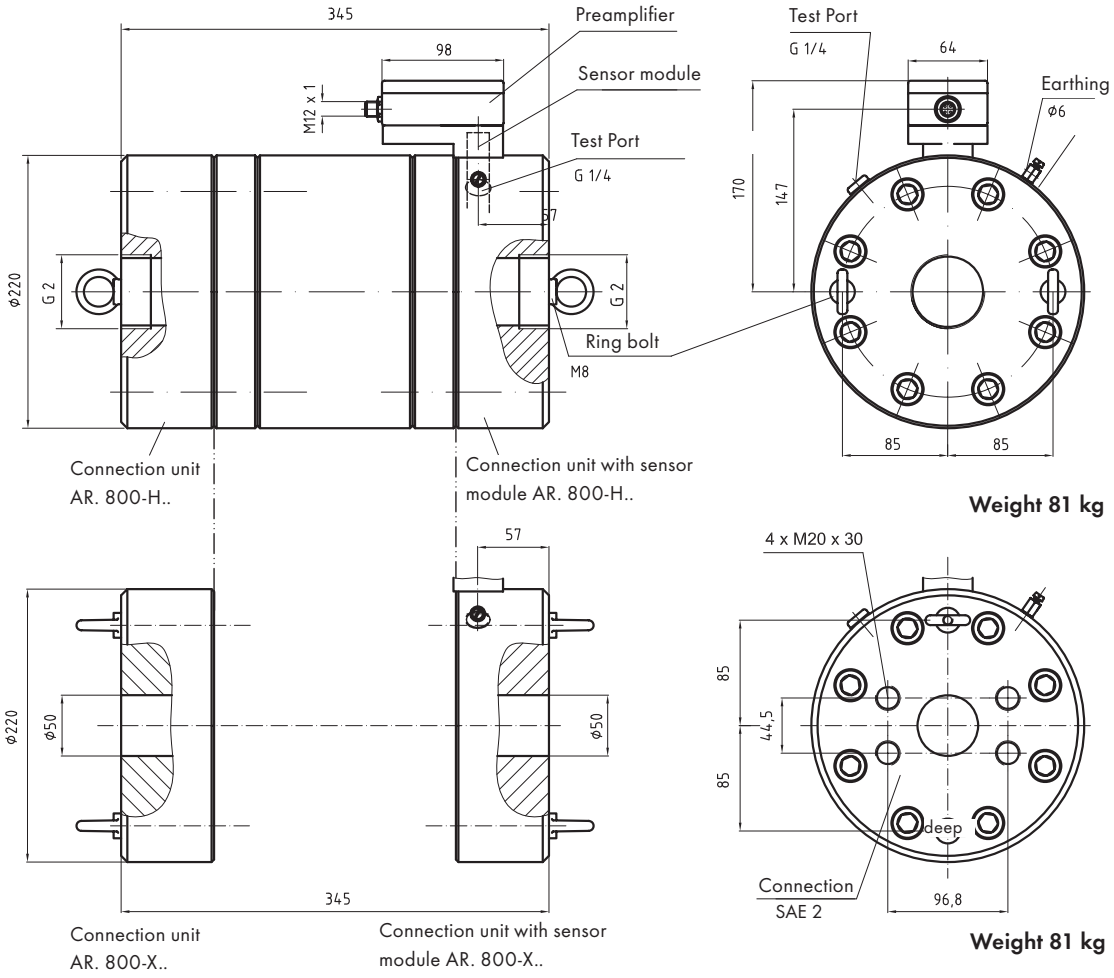


Size 1xx7

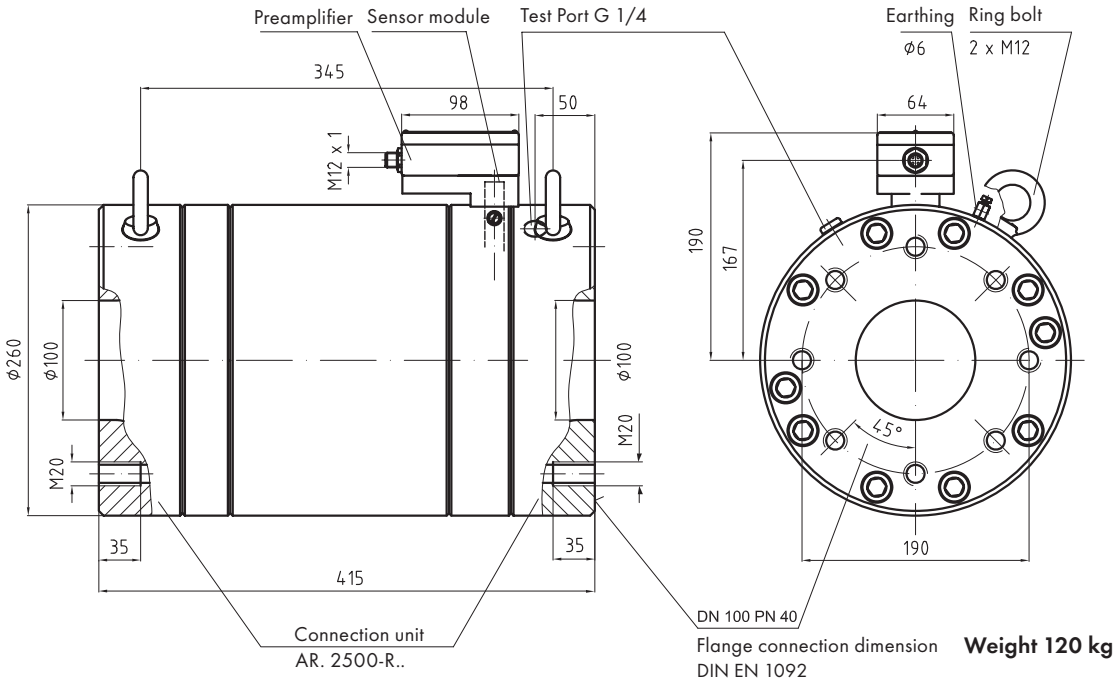
Flow range 0 up to 3,000 l/min



FHG1xx5

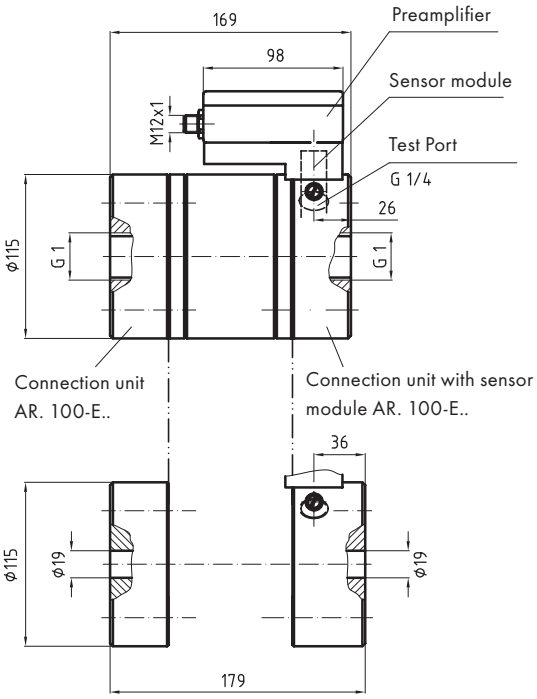


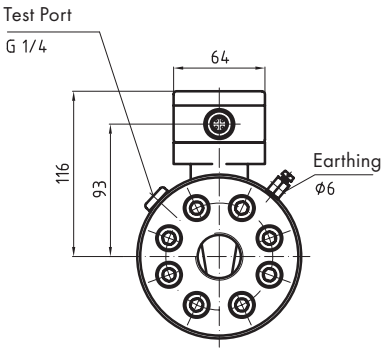
FHG1xx7



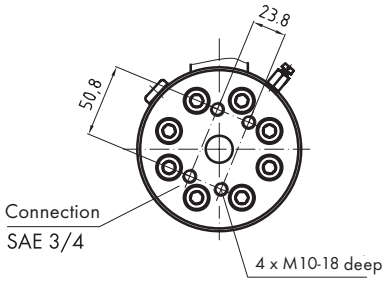
24. FHG Flow Meter Dimensions

FHG1xx2



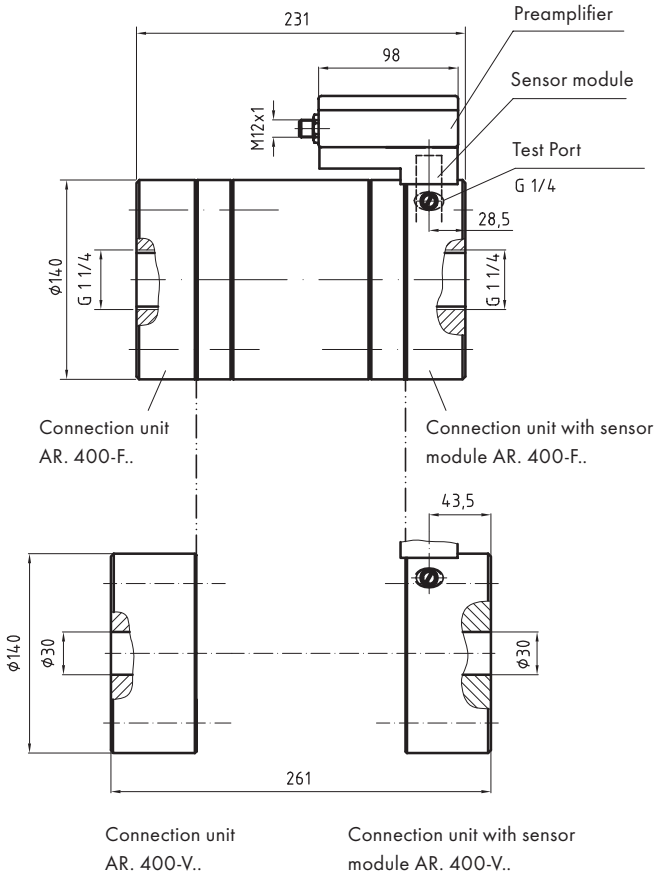


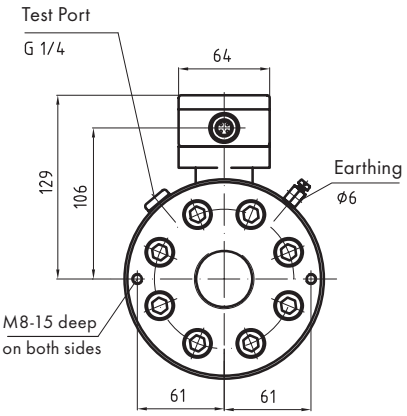
Weight 12 kg



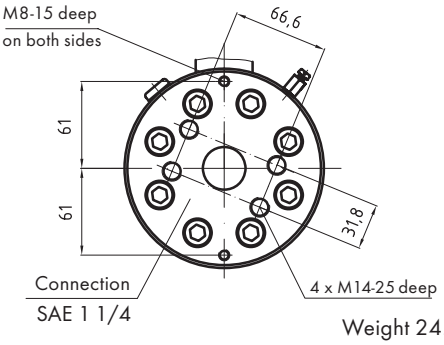
Weight 12.7 kg

FHG1xx4



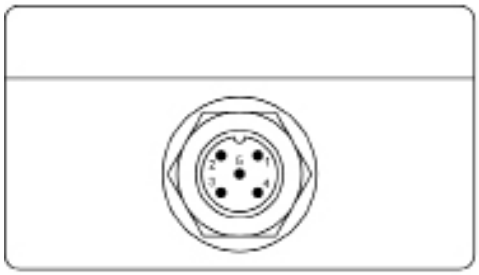


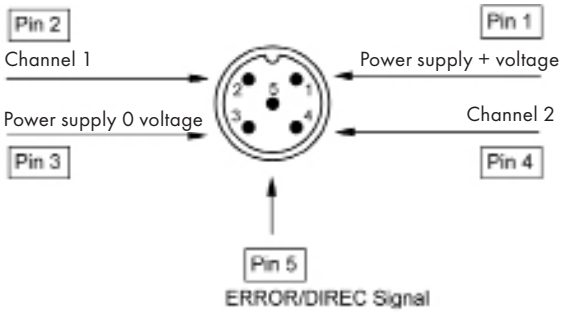
Weight 22 kg



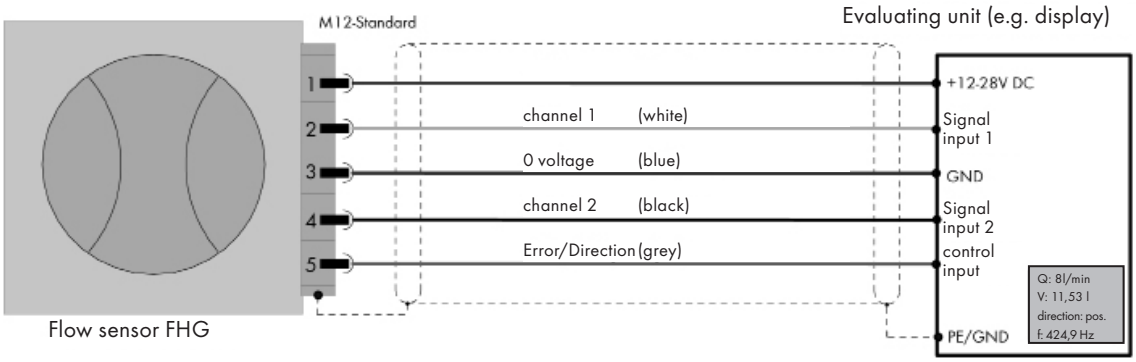
Weight 24.8 kg

25. Pin Assignment





26. Connection Diagram



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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

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3. Repair instructions and/or specific problems relative to the product.

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1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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