

1 YEAR
WARRANTY

Ω OMEGA® **User's Guide**



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FMG90 Series
Electromagnetic Flow Meter



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0 About this operating manual

- The operating manual is aimed at specialists and semi-skilled personnel.
- Before each step, read through the relevant advice carefully and keep to the specified order.
- Thoroughly read and understand the information in the section "Safety instructions".

If you have any problems or questions, please contact your supplier or contact us directly at:



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Tel: (203) 359-1660
e-mail: info@omega.com

Hazard signs and other symbols used:



WARNING! / CAUTION! Risk of injury!

This sign indicates dangers that cause personal injuries that can lead to health defects or cause considerable damage to property.



CAUTION! Electric current!

This sign indicates dangers which could arise from handling of electric current.



CAUTION! Material damage!

This sign indicates actions which could lead to possible damage to material or environmental damage.



ADHERE TO OPERATING MANUAL!



NOTICE!

This symbol indicates important notices, tips or information.



NO DOMESTIC WASTE!

The device must not be disposed of together with domestic waste.



Pay attention to and comply with information that is marked with this symbol.



Follow the specified instructions and steps. Adhere to the given order.



Check the specified points or notices.



Reference to another section, document or source.



Item.

1 Device description

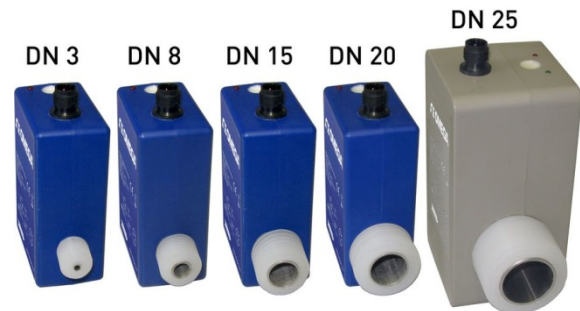
The flow meter of the FMG90 series from OMEGA ENGINEERING INC. is a magnetic inductive flow sensor for conductive liquids. The flow measurement is performed using magnetic induction and works without any moving parts.

The FMG90 is used for measuring or metering water and aqueous solutions. The compact design and independence from the intake and discharge sections allows the FMG90 to be used under a variety of conditions.

Versions*:

The FMG90 is available in different nominal sizes from DN 3 to DN 25.

The versions can be configured differently.

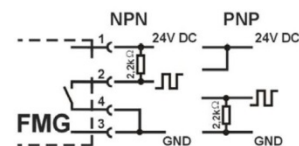


Type plate:

You can find the sticker of the type plate on the front of the FMG90.

It contains the most important data and the connection diagram for the electrical connection (Example → Fig.).

Magnetic Inductive Flow Sensor
Art.No.: FMG**_****
Serial-No.: *****
Range: *** _ **** l/min
Pulses/Litre: **** Tmax=60°C
max. 10bar at 20°C
max. 6bar at 60°C



1.1 Delivery, unpacking and accessories

All units have been carefully checked for their operational reliability before shipment.

- ☐ Immediately after receipt, please check the outer packaging for damages or any signs of improper handling.
- ☐ Report any possible damages to the forwarder and your responsible sales representative. In such a case, state a description of the defect, the type and the serial number of the device.
Report any in-transit damage immediately. Damage reported at a later date shall not be recognized.

Unpacking:

- ↗ Carefully unpack the unit to prevent any damage.
- ↗ Check the completeness of the delivery based on the delivery note.

Scope of delivery:

- ☐ 1x FMG90 according to the order data.
- ☐ 1x Operating manual.
- ☐ 1x Packaging.



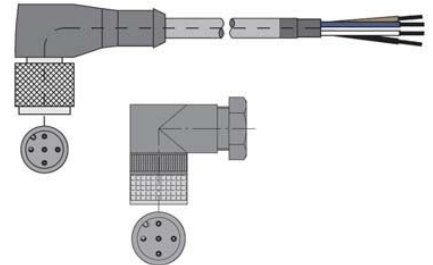
* Customised versions available on request.

**IMPORTANT!**

- ⇒ Use the type plate to check if the delivered unit corresponds to your order.
- ⇒ In particular, for devices with electrical components, check to see if the correct power supply voltage is specified.

Accessories:

- ☐ Connection cable with moulded M12x1 coupling socket.
- ☐ M12x1 coupling socket as component.



1.2 Intended use

The magnetic inductive flow sensor FMG90 must only be used for measuring and metering liquids with a minimum conductivity of 20 $\mu\text{S}/\text{cm}$.

**WARNING! No safety component!**

The magnetic inductive flow sensor of the series FMG90 is no safety component in accordance with Directive 2006-42-EC (Machine Directive).

- ⇒ Never use the FMG90 as a safety component.

The operational safety of the device supplied is only guaranteed by intended use. The specified limits (→ § 9 "Technical data") may under no circumstances be exceeded.

Before installing the device, check that the wetted materials of the device are compatible with the media being used (→ § 9.2 "Materials table").



Measuring tube empty (or partially filled). / Conductivity too low.

The green LED may blink irregularly if the measuring tube of the FMG90 is empty or partially filled or if the conductivity of the fluid being used is too low. Random pulses will be present at the output, but they do not represent an actual flow.

- ⇒ Ensure that the measuring tube of the FMG90 is always completely filled (→ § 4.1 "Installation instructions").
- ⇒ Ensure that the conductivity of the fluid is at least 20 $\mu\text{S}/\text{cm}$.

1.3 Exclusion of liability

We accept no liability for any damage or malfunctions resulting from incorrect installation, inappropriate use of the device or failure to follow the instructions in this operating manual.

2 Safety instructions



Before you install the FMG90, read through this operating manual carefully. If the instructions contained within it are not followed, in particular the safety guidelines, this could result in danger for people, the environment, and the device and the system it is connected to.

The FMG90 correspond to the state-of-the-art technology. This concerns the accuracy, the operating mode and the safe operation of the device.

In order to guarantee that the device operates safely, the operator must act competently and be conscious of safety issues.

OMEGA ENGINEERING INC. provides support for the use of its products either personally or via relevant literature. The customer verifies that our product is fit for purpose based on our technical information. The customer performs customer- and application-specific tests to ensure that the product is suitable for the intended use. With this verification all hazards and risks are transferred to our customers; our warranty is not valid.

Qualified personnel:

- ⚠ The personnel who are charged for the installation, operation and maintenance of the FMG90 must hold a relevant qualification. This can be based on training or relevant tuition.
The personnel must be aware of this operating manual and have access to it at all times.
- ⚠ The electrical connection should only be carried out by a fully qualified electrician.

General safety instructions:

- ⚠ In all work, the existing national regulations for accident prevention and safety in the workplace must be complied with. Any internal regulations of the operator must also be complied with, even if these are not mentioned in this manual.
- ⚠ Degree of protection according to EN 60529:
Please ensure that the ambient conditions at the site of use does not exceed the requirements for the stated protection rating (→ § 9 "Technical data").
- ⚠ Prevent freezing of the medium in the device with appropriate measures.
- ⚠ Only use the FMG90 if it is in perfect condition. Damaged or faulty devices must be checked without delay and, if necessary, replaced.
- ⚠ When fitting, connecting and removing use only suitable appropriate tools.
- ⚠ Do not remove or obliterate type plates or other markings on the device, as otherwise the warranty is rendered null and void.

Special safety instructions:

- ⚠ Crystallizing liquids:
Liquids which crystallize when dried out can cause a malfunction of the FMG90.
 - ☞ Make sure that the FMG90 is not run dry.
 - ☞ Prevent the crystallization of the fluid in the device by taking appropriate measures.

Further warnings that are specifically relevant to individual operating procedures or activities can be found at the beginning of the relevant sections of this operating manual.

3 Construction and function

Components:

- ① Housing:
The Housing consists of plastic and has the IP65 degree of protection.
- ② Electrical connection:
The electrical connection is made via 4-pin plug M12x1.
- ③ Operation / flow indicator LED.
- ④ Type plate with flow direction (marking)
- ⑤ Process connection:
The process connections are available in different sizes.



Construction:

The measuring tube with its earthing sleeves and electrodes passes through the housing and forms the external process connection of the FMG90.

A magnetic field for the measurement process is generated inside the housing, which also contains the sensor and signal conditioning circuitry.

The two stainless steel electrodes are located in the middle of the measuring tube between the earthing sleeves.

The FMG90 does not need any moving parts to make measurements. The inside of the measuring tube is completely open, allowing the fluid to flow unhindered through the measuring tube.



Function:

The magnetic inductive flow sensor functions according to the induction principle. A DC voltage is generated by the movement of a conductor in a magnetic field:

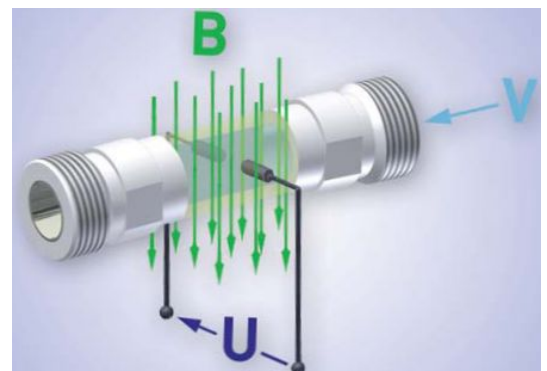
The measuring tube of the FMG90 is located in a magnetic field (B).

An electrically conductive medium (V) flows through the measuring tube. The positive and negative charge carriers are oppositely deflected.

A voltage (U) is generated at right angles to the magnetic field, which is picked up by the two electrodes.

Thereby, the induced voltage is proportional to the average flow velocity of the liquid.

The electronics of the FMG90 converts the induced voltage into a flow-proportional frequency signal.



4 Installation of FMG90

Before installing, check that

- ☐ the wetted materials of the device are suitable for the media being used (→ § 9.2 "Materials table").
- ☐ the equipment is switched off and is in a safe and de-energised state.
- ☐ the equipment is depressurised and has cooled down.



SUITABLE TOOLS:

⇒ Use only suitable tools of the correct size.

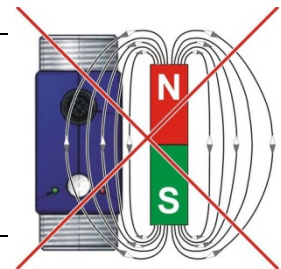
4.1 Installation instructions



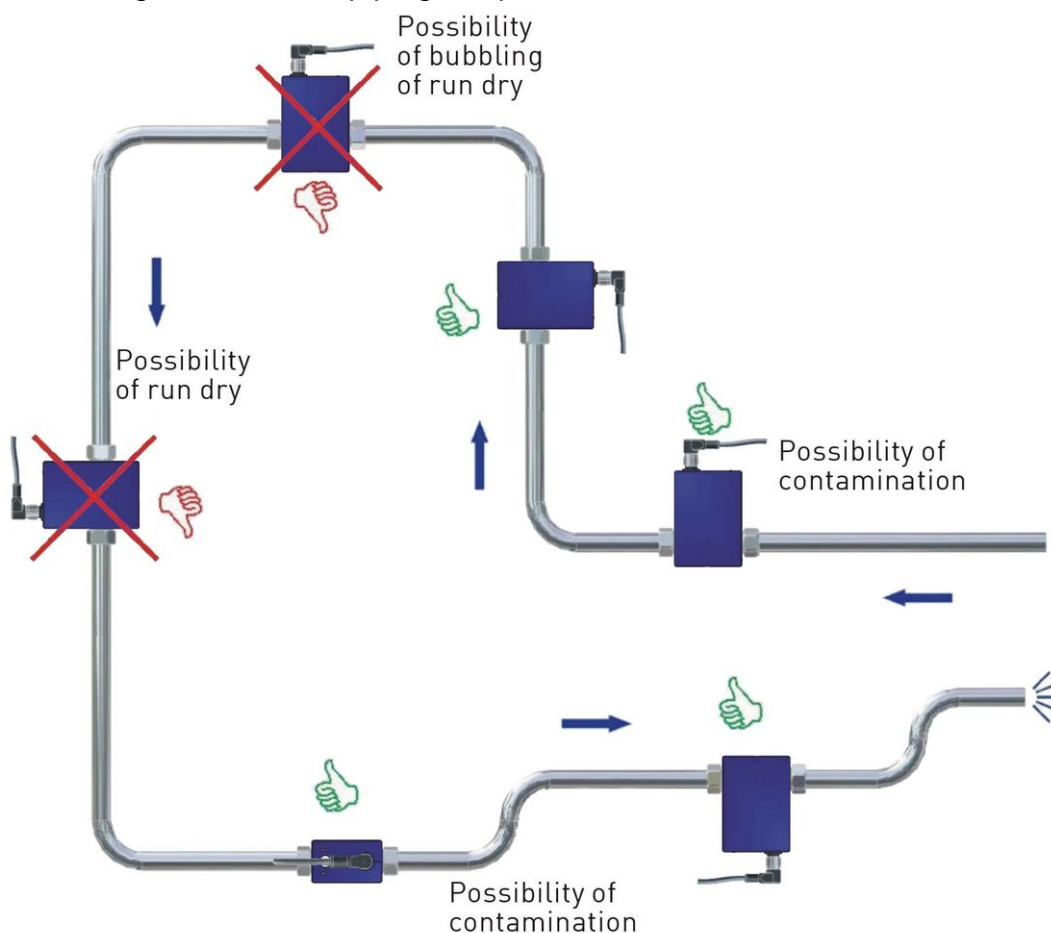
CAUTION! Risk of malfunction due to external magnetic fields!

Magnetic fields close to the device can cause malfunctions and should be avoided.

⇒ Ensure that no external magnetic fields are present at the installation site of the FMG90.



- The FMG90 can always be installed anywhere along the pipeline. However, straight sections of piping are preferable.



- Installation can occur in horizontal and vertical pipes. The flow sensor is only suitable for application in completely filled pipe systems.
- As a matter of principle magnetic inductive flow sensors are widely independent from the flow profile. An inlet section is not absolutely necessary.
To reach a most highly accuracy of the measurement, you should use straight inlet and outlet sections according to the nominal width (DN). The inlet section has to be at least 10 x DN; the outlet section 5 x DN in order to achieve the specified accuracy.
- The inlet and outlet sections and the gaskets must have the same or a slightly larger inside diameter than the measuring tube in order to achieve the specified accuracy.
- If two or more FMG90 devices are used side by side, maintain a separation of at least 2.5 cm between adjacent devices.
If adjacent devices are too close together, operation of both devices may be impaired due to mutual interference.



4.2 Assembly

The FMG90 is installed directly into the pipeline. The compact design and light weight of the unit make wall-mounting unnecessary.



IMPORTANT NOTICES:

- Only use suitable gaskets for installation.
- Observe the flow direction indicated on the type plate.
- Observe the mounting dimensions (→ § 9.4 "Dimensions").

- ⇒ Select an appropriate location for installation (→ § 4.1 "Installation instructions").

To ensure the best possible measuring accuracy, a vertical installation position with increasing flow is preferable (no collecting of dirt deposits).

- ⇒ Install the appropriate screwed connections at the installation location.
- ⇒ Insert the FMG90 together with the gaskets.
- ⇒ Screw the union nuts of the screwed connection onto the process connections of the FMG90.



CAUTION! Material damage!

Maximum torque 5 Nm.

While tightening, counter the FMG90 only by hand!
If you use an open-end or a pipe wrench, the FMG90 can be damaged.



- ⇒ Tighten both union nuts with a maximum torque of 5 Nm.

5 Electrical connection

The electrical connection of the FMG90 is via the 4-pin plug M12x1 at the top of the housing. The corresponding connection cables with moulded coupling socket are available in various lengths included in the range of OMEGA ENGINEERING INC. accessories.



CAUTION! Electric current!

The electrical connection should only be carried out by a fully qualified electrician.

⚡ De-energize the electrical system before connecting the FMG90.

Connection and wiring:

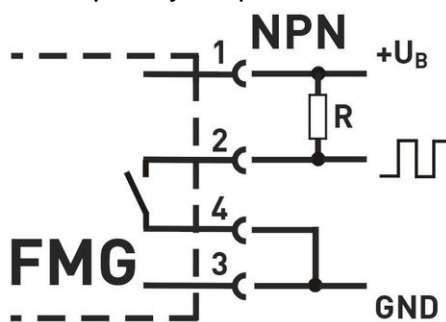
- ⚡ Screw the coupling socket of the connection cable to the plug of the FMG90.
- ⚡ Tighten the knurled nut of the coupling socket with a maximum torque of 1 Nm.
- ⚡ Connect the connection cables according to the following wiring diagrams.

Pin assignment:

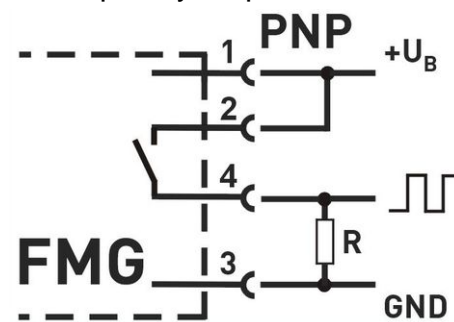


Pin 1: $+U_B$
Pin 3: GND
Pin 2 / 4: Frequency output NPN/PNP

Pin configuration with
NPN frequency output:



PNP frequency output:



Pull-up- / pull-down-resistors **R**.

We recommend using resistors of $\sim 1 \text{ k}\Omega$ (12V) respectively $\sim 2.2 \text{ k}\Omega$ (24V) and 0.25 W for the pull-up / pull-down wiring.

⚡ Please note that the maximum signal current of 25 mA will not be exceeded.

6 Commissioning and measuring operation

Before switching on the FMG90 for the first time, please follow the instructions in the following section.

6.1 Commissioning

Check that

- ☐ the FMG90 has been installed correctly and that all screw connections are sealed.
- ☐ the electrical wiring has been connected properly.
- ☐ the measuring system is vented by flushing.

6.2 Switching on and off

The FMG90 has no switch and cannot be switched on or off on its own. Switching on and off is carried out by the applied supply voltage.

↪ Switch on the supply voltage.

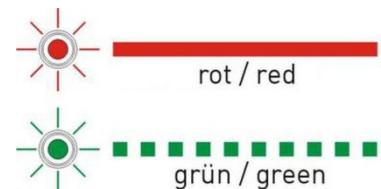
The red LED lights up permanently. The FMG90 is ready for use and goes into measuring operation.



6.3 Measuring operation

In the measuring mode, the red LED is permanently lit and indicates that the FMG90 is operational.

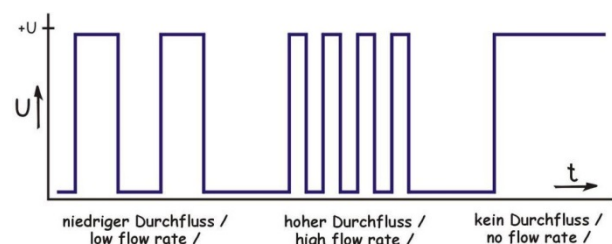
The green LED flashes proportional to the measured flow.



The human eye cannot detect the flashing any longer from a frequency of ~30 ... 40 Hz. In that case the green LED seems to be lit permanently.

Frequency output:

The frequency output provides a flow-proportional PNP/NPN square wave signal. The frequency changes according to the flow (→ Fig.).



7 Maintenance and cleaning

Maintenance:

The FMG90 is maintenance-free and cannot be repaired by the user. In case of a defect, the device must be replaced or sent back the manufacturer for repair.



CAUTION! Material damage!

When opening the device, critical parts or components can be damaged.

⚠ Never open the device and perform any repair yourself.

Cleaning:

Clean the FMG90 with a dry or slightly damp lint-free cloth. Do not use sharp objects or aggressive agents for cleaning.

7.1 Return shipment to the manufacturer

Due to legal requirements placed on environmental protection and occupational safety and health and to maintain the health and safety of our employees, all units returned to OMEGA ENGINEERING INC. for repair must be free of toxins and hazardous substances. That also applies to cavities in the devices. If necessary, the customer must neutralise or purge the unit before return to OMEGA ENGINEERING INC..

Costs incurred due to inadequate cleaning of the device and possible costs for disposal and/or personal injuries will be billed to the operating company.



WARNING! Risk of injury due to insufficient cleaning!

The operating company is responsible for all damages and harm of any kind, in particular physical injuries (e.g. caustic burns or toxic contaminations), decontamination measures, disposal etc. that can be attributed to insufficient cleaning of the measuring instrument.

⚠ Comply with the instructions below before returning the unit.

The following measures must be taken before you send the unit to OMEGA ENGINEERING INC. for repair:

- ⚠ Clean the device thoroughly. This is of extreme importance if the medium is hazardous to health, i.e. caustic, toxic, carcinogenic or radioactive etc.
- ⚠ Remove all residues of the media and pay special attention to sealing grooves and slits.
- ⚠ Attach a note describing the malfunction, state the application field and the chemical/physical properties of the media.
- ⚠ Please specify a point of contact in case our service department has any questions.

8 Disassembly and disposal

**CAUTION! Risk of injury!**

Never remove the device from a plant in operation.

✚ Make sure that the plant is shut down professionally.

Before disassembly:

Prior to disassembly, ensure that

- ☐ the equipment is switched off and is in a safe and de-energised state.
- ☐ the equipment is depressurised and has cooled down.

Disassembly:

- ✚ Remove the electrical connectors.
- ✚ Remove the FMG90 using suitable tools.

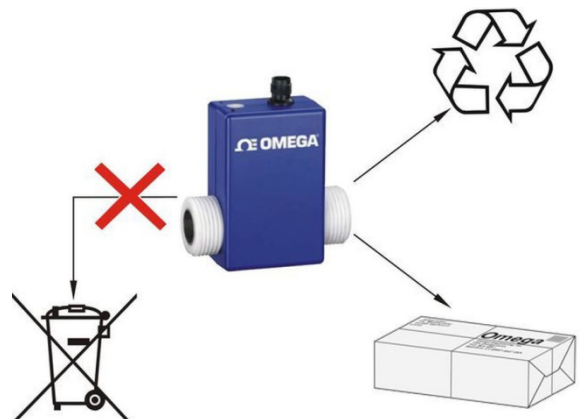
Disposal:**NO HOUSEHOLD WASTE!**

The FMG90 consists of various different materials. It must not be disposed of with household waste.

✚ Take the FMG90 to your local recycling plant

or

✚ send the FMG90 back to your supplier or to OMEGA ENGINEERING INC..



9 Technical data

The technical data of customised versions may differ from the data in these instructions. Please observe the information specified on the type plate.

9.1 Characteristics FMG90

| Type | FMG99 | FMG91 | FMG92 | FMG93 | FMG94 | FMG95 | FMG96 |
|--------------------------------------|--|----------|--------|----------|---------|----------|------------|
| Measurement device characteristics | | | | | | | |
| Flow range [l/min] | 0.1...2 | 0.25...5 | 1...20 | 2.5...50 | 5...100 | 10...200 | 12.5...250 |
| Accuracy* | ±1% of reading | | | | | | |
| Repeatability | ±1% | | | | | | |
| Output signal starting from [l/min] | 0.05 | 0.1 | 0.25 | 1 | 2 | 4 | 5 |
| Max. flow rate [l/min] | 2.5 | 6 | 25 | 60 | 120 | 240 | 300 |
| Response time | < 100 ms | | | | | | |
| Indications | red LED = Supply voltage • green LED = Flow | | | | | | |
| Output signal characteristics | | | | | | | |
| Frequency output: | | | | | | | |
| - Pulse rate / K-Factor** [pulses/l] | 10 000 | 4000 | 1000 | 400 | 200 | 100 | 80 |
| - Resolution** [ml/pulse] | 0.1 | 0.25 | 1.0 | 2.5 | 5.0 | 10.0 | 12.5 |
| - Signal shape | Square wave signal • duty cycle 50:50 can be connected as PNP or NPN open collector | | | | | | |
| - Signal current | ≤ 25 mA | | | | | | |
| Electrical characteristics | | | | | | | |
| Supply voltage | 24 V _{DC} ±15% or 12 V _{DC} ±15% | | | | | | |
| Power consumption | 0.6 W | | | | | | |
| Electrical protection measures | short-circuit proof • protected against polarity reversal | | | | | | |
| Electrical connection | 4-pin-plug M12x1 | | | | | | |
| Degree of protection (EN 60529) | IP 65 (only with a connected coupling) | | | | | | |
| Process variables | | | | | | | |
| Medium to measure | Water and other conductive liquids | | | | | | |
| - Conductivity | > 20 µS/cm | | | | | | |
| - Temperature | -10...60 °C (not freezing) | | | | | | |
| Ambient temperature | 5...60 °C | | | | | | |
| Nominal diameter | DN 3 | DN 8 | | DN 15 | DN 20 | | DN 25 |
| Inner diameter | 3 mm | 8 mm | | 14 mm | 18 mm | | 25 mm |
| Max. working pressure (at ... °C) | 10 bar (20 °C) • 8 bar (40 °C) • 6 bar (60 °C) higher pressure ratings on demand | | | | | | |
| Process connection - male thread | G¾ B | G½ B | | G¾ B | G1 B | | G1¼ B |

* test conditions: Water 23 °C

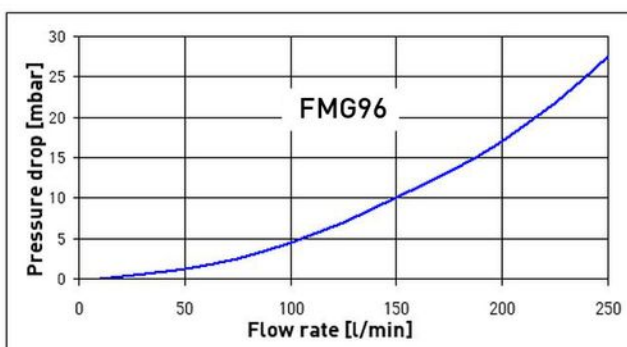
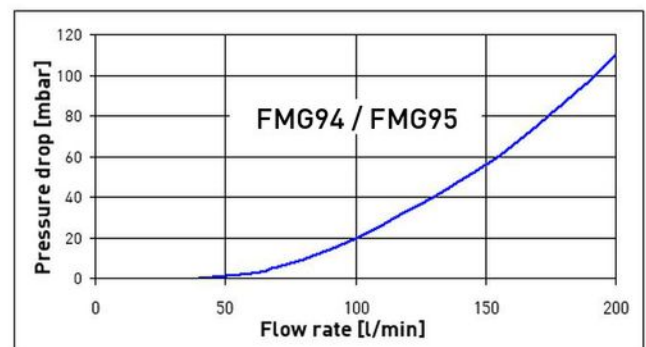
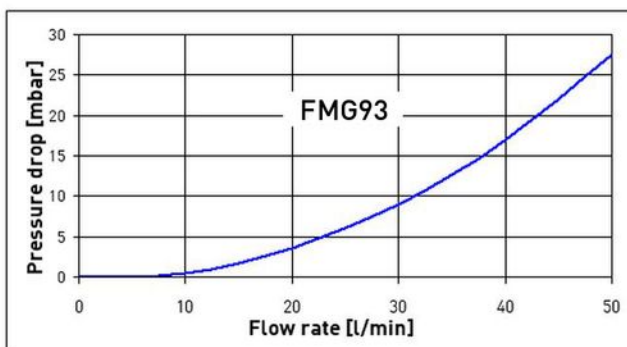
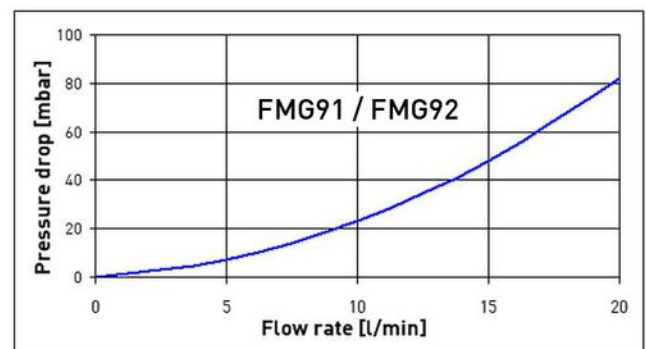
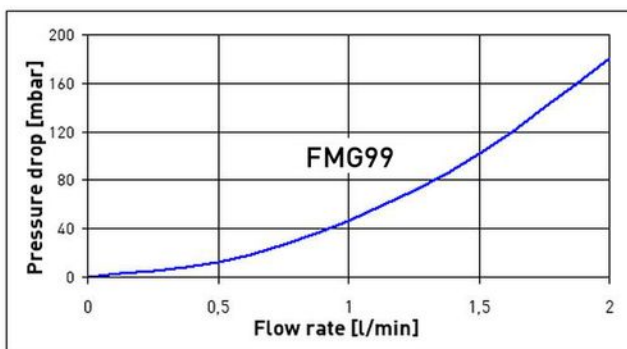
** other pulse rate / resolution on request.

optional: Output signal with lower frequency, designed specifically for connection to digital PLC inputs.

9.2 Materials table

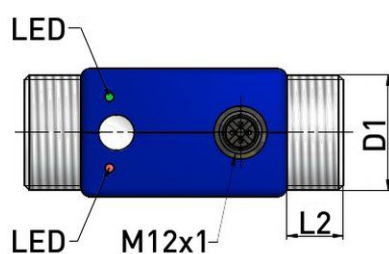
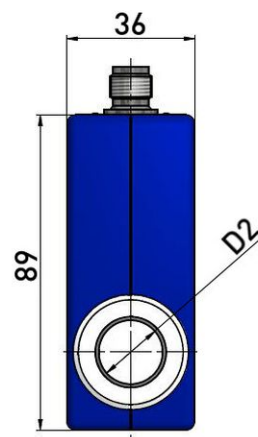
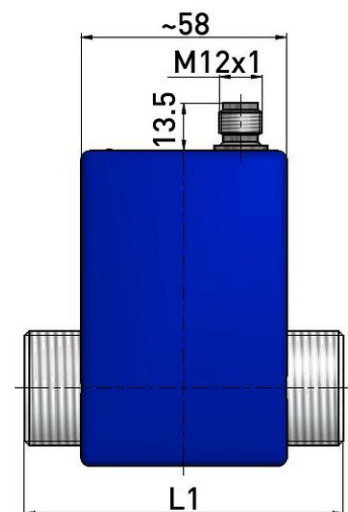
| Component | Material | Component-wetted |
|---------------------|----------------------|------------------|
| Housing | ABS | |
| Measuring tube | PVDF | X |
| Process connections | PVDF | X |
| O-ring | EPDM | X |
| Electrodes | Stainless steel 316L | X |
| Grounding rings | Stainless steel 316L | X |

9.3 Pressure drop



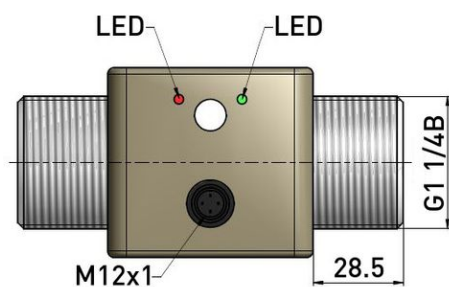
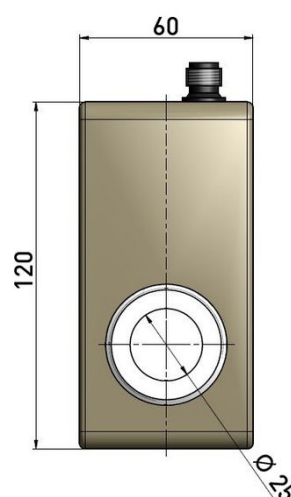
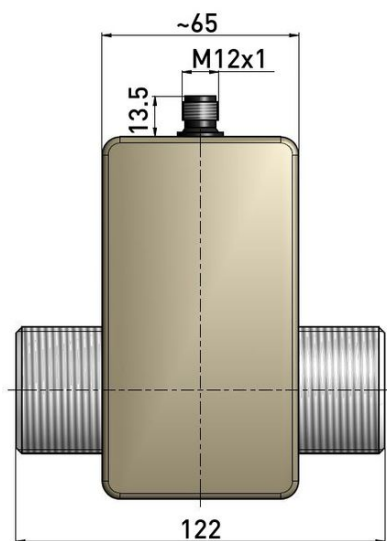
9.4 Dimensions

FMG9... DN 3 / DN 8 / DN 15 / DN 20:



| Type | L1 | L2 | D1 | D2 |
|--------------|----|------|-------------------|------|
| FMG99 | 85 | 13.3 | G $\frac{3}{8}$ B | Ø 3 |
| FMG91 | 85 | 13.3 | G $\frac{1}{2}$ B | Ø 8 |
| FMG92 | 85 | 13.3 | G $\frac{1}{2}$ B | Ø 8 |
| FMG93 | 90 | 16 | G $\frac{3}{4}$ B | Ø 14 |
| FMG94 | 90 | 16 | G1 B | Ø 18 |
| FMG95 | 90 | 16 | G1 B | Ø 18 |

FMG96 DN 25:



For your notes

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

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:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

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.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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