

**1 YEAR**  
WARRANTY

# User's Guide



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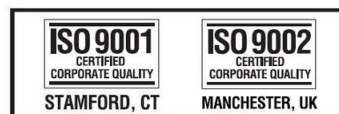
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**FMG90 Series**  
Electromagnetic Flow Meter



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It is the policy of OMEGA Engineering, Inc. to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

**WARNING:** These products are not designed for use in, and should not be used for, human applications.

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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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### 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 FMG90 series from Omega, is a non-contact flow sensor. The 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.

### Components:

- ① Sensor housing:  
The sensor 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.



### Versions:

The FMG90 is available with different inner diameters from 0.118 to 0.98 in..

The versions can be configured differently (→FMG90 Data sheet).

### Scope of delivery and accessories:

Before installing the device, check that the delivered items and ordered accessories:

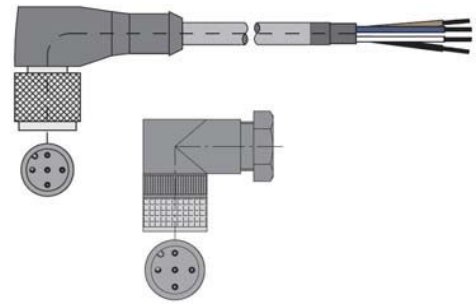
Scope of delivery:

- ☐ 1x FMG90 as ordered.
- ☐ 1x Operating manual.
- ☐ 1x Packaging.



## Accessories:

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



## 1.1 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 are not safety components 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 ( $\rightarrow$  § 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 ( $\rightarrow$  § 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 ( $\rightarrow$  § 4.1 "Installation instructions").

⚡ Ensure that the conductivity of the fluid is at least 20  $\mu\text{S}/\text{cm}$ .

## 1.2 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 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").
- ⚠ 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 the FMG90 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:

(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

**Construction:**

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

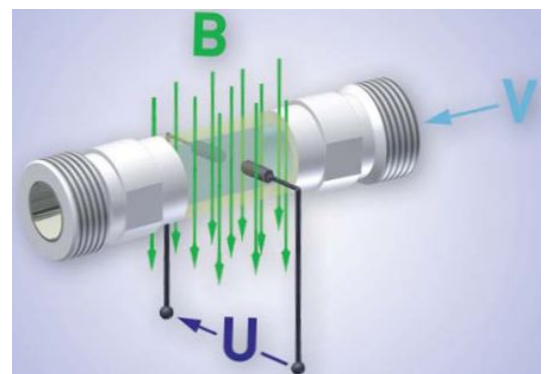
A magnetic field for the measurement process is generated inside the sensor housing, which also contains the sensor and signal conditioning circuitry.

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:

The measuring tube is located in a magnetic field ( $B$ ). If an electrically conductive medium ( $V$ ) flows through the measuring tube and, therefore, at right angles to the magnetic field, a voltage ( $U$ ) which is proportional to the mean flow velocity will be induced in the medium and subsequently picked up by the two electrodes.



### 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-energized state.
- ☐ the equipment is depressurized and has cooled down.

**SUITABLE TOOLS:**

Use only suitable tools of the correct size.



## 4.1 Installation instructions

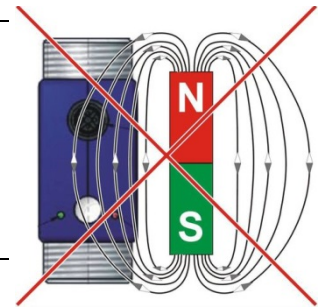


### CAUTION!

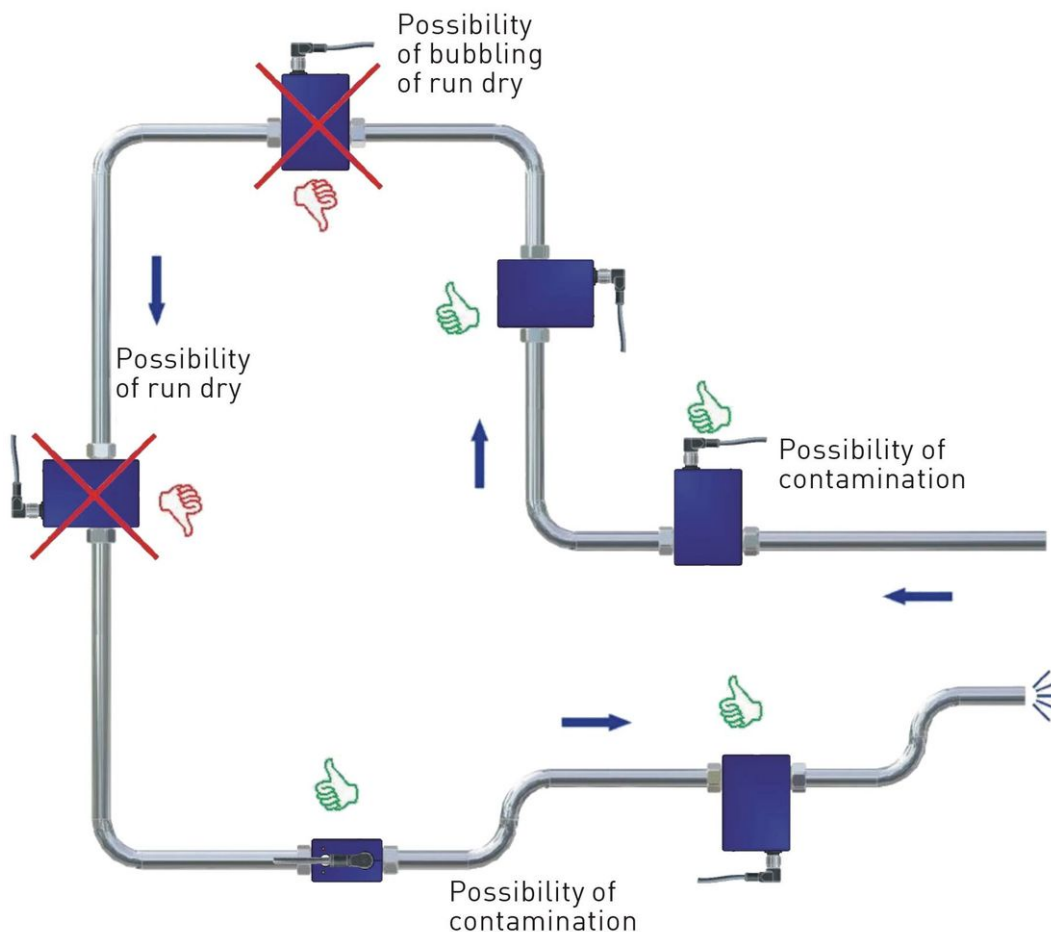
#### Risk of malfunction due to external magnetic fields!

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. Straight sections of piping are preferable, however.



- 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 inner diameter. The inlet section has to be at least 10 x inner diameter; the outlet section 5 x inner diameter 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 1.0 in 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:

- 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).
- ⇒ Wrap the FMG90 connections with 1 to 2 wraps of thread tape (e.g. Teflon® tape). Wrap tape in a clockwise direction, viewed from the end, leaving the first two threads uncovered.
- ⇒ Make sure the tape does not intrude into the flow path.
- ⇒ Attach the FMG90 with arrow pointed in the direction of flow.
- ⇒ The fittings should be screwed into FMG90 hand tight.



### CAUTION! Material damage!

**Do not use excessive force. The FMG90 can be damaged.**

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

- ⇒ To tighten the FMG90, use an open-end or a pipe wrench for the fittings and only the hand for the FMG90.
- ⇒ Tighten the FMG90 an additional  $\frac{3}{4}$  to 1 turn.



## 5 Electrical connection

The electrical connection of the FMG90 is via the 4-pin plug M12x1 at the top.

The corresponding connection cables with moulded coupling socket are available in various lengths included in the range of Omega 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:

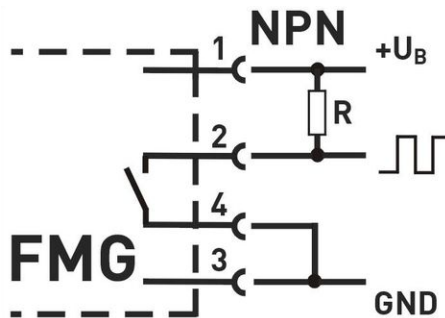
- ➞ Screw the coupling socket of the connection cable to the plug of the FMG90.
- ➞ Tighten the knurled nut of the coupling socket with a maximum torque of 1 Nm.
- ➞ Connect the connection cables according to the following wiring diagrams.

Pin assignment:

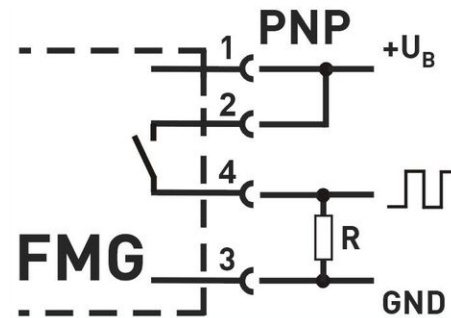


Pin 1:  $+U_B$   
 Pin 3: GND  
 Pin 2 / 4: Frequency output NPN/PNP

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.

🔌 Switch on the supply voltage.

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

### 6.2 Measuring operation

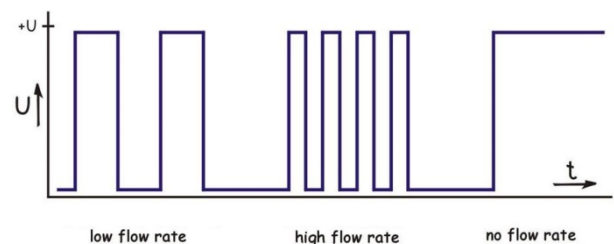
The red LED is constantly lit to indicate that the FMG90 is operational.

The green LED blinks according to the frequency of the output signal.

This blinking is not perceptible to the human eye at frequencies above 30 to 40 Hz, so the green LED appears to be constantly lit.

#### Frequency output:

The frequency output provides a flow-proportional PNP/NPN square wave signal.



## 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 to 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.

## 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-energized state.
- ☐ the equipment is depressurized and has cooled down.
- ☐

**Disassembly:**

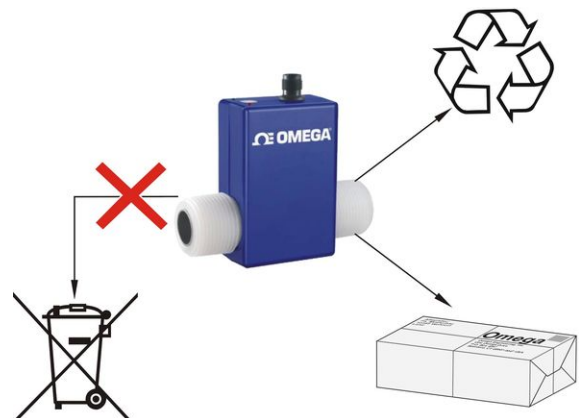
- ↪ Remove the electrical connectors.
- ↪ Remove the FMG90 using suitable tools.

☐

**Disposal:****NO HOUSEHOLD WASTE!**

The FMG90 consists of various different materials. He 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.



## 9 Technical data

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

### 9.1 Characteristics FMG90

Type	FMG 99	FMG 91	FMG 92	FMG 93	FMG 94	FMG 95	FMG 96
Measurement device characteristics							
Flow range [gpm]	0.03...0.53	0.066...1.3	0.26...5.3	0.66...13.2	1.3...26.4	2.6...53	3.3...66
Accuracy*	1% of reading						
Repeatability	1%						
Output signal starting from [gpm] (Accuracy 5%)	0.01	0.02	0.07	0.27	0.52	1.05	1.3
Max. flow rate [gpm]	0.66	1.6	6.6	15.8	31.7	63.4	79.3
Response time	< 100 ms						
Indications	red LED = Supply voltage • green LED = Flow						
Output signal characteristics							
Frequency output:							
- Pulse rate / K-Factor** [pulses/gal]	30000	15000	3000	1500	750	380	300
- Resolution** [ml/pulse]	0.1	0.25	1.3	2.5	5.0	10.0	12.6
- 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 VDC ±15% or 12 VDC ±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	IP 65 (only with a connected coupling)						
Process variables							
Medium to measure	Water and other conductive liquids						
Conductivity (medium)	> 20 µS/cm						
Medium temperature	14...140 °F (not freezing)						
Ambient temperature	41...140 °F						
Inner diameter	0.118 in	0.31 in	0.55 in	0.71 in	0.98 in		
Max. working pressure (at ... °F)	145 psi (68 °F) • 116 psi (104 °F) • 87 psi (140 °F) higher pressure ratings on demand						
Process connection	⅜ - 18 NPT	½ - 14 NPT	¾ - 14 NPT	1 - 11.5 NPT	1¼ - 11.5 NPT		

\* test conditions: Water 73.4 °F

\*\* other pulse rate / resolution on request.

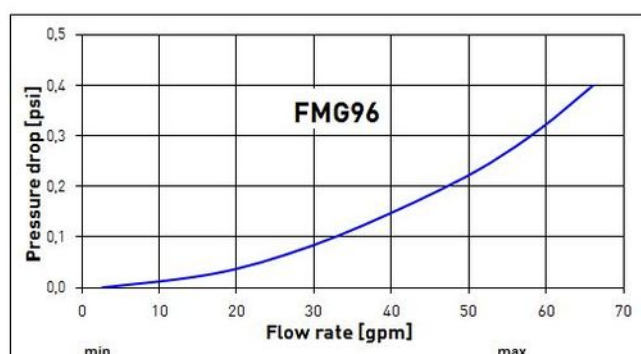
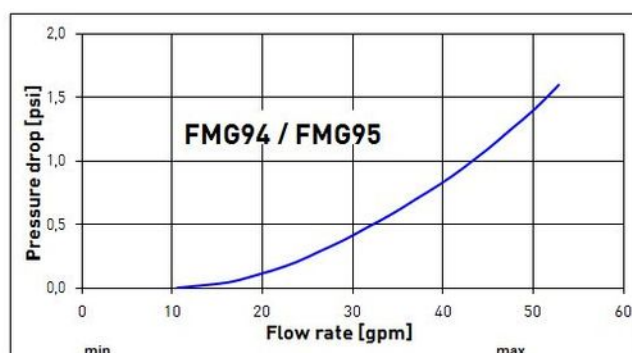
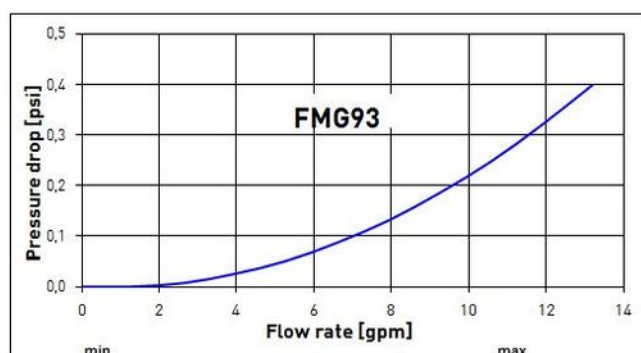
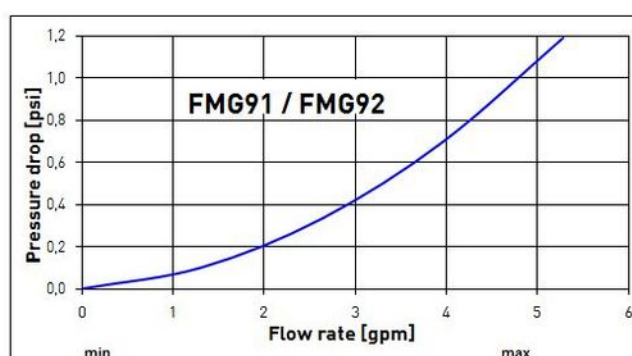
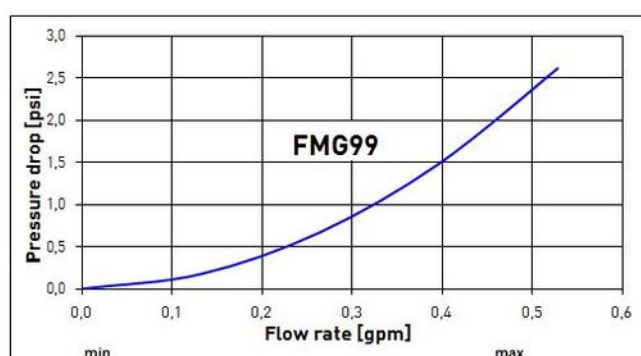
optional: Output signal with lower frequency, designed specifically for connection to digital PLC inputs.



## 9.2 Materials table

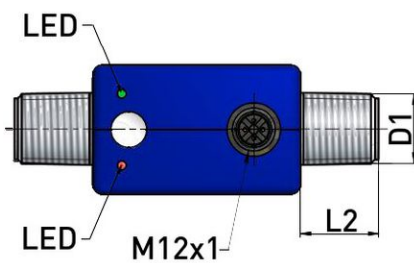
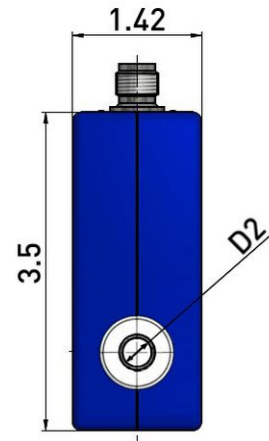
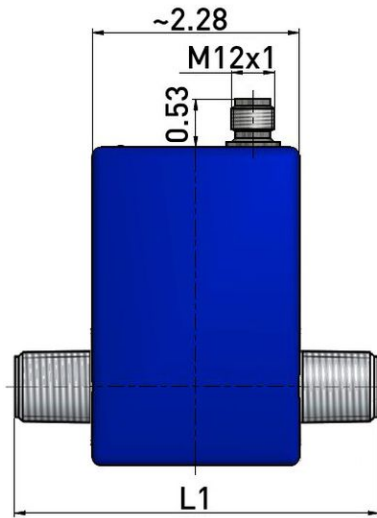
Component	Material	Component-wetted
Sensor housing	ABS	
Measuring tube	PVDF	<b>X</b>
Process connections	PVDF	<b>X</b>
O-ring	EPDM	<b>X</b>
Electrodes	Stainless steel 316L	<b>X</b>
Grounding rings	Stainless steel 316L	<b>X</b>

## 9.3 Pressure drop



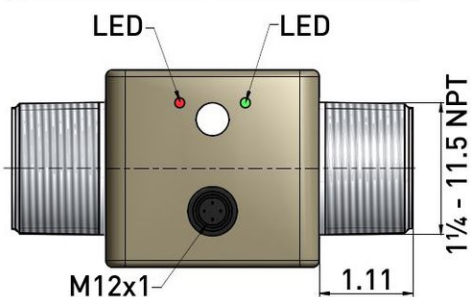
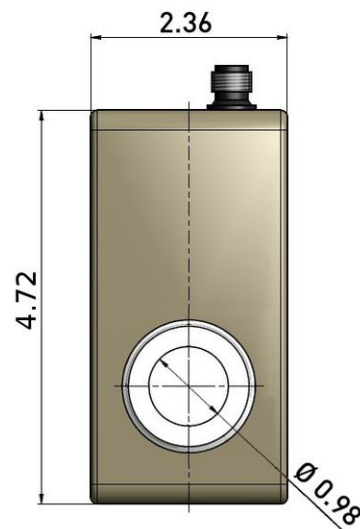
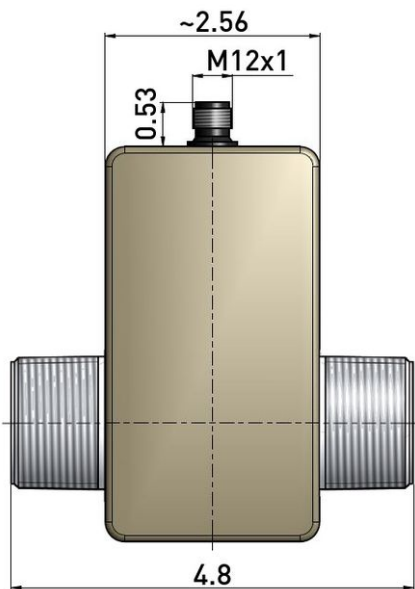
## 9.4 Dimensions

### FMG 91 ... FMG 99:



Type	L1	L2	D1	D2
<b>FMG 99</b>	3.68	0.63	$\frac{3}{8}$ - 18 NPT	Ø 0.118
<b>FMG 91</b>	4	0.86	$\frac{1}{2}$ - 14 NPT	Ø 0.31
<b>FMG 92</b>	4	0.86	$\frac{1}{2}$ - 14 NPT	Ø 0.31
<b>FMG 93</b>	4.02	0.86	$\frac{3}{4}$ - 14 NPT	Ø 0.55
<b>FMG 94</b>	4.41	1.04	1 - 11.5 NPT	Ø 0.71
<b>FMG 95</b>	4.41	1.04	1 - 11.5 NPT	Ø 0.71

### FMG 96:



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**For your notes**

**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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