

User's Guide



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Magnetic Inductive Flow Sensor
FMG70 Series



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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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1. Device description and intended use

OMEGA flow sensors FMG70 Series are used for continuously measuring flow rates or for dosing electrically conductive liquids. The operational safety of the supplied equipment is only guaranteed if it is operated according to its intended use (measuring and dosing of liquids). The specified limit values (see the chapter "Technical Data") should never be exceeded.

It is your responsibility to select a technology which is suitable for your specific application, to install it correctly, to carry out tests and to maintain all the components.

The magnetic inductive flow sensor features no moving parts and is, therefore, almost wear free and suitable for a wide range of measuring applications. A flow-proportional frequency signal is provided as the output signal.

Functional principle

The magnetic inductive flow sensor functions according to the induction principle:

The measuring pipe is located in a magnetic field (B). If an electrically conductive medium (Q) flows through the measuring pipe 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.

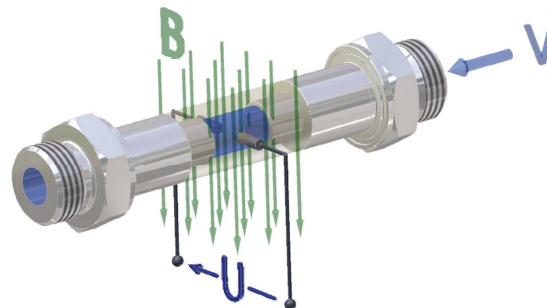


Fig. 1: Functional principle

2. Safety instructions

Always read the operating instructions carefully prior to installing the new product. Always adhere to the instructions contained herein, especially the safety instructions, otherwise there is a potential risk of personal injury and damage to instruments and systems.

Even though OMEGA provides assistance through personal consultation or the respective literature, it is the responsibility of the customers to determine the suitability of the product for the specific application.

The magnetic inductive flow sensors are state-of-the-art devices, concerning the accuracy, functioning and safe operation of the device.

However, professional and safety conscious conduct of the operator is required to ensure safe operation.

2.1. Qualified personnel

- ❖ The personnel entrusted with installing, operating and maintaining the FMG70 Series have to be suitably qualified; the required knowledge can be gained via training courses or appropriate on-the-job instruction. The personnel have to be familiar with the contents of these instructions, which have to be available to them at all times.
- ❖ The electrical connection should only be carried out by a fully qualified electrician.
- ❖ All work has to be carried out in accordance with existing national regulations on accident prevention and safety at work and with any internal regulations of the operator, even if they are not specified in these instructions.

2.2. Special safety instructions

- ❖ To avoid damages to the flow sensors and to the monitored system, only use OMEGA flow sensors to measure liquid flows.
- ❖ Prior to installation, ensure whether the material of the flow sensor is suitable for the medium which is to be measured.
- ❖ In order to achieve accurate measurements, only use liquids with a minimum conductivity of 50 $\mu\text{S}/\text{cm}$.
- ❖ Ensure that the max. specified operating pressure is not exceeded.
- ❖ Never remove a flow sensor from a pipe system under pressure.
- ❖ Ensure that the max. specified operating temperatures are not exceeded.
- ❖ Select suitable measures to prevent the medium from freezing in the flow sensor.
- ❖ Protect the flow sensor against external magnetic fields in the immediate vicinity, since these can impair device functioning.
- ❖ **Caution: voltages!**
Always de-energize the system before connecting the connector cable.
- ❖ It is prohibited to remove or make type plates or any other information attached to the equipment indecipherable, otherwise all warranties and the responsibility of the manufacturer no longer apply.
- ❖ **Caution:** Ensure that the maximum electrical load specified on the type plate is never exceeded, otherwise the electronic unit will be damaged.
- ❖ **Attention:** Do not use FMG70 Series in processes in which a disturbance possibly causes a risk for health and live of people.
 - ❖ The customer is to verify the applicability of the product on the basis of our technical details. By this checking, hazards and risks are subrogated to the customer and our warranty expires.

If problems or questions arise, please contact your supplier or OMEGA directly:

The logo features a stylized Greek letter Omega symbol (Ω) on the left, followed by the word "OMEGA" in a bold, sans-serif font with a registered trademark symbol (®) to its upper right.

3. Unpacking and inspecting the delivery

☞ Unpack your flow sensor FMG70 Series.

The FMG70 Series is delivered in special protective packaging. Keep this protective packaging for sending the instrument for repairs to the manufacturer or disposing the packaging under the official rules of the public waste disposal system of your area.

☞ Inspect the delivery first.

Standard delivery FMG70 Series:

- flow sensor
- operating instructions

4. Material specifications of components

Prior to installation, ensure whether the wetted components are suitable for the medium which is to be measured!

Components	Materials	Mediums contacting
Electrodes	Stainless steel 316 SS	Yes
Process connections	Stainless steel 316 SS	Yes
Pipe	PEEK Victrex 450GL30	Yes
Gasket	EPDM	Yes
Housing	Aluminium pressure diecasted	No

5. Suitable liquids (medium)

Liquids with a minimum conductivity of 50 $\mu\text{S}/\text{cm}$ are suitable as the medium. Always ensure whether the material of the flow sensor is suitable for the medium which is to be measured.

6. Installation of the flow sensor

6.1. Mechanical installation

- Protect the flow sensor against external magnetic fields in the immediate vicinity, since these can impair device functioning.

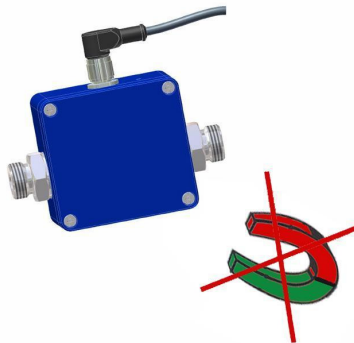


Fig. 2:
No external magnetic fields in the immediate vicinity of the FMG70 Series

- The sensor can be installed at any position in the pipe system. Straight pipe sections are recommended, since the flow velocity may vary in bends (see Fig. 3).

- Installation can occur in horizontal and vertical pipes. In horizontal pipes the sensor should be installed in a horizontal position to ensure that the measuring electrodes are always wetted by the medium. 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 with according to nominal pipe size (NPS). The inlet section has to be at least 10 x NPS; the outlet section 5 x NPS in order to achieve the specified accuracy.

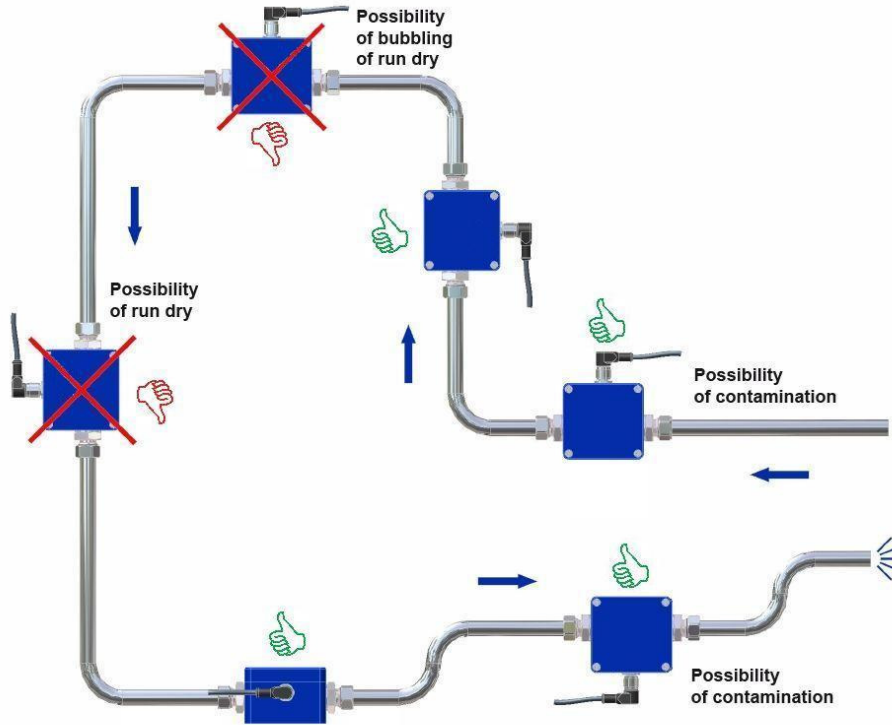


Fig. 3: Installation FMG70 Series

- 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.
- When tightening screw connections always grip the hexagon nut (see Fig. 4).



Fig. 4: Counterhold the screw connection

6.2. Electrical connection

- **Caution: voltages!**

Always de-energize the system before connecting the wires.

Warning:

We recommend the use of shielded connecting cables only. The shield should not be connected to earth. We recommend to ground the pipes directly before and behind the FMG70 Series (see Fig. 5).

OMEGA offers appropriate connecting cables with 4 pin cable socket as accessories. The shield is connected with the knurled nut. They are available in various lengths.

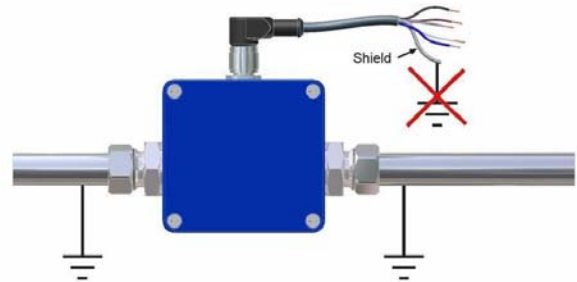


Fig. 5: Ground the pipes

Electrical connection with 4(5)-pin connector M12x1:

- ↗ Screw the 4-pin contact box M12x1 onto the connector.
- ↗ Tighten it with a tightening torque of max. 0.74 ft.lb..
- ↗ Connect the connecting cables of the FMG corresponding to Fig. 6.

Importent!

Do not connect Pin 5 (centre)!

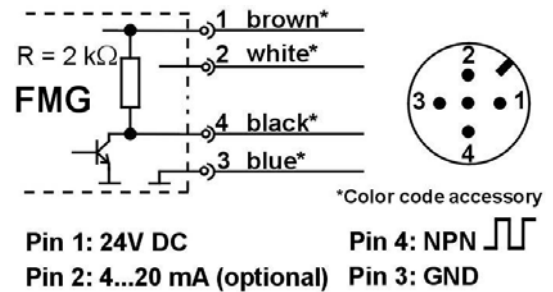


Fig. 6: Electrical connection

The output signal PIN 4 is a flow proportional frequency signal (see Fig. 7). It represents a square-wave output signal whose amplitude roughly corresponds to the supply voltage. The supply voltage and the output signal are not galvanically isolated.

After switch on, the operating status is shown by multiple flashing of the LED. Throughout the operating, the LED flash corresponding to the flow rate:

- No flow rate ⇒ no flashing.
- Low flow rate ⇒ slow flashing.
- High flow rate ⇒ fast flashing.

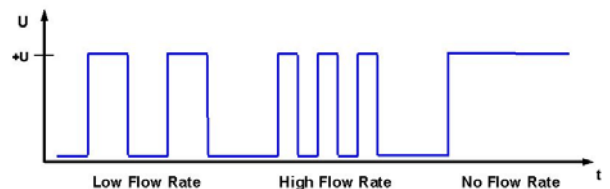


Fig. 7: Frequency output signal

The optional analog output PIN 2 provides a flow proportional signal current of 4...20 mA. Please note the max. load of 250 Ω to GND.

Connection to an Programmable Logic Controller (PLC):

Most digital PLC inputs are designed for connection to PNP signals. The FMG has an NPN frequency signal with an integrated 2kΩ pull-up resistor. Its signal current of ~12 mA is recognised as a signal by the current PLC. Thus, operating a FMG with an PLC should not present any problems.

The frequency output of the FMG should be attached to a digital input of the SPS.

Important! Please ensure that your PLC is able to process the high frequencies of the FMG output signal. If lower frequencies are necessary, the FMG can optionally be delivered with a customer-specific pulse rate (see 9. "Technical details / Pulse rate").

- ↗ Attach the connecting cable of the FMG to the PLC as illustrated in diagram 8.

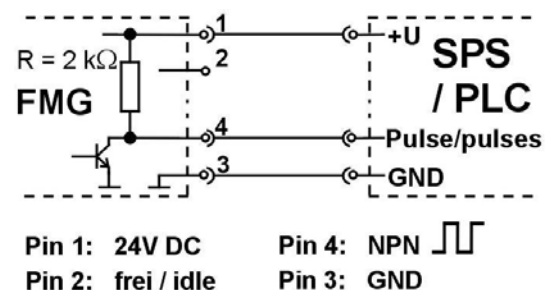


Fig. 8: Electrical connection to an PLC

7. Maintenance and repairs

The flow sensor is maintenance-free and cannot be repaired by the user. In the unlikely event of a defect, the device has to be returned to the manufacturer for repair work.

8. Decommissioning and disposal

- ↖ Never remove a flow sensor from a system under pressure.
- ↖ Remove all the electrical connectors and disassemble the flow sensor.
- ↖ The flow sensor consists of various materials. Never dispose of the flow sensor in domestic waste (refer to the crossed out waste bin displayed on the type plate).
- ↖ Return the flow sensor to the manufacturer for correct disposal.

9. Technical data

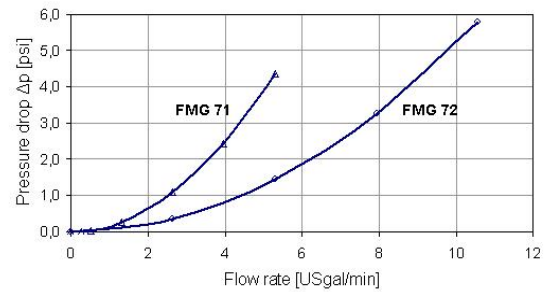
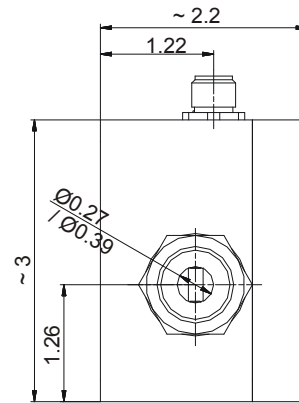
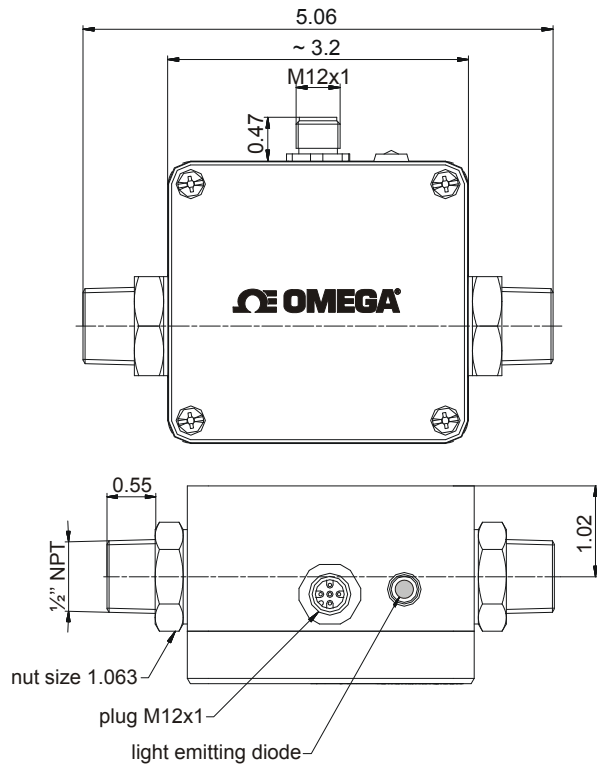
The technical data of customised versions may differ from the data in these instructions. Please observe the information specified on the type plate.

TYPE	FMG71	FMG72	FMG73
Characteristics measurement device			
Measurement range	0.25...5.3 GPM	0.5...10.5 GPM	2.5...52.8 GPM
Accuracy	±2 % of reading		
Reproducibility	1 %		
Start of output signal	~ 0.13 GPM	~ 0.25 GPM	~ 1.3 GPM
Response time	< 500 ms		
Flow indication	LED green, flow proportional flashing		
Characteristics output signal			
Frequency output:			
- Pulse rate / K-factor	3,237 pulses/gal optional: 4...7,700 pulses/gal, factory-set	3,237 pulses/gal optional: 4...3,800 pulses/gal, factory-set	757 pulses/gal optional: 4...770 pulses/gal, factory-set
- Resolution	0.0003 gal/pulse (1.2 ml/pulse) optional: 0.26...0.00013 gal/ pulse (1000...0.5 ml/pulse), factory-set	0.0003 gal/pulse (1.2 ml/pulse) optional: 0.26...0.00026 gal/ pulse (1000...1ml/pulse), factory-set	0.0013 gal/pulse (1.2 ml/pulse) optional: 0.26...0.0013 gal/ pulse (1000...5 ml/pulse), factory-set
- Signal shape	Square wave signal • duty cycle 50:50 • NPN, 2 kΩ pull-up resistor (built-in)		
- Signal current	max. 20 mA, current limited		
Analog output (optional):			
- Signal current	4...20 mA corresp. 0...5 GPM*	4...20 mA corresp. 0...10 GPM*	4...20 mA corresp. 0...52 GPM*
- max. signal current	~ 26 mA		
- max. load	250 Ω to GND		
Electrical characteristics			
Supply voltage	24 VDC ±10 %		
Current consumption	max. 80 mA		
Electrical connection	4(5)-pin-plug M12x1		
Electrical protection measures	short-circuit proof (up to 30 V) / polarity protection (up to -30 V)		
Degree of protection	IP 65		
Process variables			
Medium to measure	Water and other conductive liquids		
min. conductivity of the mediums	50 μS/cm (lower conductivity affects the accuracy)		
max. medium temperature	194 °F		
min. medium temperature	32 °F (not freezing)		
Ambient temperature	41...158 °F		
Nominal pipe size (NPS)	¼"	⅜"	¾"
Nominal pressure	232 psi		
Process connection	½" NPT male thread		1" NPT male thread

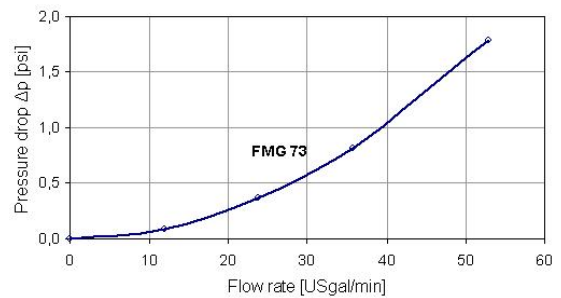
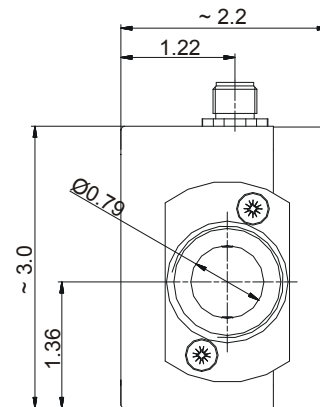
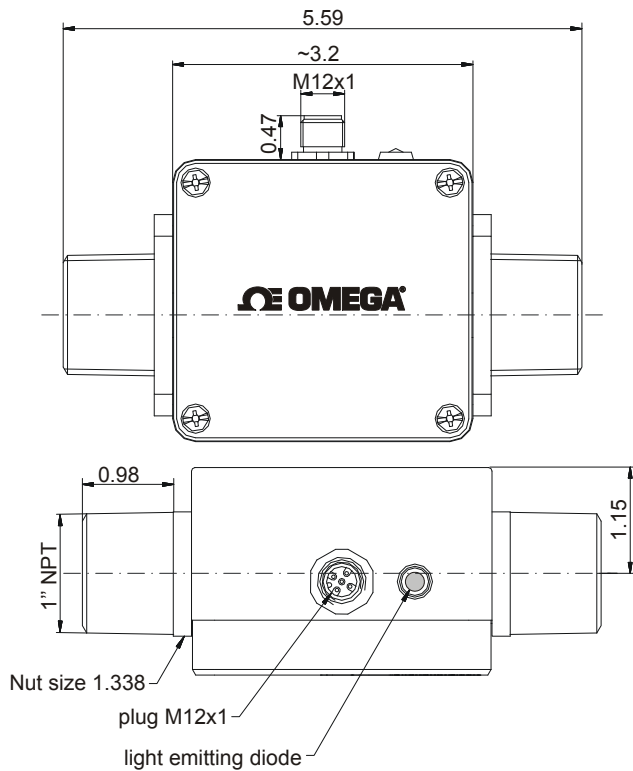
* other range on request

10. Dimensions, Pressure drop

FMG71 and FMG72



FMG73



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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