

User's Guide



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GMH3710

**Precision Thermometer
For Pt100 4-Wire Temperature Probes**

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It is the policy of OMEGA 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 Engineering, Inc. 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, patient-connected applications.

This device is marked with the international caution symbol. It is important to read the Setup Guide before installing or commissioning this device as the guide contains important information relating to safety and EMC.

Chapter	Page
Chapter 1 In General	4
1.1 Safety Instructions	4
1.2 Operating And Maintenance	4
1.3 Connections	5
1.4 Display Elements	6
1.5 Pushbuttons	6
Chapter 2 Device Configuration	7
2.1 'Unit': Selection of Temperature Unit °C /°F	7
2.2 'Resolution': The Display Resolution	7
2.3 'Offset': Zero Displacement	7
2.4 'Scal': Scale Correction	7
2.5 'Power.off': Selection of Power-Off Delay	8
2.6 'Out': Function of the Output	8
2.7 'Address': Selection of Base Address when Output = Serial Interface	8
2.8 'dAC.0Volt': Output Offset when Output = Analogue Output	8
2.9 'dAC.1Volt': Output Scale when Output = Analogue Output	8
Chapter 3 Some Basics Of Precision Temperature Measuring	9
Chapter 4 Special Functions	11
4.1 Display Resolution	11
4.2 Zero Displacement ('Offset')	11
4.3 Scale Correction ('Scale')	11
4.4 Output	12
4.4.1 Interface - Base Address ('Adr.')	12
4.4.2 Analogue Output – Scaling with DAC.0 and DAC.1	13
Chapter 5 Fault and System Messages	14
Chapter 6 Probe pin assignment	15
Chapter 7 Calibration Services	15
Chapter 8 Specification	16

Chapter 1 In General

1.1 Safety Instructions

This device has been designed and tested in accordance to the safety regulations for electronic devices.

However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using it.

1. Trouble-free operation and reliability of the device can only be guaranteed if it is not subjected to any other climatic conditions than those stated under "Specification".
2. Transporting the device from a cold to a warm environment condensation may result in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.
3. The circuitry has to be designed most carefully if the device should be connected to other devices. Internal connection in third party devices (e.g. connection GND and earth) may result in not-permissible voltages impairing or destroying the device or another device connected.
4. Warning: Operating the device with a defective mains power supply (e.g. short circuit from mains voltage to output voltage) may result in hazardous voltages at the device (e.g. at sensor socket).
5. Whenever there may be a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting. Operator safety may be a risk if:
 - there is visible damage to the device
 - the device is not working as specified
 - the device has been stored under unsuitable conditions for a longer time


In case of doubt, please return device to manufacturer for repair or maintenance.

6. Warning: Do not use these product as safety or emergency stop device, or in any other application where failure of the product could result in personal injury or material damage.

Failure to comply with these instructions could result in death or serious injury and material damage.

1.2 Operating And Maintenance

- Battery Operation

The battery has been used up and needs to be replaced, if  and "bAt" are shown in lower display.

The device will, however, continue operating correctly for a certain time.

The battery has been completely used up, if 'bAt' is shown in the upper display. The battery has to be taken out, when storing device above 50°C.

Hint: We recommend to remove the battery if device is not used for a longer period of time!

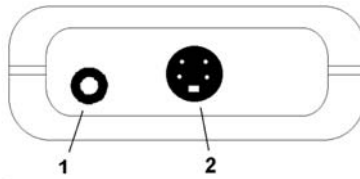
- **Mains Operation**

Attention: When using a power supply unit please note that operating voltage has to be 10.5 to 12 V DC. Do not apply overvoltage!! Simple 12V-power supplies often have excessive no-load voltage. We, therefore, recommend using regulated voltage power supplies. Trouble-free operation is guaranteed by our power supply GNG10/3000.

Prior to connecting the plug power supply with the mains supply make sure that the operating voltage stated at the power supply is identical to the mains voltage.

- Treat device and probes carefully. Use only in accordance with above specification. (do not throw, hit against etc.). Protect plugs and sockets from soiling.
- To disconnect sensor plug do not pull at the cable but at the plug.
- When connecting the probe the plug will slide in smoothly if plug is entered correctly.
- Selection of Output-Mode: The output can be used as serial interface or as analogue output. This choice has to be done in the configuration menu.

1.3 Connections



1. Output:

Operation as interface: Connect to optically isolated interface adapter (accessory: GRS 3100 or GRS3105).

Operation as analogue output: Connection via suitable cable.

Attention: The output mode has to be configured (p.r.t 2.7) and influences battery life!

2. Probe connection Pt100 4-wire

3. The **mains socket** is located at the left side of the instrument.

1.4 Display Elements



1 = **Main Display:** Currently measured temperature

2 = **Auxiliary Display:** Display of min, max or hold values

Special display elements:

3 = **Warning triangle:** indicates a low battery

4 = **Corr-arrow:** indicates that correction factor is activated

5 = **Offset-arrow:** indicates that zero point offset (offset) is activated

6 = **Min/Max/Hold:** shows if a min., max. or hold value is displayed in the secondary display

1.5 Pushbuttons



key 1: **On/Off key**

key 4: **Set/Menu**

press (Menu) for 2 sec.: configuration will activated

keys 2, 5: **min/max when taking measurements:**

press shortly: min. or max. measuring value will be displayed

press for 2 sec.: the min. or max. value will be deleted

up/down for configuration: to enter values or change settings

key 6: **Store/Quit**

- Measurement: Hold current measuring value ('HLD' in display)

- Menu: Acknowledge setting, return to measuring

key 3: no function

Chapter 2 Device Configuration

For configuration of the device press "Menu"-key (key 4) for 2 seconds, the first menu will be shown.

Choose between the individual values that can be set by pressing the "Menu"-key (key 4) again.

The individual values are changed by pressing the keys "UP" (key 2) or "DOWN" (key 5).

Use key "Quit" (key 6) to leave configuration and to store settings.

2.1 'Unit': Selection of Temperature Unit °C /°F



°C: All temperature values are in degrees Celsius

°F: All temperature values are in degrees Fahrenheit

2.2 'Resolution': The Display Resolution



0.1°: Resolution 0.1°C

0.01°: Resolution 0.01°C

Auto: Resolution is selected automatically

2.3 'Offset': Zero Displacement



-2.50°C...2.50°C

respectively

-4.50°F...4.50°F The zero point of the measurement will be displaced by this value to compensate for deviations in the temperature probe or in the measuring device:

oFF: Zero displacement inactive (=0.0°)

2.4 'Scal': Scale Correction



-2.000...2.000: The scale of the measuring will be changed by this factor to compensate for deviations in the temperature probe or in the measuring device (factor is in %)

oFF: Scale correction factor inactive (=0.000)

2.5 'Power.off': Selection of Power-Off Delay



- 1...120: Power-off delay in minutes.
Device will be automatically switched off as soon as this time has elapsed if no key is pressed/no interface communication takes place
- oFF: Power-off function inactive (continuous operation, e.g. mains operation)

2.6 'Out': Function of the Output



- oFF: No output function, lowest power consumption
- SEr: Output is serial interface
- dAC: Output is analogue output 0...1V

2.7 'Address': Selection of Base Address when Output = Serial Interface



- 01, 11, 21, ..., 91: Base address of device for interface communication.

2.8 'dAC.0Volt': Output Offset when Output = Analogue Output



- 200.0...850.0°C
- respectively
- 328.0...1562.0°F
- Enter desired temperature value at which the analogue output potential should be 0V

2.9 'dAC.1Volt': Output Scale when Output = Analogue Output



- 200.0...850.0°C
- respectively
- 328.0...1562.0°F
- Enter desired temperature value at which the analogue output potential should be 1V

Hint:

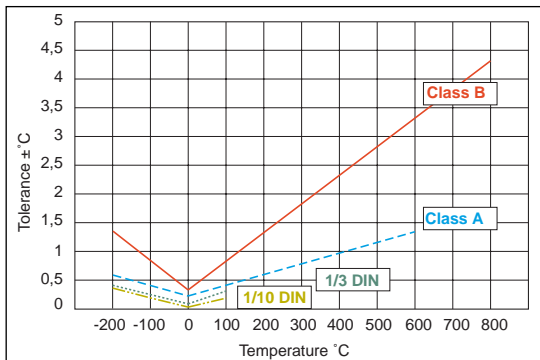
The settings will be set to the settings ex works, if keys 'Set' and 'Store' are pressed simultaneously for more than 2 seconds.

Chapter 3 Some Basics Of Precision Temperature Measuring

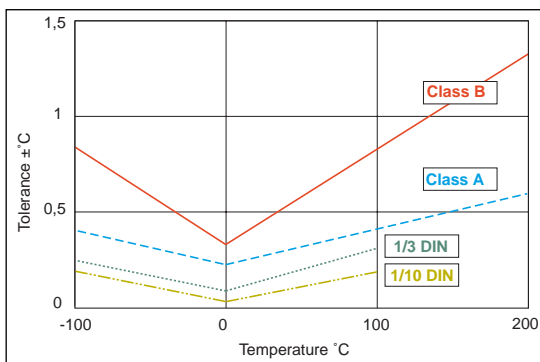
• Probe Precision/Device Precision

The device is very precise (please refer to technical data). To be able to use this high precision, the connected temperature probe has to be as precise as possible, too. The following precision classes are available as a standard at reasonable prices (Platinum resistor thermometers according to EN60751):

Class	Error ranges
B	$\pm (0,3 + 0,005 \cdot [\text{temperature}])$
1/3 B (=1/3 DIN)	$\pm (0,1 + 0,0017 \cdot [\text{temperature}])$
1/10 B (=1/10 DIN)	$\pm (0,03 + 0,0005 \cdot [\text{temperature}])$
A	$\pm (0,15 + 0,002 \cdot [\text{temperature}])$



Error over measuring range



Error over range -50...150°C

For applications demanding higher precision than given by this classes we suggest to adjust the device to the used probe or to get a calibration certificate for the device combined with the probe.

When demanding highest possible precision we suggest the usage of the instrument GMH3750.

Attention: if an adjusted or calibrated probe is replaced, also the adjustment or calibration certificate has to be renewed to maintain the referring overall precision!

Be careful when buying third party temperature probes: Besides the standard EN60751 there are some other obsolete or unusual standards on the market. If such a probe has to be connected, the GMH3750 should be used instead!

- **4-Wire-Measuring**

When using resistance thermometers as the Pt100 a quite large measuring error can be caused by inadequate cables and connections. Using 4wire measuring avoids this kinds of errors mainly caused by unwanted resistances. It is suggested to use suitable probes and extensions only. (For pin assignment please refer to chapter 6).

- **Heat loss caused by probe construction**

Especially when measuring temperatures which deviate very much from the ambient temperature, measuring errors often occur if the heat loss caused by the probe is not considered. When measuring fluids therefore the probe should be emerged sufficiently deep and be stirred continuously. When measuring gases the probe should also emerge as deep as possible in the gas to be measured (e.g. when measuring in channel/pipes) and the gas should flow around the probe at sufficient flow.

- **Measuring Surface Temperature**

If temperature of the surface of an object has to be measured, one should pay attention especially when measuring hot (or very cold) surfaces, that the ambient air cools (or heats) the surface. Additionally the object will be cooled (or heated) by the probe or the probe can have a better heat flow to the ambient temperature as to the objects surface. Therefore specially designed surface probes should be used. The measuring precision depends mainly on the construction of the probe and of the physics of the surface itself. If selecting a probe try to choose one with low mass and heat flow from sensor to handle. Thermally conductive paste can increase the precision in some cases.

- **Allowable temperature Range Of Probes**

Pt100 Sensors are defined over a wide temperature range. Depending on probe materials and sort of sensor (e.g. hybrid sensors, wire wound resistors...) the allowable temperature ranges have to be considered. Exceeding the ranges at least causes a wrong measuring, it may even damage the probe permanently!

Often it also has to be considered, that the temperature range is just valid for the probe tube, (plastic-) handles can't stand the same high temperatures. Therefore the tube length should be selected long enough, that temperature keeps low at the handle.

- **Self Heating**

The measuring current of the instrument is just 0.3mA. Because of this comparably low current practically no self heating effect has to be considered, even at air with low movement the self heating is $\leq 0.01^{\circ}\text{C}$.

- **Cooling by Evaporation**

When measuring air temperature the probe has to be dry. Otherwise the cold due to the evaporation causes too low measurements.

Chapter 4 Special Functions

4.1 Display Resolution

Standard setting: 'Auto', i.e. the device automatically switches over to the optimum resolution between $.01^{\circ}$ and 0.01° .

If temperatures to be measured are near the switching threshold, a fixed resolution may be better, e.g. for easy recording. In such a case please select the optimum resolution manually.

4.2 Zero Displacement ('Offset')

A zero displacement can be carried out for the measured temperature:

temperature displayed = temperature measured - offset

Standard setting: 'off' = 0.0° , i.e. no zero displacement will be carried out. Together with the scale correction (see below) this factor is mainly used to compensate for sensor deviations. Unless the factor is set to 'off', the offset arrow in the display shows an active zero displacement.

4.3 Scale Correction ('Scale')

The scale of the measuring can be influenced by this setting (factor is in %):

displayed temperature[$^{\circ}\text{C}$] = measured temperature[$^{\circ}\text{C}$] * (1+Scal/100)

respectively

displayed temperature[$^{\circ}\text{F}$] = (measured temperature [$^{\circ}\text{F}$]- 32°F) * (1+Scal/100) + 32°F

Standard setting: 'off' =0.000, i.e. temperature is not corrected. Together with the zero displacement (see above) this factor is mainly used to compensate for sensor deviations.

Unless the factor is set to 'off', the Corr arrow in the display shows an active scale correction.

4.4 Output

The output can be used as serial interface (for GRS3100 or GRS3105 interface adapters) or as analogue output (0-1V). If none of both is needed, we suggest to switch the output off, because battery life then is extended.

4.4.1 Interface - Base Address ('Adr.')

By using an electrically isolated interface converter GRS3100 or GRS3105 (accessory) the device can be connected to a PC. With the GRS3105 it is possible to connect up to 5 instruments to a single interface (please also refer to GRS3105-manual). As a precondition the base addresses of all devices must not be identical. In case several devices will be connected via one interface make sure to configure the base addresses accordingly. In order to avoid transmission errors, there are several security checks implemented (e.g. CRC).

The following standard software packages are available for data transfer:

- **EBS9M** : 9-channel software to record and display the measuring values
- **EASYCONTROL** : Universal multi-channel software (EASYBUS-, RS485-, and/or GMH3000-operation possible) for real-time recording and presentation of measuring data in the ACCESS®-data base format.

In case you want to develop your own software we offer a GMH3000-development package including

- an universally applicable 32bit Windows functions library ('GMH3000.DLL') with documentation that can be used by all 'serious' programming languages.
- Programming examples for Visual Basic 6.0™, Delphi 1.0™, Testpoint™, Labview™

Note: The measuring and range values read via interface are always in the selected display unit (°C/°F)!

Supported interface functions:

Code	Name/Function	Code	Name/Function
0	read nominal value	199	read meas. type in display
3	read system status	200	read min. display range
6	read min. value	201	read max. display range
7	read max. value	202	read unit of display
12	read ID-no.	204	read decimal point of display
174	delete min. value	208	read channel count
175	delete max. value	214	read scale correction
176	read min measuring range	215	set scale correction
177	read max measuring range	216	read zero displacement
178	read measuring range unit	217	set zero displacement
179	read measuring range decimal point	240	Reset
180	read measuring type	254	read program identification
194	set display unit		

4.4.2 Analogue Output – Scaling with DAC.0 and DAC.1

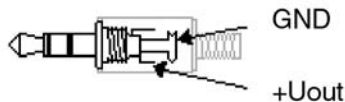
With the DAC.0 and DAC.1 values the output can be rapidly scaled to Your efforts.

Keep in mind not to connect low-resistive loads to the output, otherwise the output value will be wrong and battery life is decreased. Loads above ca 10kOhm are uncritical.

If the display exceeds the value set by DAC.1, then the device will apply 1V to the output.




If the display falls below the value set by DAC.0, then the device will apply 0V to the output.

In case of an error (Err.1, Err.2, no sensor, etc.) the device will apply slightly above 1V to the output.

Plug wiring:**Attention!**

The 3rd contact has to be left floating! Only stereo plugs are allowed!

Chapter 5 Fault and System Messages

Display	Meaning	Remedy
	low battery voltage, device will continue to work for a short time	replace battery
	If mains operation: wrong voltage	replace power supply, if fault continues to exist: device damaged
	low battery voltage	replace battery
	If mains operation: wrong voltage	Check/replace power supply, if fault continues to exist: device damaged
<p>No display or weird display</p> <p>Device does not react on keypress</p>	low battery voltage	replace battery
	If mains operation: wrong voltage	Check/replace power supply, if fault continues to exist: device damaged
	system error	Disconnect battery or power supply, wait some time, re-connect
	device defective	return to manufacturer for repair
	Sensor error: no sensor connected	Connect sensor to socket
	sensor/cable or device defective	return to manufacturer for repair
Err.1	Value exceeding measuring range	Check: Is the value exceeding the measuring range specified? ->temperature too high!
	Wrong probe connected	Check probe
	sensor/cable defective	-> replace
Err.2	Value below display range	Check: Is the value below the measuring range specified? -> temperature too low!
	Wrong probe connected	Check probe
	sensor/cable defective	-> replace
Err.3	Value exceeding display range	-> set resolution to 0.1° or Auto
Err.4	Value below display range	-> set resolution to 0.1° or Auto
Err.7	system error	return to manufacturer for repair

Chapter 6 Probe pin assignment

The device is constructed for the connection of a Pt100 4-wire probe. The connection is carried out as follows:

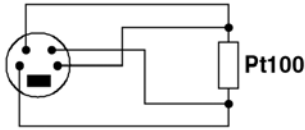
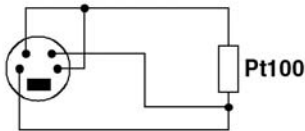
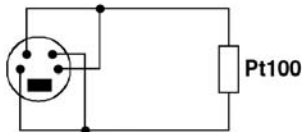


figure shows view upon probe jack pins

It is also possible to connect an 3- or 2-wire probe to the device. Please observe that in consequence of the cable resistance a increased measuring fault will occur. The connection of this probes should be carried out as follows:



3-wire connection



2-wire connection

Chapter 7 Calibration Services

Calibration certificates can be issued by the factory.

For this the device has to be sent to the manufacturer. Just the manufacturer can check the factory settings and correct them if necessary.

Chapter 8 Specification

Supported probes	Pt100 4-wire (2-wire possible)	
Sensor Curve	according to EN60751	
Probe connection	4pole Mini-DIN socket	
Resolution	0.01°C respectively 0.1°C, 0.01°F respectively 0.1°F	
Measuring Ranges	0.01°C	0.1°C
	-199.99... +199.99°C	-200.0... +850.0°C
	0.01°F	0.1°F
	-199.99... +199.99°F	-328.0... +1562.0°F
Precision	Device without probe	±1 Digit (at nominal temperature)
	Range 0.01°C/F:	±0.03°C / ±0.06°F
	Range 0.1°C/F:	±0.1°C / ±0.2°F
Measuring	4-wire measuring with automatic compensation of thermovoltage errors, measuring current ca. 0.3mA	
Temperature drift	<=0.002K per 1K	
Nominal temperature	25°C	
Ambient	Temperature:	-25 ... +50°C (-13 ... 122°F)
	Rel. humidity:	0 ... 95% r.F. (not condensing)
Storage temperature	-25 ... +70°C (-13 ... 158°F)	
Housing	Dimensions: 142 x 71 x 26 mm (L x W x D) impact-resistant ABS plastic housing, membrane keyboard, transparent panel. Front side IP65, integrated pop-up clip for table top or suspended use.	
Weight	approx. 155 g	
Output:	3,5 mm audio plug, stereo	
	Selectable as serial interface: via optically isolated interface adapter GRS3100 or GRS3105 (p.r.t. accessories) directly connectable to RS232-interfaces.	
	or analogue output: 0..1V, freely scaleable (resolution 13 bit, accuracy 0.05% at nominal temperature, cap. load <1 nF)	
Power Supply	9V-Battery, type IEC 6F22 (included) as well as additional d.c. connector (diameter of internal pin 1.9 mm) for external 10.5-12V direct voltage supply. (suitable power supply: GNG10/3000)	
Power Consumption	output off	approx. 0.90mA
	output serial interface:	approx. 1.15mA
	analogue output:	approx. 1.25mA
Display	Two 4 ½ digits LCD's (12.4 mm high and 7 mm high) for temperature, min./ max values, hold function, etc. as well as additional pointing arrows.	
Pushbuttons	6 membrane keys for on/off switch, menu operation, min. and max. value memory, hold-function etc.	
Min-/Max-Value Memory	Both the max. and the min. value will be memorised.	

Hold Function

Press button to store current value.

Automatic-Off-Function

Device will be automatically switched off if no key is pressed/no interface communication takes place for the time of the power-off delay. The power-off delay can be set to values between 1 and 120 min.; it can be completely deactivated.

EMC

The GMH3710 corresponds to the essential protection ratings established in the Regulations of the Council for the Approximation of Legislation for the member countries regarding electromagnetic compatibility (2004/108/EG) EN61326 +A1 +A2 (Appendix B, class B), additional error: < 1% FS.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of one (1) year from the date of purchase. In addition to OMEGA's standard warranty period, OMEGA Engineering will extend the warranty period for one (1) additional year if the warranty card enclosed with each instrument is returned to OMEGA.

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 which wear are not warranted, including but 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 it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS 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 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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