

1 YEAR
WARRANTY

Ω OMEGA™ **User's Guide**

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LDX-4



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2.0: Safety Information

Terms in this Manual

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

Symbols in this manual



This symbol indicates where applicable cautionary or other information is to be found.

WARNINGS:

Do not operate in explosive atmosphere

To avoid explosion, do not operate this equipment in an explosive atmosphere.

Safety Critical Environments

This equipment is not intended for use in a safety critical environment.

CAUTION:

Low Voltage

This equipment operates at below the SELV and is therefore outside the scope of the Low Voltage Directive.

This equipment is designed to work from a low voltage DC supply. Do not operate this equipment outside of specification.

CAUTION:

Electrostatic Discharge

This equipment is susceptible to **ESD** (Electrostatic Discharge) when being installed or adjusted, or whenever the case cover is removed. To prevent ESD related damage, handle the conditioning electronics by its case and do not touch the connector pins. During installation, follow the guidelines below.

- Ensure all power supplies are turned off.
- If possible, wear an ESD strap connected to ground. If this is not possible, discharge yourself by touching a metal part of the equipment into which the conditioning electronics is being installed.
- Connect the transducer and power supplies with the power switched off.
- Ensure any tools used are discharged by contacting them against a metal part of the equipment into which the conditioning electronics is being installed.
- During setting up of the conditioning electronics, make link configuration changes with the power supply turned off. Avoid touching any other components.
- Make the final gain and offset potentiometer adjustments, with power applied, using an appropriate potentiometer adjustment tool or a small insulated screwdriver.

3.0: Introduction

The LDX-4 MK2 is a development of the original LDX-4. It is a compact conditioning module powered from a single DC supply. Adjustable gain and zero controls are provided for use with the complete range of Omega transducers. The unit is of robust construction, housed in a die cast aluminium box providing a substantial degree of mechanical protection.

The LDX-4 MK2 incorporates its own voltage regulation for operation from 10-30 VDC and can provide outputs of up to ± 10 V together with ± 20 mA.

3.1: LDX-4 Enhancements

The LDX-4 MK2 has been designed as a form, fit and function replacement for the original LDX-4, but with several enhancements.

- Wider gain range, allowing ALL Omega transducers to be connected without the need for attenuation resistors.
- Up to ± 10 VDC and ± 20 mA are available for all gain settings.
- Fixed and variable offsets make setting of uni-polar output easier.
- Gain and offset adjustment are fully independent.
- Selectable transducer excitation frequency.
- Selectable transducer load resistances.
- Selection between forward and reverse connection.
- Fully CE Compliant.
- Half-Bridge transducers can now be accommodated with simple plug wiring changes.*

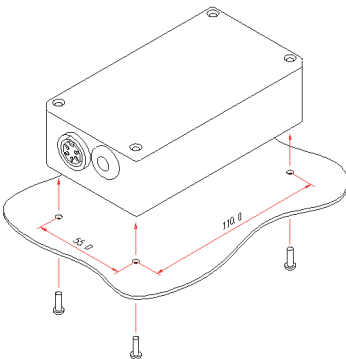
* For half-bridge only variant see section 6.0.

4.0: Installation

4.1: Mounting

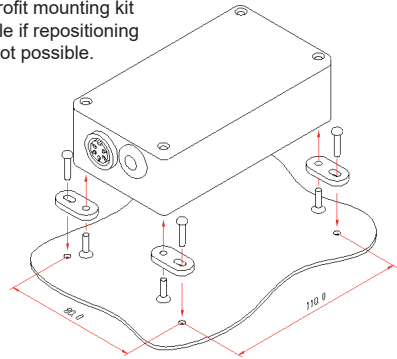
The LDX-4 may be mounted in a variety of ways and in any attitude. Ensure that there is enough space for the cover to be removed to allow for internal adjustments. Space should also be allowed for the transducer connector, EMC glands (if fitted) and cabling. It is recommended that the LDX-4 case be connected to earth or chassis. This earth connection is not a safety earth, but is part of the overall electrical screening scheme.

Underside Mounting



Top-Side Mounting

Note: If replacing LDX-4 MK1 a retrofit mounting kit is available if repositioning holes is not possible.



4.0: Installation (continued)

4.2: Operational Environment

This section discusses the type of installation required depending on the electrical environment.

4.2.1: Residential, Commercial and Light Industrial Environments

Typically, this will be an office, laboratory or industrial environment where there is no equipment likely to produce high levels of electrical interference, such as welders or machine tools.

Connections may be made using twisted, unshielded wire. This is a cost effective option and will give good performance in this environment.

Standard equipment wire such as 7/0.2 (24AWG) can be twisted together as required. Standard data cable such as generic CAT5 UTP will also give good performance.

4.2.2: Industrial Environments

Typically, this will be an industrial environment where there is equipment likely to produce high levels of electrical interference, such as welders, machine tools, cutting and stamping machines.

Connections should be made using shielded cable. Braided or foil shielded cables may be used. The cable shield should be connected to the LDX-4 case at cable entry point. The case of the LDX-4 should be connected to a local ground. An EMC cable gland is recommended. This is supplied with the LDX-4.

When selecting the type of wire or cable to be used, consider the following parameters:

- Screening.
- Conductor size (resistance).
- Mechanical aspects such as flexibility and robustness.

This is not a complete list. Installations may require other special cable characteristics.

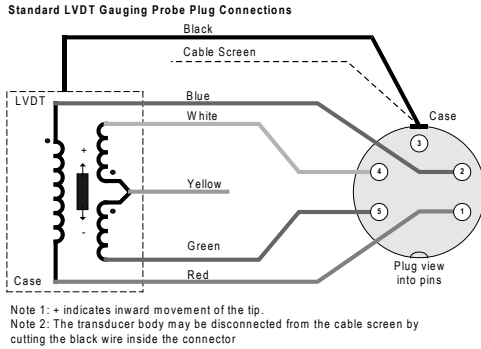
4.3: Electrical Connections

The LDX-4 requires three connections.

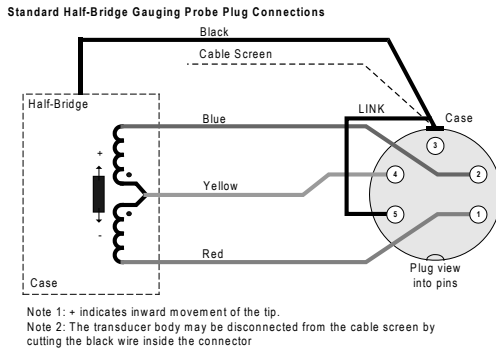
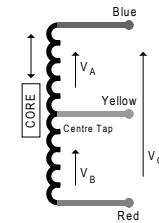
1. Transducer.
2. Power Supply.
3. Output Signal, Voltage or Current.

A small hole should be made in the grommet prior to passing the wires through. If a shielded cable is to be used, an EMC cable gland is recommended (see section 4.7).

4.4: Connecting the Transducer (continued)



Half-Bridge Electrical Connections	
Red and Blue	Energizing
Yellow	Signal
Red and Yellow	In Phase for Inward Displacement
Black	Transducer Body Ground



4.5: Connecting the Power Supply

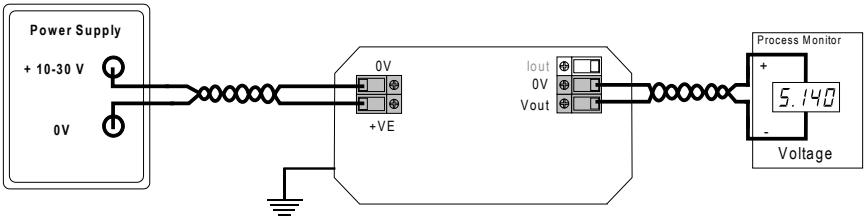
The LDX-4 requires a dc power supply in the range 10-30 V. A fully regulated supply is not required, but the voltage at the input to the LDX-4 must remain within specification. Ideally, the 0 V at the power supply should not be connected to earth or the chassis, as this would result in ground loops being formed. The 0 V supply, 0 V signal and case are all internally connected together at the LDX-4.

4.6: Connecting the Signal Out

The output signal may be voltage or current.

4.6.1: Voltage Connections

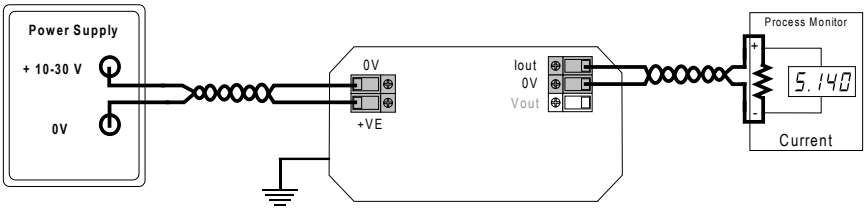
Voltage can easily be monitored using a variety of instrumentation such as voltmeters. Voltage drops along wires contribute to measurement errors, so care must be taken when using long cable lengths (100 m for example). High impedance instruments are more prone to interference.



The signal 0 V should always be used as reference. If power supply 0 V is used, then error voltages may be introduced.

4.6.2: Current Connections

Current output requires the use of purposely designed current input instrumentation. Current output is more suitable for transmitting over longer distances because current is not lost due to wiring resistance. Additionally, with a low impedance, a current loop is less likely to pick up noise.

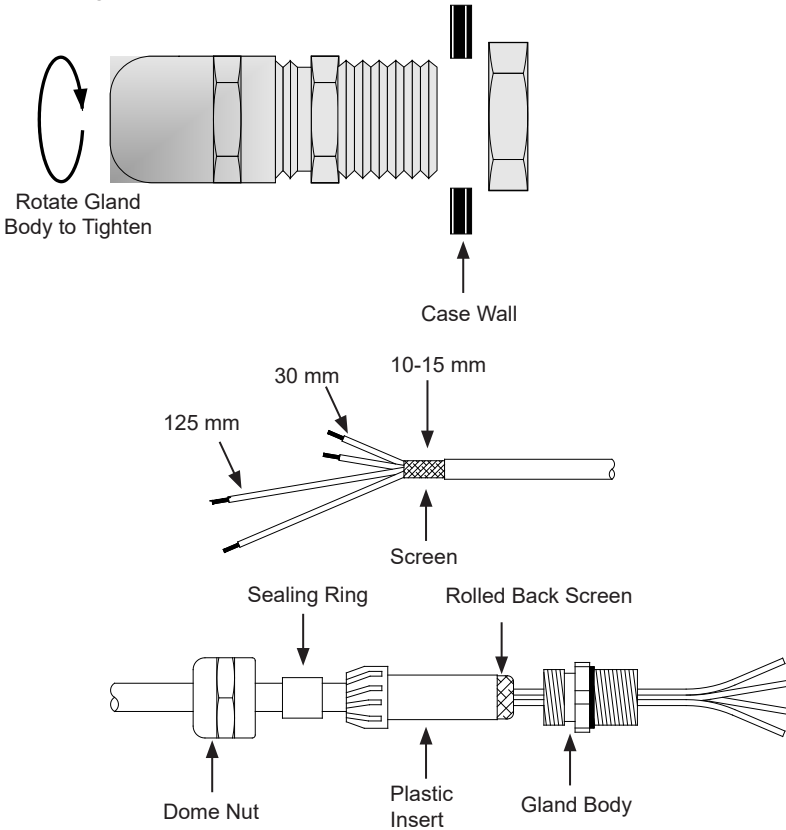


The total loop resistance (resistance of measuring equipment and wiring) must not exceed specification.

Note: The LDX-4 is not loop-powered, so a power supply must not be used in-line with the current output.

4.7: Using an EMC Cable Gland

To ensure the cable screen is properly connected to the LDX-4 case, an EMC cable gland should be used. This is supplied as an optional extra. The diagrams below assume a single 4-way cable is being used. Remove the grommet and fit the cable gland as shown below.



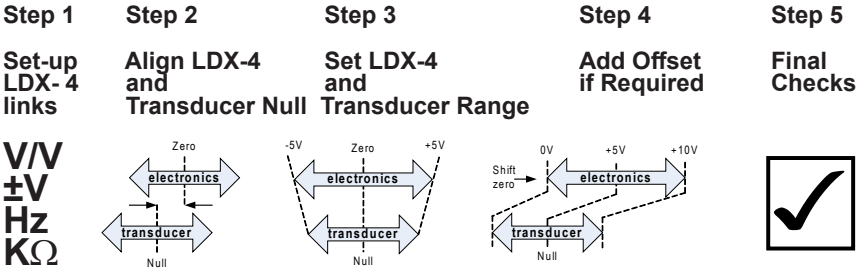
- Prepare cable as shown.
- Slide the Dome nut, sealing ring and plastic insert over cable.
- Fold and roll the screen back over itself to form a lump.
- Push cable into gland body followed by the plastic insert (ensure anti-rotation slots engage), sealing ring and Dome nut.
- Ensure all components are properly seated before tightening the dome nut.

5.0: Setting up the Transducer and LDX-4 m(continued)

5.2: Basic Procedure

To set-up the LDX-4, some basic steps should be followed.

The following steps describe a typical setting procedure and applies to most applications. Other procedures may be used as appropriate.



For a bi-polar output i.e. ± 10 VDC or ± 20 mA, follow steps 1 to 3.

For a uni-polar output i.e. 0-10 V, 0-20 mA or 4-20 mA, follow steps 1 to 4.

In either case, step 5 (final checks) should be followed on the completion of the set-up.

5.2: Basic Procedure

STEP 1 - Set-up LDX-4 Links

If the transducer characteristics are known, set the frequency and input resistance links as required. If the transducer characteristics are not known, the standard link settings should be used.

If your transducer is known to be outside of the standard sensitivity range, the X2 or DIV2 links will have to be used. See section 5.3.

STEP 2 - Align LDX-4 Null and Transducer Null

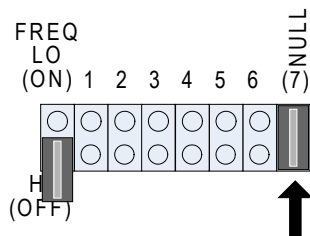
Any electrical offset in the LDX-4 is removed. The transducer position is adjusted so that transducer and LDX-4 nulls are aligned.

Null the LDX-4

1. Put the Gain link on position (7) as shown. This allows any electronics offset in the output stage to be removed.
2. Adjust the Fine Offset control to give as near to zero output as practical.

Null the transducer.

1. Replace the Gain link to the original position.
2. Adjust the position of the transducer to give as near to zero output as practical. This is the centre of the mechanical range.

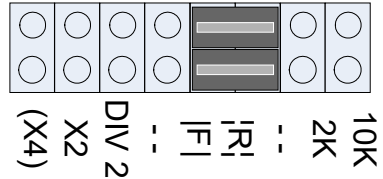
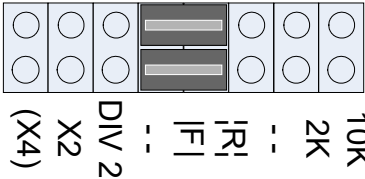


If the transducer cannot be centered for practical reasons an offset will remain within the system. There may be noticeable interaction between Gain and Offset adjustment. This does not prevent the LDX-4 being set-up, however several iterations may be required when adjusting Gain and Offset. Please contact your supplier if guidance is required.

5.2: Basic Procedure

STEP 3 - Setting Bi-Polar Full-scale Output

1. Move the transducer to the position where maximum LDX-4 output is required.
2. If the polarity of the output is wrong, move the Polarity (FR) links to the R position (see link diagram).



3. Move the RANGE link between 1 and 6 until the LDX-4 output is near the required value.
4. Adjust the Fine Gain control to give the required output.
5. A bi-polar output has now been set, proceed to step 5. If a uni-polar output is required, proceed to step 4.

Example: ± 10 VDC is required from a ± 1 mm transducer. Set the transducer to ± 1 mm and set the output to 10 V.

If your transducer is known to be outside of the standard sensitivity range, the X2, X4 or DIV2 links will have to be used. See section 5.3.

STEP 4 - Setting Uni-polar Full-Scale Output (adding an offset)

1. Move the transducer to the null position. LDX-4 output will be 0 V or 0 mA.
2. Apply offset using the +VE, -VE, 5 V and 10 V links and then adjust the Fine Offset control to set the offset precisely.
3. Perform final checks, step 5.

Example: 0-10 V is required for a ± 1 mm transducer. Set the transducer to give ± 5 V over the full range and then, with the transducer at null, add +5 V offset. Adjust the Fine Offset control to give 5 V. When the transducer is moved to the +1 mm position, the output will be +10 V.

Example: 4-20 mA is required for a ± 1 mm transducer. Set the transducer to give ± 8 mA over the full range and then, with the transducer at null, add +2.5 V (approx. 5 mA) offset. Adjust the Fine Offset control to give +12 mA. When the transducer is moved to the +1 mm position, the output will be +20 mA.

STEP 5 - Final Checks

Ensure that the calibration is correct by moving the transducer across the required mechanical range, checking calibration points. Fine adjustment can be made if required.

It may only be possible to set the output accurately at the two calibration points. This is due to non-linearity within the transducer.

5.3: Transducer Sensitivity and the X2, X4, DIV2 Link

The LDX-4 compensates for changes in primary signal amplitude by producing an internal error signal that is the ratio between the primary and secondary signals. If the transducer output signal is too high or too low, errors may occur that can degrade the performance of the LDX-4 / transducer combination. For these transducers, the X2, X4 or DIV2 input gain link must be used.

5.3: Transducer Sensitivity and the X2, X4, DIV2 Link

Transducer Full Range Output

In general, transducer sensitivity is quoted as **mV/V/mm**

Where:

mV is the output of the transducer

V is the primary voltage

mm is the mechanical position of the transducer from null (usually mid mechanical range).

To get the transducer Full Range Output, multiply all three together.

Example: GP911-1 sensitivity is 210 mV/V/mm
 GP911-1 range is ± 1 mm
 LDX-4 primary voltage 3 V

Transducer Full Range Output = $210 \times 3 \times 1 = 630$ mV (0.63 V)

Set the X2, X4, DIV2 link as shown in the table below.

Transducer Full Range Output	Input Gain Link Setting
400 mV FR to 2500 mV FR	Standard Range - Link Parked on X2
2500 mV FR to 5000 mV FR	High Transducer Output - Link ON DIV2
150 mV FR to 400 mV FR	Low Transducer Output - Link ON X2
55 mV FR to 150 mV FR	Very Low Transducer Output - Link ON X4

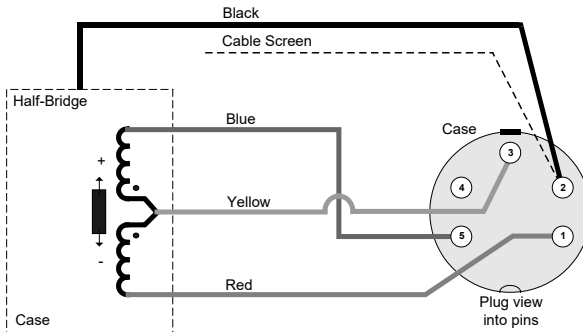
6.0: Half-Bridge only Variant

This is a half-bridge optimized variant of the standard product. The excitation frequency is higher (see specification) and the transducer input connector is wired to accept half-bridge transducers with standard connections.

6.1: Connecting the transducer

The 5-pin DIN plug is screwed into the case mounted socket. Transducers not fitted with a plug should be wired to the plug supplied. LVDT transducers cannot be connected to this input.

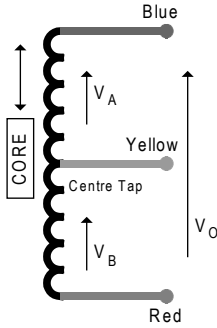
Standard Half-Bridge Gauging Probe Plug Connections



Note 1: + indicates inward movement of the tip.

Note 2: The transducer body may be disconnected from the cable screen by cutting the black wire inside the connector

6.1: Connecting the transducer



Half-Bridge Electrical Connections

Red and Blue Energizing
 Yellow Signal
 Red and Yellow In Phase for Inward Displacement
 Black Transducer Body Ground

6.2: Setting up the Half-Bridge Transducer

The setting up procedure is the same as LVDT transducers. See section 5. The sensitivity of half-bridge transducers is generally lower than for LVDT types, the x2 and x4 gain position may have to be used.

7.0: Specifications

7.1: Electrical

Parameter	Value	Comments
Power Supply		
Typical Voltage / Current	24 VDC at 55 mA	
Voltage Range	10 to 30 VDC	
Current Range	140 mA at 10 V to 50 mA at 30 V	
Transducer Excitation		
Energizing Voltage	3 Vrms nominal	see note 1
Energizing Frequency	2.5 kHz (Lo) or 5 kHz (Hi) nominal 10 kHz (Lo) or 13 kHz (Hi)	link selectable Half-Bridge version only
Energizing Current	30 mA max.	
Transducer Signal Input		
Input Signal Range Standard	400 to 2500 mV FR	6 gain ranges (applies to LVDT only)
Special	DIV2 2500 to 500 mV FR x2 150 to 400 mV FR x4 55 to 150 mV FR	see note 2
Input Load Resistance	2, 10, 10 KΩ	link selectable
Options	Forward and Reverse LVDT Input Half-Bridge Input	link selectable standard special plug wiring or half-bridge version only

7.1: Electrical

Parameter	Value	Comments	
Signal Output			
Output Voltage Range	up to ± 10 VDC into 1 K Ω	see notes 3 and 4	
Output Residual Noise	<1 mVrms		
Output Current	up to ± 20 mA into 150 Ω load	see note 5	
Output Offset	Coarse	± 5 VDC (approx 10 mA) fixed	link selectable
		± 10 VDC (approx 20 mA) fixed	link selectable
	Fine	± 2.8 VDC (approx 5.6 mA)	Variable (adds to fixed offsets)
Temperature Coefficient Gain	<0.01% FRO/ $^{\circ}$ C		
Temperature Coefficient Offset	<0.01% FRO/ $^{\circ}$ C		
Warm-Up	15 minutes recommended		
Linearity	<0.1% FRO		
Bandwidth (-3dB)	500 Hz typical		
Protection (see note 6)			
Power Supply	Reverse connection protected		
Inputs and Outputs	Short circuit protected Transient and ESD Protected		
Certification (see note 7)			
Immunity	BS EN61000-6-2:2001	Immunity for Industrial Environments	
Emissions	BS EN61000-6-3:2001	Emission for Residential, commercial and light-industrial environments	

7.2: Mechanical and Connections

Parameter	Value	Comments
Transducer	5-pin circular DIN	
Power Supply	Internal Terminal Block	
Output Signal	Internal Terminal Block	
Enclosure - Size	120 x 65 x 40 mm	Excluding connectors
Weight	300 g (0.66 lbs) approx.	
Material of Case	Die-Cast Zinc Alloy (painted)	

7.3: Environmental

Parameter	Value	Comments
Operating Temperature Range	0 - 60°C	
Storage Temperature Range	-20 - 85°C	see notes 3 and 4
IP Rating	IP40	

7.4: Notes

1. Primary voltage absolute value and drift is not specified. The LDX-4 uses ratio-metric techniques to compensate for primary voltage drift.
2. The way in which the LDX-4 functions means a special configuration must be used for transducers outside of the standard range. This is selectable by links. The majority of Omega LVDT transducers are within the standard range. See section 5.
3. LDX-4 can drive into a 1 K Ω load but this offers no advantage. 10-100 K Ω is recommended.
4. Output voltage range can be adjusted as required anywhere within this range by using a combination of gain and offset, for example. ± 10 VDC, ± 5 VDC, 0-5 VDC, 0-10 VDC, 4-20 mA.
5. Current output may be used at the same time as voltage output. Calibration of voltage and current cannot be individually adjusted.
6. Protection applies to the product when fully installed according to the user manual. During installation the top of the enclosure has to be removed for access to user adjustments. At this time standard ESD handling precautions for electronic equipment should be followed.
7. The LDX-4 complies with the toughest electrical emissions and immunity regulations. Compliance requires installation according to the user manual. Compliance does not guarantee performance as the installation environment may be outside of test specification limits. The flexibility of LDX-4 means it can be installed in a variety of ways according to user requirements. Simple installations with short non-screened cables will meet the lesser light-industrial immunity regulations. Heavy industrial installations, especially with longer cables, will need more careful installation with screened cables.

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.

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

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

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

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.

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