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OM-USB-2404-60
4-Channel Voltage Input USB Data Acquisition Module

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

Table of Contents

About this User's Guide

What you will learn from this user's guide

This user's guide describes the Omega Engineering OM-USB-2404-60 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

bold text — **Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

italic text — *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

Where to find more information

Additional information about OM-USB-2404-60 hardware is available on our website at www.omega.com. You can also contact Omega Engineering by phone, fax, or email with specific questions.

- Phone: (203) 359-1660
- Fax: (203) 359-7700
- Email: das@omega.com

Safety guidelines

You can connect hazardous voltages to the OM-USB-2404-60 device's screw terminals. A hazardous voltage is a voltage greater than 42.4 V_{pk} or 60 VDC to earth ground. Take the following precautions if you connect hazardous voltages to the OM-USB-2404-60:

Caution! Ensure that hazardous voltage wiring is performed only by qualified personnel adhering to local electrical standards.

Do not mix hazardous voltage circuits and human-accessible circuits on the same device.

Make sure that devices and circuits connected to the OM-USB-2404-60 are properly insulated from human contact.

When device terminals are hazardous voltage LIVE (>42.4V_{pk}/60 VDC), ensure that devices and circuits connected to the OM-USB-2404-60 are properly insulated from human contact. Use the OM-ACC-160 connector backshell kit to ensure that the terminals are not accessible.

Introducing the OM-USB-2404-60

The OM-USB-2404-60 is a USB 2.0 high-speed device that is supported under popular Microsoft® Windows® operating systems. The OM-USB-2404-60 is fully compatible with both USB 1.1 and USB 2.0 ports.

The OM-USB-2404-60 provides four channels of 24-bit simultaneous analog inputs.

The maximum sampling rate is 50 kS/s per channel, and the input voltage range is ±60 V, nominal.

An anti-alias filter removes noise that may be present in the signals prior to conversion. A 250 Vrms channel-to-channel and channel-to-ground isolation protects the device and computer from ground spikes, and ensures a reliable data stream. An on-board LED indicates the status of the device.

Field connections are made to four 2-position detachable screw terminals. Ten additional two-position connectors are available with the optional OM-ACC-102 connector kit.

The USB 2.0 high-speed driver transfers data at rates up to 480 Mbps. The OM-USB-2404-60 is powered by the +5 volt USB supply from your computer. No external power is required.

Functional block diagram

OM-USB-2404-60 functions are illustrated in the block diagram shown here.

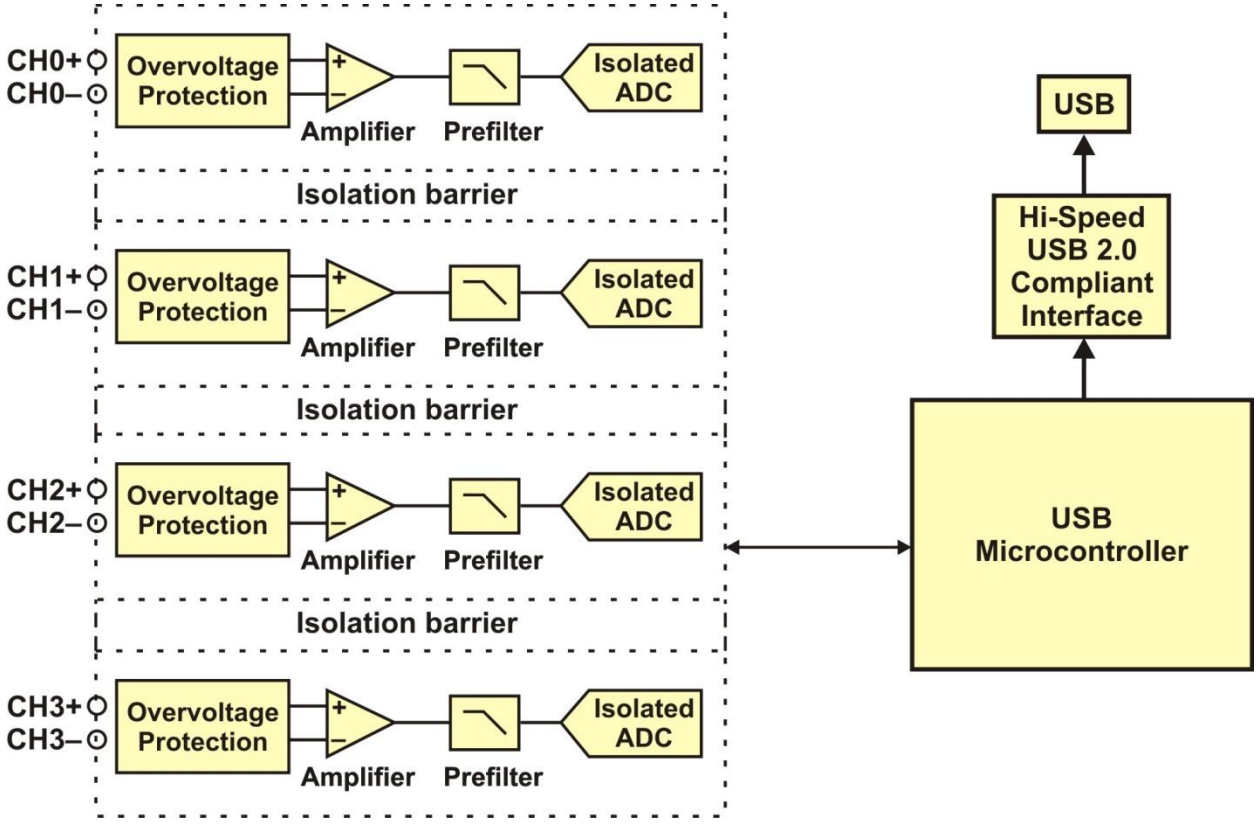

Figure 1. OM-USB-2404-60 functional block diagram

Installing the OM-USB-2404-60

What comes with your shipment?

As you unpack your OM-USB-2404-60, verify that the following components are included.

Hardware

- OM-USB-2404-60
- USB cable

Software

- Software for OMB-DAQ-2400, OM-USB, OM-WEB, and OM-WLS Series Data Acquisition Modules CD

Documentation

In addition to this hardware user's guide, you should also receive the *OMB-DAQ-2400, OM-USB, OM-WEB, and OM-WLS Series Data Acquisition Software User's Guide*. This booklet provides an overview of the software you received with the device, and includes information about installing the software.

Optional accessories

- OM-ACC-102 — Two-position screw terminal connector blocks (quantity ten).
- OM-ACC-160 — Backshell for use with the OM-ACC-102 two-position screw terminal connector blocks. Provides strain relief and operator protection from high-voltage signals (quantity six).

Unpacking

As with any electronic device, take care while handling to avoid damage from static electricity. Before removing the device from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If any components are missing or damaged, notify Omega Engineering immediately by phone, fax, or e-mail.

- Phone: (203) 359-1660
- Fax: (203) 359-7700
- Email: das@omega.com

Installing the software

Refer to the *Software User's Guide* for instructions on installing the software. This booklet ships with the hardware, and is available in PDF at http://www.omega.com/manuals/manualpdf/M4803.pdf.

Installing the hardware

Install the software before you install your device

The driver needed to run the OM-USB-2404-60 is installed when you install the software. Therefore, you need to install the software you plan to use before you install the hardware.

To connect the OM-USB-2404-60 to your system, connect the USB cable to an available USB port on the computer or to an external USB hub connected to the computer. Connect the other end of the USB cable to the USB connector on the device. No external power is required.

When connected for the first time, a **Found New Hardware** dialog opens when the operating system detects the device. When the dialog closes, the installation is complete. The LED on the OM-USB-2404-60 blinks steadily to indicate that the device is initialized and receiving power.

Allow the OM-USB-2404-60 to operate for at least 30 minutes before using the device. This warm up time is required to achieve the specified rated accuracy of measurements.

Calibrating the hardware

The OM-USB-2404-60 is shipped fully calibrated. Calibration coefficients are stored in EEPROM. Return the device to Omega Engineering when calibration is required. The recommended calibration interval is once per year.

Functional Details

Components

The OM-USB-2404-60 has the following external components:

- Screw terminal connectors
- USB port
- LED
- Strain relief slot

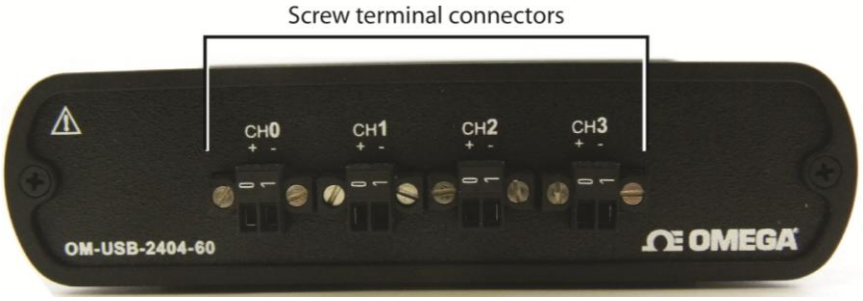

Figure 2. Front panel

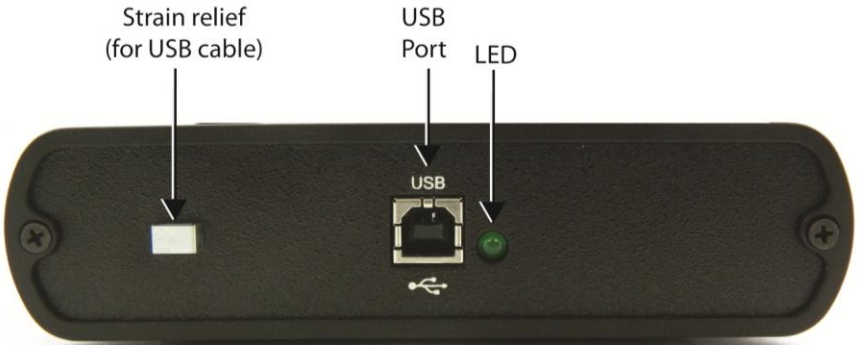

Figure 3. Rear panel

Screw terminals (CH0 to CH3)

The OM-USB-2404-60 has four 2-terminal detachable screw terminals for connection to four isolated analog inputs. The maximum sampling rate is 50 kS/s per channel, and the input voltage range is ±60 V, nominal. The channels may be sampled individually or simultaneously. Signal assignments are listed in the following table.

Screw terminal pin assignments

Screw terminal	Signal
0	CH0+ (CH0 IN HI)
1	CH0– (CH0 IN LO)
0	CH1+ (CH1 IN HI)
1	CH1– (CH1 IN LO)
0	CH2+ (CH2 IN HI)
1	CH2– (CH2 IN LO)
0	CH3+ (CH3 IN HI)
1	CH3– (CH3 IN LO)

Use 16 AWG to 28 AWG wires to connect signals to the device.

USB connector

The USB connector provides +5 V power and communication. The voltage supplied through the USB connector is system-dependent, and may be less than 5 V. No external power supply is required.

LED

The LED indicates the device status. When connected to a USB port, the LED blinks steadily to indicate that the device is initialized and receiving power. Refer to the following table for the possible LED states.

LED states

LED State	device status
Off	The device is not connected to a USB port or hub.
Continuous single-blink	The device is operating normally.
Continuous double-blink	The device is connected to a USB 1.1 Full-Speed port or hub, which may affect performance. Optimum performance requires connections to a USB 2.0 Hi-Speed host controller (480 Mbps) and USB 2.0 high-speed hubs.

Strain relief slot

Use the strain relief slot to keep the USB cable from disconnecting from the device inadvertently. Feed a tie wrap through the slot and secure to the USB cable when it is connected to the device.

High-voltage applications

For high voltage applications, we recommend using the OM-ACC-160 backshell to ensure that the terminals are not accessible. The backshell also provides strain relief to protect the screw terminals.

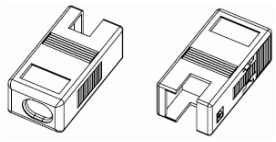

Figure 4. Connector backshell (OM-ACC-160 accessory)

Signal source connections

You can connect ground-referenced or floating signal sources to the OM-USB-2404-60.

- Connect the positive signal of the signal source to the CH+ screw terminal.
- Connect the negative signal of the signal source to the CH – screw terminal.

The following figures show the connections between the OM-USB-2404-60 and both a grounded signal source and a floating signal source.

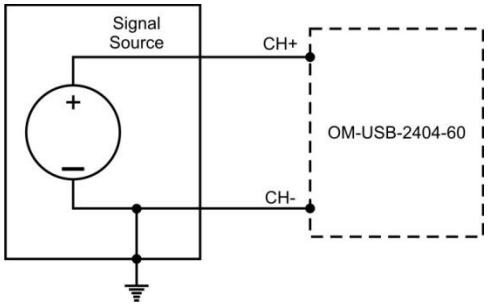

Figure 5. Connecting a grounded signal source

When making a ground-referenced connection between the signal source and the OM-USB-2404-60, make sure the voltage on the CH+ and CH– connections are within the channel-to-earth safety voltage range. Refer to the *Specifications* chapter for information about operating voltages and overvoltage protection.

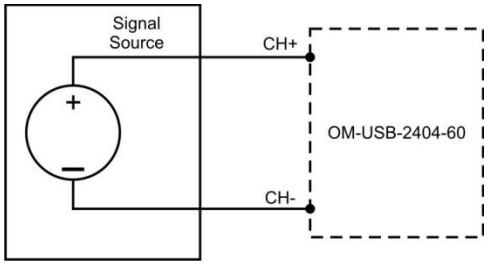

Figure 6. Connecting a floating signal source

Don't connect to signals or use for measurements within category III or IV

Refer to the "*Safety voltages"* section in the *Specifications* chapter for information about Measurement Categories.

Analog input circuitry

The OM-USB-2404-60 analog input channels are floating with respect to earth ground and to each other. The incoming analog signal on each channel is conditioned, buffered, and then sampled by a 24-bit Delta-Sigma ADC. Each channel provides an independent signal path and ADC, enabling you to sample all four channels simultaneously. Figure 7 shows the circuitry for one analog input channel.

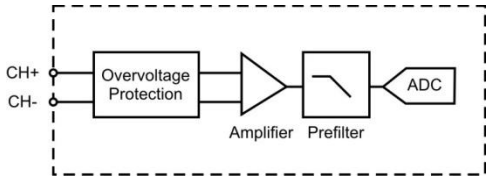

Figure 7. Analog input circuitry for one channel

Filtering

The OM-USB-2404-60 uses a combination of analog and digital filtering to provide an accurate representation of in-band signals while rejecting out-of-band signals. The filters discriminate between signals based on the frequency range, or bandwidth, of the signal. The passband, stopband, and alias-free bandwidths are important.

The OM-USB-2404-60 represents signals within the passband frequency, as quantified primarily by passband ripple and phase nonlinearity. All signals within the alias-free bandwidth are either unaliased signals or signals that have been filtered by at least the amount of the stopband rejection.

Passband bandwidth

The signals within the passband bandwidth have frequency-dependent gain or attenuation. The small amount of variation in gain with respect to frequency is called the *passband flatness*. The device's digital filters adjust the frequency range of the passband to match the data rate. Therefore, the amount of gain or attenuation at a given frequency depends on the sample rate. Figure 8 shows typical passband flatness for the 50 kS/s sample rate.

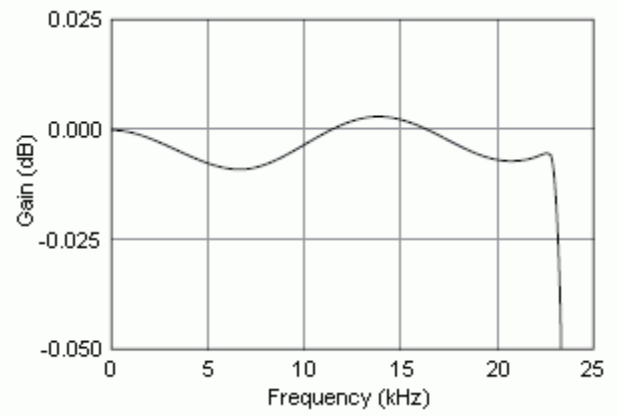

Figure 8. Passband response (typical)

Stopband bandwidth

The filter significantly attenuates all signals above the stopband frequency ($0.547 \cdot f_s$, where f_s is the sample rate). The filter is used primarily to prevent aliasing. Therefore, the stopband frequency scales precisely with the sample rate.

The stopband rejection (100 dB) is the minimum amount of attenuation applied by the filter to all signals with frequencies within the stopband bandwidth.

Alias-free bandwidth

Any signal that appears in the alias-free bandwidth of the OM-USB-2404-60 is not an aliased artifact of signals at a higher frequency. The alias-free bandwidth ($0.453 \cdot f_s$) is defined by the ability of the filter to reject frequencies above the stopband frequency. The alias-free bandwidth equals the sample rate minus the stopband frequency.

Sample rates

A master timebase frequency (f_M) controls the OM-USB-2404-60 sample rate (f_S). The internal master timebase frequency is 12.8 MHz.

The equation below provides the available sample rates of the OM-USB-2404-60:

$$f_S = \frac{(f_M \div 256)}{n}$$, where *n* is any integer from 1 to 31

The sample rate must keep the device within the sample rate range. Refer to the *Specifications* chapter for more information about the sample rate range.

Using the internal master timebase of 12.8 MHz results in sample rates of 50 kS/s, 25 kS/s, 16.67 kS/s and so on down to 1.613 kS/s, depending on the value of *n*.

Specifications

All specifications are subject to change without notice.
Typical for the range 0 to 60 °C unless otherwise noted.
All voltages are relative to the CH– signal on each channel unless otherwise noted.

Analog input

Table 1. Analog input specifications

Parameter	Conditions	Specification
Number of channels		4
A/D converter resolution		24-bit
A/D converter type		Delta-Sigma with analog pre-filtering
Sampling mode		Simultaneous
Sample rate range (f_s)		Minimum: 1.613 kS/s Maximum: 50 kS/s (Note 1)
Sample rates (f_s)		$\frac{(f_M \div 256)}{n}, n = 1, 2, \ldots 31$
Internal master timebase (f_M)		Frequency: 12.8 MHz Accuracy: ±100 ppm maximum
Input voltage ranges	CH+ to CH–	±60 V, nominal ±62.64 V, typical ±61.5 V, minimum
Overvoltage protection		±100 V
Input coupling		DC
Input impedance	CH+ to CH–	1 MΩ
Input noise		320 µV rms
Gain drift		±5 ppm/ºC
Offset drift		±150 µV/ºC
Post calibration gain match	channel-to- channel, 20 kHz	0.22 dB maximum
Crosstalk	1 kHz	–130 dB
Phase mismatch	channel-to- channel	0.045º/kHz maximum
Phase nonlinearity	f_s = 50 kS/s	0.11º maximum
Input delay		$38.4/f_s$ +2.6 µs
Passband frequency		0.453 · f_s
Passband flatness	f_s = 50 kS/s	±100 mdB maximum
Stopband frequency		0.547 · f_s
Stopband rejection		100 dB
Alias-free bandwidth		0.453 · f_s
–3 dB pre-filter bandwidth	f_s = 50 kS/s	24.56 kHz
Common mode rejection ratio (CMRR)	f_{in} = 60 Hz	116 dB
Spurious free dynamic range (SFDR)	1 kHz, –60 dBFS	–128 dBFS
Total harmonic distortion	1 kHz, –1 dBFS	–99 dB
	1 kHz, –20 dBFS	–105 dB

Note 1: Full performance requires connections to a USB 2.0 Hi-Speed host controller and USB 2.0 high-speed hubs.) The maximum sample rate may be lower on USB 1.1 ports.

Accuracy

Table 2. Analog input accuracy

Measurement conditions	Percent of reading (gain error)	Percent of range (offset error) (Note 2)
Calibrated maximum (–0 to 60 ºC)	±0.13%	±0.05%
Calibrated typical (25 ºC, ±5 ºC)	±0.03%	±0.008%
Uncalibrated, maximum (–0 to 60 ºC)	±1.2%	±0.55%
Uncalibrated, typical (25 ºC, ±5 ºC)	±0.3%	±0.11%

Note 2: The range is equal to 62.64 V.

Power

Table 3. Power specifications

Parameter	Specification
Current consumption from USB	500 mA, maximum

Bus interface

Table 4. Bus specifications

Parameter	Specification
USB specification	USB 2.0 Hi-Speed mode (480 Mbps) is recommended. Otherwise, USB 1.1 Full-Speed mode (12 Mbps)

Environmental

Table 5. Environmental specifications

Parameter	Specification
Operating temperature range	0 to 60 °C
Storage temperature range	–40 to 85 °C
Operating humidity	10 to 90% relative humidity, non-condensing
Storage humidity	5 to 95% relative humidity, non-condensing
Maximum altitude	2000 meters (6561.679 feet)
Pollution degree (IEC60664)	2

Mechanical

Table 6. Mechanical specifications

Parameter	Specification
Dimensions	4.5" L x 5.5" W x 1.5" H
Weight	1.2 lbs. (544 grams)

Safety voltages

Table 7. Safety specifications (Note 3)

Parameter	Conditions	Specification
Channel-to-earth ground isolation	Continuous	250 Vrms, Measurement Category II (Note 4)
	Withstand	2,300 Vrms, verified by a 5 sec dielectric withstand test
Channel-to-channel isolation	Continuous	250 Vrms, Measurement Category II (Note 4)
	Withstand	1390 Vrms, verified by a 5 sec dielectric withstand test

Note 3: Connect only voltages that are within the limits specified in this table.

Note 4: Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example 115 V for US or 230 V for Europe.

Caution! Do not connect the device to signals or use for measurements within Measurement Categories III or IV.

Screw terminal connectors

Table 8. Screw terminal connector specifications

Connector type	Screw terminal
Screw terminal wiring	16 to 28 AWG copper conductor wire with 7 mm (0.28 in.) of insulation stripped from the end.
Torque for screw terminals	0.22 to 0.25 N· m (1.95 to 2.21 lb. · in.)

Table 9. Screw terminal assignments

Screw terminal	Signal
0	CH0+ (CH0 IN HI)
1	CH0– (CH0 IN LO)
0	CH1+ (CH1 IN HI)
1	CH1– (CH1 IN LO)
0	CH2+ (CH2 IN HI)
1	CH2– (CH2 IN LO)
0	CH3+ (CH3 IN HI)
1	CH3– (CH3 IN LO)

Accessory products

Table 10. Screw terminal connector specifications

ACC-102	Two-position detachable screw terminal connector blocks (quantity ten)
ACC-160	Backshell for use with the ACC-102 two-position screw terminal connector blocks. Provides strain relief and operator protection from high-voltage signals (quantity four)

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:

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

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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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