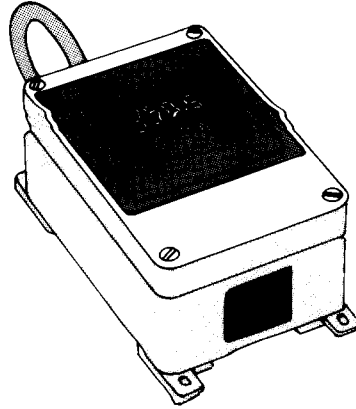


Ω LV401, LV402, LV403, LV404

**Ω Non-Contact Ultrasonic
Level/Distance Transmitters**



Operator's Manual

The OMEGA Complete Measurement and Control Handbooks & Encyclopedias

- ✓ Temperature
- ✓ Pressure, Strain & Force
- ✓ Flow and Level
- ✓ pH and Conductivity
- ✓ Data Acquisition Systems
- ✓ Electric Heaters
- ✓ Environmental Monitoring and Control



Call for Your **FREE** Handbook Request Form Today: (203) 359-RUSH

DFM0495MAJ2BA



Servicing USA and Canada: Call OMEGA Toll Free

USA

One Omega Drive, Box 4047
Stamford, CT 06907-0047
Telephone: (203) 359-1660
FAX: (203) 359-7700

Canada

976 Bergar
Laval (Quebec) H7L 5A1
Telephone: (514) 856-6928
FAX: (514) 856-6886

Sales Service: 1-800-826-6342 / 1-800-TC-OMEGASM
Customer Service: 1-800-622-2378 / 1-800-622-BESTSM
Engineering Service: 1-806-872-9436 / 1-800-USA-WHENSM
TELEX: 996404 EASYLINK: 62968934 CABLE: OMEGA

Servicing Europe: United Kingdom Sales and Distribution Center

25 Swannington Road, Broughton Astley, Leicestershire
LE9 6TU, England
Telephone: 44 (1455) 285520 FAX: 44 (1455) 283912

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING 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.

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

1. P.O. 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 OR **CALIBRATION**, consult OMEGA for current repair/calibration charges. Have the following information available BEFORE contacting OMEGA:

1. P.O. number to cover the COST of the repair/calibration.
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. We provide our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Copyright 1995 OMEGA ENGINEERING, INC. All rights reserved. This documentation may not be copied, reproduced, translated, or reduced to any electronic medium or machine-readable form, in whole or in part, without prior written consent of OMEGA ENGINEERING, INC.

TABLE OF CONTENTS
LV400 SERIES

SECTION	PAGE
SECTION 1 INTRODUCTION	1
1.1 General Description	1
1.2 Features	1
1.3 Available Models	2
SECTION 2 INSTALLATION	2
2.1 Unpacking	2
2.2 Installation and Wiring	3
SECTION 3 OPERATION	8
3.1 Power On	8
3.2 Protocol Commands	9
3.3 Setting Limits.....	9
3.4 Temperature Compensation Mode	9
3.5 Gain Adjustment.....	10
SECTION 4 SPECIFICATIONS	12

SECTION 1 INTRODUCTION

1.1 GENERAL DESCRIPTION

OMEGA's LV400 Series non-contact ultrasonic distance transmitter measures, displays and transmits the distance of objects located in front of the sensor in the range from 0.5 to 30 feet, with an accuracy of up to 1%. It is suitable for measuring liquid levels in tanks open to the air (0 internal PSIG), certain solid levels (consult Flow department for details), as well as other general distance measurements. All units feature a 4-digit LED display with 0.1 inch resolution. Versions are available with one or two alarm relays, analog 4-20 mA, 0-3, or 0-10 VDC outputs, RS-232 or RS-422 two-way computer communications, and a remote transducer with up to 40 feet of cable.

Setting the limits of the LV400 alarms and analog output can be performed manually by presenting targets at the desired setpoints, or by entering the exact distance value (in inches) by computer communication. Alarm setpoints equal the analog output span. Temperature compensation for variations in air temperature is done automatically by placing a reference target at an exact distance away from the sensor.

1.2 FEATURES

- Manual or Computer Programmable
- Relay Output, Analog Outputs
- Serial ASCII, 9600 Baud Communications

- 4-Digit LED Display
- Optional Remote Sensor

1.3 AVAILABLE MODELS

LV401 Unit with high relay ONLY
LV402 Unit with high relay and 4-20 mA output
LV403 Unit with high relay and 0-3 VDC output
LV404 Unit with high relay and 0-10 VDC output

Add suffix "-RS232" or "-RS422" for communication option.
Add suffix "-R" for additional low relay output. Add suffix
"-RS" to reverse action of analog output (increasing output
with decreasing distance from the sensor face). Add suffix
"-RT(*)" for remote sensor, replacing asterisk with cable
length in feet up to 40.

To display height, reverse the distance display with option
"-ZO". For extended range measurement, displays in feet
(0.1) up to 60-ft., add suffix "-ER".

SECTION 2 INSTALLATION

2.1 UNPACKING

Remove the packing list and verify that all equipment has
been received. If there are any questions about the
shipment, please call OMEGA Customer Service Department
at 1-800-622-2378 or (203) 359-1660.

Upon receipt of the shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 INSTALLATION AND WIRING

Mount the instrument as is appropriate for your application. Refer to Figure 2-1. The transmitter's 12 degree beamwidth should be aimed as squarely as possible at the intended target. The transducer of the LV400 must NOT be mounted where it will be exposed to vapors which will attack the nylon, Kapton, or stainless steel construction of the transducer. Materials which attack the transducer include, but are not limited to, alkyd solvents (such as found in some printing inks) which attack Kapton and acids, such as HCL, which attack the stainless steel. In addition, the transducer must NOT be exposed to condensing vapors, such as those found above a tank of heated liquid (including water).

Connect the 12 VDC power source using the labeled leads: red (+) and black (-). Be sure the polarity is not reversed or damage to the instrument may result.

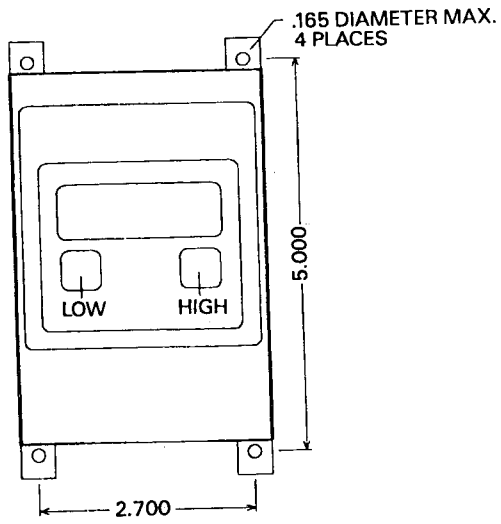


Figure 2-1. Mounting Dimensions

For relay, analog output, RS-232 and RS-422 interface connections using the standard 12-conductor cable, refer to Table 2-1.

For connections using a 15-conductor cable, refer to Table 2-2.

TABLE 2-1
WIRING CONNECTIONS, 12-CONDUCTOR CABLE

+12VDC	Red	DC POWER IN
*DC GND	BLACK	DC RETURN
RLYNO	BROWN	N.O. RELAY
RLYNC	GREEN	N.C. RELAY
RLYCOM	WHITE	COMMON RELAY
AN+	ORANGE	ANALOG OUT (mA/VDC)
*AN-	BLUE	ANALOG RETURN
TX/RX-	PINK	RS232XMIT/RS422 RECV-
RX/RX+	GRAY	RS232 RECV/RS422 RECV+
COM	TAN	RS232 COMMON
TX+	PURPLE	RS422 XMIT+
TX-	YELLOW	RS422 XMIT-

TABLE 2-2
WIRING CONNECTIONS, 15-CONDUCTOR CABLE

+12 VDC	RED	DC POWER IN
DC GND	BLACK	DC RETURN
RLYNO #1	BROWN	N.O. RELAY #1
RLYNC #1	GREEN	N.C. RELAY #1
RLYCOM #1	WHITE	COMMON RELAY #1
AN+	ORANGE	ANALOG OUT (mA/VDC)
AN-	BLUE	ANALOG RETURN
TX/RX-	WHITE/BLACK	RS232XMIT/RS422 RECV-
RX/RX+	GRAY	RS232 RECV/RS422 RECV+
COM	WHITE/RED	RS232 COMMON
TX+	PURPLE	RS422 XMIT+
TX-	YELLOW	RS422 XMIT-
RLYNO #2	WHITE/BROWN	N.O. RELAY #2
RLYNC #2	WHITE/YELLOW	N.C. RELAY #2
RLYCOM #2	WHITE/ORANGE	COMMON RELAY #2

***DC GND* and *AN-* are internally common; thus, 2 separate power supplies are recommended in order to power the unit and to power the analog.*

NOTES:

SECTION 3 OPERATION

3.1 POWER ON

The LV400 Series begins operating and making measurements as soon as power is applied. This is indicated on the numeric display which reads in inches. Echo loss or measurements that are out of range (greater than 60 feet) are indicated by four dashes (---) in the display.

3.2 PROTOCOL COMMANDS

LV400 Series commands are ASCII characters:

"L" "L123.4" sets the LOW limit to 123.4 inches.

"R" "R234.5" sets the HIGH limit to 234.5 inches.

"E" Enables LV400 Series control of the relay.

"D" Disables LV400 Series control of the relay.

"O" Opens relay if control has been disabled.

"C" Closes relay if control has been disabled.

"S" LV400 transmits status.

(Example: Terminal sends "S", LV400 returns 123.4, 234.5, EN, CL:LOW limit set at 123.4", HIGH limit set at 234.5", relay control enabled, relay closed.)

"U" Command returns the raw count. It must be multiplied in the receiving computer by the scale factor .00732421875 to convert to inches.

3.3 SETTING LIMITS

Measurement limits which control the condition of the relay can be set both manually or by computer commands (for units with serial interface4s). If a target is found inside this range, the relay is actuated, otherwise the relay remains in its normal condition.

The limits can be displayed by momentarily depressing either the "HIGH" or "LOW" limit switches. The current measurement display will be suspended for a few seconds while the limit is displayed.

Manual limit setting is performed by placing a target at the desired setpoint and pressing and holding the limit switch (LOW or HIGH) until the display reads the desired setting. The limits can be changed as often as necessary but not greater than 10,000 times. Limit setting via the serial port is accomplished using the protocol commands.

Analog signals represent the measurements and are set to maximum at or above the "HIGH" limit. They are set to minimum at or below the "LOW" limit and are scaled as 256 steps within the HI/LO range.

The standard 4-20 mA current sink requires an external voltage.

3.4 TEMPERATURE COMPENSATION MODE

The LV400 Series incorporates a high accuracy self-calibration mode ("CAL" Mode) which can be evoked manually. This mode is selected by depressing both limit

switches at the same time. The display will indicate "CAL" and toggle between "ON" and "OFF" until the switches are released. The last condition displayed before the switches are released will be selected.

3.5 GAIN ADJUSTMENT

The LV400 has been factory-tuned for general purpose level applications, and for the cable length specified at the time of order for the remote transducer (-RT) option. The cable length of the remote transducer can be altered in the field with commercially available RG62 coax cable, but this will require gain adjustment as shown below. In addition, when measuring irregular shaped solids or where dust is present, gain adjustment may also be required.

1. Remove power from the instrument.
2. Remove the front cover of the LV400 by loosening the 4 captive screws.
3. If you have the remote transducer (-RT), connect the transducer & cable to the LV400. If you are performing this adjustment on a bench, set the transducer up so that it is firmly held and is aimed at a target nominally 20' away. Neither the transducer nor the target should be free to move. Or you may perform this adjustment in the actual application.
4. Set up an oscilloscope such that it is triggered from pin 5 of the 40 controller chip.
5. Monitor pin 7 of the TL852 on the oscilloscope.
6. Apply power to the LV400 and adjust the scope unit the

target echo is displayed and prominent (adjust gain for .5v p-p max. echo).

7. Locate the variable transformer TX1 found next to the small white potentiometer in the lower left corner of the rear PCB.
8. Adjust the transformer tuning slug by turning it clockwise or counterclockwise until the echo amplitude is at a maximum. Clockwise is increasing
9. Replace the front cover and test.
10. Repeat if required.

THIS ADJUSTMENT SHOULD BE MADE BY QUALIFIED PERSONNEL ONLY AS DAMAGE MAY OCCUR IF THE INSTRUMENT IS HANDLED IMPROPERLY THEREBY VOIDING THE WARRANTY.

When using the Temperature Compensation Mode, a wire target of nominally 1/8 inch diameter must be located 6.22 inches from the face of the LV400 Series transducer.

At room temperature (68°F), prior to selecting the CAL Mode, a measurement display of 6.4" can be used to indicate the proper reference point. Once the reference target is in place, the CAL Mode can be selected. Under these conditions, measurement accuracies of better than $\pm 1\%$ can be obtained.

SECTION 4 SPECIFICATIONS

RESOLUTION:	.007" for analog, RS-232 and RS-422 output, 0.1" display The analog output is divided into 256 increments between the HI/LO limits. The best possible resolution of the analog output is .007"; the resolution could be much lower, depending upon the span of the HI/LO limits.
TEMPERATURE EFFECT:	1% shift in accuracy for every 18°F away from 68°F air temperature when not using the Auto Temp. Compensation
BEAMWIDTH:	12 degrees; target should occupy one square ft/10ft of distance for optimal performance. Consult Flow Dept. for collimator for small targets at large distance.
UPDATE RATE:	13 measurements per second
RANGE:	.5 to 30 feet
WEIGHT:	11 oz.
DIMENSIONS:	1.77" x 3.50" x 4.70"
ELECTRONICS CABLE:	72" length, 12 conductor, stripped ends

ELECTRICAL:	RS-422 or RS-232, 9600 baud, 8 bit data, no parity, 1 stop bit
PROTOCOL:	All communications are initiated by the host computer or terminal. Commands are sent to and interpreted by the LV400 Series and data is returned.
RELAY:	.25 amp @ 120 VAC resistive, SPDT
ANALOG OUTPUT:	0-3VDC, 0-10 VDC, or 4-20 mA, 256 steps within setpoints. 4-20 mA requires external 5-50 VDC power supply. Max. loop resistance = (supply voltage -5) x 53. 1000 ohms for 24 VDC supply. Standard output increases with increasing distance from sensor face.
POWER:	7.5 to 12 VDC @ 500 mA (LV404 accepts 12 VDC only)
OPERATING TEMPERATURE:	-20°F to 160°F for sensor; 32°F to 158°F for electronics
STORAGE TEMP.:	-40°F to 250°F for sensor and electronics
RELATIVE HUMIDITY:	5% to 95% for non-condensing
SENSOR CONSTRUCTION:	24K gold on Kapton film diaphragm, nylon housing with stainless steel grille

NOTES:



WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA 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 should malfunction, 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. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being 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 or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

OMEGA is glad to offer suggestions on the use of its various products. Nevertheless, OMEGA only warrants 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, 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.

Every precaution for accuracy has been taken in the preparation of this manual; however, OMEGA ENGINEERING, INC. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that result from the use of the products in accordance with the information contained in the manual.

SPECIAL CONDITION: Should this equipment be used in or with any nuclear installation or activity, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the equipment in such a manner.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE/STRAIN FORCE

- Transducers & Strain Gages
- Load Cells & Pressure Gauges
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition and Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M0992/0495