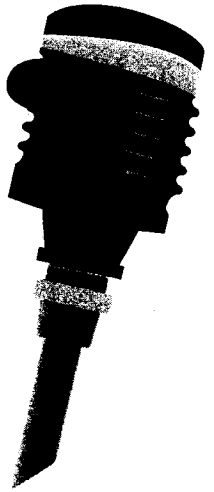
LVCN-71/-72/-73

Continuous RF Capacitance



OMEGA®

An OMEGA Technologies Company

Operator's Manual

Unpacking Instructions

Remove the Packing List and verify that you have received all equipment. If you have any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378 or (203) 359-1660.

When you receive the shipment, inspect the container and equipment for signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

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

Table of Contents

LVCN-71/-72/-73 Continuous Capacitance Manual

Safety Precautions **4**
- About this Manual 4
- User's Responsibility for Safety 4
- Proper Installation and Handling 5
- Material Compatibility 5
- Temperature and Pressure 5
- Wiring and Electrical 6
- Flammable, Explosive and Hazardous Applications 6

Introduction **7**
- About RF Capacitance Technology 7
- Table of Common Dielectric Constants 8
- Specifications 10
- Dimensional Drawings 11
- In-Tank Installation 13

Electrical, Signal and Test **15**
- Supply Voltage 15
- Signal Outputs 16
- Testing the Sensor 16

Calibration **17**

Maintenance **21**
- Cleaning Procedure 21

Unpacking and Inspection:

The following items are included in this package:

- One LVCN-71 Continuous RF Capacitance Transmitter or one LVCN-72 Continuous RF Capacitance Controller or one LVCN-73 Continuous RF Capacitance Controller with Strobe Alert.
- One LVP-30 Series Continuous RF Capacitance Sensor Assembly.
- Operator's Manual
- Warranty Card

Please fill out and return the LVCN-70 Series warranty card immediately to OMEGA.

Part Number Information:

Part #	Description	Mat'l	Size
LVCN-71	Transmitter	PP	4.5" x 2.8" x 3/4" NPT
LVCN-72	Controller	PP	4.5" x 2.8" x 3/4" NPT
LVCN-73	Controller	PP	4.5" x 2.8" x 3/4" NPT
LVP-31	Sensor Assy.	PFA	18" X 0.625"
LVP-32	Sensor Assy.	PFA	24" X 0.625"
LVP-33	Sensor Assy.	PFA	36" X 0.625"
LVP-34	Sensor Assy.	PFA	48" X 0.625"
LVP-35	Sensor Assy.	PFA	60" X 0.625"
LVP-36	Sensor Assy.	PFA	72" X 0.625"
LVP-37	Sensor Assy.	PFA	96" X 0.625"
LVP-38	Sensor Assy.	PFA	120" X 0.625"

Safety Precautions

About this Manual

PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on two different models of continuous RF capacitance systems from OMEGA: LVCN-71 and LVCN-72. Please refer to the part number located on the sensor label to verify the exact model which you have purchased.

User's Responsibility for Safety

OMEGA manufactures a wide range of liquid level sensors and technologies. While each of these sensors is designed to operate in a wide variety of applications, it is the user's responsibility to select a sensor model that is appropriate for the application, install it properly, perform tests of the installed system, and maintain all components. The failure to do so could result in property damage or serious injury. The symbol on the left appears in the manual to call special attention to instructions that affect the safe installation and use of the product.

Proper Installation and Handling

OMEGA strongly recommends the use of a proper sealant with all installations. Never overtighten the sensor within the fitting. Always check for leaks prior to system start-up.

Material Compatibility

The LVP-30 series sensors are made of FEP (Fluorinated Ethylene Propylene, also known by the trade name Teflon®). Make sure that FEP is compatible with the application liquid. To determine the chemical compatibility between the sensor and its application liquids, refer to the Compass Corrosion Guide, available from Compass Publications (619-589-9636).

Temperature and Pressure

The LVP-30 series sensor is designed for use in application temperatures up to 70 °C, and for use at pressures up to 150 psi @ 25 °C, derated @ 1.667 psi per °C above 25 °C. (See graph on page 12.)

Wiring and Electrical

A supply voltage of 14-36 Vdc is used to power the LVCN-71/72/73. These sensor systems should never exceed a maximum of 36 volts dc. Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes. The symbol on the left appears next to passages in the manual that affect the safe electrical operation of this product.

Flammable, Explosive and Hazardous Applications

The LVCN-70 Series sensor systems should not be used within flammable or explosive applications. In hazardous applications, use redundant measurement and control points, each having a different sensing technology.

Introduction

About Continuous RF Capacitance Technology

OMEGA's LVCN-70 Series sensor systems generate a 1 MHz pulse-wave radio frequency signal from the continuous capacitance sensor. When the liquid comes into contact along the length of the sensor, the capacitance as measured by the system electronics changes. These changes in capacitance are based on the length of the sensor which is in the liquid, and the dielectric constant of the liquid. OMEGA's sophisticated electronics convert the capacitance value into a simple two-wire, 4 to 20 mA output which indicates the level of the liquid in the tank.

The sensor's operation may vary based on the dielectric properties of various application liquids. The LVCN-70 Series sensor systems are factory-calibrated to be used with liquids with a dielectric value between 20 and 80.

Warning: Do not install the OMEGA Continuous RF Capacitance sensor within 6 inches of any metallic object. Metal will adversely affect the dielectric sensitivity of the sensor.

OMEGA's LVCN-70 Series sensor systems are not recommended for use with electrically charged application liquids. For most reliable operation, the liquid being measured may need to be electrically grounded.

Table of Common Dielectric Constants

NOTE: Liquids with a dielectric constant less than 20 will not be detected by the LVCN-70 Series sensor systems, as factory calibrated.

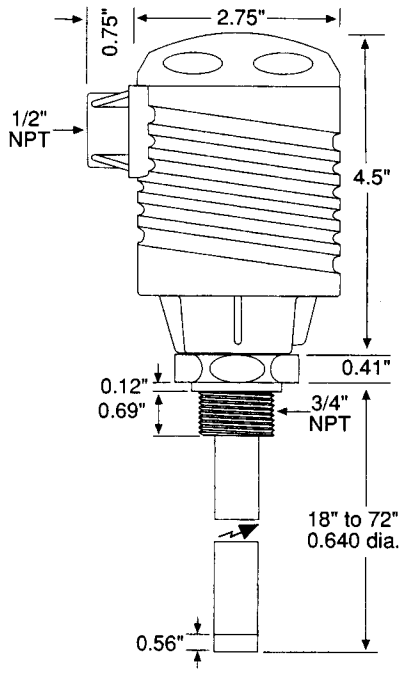
Acetone	21
Acetoaldehyde	22.2
Acetyl methyl hexyl ketone	28
Alcohol	**16** to 31
Ammonia	**15** to 25
Acetic acid	**4.1 to 6.2**
Butyl chloride	**9.6**
Barium chloride	**9 to 11**
Benzene	**2.3**
Benzine	**2.3**
Barium nitrate	**5.6**
Bromine	**3.1**
Chlorobenzene	**4.7 to 6**
Chlorotoluene	**4.7**
Chloroform	**4.5 to 5.0**
Chlorine, liquid	**2.0**
Carbon tetrachloride	**2.2**
Cyan	**2.6**
Cyclohexane methanol	**3.7**
D.I.Water	**20**
Ethyl toluene	**2.2**
Ethyl alcohol	23
Ethylene glycol	37
Ethylene oxide	**14**
Ethylene dichloride	**11 to 17**
Ethylene chloride	**10.5**
Ethyl acetate	**6.4**
Ethyl salycilate	**8.6**
Ethyl stearate	**2.9**
Ethyl silicote	**4.1**
Formic acid	59
Ferric oleate	**2.6**
Freon	**2.2**
Glycerine	47
Glycol	30
Glycol nitrite	27
Gasoline	**2 to 2.2**
Hydrochloric acid	**4.6**
Isobutyric acid	**2.7**
Isobutyl methyl ketone	**13**
Jet fuel	**1.7**
Lead carbonate	**18**
Lead nitrate	38
Methyl salycilate	**9.0**
Methanol	33
Methyl alcohol	33 to 38
Margarine, liquid	**2.8 to 3.2**

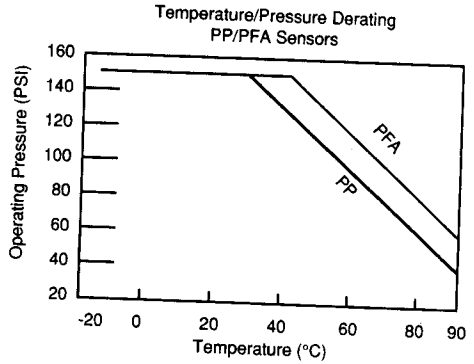
Methyl acetate	**7.3**
N-butyl formate	**2.4**
Nitrobenzene	26 to 35
Nitrotoluene	25
Nephshalene	**2.3 to 2.5**
Oils, vegetable	**2.5 to 3.5**
Oils, mineral	**2.3 to 2.4**
Oils, petroleum	**1.8 to 2.2**
Oleic acid	**2.5**
Propane, liquid	**1.8 to 1.9**
Potassium nitrate	**5.0 to 5.9**
Potassium chloride	**5.0**
Stearic acid	**2.3**
Toluene	**2.4**
Trichloroethylene	**3.4**
Trichloroacetic acid	**4.5**
Terephthalic acid	**1.5 to 1.7**
Thinner	**3.7**
Urea	**3.5**
Vinyl chloride	**2.8 to 6**
Vinyl alcohol	**1.8 to 2.0**
Water, 20°C	80
Water, 100°C	48

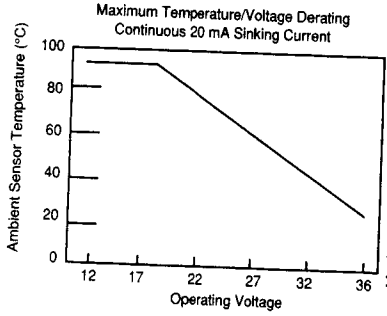
Specifications

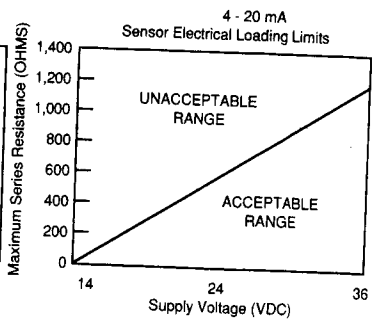
Capacitance range:	10 to 600 pF
Sensitivity:	0.5 pF max.
Max. sensor length:	120"
Dead band hysteresis:	0.5"
Dielectric range:	20 to 80 @ 1 MHz
Signal output:	4 to 20 mA (LVCN-71), 4 to 20 mA + 5A relay @ 110-220 Vac (LVCN-72/73)
Supply voltage:	14 to 36 volts dc
Wetted materials:	Fluorinated Ethylene Propylene (FEP)
Max. temp. rating:	70°C or 160°F
Max. pressure rating:	PFA: 150 psi @ 25°C, derated @ 1.667 psi per °C above 25°C. See chart on page 12.
Loop resistance:	600 ohms @ 24 Vdc
Dimensions:	See drawing on page 11. Electronic housing: 4.5 x 2.8" x 3/4" NPT. Sensor diameter: 0.625" (available in different lengths)

Dimensional Drawings




Temperature/Pressure Derating
PP/PFA Sensors
Operating Pressure (PSI)
160
140
120
100
80
60
40
20
PFA
PP
-20
0
20
40
60
80
90
Temperature (°C)


Maximum Temperature/Voltage Derating
Continuous 20 mA Sinking Current
Ambient Sensor Temperature (°C)
100
80
60
40
20
0
12
17
22
27
32
36
Operating Voltage


4 - 20 mA
Sensor Electrical Loading Limits
Maximum Series Resistance (OHMS)
1,400
1,200
1,000
800
600
400
200
0
UNACCEPTABLE
RANGE
ACCEPTABLE
RANGE
14
24
36
Supply Voltage (VDC)

Installation

In-Tank Installation

OMEGA's LVCN-70 Series sensors may be threaded into a 3/4" NPT coupling, pipe, and fitting assembly, which is installed through the top wall of the tank. If no tank top is available, the assembly may be installed to the side wall of the tank, using OMEGA's side mount bracket (LVM-30) and a 2" NPT male adapter.

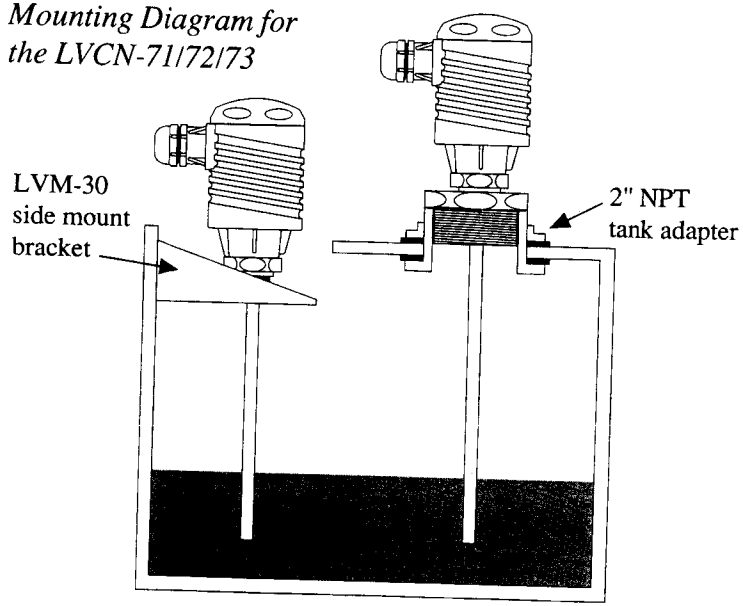
1. **3/4" NPT Coupling, Pipe and Fitting:** Select the appropriate 3/4" NPT couplings, pipe and fittings to achieve the desired installation. Make sure that the threads of the fitting components are not damaged or worn. If damaged, use new components for installing the LVCN-70 Series sensor systems.

2. **Sealant:** The sensor and its fitting components should be assembled with the use of a sealant. Apply the appropriate amount of sealant around the threads of the sensor.

3. **Crescent Wrench:** Insert the sensor into the coupling by hand and rotate the sensor's body clockwise until hand tight. Using a crescent wrench, tighten the sensor a minimum of 1/2 additional turn, or up to a maximum of 80 inch-pounds

torque. Be careful not to overtighten the sensor within the coupling. Always check for leaks prior to system start-up.

Mounting Diagram for the LVCN-71/72/73



Electrical, Signal and Test

General

Electrical wiring and use of the LVCN-70 Series sensor systems should be performed in accordance with all applicable national, state and local codes.

Supply Voltage

The supply voltage to the LVCN-70 Series sensor systems should never exceed a maximum of 36 Vdc.

1. **Power**: Before installation, make sure that all power to the sensor, controller and/or power supply is completely disconnected.

2. **Required Cable Length**: Determine the length of cable required between the LVCN-71/72/73 sensor system and its point of termination. Allow enough slack to ensure the easy installation, removal and/or maintenance of the system. The cable length may be extended up to a maximum of 1000 feet, using a well-insulated, 22 gauge twin-pair shielded wire.

3. **Conduit and Termination**: To ensure the protection of the sensor's power and signal wires, use proper conduit and means of termination.

Signal Outputs

The standard signal output of the LVCN-70 Series sensor systems is 4 to 20 mA. The LVCN-72 has an additional 5A @ 110-220 Vac relay output. Select one of the following means of connection to achieve the desired signal output.

4 to 20 mA Signal Output

Connect the red wire to the appropriate terminals of the 14 – 36 Vdc power supply. Connect the black wire to the appropriate terminals for signal output. Proper polarity must be observed. For longer cable runs, make sure to connect the shield wire to a grounding terminal.

Testing the Sensor

1. **Power:** Apply power to sensor, by connecting power to the power supply.
2. **Immersing the Sensor:** OMEGA recommends calibration of the sensor in the application liquid and tank.
3. **Test:** With the sensor being wetted between low and high levels of liquid, use a multimeter in series with the signal wires to ensure that the correct signals are being produced by the LVCN-70 Series sensor systems.

Calibration

There are four basic steps in the calibration of the OMEGA LVCN-70 Series Continuous Capacitance Sensors.

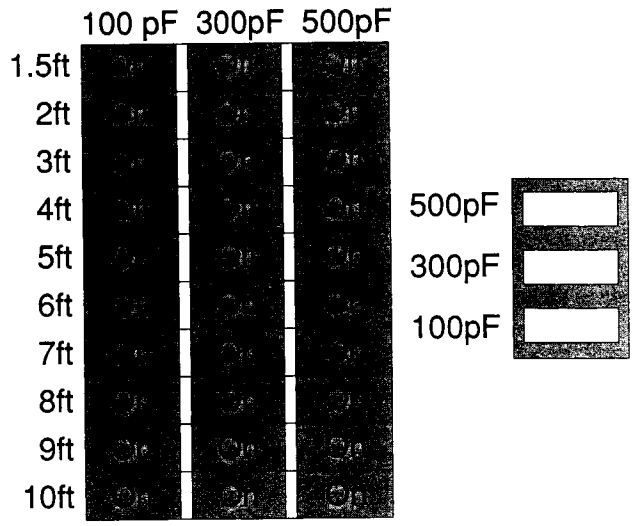
1. Determine Capacitance of Probe

Prior to using the OMEGA continuous capacitance probe, the processing electronics must first be told what the capacitance value of the probe is. This is done by setting one of three "dip" switches on the controller printed circuit board (PCB). The switches are labeled "100", "300", and "500", respectively (see diagrams on pages 18 and 22). Remember, the dip switches are additive (for example, turning on "100" and "300" switches will give a setting of "400"). To determine which switch to depress, use the table provided on page 18.

Note: this step should only be done when the length of the probe has been changed. The dip switches will arrive from the factory pre set. The Capacitance Probe has been factory calibrated for the full length of the probe in city water.

Calibration

pF vs. Dip Switch Settings Table



2. Determine "invert" switch position

The OMEGA 4 to 20 mA output may be set to one of two modes. In one mode, the output will have 4 mA output at the low set point and 20 mA at the high set point. In the "invert" mode, the output will be equal to 20 mA at the low set point and 4 mA at the high setpoint. This "invert" mode is selectable via the switch labeled "invert". This switch is accessible by removing the top cover of the controller. (See the diagram on page 20.)

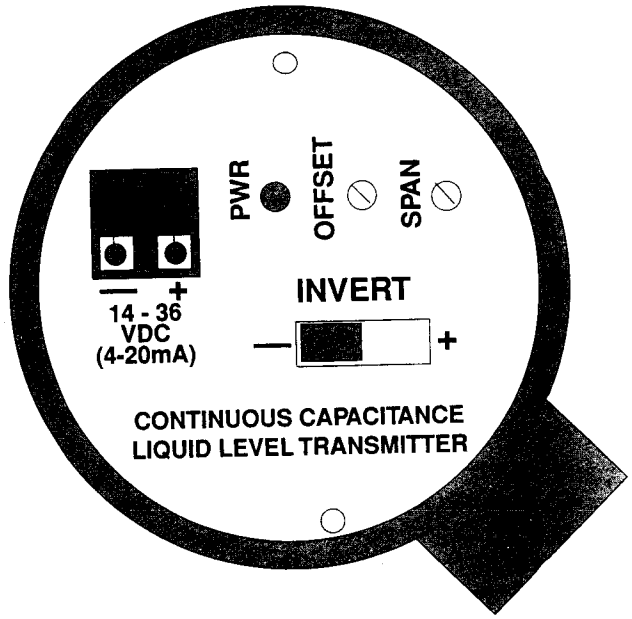
3. Adjust "zero" and "span" potentiometers

Observe the point at which the rising or falling fluid level causes the sensor to reach the 4 or 20 mA output state. If the current states are not correct, adjust the "offset" and "span" potentiometers in the following manner ("invert" switch in "+" position):

a. "offset": With the fluid level in the tank at its desired minimum measurement point, adjust the "offset" potentiometer to set the current output to 4 mA.

b. "span": With the fluid level in the tank at its desired maximum measurement point, adjust the "span" potentiometer to set the current to 20 mA.

4. Repeat step 3 until the output current state values are correct.



Location of "invert" switches and "offset"/"span" adjustments

Maintenance

General

While the LVCN-70 Series sensor resists the effects of process coating and scaling, periodically remove and clean the sensor. It is the responsibility of the user to determine the appropriate maintenance schedule, based on the specific characteristics of the application liquids.

Cleaning Procedure

1. **Power:** Make sure that all power to the sensor, controller and/or power supply is completely disconnected.

2. **Cleaning the Sensor:** Using a soft bristled brush and mild detergent, carefully wash the LVCN-71 series sensor. Do not use harsh abrasives such as steel wool or sandpaper, which might damage the surface of the sensor. Do not use incompatible solvents which may damage the sensor's PFA plastic body.

3. **Sensor Installation:** Follow the appropriate steps of installation as outlined in the Installation section of this manual.

Maintenance

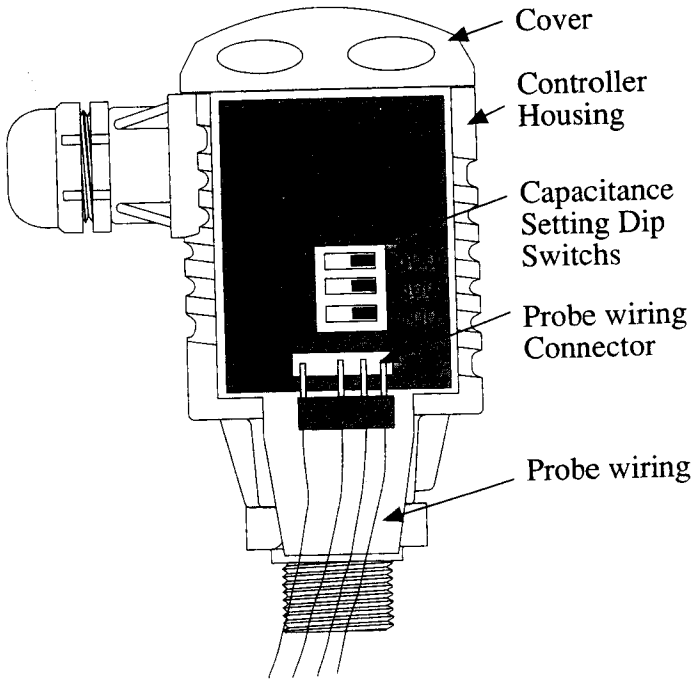


Diagram of PCB with sensor connector and probe capacitance switches

Probe Modification/Assembly Procedure

In some instances, it may be necessary to shorten the length of the probe in order to best fit the application. In order to do this, the probe must be disassembled, cut to length, and then reassembled. Take the following steps to modify and reassemble the probe.

A. Disassembly

1. Turn off all power to the sensor.
2. Remove the probe assembly from the tank.
2. Clean off the probe following the instructions in the Cleaning Procedure.
3. Make sure power has been turned "off". Open the top of the controller housing and remove the wiring for the power and outputs.
4. Remove the small Phillips screw which holds the label in place. Remove the label.
5. Gently remove the PCB assembly by sliding it up and out along the rails. Before pulling it out completely, disconnect the three wire connector at the bottom of the PCB by pushing down along the connector pins.

6. With the PCB removed, place an object (such as the butt end of a small screwdriver) between the nut of the "housing fitting" (see diagram on page 26) and the controller housing wall. With this "wedge" firmly in place, loosen the tank adapter fitting by using an adjustable wrench to turn the tank adapter fitting nut counterclockwise. When the housing nut is freed, remove it by sliding it over the wires and connector.
7. Loosen the tank fitting and slide it off the probe end.
8. Slide the rubber grommets and TFE washers down the probe enough to stay clear of the following steps.
9. Remove locking pin. Then slide the crimp terminal assembly up off the top of the probe and over the wires and connector.

B. Modifying the probe length

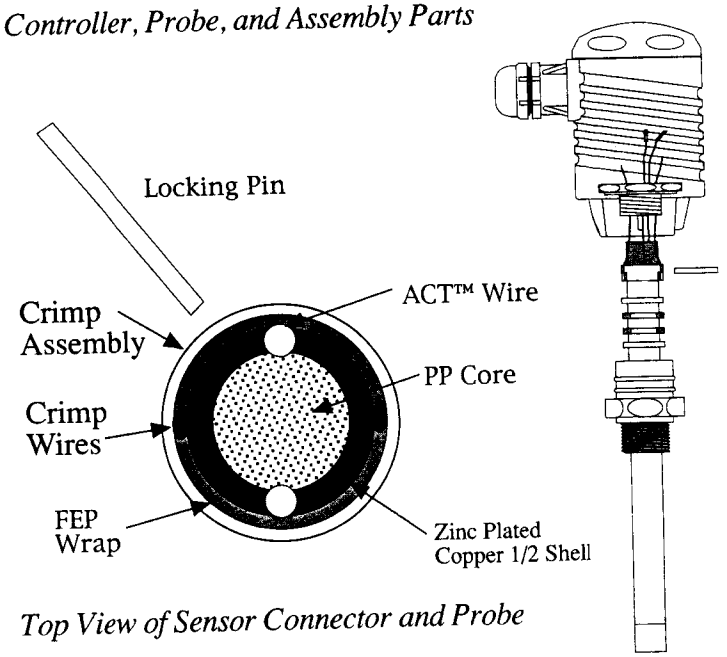
1. Using a sharp Exacto knife, **carefully** trim back the Teflon outer skin of the sensor about 1" below where the probe is to be cut. DO NOT CUT THE WIRES!
2. Fold down the wires so that they will not be damaged during the cutting process.
3. Using a sharp saw, carefully cut through the two copper inner layers and the polycarbonate core of the sensor.
4. Recalibrate dip switches for the new length.

C. Assembling the probe

1. Slide the tank adapter fitting over the top of the probe, wires and connector with the 3/4" NPT threads sliding over first (pointing towards the bottom of the probe). See diagram on page 26. MAKE SURE THE TANK FITTING DOES NOT SLIDE OFF THE BOTTOM END OF THE PROBE.
2. Slide the rubber grommet, then a TFE washer, then the other TFE washer and the last rubber grommet onto the probe. Slide them down about 1" below the cut in the outer FEP layer.
3. Slide the crimp terminal assembly over the wires and connector and onto the two copper halves of the probe. The crimp connectors should slide on to the centers of the copper halves. See diagram on page 26. Slide the crimp terminal assembly down to where the FEP outer skin is cut back and place locking pin in.
4. Place the wires through the bottom of the controller housing.
5. Slide the "washers" up the sensor until they are resting against the bottom of the crimp terminal assembly.
6. Slide the tank fitting up the sensor until it rests against the "washers" and the crimp terminal assembly.
7. Place the housing fitting over the wires and slide the housing onto the tank adapter fitting.

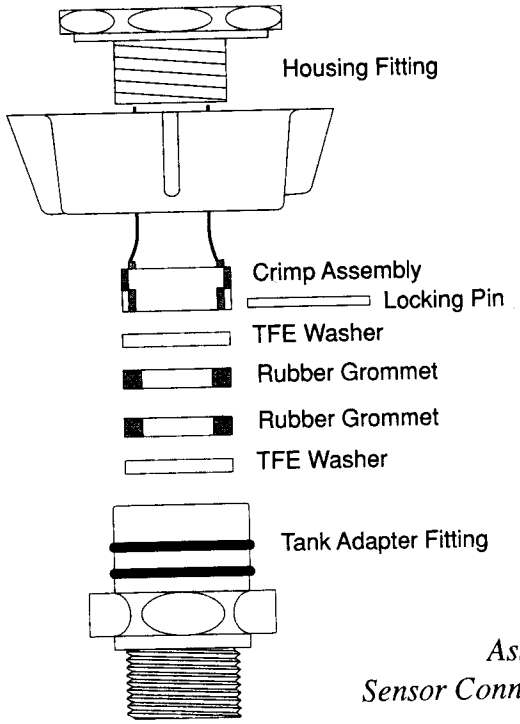
Maintenance

Controller, Probe, and Assembly Parts



Top View of Sensor Connector and Probe

8. Tighten the tank fitting and the housing fitting together by holding either end and rotating the other. DO NOT TWIST THE CRIMP TERMINAL ASSEMBLY !
9. Make sure the assembly is securely tightened.
10. Connect the connector to the PCB. See diagram on page 14.
11. Slide PCB into place along rails in housing walls. If the length of the sensor has been changed considerably, the capacitance switch settings may need to be changed. Check the calibration section of this manual now to verify the present setting.
12. Place label over PCB and replace small Phillips screw. Tighten screw.
13. Replace wires for power and outputs.
14. Replace cover on top of housing.
15. Install sensor in tank. See installation section of this manual.
16. Calibrate system. See calibration section of this manual.



Assembly Parts for
Sensor Connector and Probe

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-OMEGA℠
Customer Service: 1-800-622-2378 / 1-800-622-BEST℠
Engineering Service: 1-806-872-9436 / 1-800-USA-WHEN℠
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 (0455) 285520 FAX: 44 (0455) 283912

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. Call toll free in the USA and Canada: 1-800-622-2378, FAX: 203-359-7811; International: 203-359-1660, FAX: 203-359-7807.

BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, YOU MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OUR 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 you are having with 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 you are having with 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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MADE IN USA

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 our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our 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.

We are glad to offer suggestions on the use of our 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 buyer 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, buyer 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.

OMEGA... Your Source for Process Measurement and Control

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

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