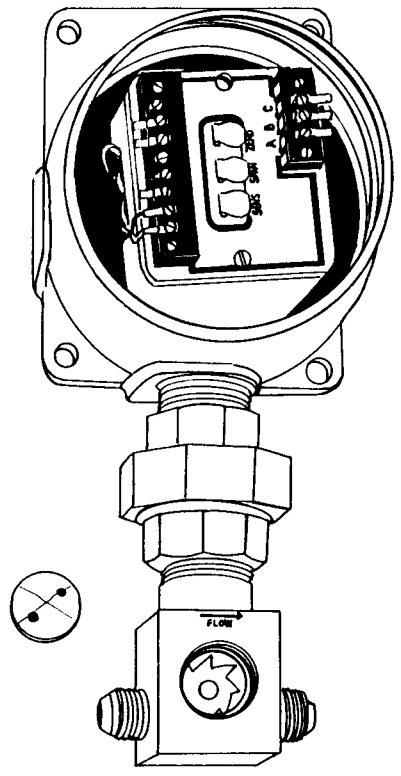


® FTB500 Series

® Low Flowrate Meters



 **OMEGA**[®] Operator's Manual
An OMEGA Technologies Company



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SECTION 1 INTRODUCTION

1.1 DESCRIPTION

The OMEGA® FTB500 Series Low Flowmeters offer extremely accurate low flow measurement of liquids and gases. They utilize a pelton wheel-like rotor whose motion is converted into a pulse output proportional to flow by a pickup coil. They come with an integral signal conditioner, powered by either 15-35 VDC or 115 VAC (optional) to provide amplified frequency and analog output. The signal conditioner corrects for the inherent zero offset of the flowmeter pulse output. It is mounted in a NEMA 4X, explosion proof enclosure (Adalet XJS DO) rated for class I, groups C and D, and class II, groups E, F and G.

Features of the FTB500 include:

1. Integral signal conditioner which provides K-factor offset correction for the mini-flowmeters.
2. Versatile AC and DC power versions are available.
3. Configurable pulse voltage or analog output options.

1.2 AVAILABLE MODELS

DESCRIPTION (LINEAR FLOW RANGE)	PART NUMBER*
STANDARD PART NUMBERS	
0.02 to 0.15 GPM	FTB501-(*CK)
0.025 to 0.25 GPM	FTB502-(*CK)
0.05 to 0.5 GPM	FTB503-(*CK)
0.1 to 1.0 GPM	FTB504-(*CK)
0.2 to 2.0 GPM	FTB505-(*CK)
OPTIONAL PART NUMBERS	
TTL Pulse output	FTB50X-(*CK)-P
0-5VDC output	FTB50X-(*CK)-5VDC
115VAC signal conditioner power supply	FTB50X-(*CK)-115VAC
5000 PSIG	FTB50X-(*CK)-5KP

NOTE

* Replace (*CK) in part number with the viscosity (in centistokes) of your liquid. The maximum is 25CK.

X 1 for 501, 2 for 502, 3 for 503, 4 for 504, or 5 for 505.

1.3 THEORY OF OPERATION

A simplified block diagram of the FTB500 Mini Flow Signal Conditioner is shown in Figure 1-1.

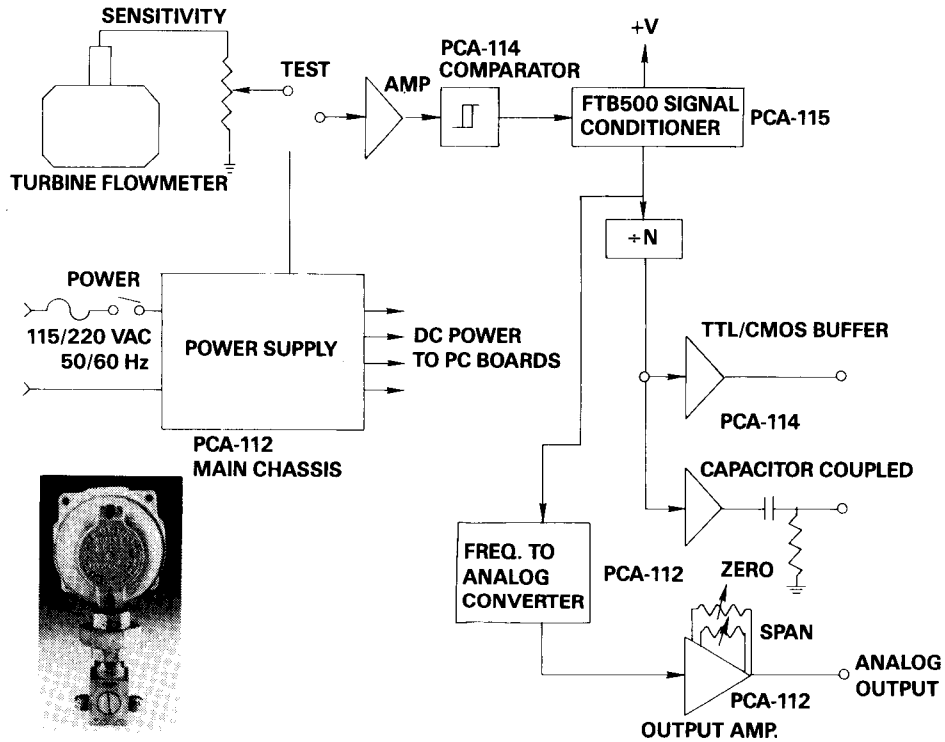


Figure 1-1. Block Diagram

The basic operation of the system is as follows:

The frequency signal from the flowmeter is connected to the FTB500 with a twisted pair shielded cable. The signal enters through the SENSITIVITY control which is used to reject unwanted noise by raising the trigger threshold above the background noise present.

The low level flowmeter signal is then passed through a special conditioning chain where it is filtered, amplified, and shaped into a train of digital pulses whose frequency is non-linearly related to the volume flow rate.

The digital pulse train is then passed through the linearizer where the offset frequency signal is injected into it. For flow rates within the range of the meter, the linearizer output will be linearly related to the volumetric flow rate. In addition, this circuitry drives the 'low flow' out of range indicator.

The signal entering the frequency to analog converter is passed through a combination of divide by N and DIP switch matrix. The output is chosen whose pulse rate is between 75 and 150 Hz at the maximum flow rate to be measured. This scaled pulse rate is fed into a precision monostable circuit. The output of the monostable is then filtered into an analog voltage that is proportional to flow.

The output amplifier will take this voltage and perform either a voltage to voltage amplifier or voltage to current amplifier.

Finally, the output is divided by 8 to reduce irregular pulse spacing. Then, the pulse train enters a buffer and an attenuator simultaneously. The buffer output produces a square wave pulse which can be used as a CMOS/TTL compatible output. The attenuator produces a capacitor coupled AC output which is suitable for driving other signal conditioners, indicators, or controllers which require an AC signal input.

The output frequency from the FTB500 Series Turbine Meter versus flow is essentially a straight line of frequency as a function of flowrate which does not pass through zero. Left uncorrected, this will result in a K-factor which varies with flow rate.

The FTB500 integral signal conditioner will compensate for the frequency offset characteristics of the flowmeter, by using the method of offset frequency injection. Offset frequency injection is implemented electronically by adding a signal equal to the offset frequency required to linearize the output of the flowmeter. This effectively shifts the output characteristic to that of the desired ideal. A low-flow cutout feature is provided where the offset signal is inhibited during no flow to prevent false outputs from being generated.

The FTB500 Series Turbine Meter is a family of low flow rate measurement devices based on a pelton wheel-like rotor. The measured fluid is directed tangentially through a velocity nozzle against the pelton rotor causing it to rotate. The motion of the rotor is sensed by the pickup coil and converted to a pulsing output signal where the frequency is related to the flowrate, and the accumulated pulses are related to the total volume passing through the flowmeter.

1.3.1 Performance Characteristics

The basic performance characteristics of the FTB500 flowmeter are shown in Figures 1-2 and 1-3. The FTB500 Series of meters establish a linear response after an initial offset correction when operating at a constant viscosity.

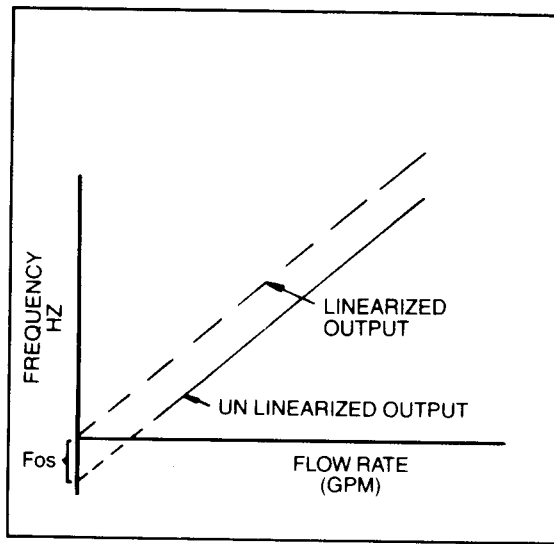


Figure 1-2. FTB500 Output Characteristics Diagram

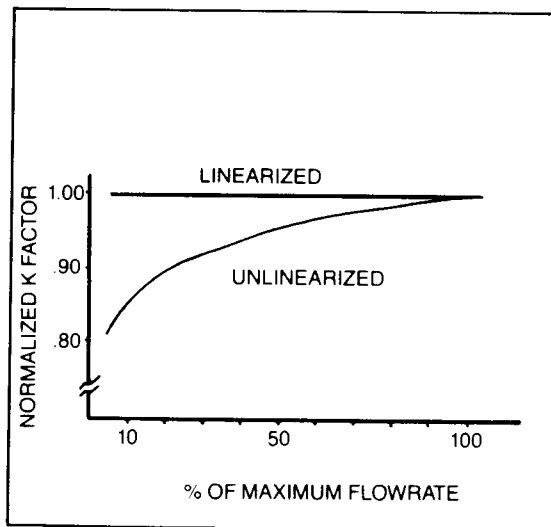


Figure 1-3. Normalized FTB500 Calibration Curve

Over the linear flow range, the input/output characteristics takes the form of:

Equation 1

$$\text{Frequency} = C_1 \times \text{Flowrate} - C_2$$

The FTB500 Series Turbine Meter requires the use of a linearization conditioner available in all OMEGA instrumentation. Accuracies of $\pm 1\%$ of reading are typical after initial correction for offset. Better accuracies approaching $\pm 2\%$ are possible using smart transmitters which can store the entire characteristics of the FTB500 Series Turbine Meter.

The K-Factor is the number of pulses per unit volume produced by the flowmeter under a given set of conditions. Repeatability is a measure of the stability of the output under a given set of flowing conditions. The repeatability is defined as the allowable percentage deviation from the stated K-Factor.

The pressure drop characteristics are given based on water at a viscosity of 1 Cpse and a specific gravity of 1.00. For other fluid's, the following equation may be used to estimate the pressure drop across the FTB500 Series Turbine Meter given the pressure drop on water at the maximum flowrate and the fluids viscosity and density.

$$\text{PSID} = (\text{Cpse})^k \times (\text{SpGr})^k \times \text{PSID H}_2\text{O}$$

where: Cpse is viscosity in centipoise
 SpGr is the specific gravity
 PSID H₂O is the pressure drop from Figure 1-4

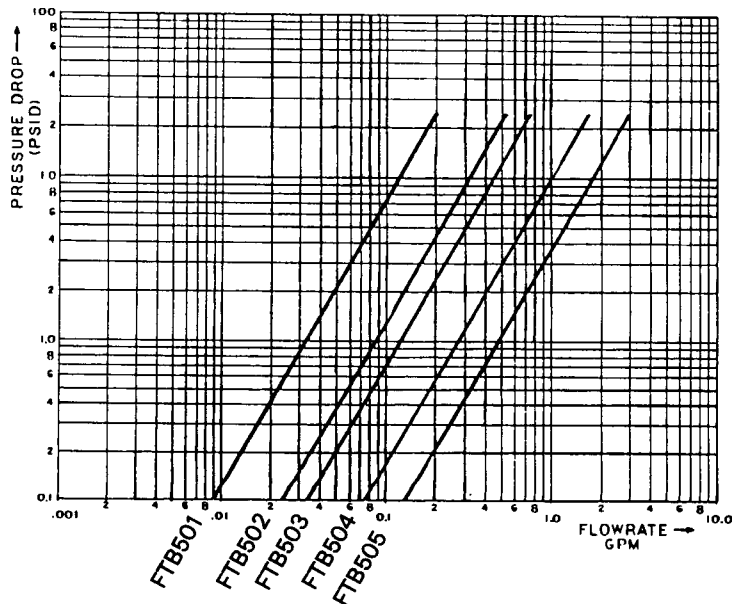


Figure 1-4. Gross Pressure Drop Characteristic Curve on Water

1.3.2 Viscosity Effects

An ideal flowmeter may be defined as one in which the output is solely a function of the fluid flow being measured. Real flowmeters display dependencies on secondary fluid properties, such as viscosity, temperature, and/or pressure. These effects tend to obscure or degrade the precision of the flow measurement.

In very few flowmeter designs, the viscosity dependency is well understood and given suitable documentation, may be compensated for. The OMEGA instruments are among this select group.

In selecting an FTB500 Series Flowmeter for operation on a viscous fluid, it is generally preferable to size the flowmeter so it will be operating in the higher portion of its range to minimize viscosity effects in the measurement. Some loss in flow turndown range may be expected.

1.3.3 Viscosity Calibration and UVC Curves

In some flowmeter applications the viscosity is held nearly constant owing to regulated conditions of temperature and fluid consistency. For such applications it is only necessary to document the flowmeter's performance at the expected operating viscosity. For such fixed viscosity applications the standard specifications usually apply.

The FTB500 Series Turbine Meter may be used over wide viscosity ranges, since the flowmeter has a unique, documented, Universal Viscosity Curve (abbreviated UVC) which is accurate to $\pm 1\%$ of reading.

In some applications, the fluid viscosity is a known function of temperature. A PC could be used to eliminate the otherwise adverse viscosity effect on the flow measurement.

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 the OMEGA Customer Service.

Upon receipt of 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 OPERATION

Perform any purging of piping with spool piece in place. Once completed, install the flowmeter and connect cabling to pickup coil.

With the FTB500 Mini Flow Signal Conditioner properly installed and calibrated, verify the following performance.

With the power ON and no flow through the flowmeter, there should be no pulse output from the unit. To verify this, connect either a digital Frequency Counter or an AC voltmeter.

If using a Digital Frequency Counter, the display should display zero. If some other constant or varying indication occurs, noise may be present.

Slowly turn the SENSITIVITY threshold control counter-clockwise until indication stops.

NOTE

Turning the sensitivity control FULLY counter-clockwise will render the outputs inoperative. Turn potentiometer clockwise to return to normal operation.

If using an AC voltmeter, the meter should be at zero. If noise is present, the voltmeter will deflect and swing from 0 to 2.5V.

Slowly turn the SENSITIVITY threshold control counter-clockwise until indication stops.

2.3 GENERAL

Proper application of the turbine flowmeter requires a suitable piping installation in order to achieve accurate and reliable operation. Refer to Figure 2-1.

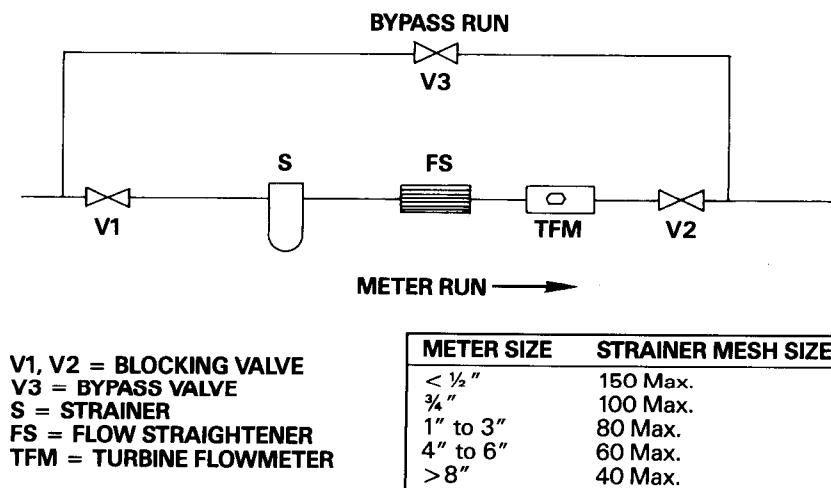


Figure 2-1. Typical Turbine Meter Installation

The piping configuration immediately preceding and following the flowmeter is termed the meter run.

METER RUN—In general, the meter run should be chosen to have the same inner diameter as the meter bore. A minimum of 10 pipe diameters of straight pipe upstream and 5 pipe diameters downstream are required. Where this optimum line configuration can not be implemented, it is advisable to install a flow straightener properly positioned upstream of the flowmeter. Orientation is not a critical factor, however, horizontal is a preferred orientation.

RELATIVE—The performance of the turbine flowmeter is affected by fluid swirl and non-uniform velocity profiles. The following recommendation will reduce such flow irregularities.

It is advisable not to locate the meter run immediately downstream of pumps, partially opened valves, bends or other similar piping configurations. In addition, the area surrounding the flowmeter should be free of sources of electrical noise such as motors, solenoids, transformers and power lines which may be coupled to the pickoff device.

The metering section should not be subjected to excessive vibration or shock. Such a condition may result in a mechanically induced output signal from the pickoff device.

BYPASS RUN—A properly sized bypass run with suitable blocking valves may be equipped where an interruption in fluid flow for turbine meters servicing can not be tolerated.

STRAINER—A strainer, filter and/or air eliminator is recommended to reduce the potential of fouling or damage. Recommended mesh size is at least 100 microns. Finer filters are preferred.

On initial startup of a line, it is advisable to install a spool piece purging the line to eliminate damaging the flowmeter, due to flux, tape, solder, welds or other contaminants carried along by the fluid stream.

2.4 INSTALLATION WIRING LAYOUT FOR INTERCONNECTIONS

In considering the interconnections between the flowmeter and the flow measurement system some attention must be given to anticipated noise sources and to the coupling of these noise sources to the interconnecting wiring.

Noise signals may be coupled inductively or capacitively into the wiring between the flowmeter and the electronic measuring systems. In general, utilizing a shielded, twisted pair for the interconnection greatly reduces this coupling. The shield should be grounded on one end of the cable only. In general, grounding only on the electronic measuring system is best.

However, even with proper interconnecting cabling cross talk with other signal lines or power lines may still occur and should be avoided. Physical isolation in the manner in which the wiring is run reduces the chance of potential problems.

It is common to transmit the low level output signal from the flowmeter several hundred feet through a shielded, twisted pair instrument cable. Where a noisy environment is suspect, it is recommended that a pre-amplifier be installed on or near the flowmeter to assure the preservation of flow information from the flowmeter to the electronic measuring system. Suitable accessory models are available from the manufacturer.

2.5 INSTALLATION OF THE FTB500 MINI FLOW SIGNAL CONDITIONER

The FTB500 should be placed in a convenient location with sufficient room for easy opening of the enclosure. Refer to Figure 2-2 for the mounting drawing for the FTB500.

Drill appropriate mounting holes as required. Mount the unit to the panel.

Refer to Figure 2-3 for DC hookup or Figure 2-4 for 115VAC (optional) for appropriate terminals for installation. Connect the flowmeter cable to the FTB500 including shield.

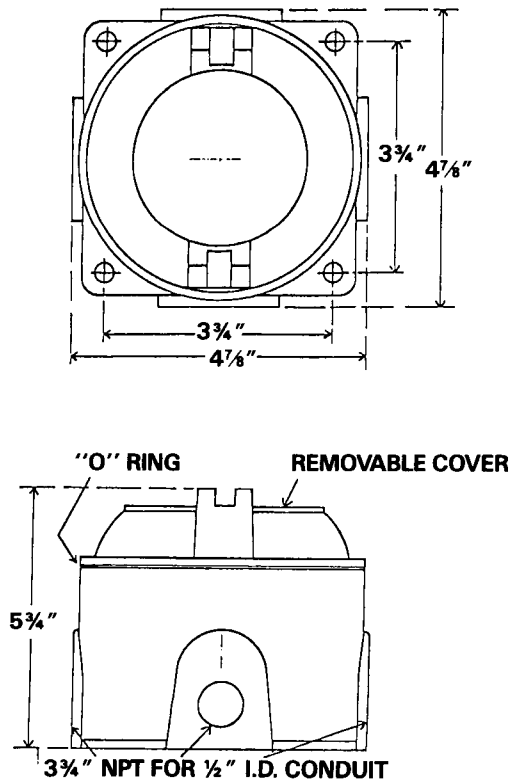


Figure 2-2. Mounting Holes Location Diagram

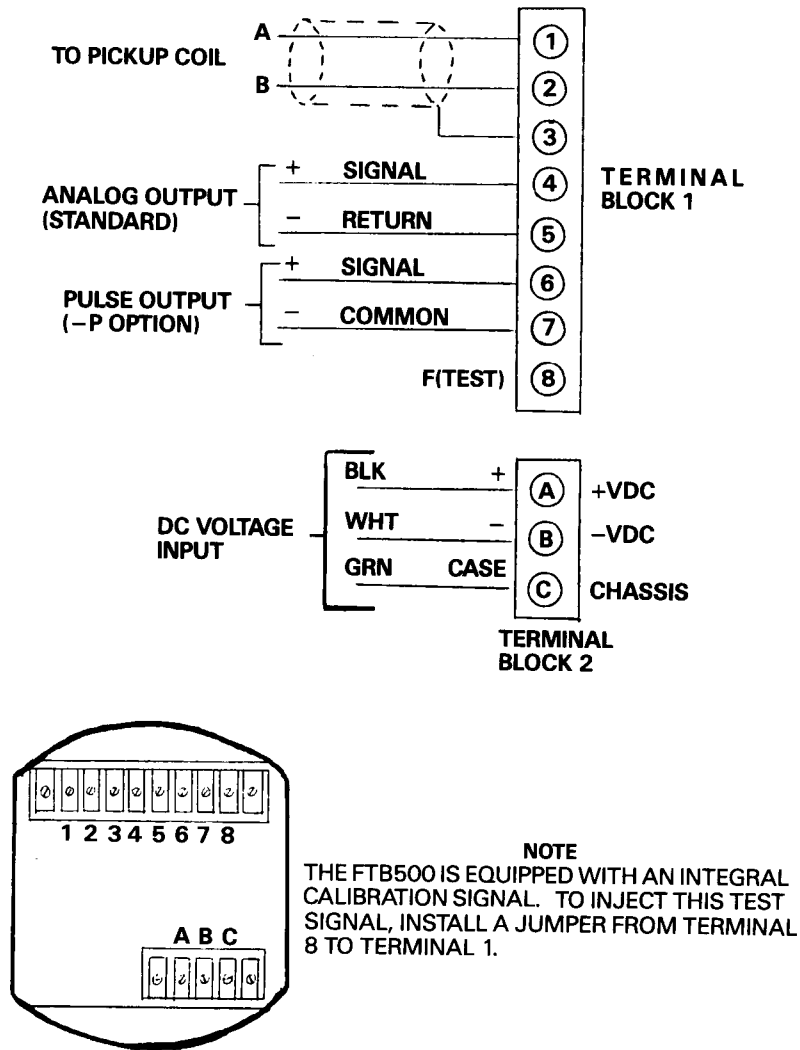
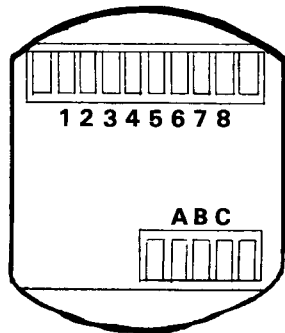
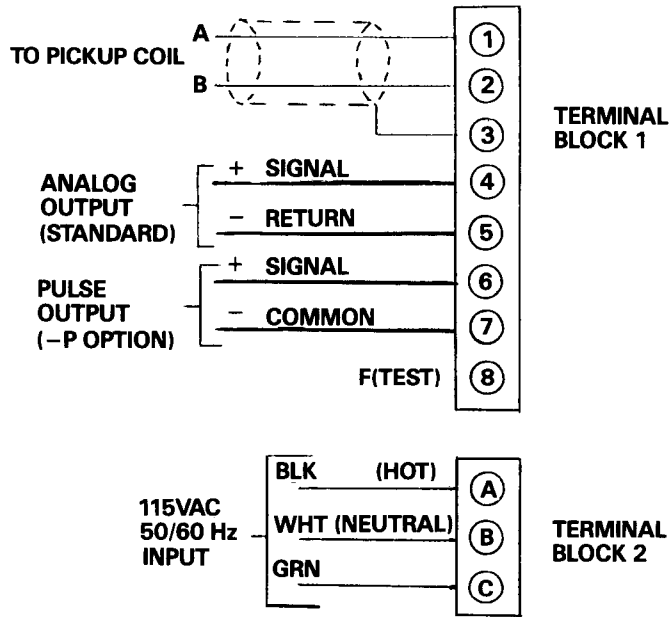


Figure 2-3. DC Input Installation Wiring Diagram



NOTE
THE FTB500 IS EQUIPPED WITH AN INTEGRAL CALIBRATION SIGNAL. TO INJECT THIS TEST SIGNAL, INSTALL A JUMPER FROM TERMINAL 8 TO TERMINAL 1.

Figure 2-4. 115VAC Input Installation Wiring Diagram

Connect the line power and ground to appropriate terminals. The line power should be an 'instrument grade' line whose various loads do not contain solenoids, valves or other similar transient producing load which might adversely affect the operation of the system.

Connect the cabling to the pulse output and to the inputs of the final measurement system. Observe same precautions listed for interconnecting cabling.

SECTION 3 CALIBRATION

3.1 INTRODUCTION

In general, all FTB500 flowmeter systems supplied by OMEGA Engineering, Inc. have been factory calibrated at the time of purchase.

All systems which were factory calibrated have a calibration card attached prior to shipment. This card contains the flow rate, offset frequency F(OS) and low flow setpoint.

Field calibration is only required when a change has occurred. Such a change may be due to repair, replacement or recalibration of the flowmeter.

3.2 CALIBRATION PROCEDURE

Before calibrating the FTB500 flowmeter, analog outputs, be sure the response time adjustment potentiometer is turned fully clockwise for fastest response time (0.5 seconds nominal). This potentiometer is found inside the signal conditioner, inside the rectangular case, on the top printed circuit board, just beneath terminal 1. Slowest response time, with potentiometer fully counter-clockwise, is 2 seconds. Increasing the response time can act to reduce "jitter" in the analog output.

Begin by determining the offset frequency of the mini flowmeter. This is supplied on the calibration card [F(OS)].

The mini flow signal conditioner may be calibrated with the internal TEST frequency used in conjunction with a frequency counter.

The TEST switch, when jumpered to the input terminal (connecting Terminal 8 to Terminal 1, refer to Figure 2-3 or 2-4), injects an internally generated frequency. When using this feature, F (TEST) is equal to 120 Hz.

$$F(\text{OUT}) = 1.8 [F(\text{TEST}) + F(\text{OS})]$$

where: F(OUT) is the output frequency of the linearizer
F(TEST) is the test frequency
F(OS) is the offset frequency

3.3 TO CONFIRM FTB500 SIGNAL CONDITIONER OFFSET

1. Connect frequency counter to the offset frequency test point of the unit.
2. Inject the TEST frequency and observe that the frequency equals $10 \times F(OS)$.

For analog, go to Section 3.4.

For pulse, continue to step 3.

3. Connect frequency counter to the output of the unit and with an injected TEST frequency, verify that the output frequency equals $F(OUT)$ in the equation stated above.

3.4 CALIBRATION OF FTB500 ANALOG OUTPUT

3.4.1 Set Up

The signal conditioner may be calibrated with an internal "TEST" frequency or an external oscillator used in conjunction with a frequency counter.

METHOD 1

As stated before, the "TEST" frequency jumpered to the input (Terminal 8 tied to Terminal 1), injects an internally generated frequency into the unit. When using this feature, $F(TEST)$ is equal to 120 Hz and is used in the following equation.

METHOD 2

Alternate or external oscillator may be used to supply a test frequency. In this method, the external oscillator is connected to the signal input terminals. The oscillator's output frequency is set to equal $F(MAX)$ as indicated on the frequency counter. For this approach, use $F(MAX)$ in the following equations for $F(TEST)$.

Regardless of the method used, begin by calculating the following set points indicated by Equation 1 through Equation 3. Use the frequency $F(TEST)$ depending on calibration method chosen above.

3.4.2 Equations

$$\text{Equation 1} \quad F(MAX) = \frac{K \text{ FACTOR} \times R(MAX) - F(OS)}{60}$$

$$\text{Equation 2} \quad \text{Set (ZERO)} = \text{SET TO NO FLOW CONDITION} \\ \text{i.e., 4mA, 5mA, or 0V}$$

$$\text{Equation 3} \quad \text{Set (SPAN)} = \frac{[F(TEST) + F(OS)] \times \text{SPAN}}{[F(MAX) + F(OS)]} + \text{ZERO}$$

- where: F(TEST) = test frequency used
 F(OS) = offset frequency
 F(MAX) = the flowmeter output frequency at R(MAX) when at the reference condition at which the relation with F(MAX) was defined.
 K Factor = in units of readout, i.e., PULSE/GAL
 SPAN = varying component of analog output. For example, 16 mA for 4 to 20 mA output, 5V for 0 to 5V output
 ZERO = fixed offset component of analog output. For example, 4 mA for 4 to 20 mA output, 0V for 0 to 5V output.

1. The Range Adjustment is accomplished by selecting a switch position on a DIP switch located on the PCA-112 printed circuit card depending on the model. Refer to Table 3-1 to determine required switch position, and select the switch position on the top printed circuit board adjacent to the zero adjust potentiometer.

**TABLE 3-1
 RANGE SELECT SWITCHES**

F (MAX)	RANGE SELECT SWITCH POSITION
300 to 600	3
600 to 1200	4
1200 to 2400	5
2400 to 4800	6

2. Turn the "SPAN" potentiometer fully counter-clockwise until slippage is felt or 25 turns. Refer to Figure 3-1.

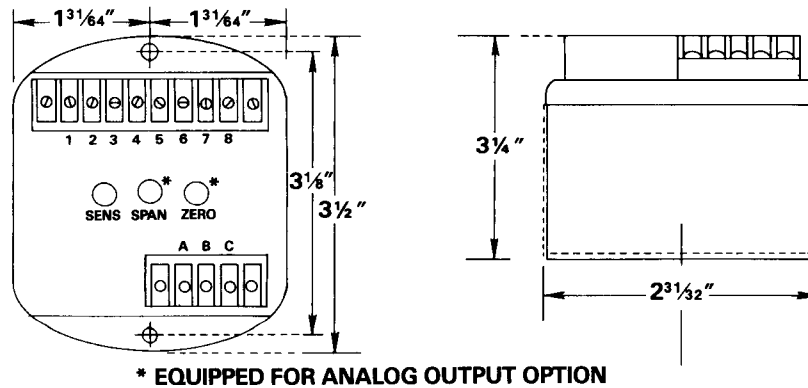


Figure 3-1. Dimensions and Potentiometer Locations

FOR CURRENT OUTPUT OPTION ONLY

3. Connect a digital milli-ammeter or equivalent, across the current output terminals.
4. Adjust "ZERO" potentiometer (refer to Figure 3-1) for desired "ZERO" current (i.e., 4 mA).
5. Inject the test frequency while adjusting "SPAN" potentiometer (refer to Figure 3-1) so the current equals to SET (SPAN).
6. Repeat steps 4 and 5 until no change is observed.

FOR VOLTAGE OUTPUT OPTION ONLY

7. Connect a digital voltmeter across the voltage output terminals.
8. Inject the test frequency while adjusting "SPAN" potentiometer so voltage equals to SET (SPAN).

SECTION 4 MAINTENANCE

4.1 INTRODUCTION

OMEGA's Flow Measurement Systems are constructed to give a long service life. However, problems do occur from time to time and the following points should be considered for preventative maintenance and repairs.

The bearing type used in the flowmeter was chosen to give compromise between long life, chemical resistance, ease of maintenance and performance. A preventative maintenance schedule should be established to determine the amount of wear which has occurred since last overhaul.

In case the flow measurement system malfunctions or becomes inoperative, refer to the Troubleshooting Guide in Section 5.

4.2 SERVICING AND PREVENTATIVE MAINTENANCE OF THE FTB500 FLOWMETER (BALL BEARING DESIGN)

Preventative maintenance requires that the Mini Flowmeter under go a general inspection. Refer to Figure 4-1 and the following procedure to remove the flowmeter internals from the housing. A clean work area is required.

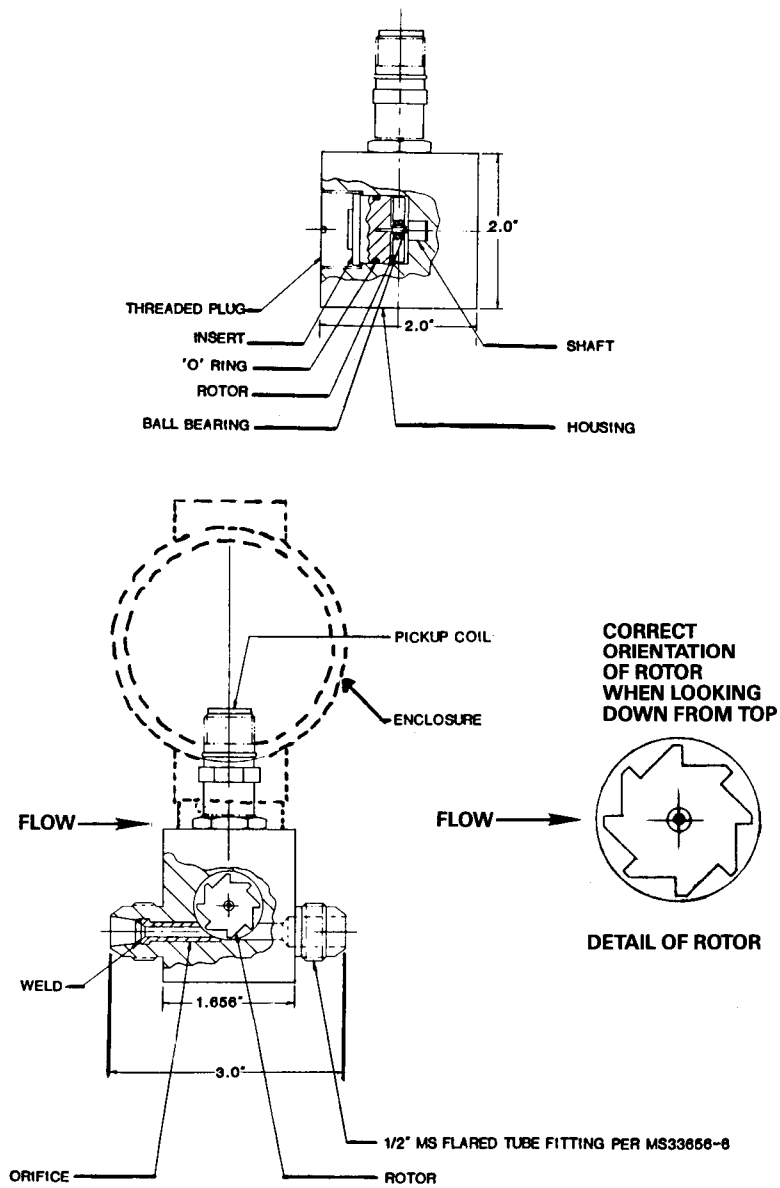


Figure 4-1. Standard Ball Bearing Cutaway Diagram

1. The FTB500 Flowmeter must be held in place by a vise. Meter orientation should be such that the threaded plug is facing upwards.
2. Using a screwdriver and turning counter clockwise, break the seal and remove the plug.
3. Using tweezers or needle nose pliers, slowly pull the insert out, while taking care not to damage the shaft or lose the thrust stop.
4. Remove the rotor by using a pair of tweezers.
5. Remove the shaft assembly with smooth needle nose pliers. Care should be taken in not deforming the shaft and loss of any parts.
6. Examine the flowmeter internals for signs of corrosion or fouling by foreign materials.
7. Examine the shaft and bearings for signs of wear or corrosion on the mating surface.
8. If wear or corrosion is present in bearings, obtain new bearings from stock of the manufacturer.
9. Insert ball bearings in rotor.
10. Guide the rotor bearing assembly onto the shaft. Make sure to orient the rotor so the cup side of the pelton wheel faces the IN side of the housing. Refer to Figure 4-1 detail.

NOTE

IF THE ROTOR IS INSTALLED BACKWARDS, THE METER WILL NOT GIVE YOU THE ACCURACY YOU REQUIRE. REFER TO THE DETAIL CLOSELY.

11. Install a new Viton "O" ring #77-545-018 or equivalent on the insert.

NOTE

"O" ring should be lightly lubricated with "O" ring lubrication which is silicone based.

12. Place insert on the shaft. When properly seated gently push the insert back on the shaft.
13. Install and tighten the threaded plug. Tighten plug until snug. Do not over tighten.

The flowmeter is ready for service. When installing the flowmeter be sure to orient the input and output correctly.

SECTION 5 TROUBLESHOOTING AND MAINTENANCE

Refer to Figure 5-1.

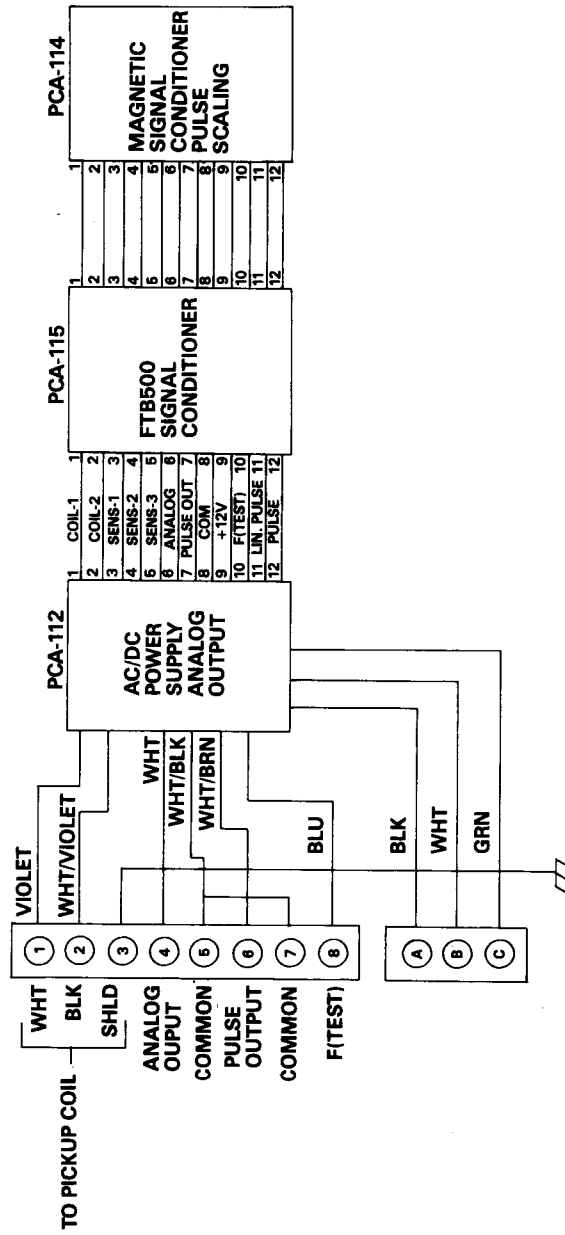


Figure 5-1. Internal Wiring

TROUBLESHOOTING GUIDE (Cont'd)

In case of an inoperable or malfunctioning system the following procedures can be used to isolate the faulty wiring, printed circuit boards and/or alternate causes. The majority of repairs can be made in the field thereby reducing the time a unit is out of service.

A recommended spare parts list is given in Section 6. The necessary documentation is contained within this manual with the exception of the calibration data sheet for the turbine flowmeter. This calibration is supplied separately.

To test the FTB500, an internal 120 Hz test frequency has been provided. Refer to Section 3.2, Calibration Procedure. Failure conditions are listed and the possible corrective actions are given to eliminate the observed problems.

TROUBLESHOOTING GUIDE

OBSERVED CONDITION	CORRECTIVE ACTION
Unit repeatedly blows fuses.	<ol style="list-style-type: none">1. Inspect terminal strip wiring for conformity to the installation instructions and for acceptable workmanship.2. Verify correct fuse size.3. Replace PCA-112.4. Replace PCA-115.5. Replace PCA-114. <p style="text-align: center;">NOTE If unit continues to blow fuses it is advisable to return it to the factory. This defect is difficult to diagnose in an assembled system.</p>
Unit gives no pulse output with flow present.	<ol style="list-style-type: none">1. Turn sensitivity (SENS) potentiometer clockwise.2. Replace pickup coil and/or interconnecting wiring.3. Replace PCA-114.4. Replace PCA-115.5. Replace PCA-112.
Unit gives pulse output with no flow present	<ol style="list-style-type: none">1. Noise pickup, turn sensitivity adjust counter clockwise until correct zero flow indication is obtained.2. Replace pickup coil.3. Replace PCA-115.4. Replace PCA-114.

TROUBLESHOOTING GUIDE (Cont'd)

OBSERVED CONDITION	CORRECTIVE ACTION
Unit does not function	<ol style="list-style-type: none">1. PCA-115 has incorrect offset frequency setting.2. Replace PCA-115.3. Flowmeter used below or above normal range. Obtain correct flowmeter.
Analog output.	<ol style="list-style-type: none">1. Replace PCA-112.
Analog output with no flow.	<ol style="list-style-type: none">1. Turn sensitivity (SENS) potentiometer slowly CCW. NOTE Fully CCW will make the unit inoperative.2. Replace PCA-112.

SECTION 6 RECOMMENDED SPARE PARTS LIST

PART NUMBER	DESCRIPTION	QTY
PCA-112	POWER SUPPLY/ANALOG OUTPUT CARD	1
PCA-114	SIGNAL CONDITIONER CARD (MAGNETIC PICKUP COIL)	1
PCA-115	LINEARIZE AND FLOW DRIVE, PLUG-IN CARD	1
¼ SLO BLO	FUSES, POWER SUPPLY	1 BOX

SECTION 7 ACCESSORIES

DESCRIPTION	PART NUMBER
½" MS flare to ½" MNPT adaptor kit with 10" upstream and 5" downstream straight SS tubing	FTB500-ADP

SECTION 8 SPECIFICATIONS

INPUT POWER OPTION:	15 to 35 VDC at 75 mA (standard) 115VAC, 50/60 Hz (optional)
INPUT:	Input protected, RF and band pass filtered, adjustable trigger level. Input impedance—40k Ω Trigger sensitivity—10mV _{RMS} (minimum) 10 Hz to 1000 Hz Over voltage—120V _{RMS} absolute (maximum)
METHOD:	Frequency injection of offset frequency with post scaling and low flow alarm
OFFSET FREQUENCY:	7 to 150 Hz
THERMAL STABILITY:	200 parts per million/ $^{\circ}$ C
LOW FLOW ADJUSTMENT:	20 to 200 Hz (based on comparison with input flowmeter frequency)
LOW FLOW INDICATION:	None
ACCURACY:	\pm 1% of reading for pulse
REPEATABILITY:	\pm 0.25% of reading
MAX. PRESSURE DROP AT 1CSTK:	10 PSID
MAX. PRESSURE:	1000 PSIG standard 5000 PSIG optional
FREQUENCY OUTPUT AT FULL SCALE-FLOW (-P OPTION, REFER TO SECTION 1.2):	125 Hz nominal
ANALOG OUTPUTS	
CURRENT OUTPUT (STANDARD):	
ACCURACY:	\pm 0.05% of full scale, \pm 200 PPM/ $^{\circ}$ C.
RANGE:	4 to 20mA into 375X max.
RESPONSE TIME:	0.5 seconds for 10-90%. Adjustable from 0.5 to 2 seconds. Output suitable for driving grounded or floating load types
VOLTAGE OUTPUT (OPTIONAL):	
ACCURACY:	\pm 0.05% of full scale; \pm 200 PPM/ $^{\circ}$ C.
RANGE:	0-5V.
IMPEDANCE:	< 10 Ω
RESPONSE TIME:	0.5 seconds for 10-90%

SPECIFICATIONS (Cont'd)

PULSE OUTPUTS (OPTIONAL): STANDARD OPTION—TTL/CMOS fanout of 10 TTL/CMOS loads. AC capacitively coupled square wave.

OPTIONAL—Open collector—adjustable V_{mos} transistor 2N6660. Maximum OFF state voltage 60 VDC. Maximum ON current 1.0A.

ENVIRONMENTAL

OPERATING AMBIENT TEMPERATURE: -4° to 176° F
FLUID TEMPERATURE RANGE: -450° to $+450^{\circ}$ F
STORAGE TEMPERATURE: -65° to 150° C

MATERIALS OF CONSTRUCTION

HOUSING: 316 Stainless Steel
BALL BEARINGS: 440C
ROTOR: 17-4 PH
SEALS: Viton
CONNECTIONS: $\frac{1}{2}$ " 37° flare per MS-33656-8
 $\frac{1}{2}$ " MNPT adaptor kit optional

CONTROLS AND ADJUSTMENTS

FUSE: A circuit protection device located internally. Check main schematic for proper size and type.

SENS: A single control used to set the threshold sensitivity level above the ambient noise pickup.

OFFSET FREQUENCY: An internal 20 turn adjustment on the PCA-115 printed circuit card used to adjust the equivalent offset frequency of the FTB500, 7 to 150 Hz.

LOW FLOW ADJUST: An internal adjustment on the PCA-115 printed circuit card which is factory set to turn off the offset frequency oscillator at no flow.

RANGE: A dual-in-line (DIP) switch located on a PCA-112 board which is used to program the module to accept an input frequency range.

ZERO: A multiple turn adjustment potentiometer which is used to set the current/voltage output signal with no flow to the desired "zero" value (i.e., 4 mA or 100 mA).

SPECIFICATIONS (Cont'd)

SPAN :	A multiple turn adjustment potentiometer which is used to set the current/voltage output signal to the desired span corresponding to mA equivalent flow range (i.e., 4 to 20 mA or 0 to 10V corresponding to 0-100GPM).
RESPONSE:	A multiple turn adjustment potentiometer which is used to dampen the response at the analog output.
SCALING FACTOR:	A dual-in-line (DIP) switch located on the PCA-112 board which is used to select the desired pulse output scaling factor.



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.

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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.

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 **CALL-BRICATION**, 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. This affords our customers the latest in technology and engineering.

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