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OPERATING INSTRUCTION MANUAL

Model DOCN-72
Dissolved Oxygen
Analyzer

IMPORTANT SAFETY INFORMATION

This analyzer is compliant with safety standards as outlined in:

EN 61010-1 (European Community low voltage directive)

Please read and observe the following:

- Opening the analyzer door exposes you to line power voltage, if present, at terminals on TB5 and TB6 in the base of the enclosure. This may be hazardous. Always remove line power before entering this area in the analyzer. However, the analyzer door assembly contains only low voltage and is completely safe to handle.
- Wiring or repairs should only be performed by qualified personnel, and only to an unpowered analyzer.
- Whenever it appears that system safety is questionable, disable the analyzer to ensure against any unintended operation. For example, an unsafe condition is likely when:
  1) The analyzer appears visibly damaged.
  2) The analyzer fails to operate properly or provide the intended measurements.
  3) The analyzer has been stored for long periods at temperatures above 140°F (60°C).
- This analyzer must be installed by specially trained personnel in accordance with relevant local codes and instructions contained in this operating instruction manual. Observe the analyzer technical specifications and input ratings. If one line of the line power mains is not neutral, use a double-pole mains switch to disconnect the analyzer.

HELPFUL IDENTIFIERS

In addition to information on installation and operation, this instruction manual may contain WARNINGS pertaining to user safety, CAUTIONS regarding possible instrument malfunction, and NOTES on important, useful operating guidelines.

WARNING:

A WARNING LOOKS LIKE THIS. ITS PURPOSE IS TO WARN YOU OF THE POTENTIAL FOR PERSONAL INJURY.

CAUTION:

A CAUTION LOOKS LIKE THIS. ITS PURPOSE IS TO ALERT YOU TO POSSIBLE INSTRUMENT MALFUNCTION OR DAMAGE.

☞ ***NOTE:*** *A note looks like this. Its purpose is to alert you to important operating information.*

Definition of Equipment Symbols

This symbol on the equipment **means CAUTION** and alerts the user to possible instrument malfunction or damage. Refer to this manual before proceeding.

This symbol, which appears on the analyzer enclosure at the green ground screw (shown in Figure 2-3), **means that this is a protective ground terminal** and alerts the user to connect an earth ground to it.

This symbol on the equipment **means that there is alternating current present** and alerts the user to be careful.

CONDENSED OPERATING INSTRUCTIONS

This manual contains details for all operating aspects of the instrument. The following condensed instructions are provided to assist you in getting the system started up and operating as quickly as possible. These condensed instructions only pertain to basic operation. To use specific analyzer features, refer to the appropriate sections in this manual for instructions.

1. CONNECTING SENSOR

After the analyzer is properly mounted (Part Two, Section 2), refer to Figure 2-3 and connect the sensor:

A. Plug the sensor cable into the mating receptacle on the junction box supplied with any Omega Engineering optional D.O. sensor mounting hardware.

B. Route the 6-conductor interconnect cable from the junction box to the analyzer.

CAUTION:

FOR STEPS C AND D, TWIST THE TWO SHIELD WIRES OF THE INTERCONNECT CABLE TOGETHER. THEN INSULATE THEM WITH PLASTIC TUBING OR TAPE TO PREVENT THEM FROM CONTACTING EARTH GROUND THROUGH THE ANALYZER ENCLOSURE OR THE JUNCTION BOX.

C. Connect the wires of the interconnect cable to terminals in the junction box, matching colors as indicated.

D. Connect the wires at the other end of the interconnect cable to analyzer TB1 Terminals 1 through 7, matching colors as indicated.

2. ADJUSTING DISPLAY CONTRAST

Ambient lighting conditions may make it necessary to adjust display contrast to improve visibility. With the MEASURE screen displayed, press and hold the **ENTER key** and simultaneously press the ⇧ **or** ⇩ **key** until attaining the desired contrast.

3. CALIBRATING THE SYSTEM

To ensure accurate measurement, calibrate using one of the seven different methods.

Calibration Tip! It is highly recommended to use the "D.O. Cal In Air" method with a special calibration bag (provided with D.O. sensor) because this:

- Ensures high calibration accuracy by providing a stable atmosphere at the sensor membrane.
- Is considerably more convenient than using a portable meter to determine the D.O. (even when using an optional self-cleaning system).
- Provides high repeatability because the sensor is in a controlled environment.

(continued on next page)

CONDENSED OPERATING INSTRUCTIONS

3. CALIBRATING THE SYSTEM -- (continued)

CAUTION:

DURING INITIAL STARTUP AND BEFORE CALIBRATION, ALWAYS CONDITION THE MEMBRANE OF THE D.O. SENSOR BY OPERATING THE SENSOR IN CLEAN WATER FOR AT LEAST 12 HOURS TO POLARIZE THE ELECTRODES. FAILURE TO PROPERLY CONDITION THE SENSOR WILL RESULT IN SIGNIFICANT MEASUREMENT ERROR.

Since Omega highly recommends the "D.O. Cal In Air" method for calibration, this method is described below. (When using one of the other methods, refer to Part Three, Section 4 for instructions.)

A. Press the **CAL key** to display the CALIBRATION root menu.

B. Using the ⇩ **key**, select the "D.O. Cal In Air" submenu (shown in reverse video), and press the **ENTER key**.

C. Using the ⇦ **and** ⇨ **keys**, select to "hold" the analog outputs at their present states during calibration. (Outputs can also be transferred to preset values or allowed to remain active. Since the analyzer has not yet been configured, transferring the outputs would provide factory-set default values.)

D. With the display flashing "HOLD," press the **ENTER key** (selected choice and "CONTINUE" stops flashing). Press the **ENTER key** again to continue.

E. Using the ⇦ key, select "YES" because this is a first-time calibration for this sensor. Press the **ENTER key** to select the "CONTINUE" line. Press the **ENTER key** again to continue calibrating.

F. Remove the sensor from the clean conditioning water, place the special calibration bag over the wet membrane end of the sensor, and secure the bag to the sensor body. With the "CONTINUE" line selected, press the **ENTER key**.

G. The calibration data screen appears. Wait for the "ppm" annunciator in the "Meas'd Val" line to stop flashing (approximately 15 minutes) and then press the **ENTER key** to complete the calibration.

4. CONFIGURING THE ANALYZER

The analyzer has many features such as analog and TTL outputs, three relays, software alarms, etc. that you may want to use. To further configure the analyzer to your application requirements, use the appropriate CONFIG submenus to make selections and "key in" values. Refer to Part Three, Section 5 for configuration details.

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ILLUSTRATIONS

TABLES

PART ONE - INTRODUCTION

SECTION 1
GENERAL INFORMATION

1.1 Capability Highlights

Sensor Input

The analyzer directly accepts any membrane D.O. sensor.

Informative Display

The MEASURE screen (normal display mode) shows the measured D.O. in ppm or % saturation. By using the ⇧ **or** ⇩ **key** to scroll the lower line on the MEASURE screen, you can also display other important system information such as analog output values, process temperature, next scheduled date for calibration, etc. Refer to the specifications in Section 2.1 for a complete listing of all displayed data.

Advanced Diagnostics

True predictive diagnostics will forecast the date when the sensor eventually requires replacement. Reactive diagnostics alerts you to changes in vital sensor data including punctured membrane, slope, open or shorted temperature compensator, disconnected sensor, and depleted electrolyte solution. All data is logged. The analyzer can be set to enable specific data to drive alarms. Additionally, the analyzer has self-checking diagnostic functions for its memory, keypad, and display.

Data Logbook

The analyzer logbook records up to 100 system events including calibrations, warning and failure messages, power-up/power-down, and configuration activity. Each event is logged with the date and time of occurrence.

Passcode-protected Access

For security, you can assign a passcode to restrict access to configuration settings for authorized personnel only. Refer to Part Three, Section 5.9 for details.

Calibration Methods

Seven methods are provided to calibrate the analyzer. See Part Three, Section 4.4 for details. Also provided is a method for calibrating temperature. This feature, however, is typically not needed since the analyzer is factory-calibrated for highly accurate temperature measurement.

Dual Analog Outputs

The analyzer provides two sets of analog outputs. Each set consists of one 4-20 mA and one 0-5 VDC/0-1 mA output. Each output set can be assigned to represent the measured

D.O. (in ppm or % saturation) or temperature. Also, whenever the analyzer detects that one of the 4-20 mA loops is open, it displays a "Current Load High" diagnostic message.

Relays

The analyzer is equipped with three relays that may be the standard electromechanical type, or the optional solid state AC or DC type relays.

TTL Outputs

The analyzer provides three TTL (NAMUR) outputs. They can be used to represent the established standards of the German NAMUR Committee for measurement and control:

- Analyzer is off line for calibration/maintenance (Output A)
- One or more software or system alarms are in the warn state (Output B)
- One or more software or system alarms are in the fail state (Output C)

Each enabled TTL output can be set to operate as "fail safe" and assigned an "on delay" time.

Transfer Condition (for analog outputs, relays, and TTL outputs)

You can independently transfer the states of the analog outputs, relays, and TTL outputs to desired preset states. This is especially useful during calibration or maintenance. Refer to Part Three, Section 5.6 for details.

1.2 Modular Construction

This modular construction of the analyzer simplifies field servicing and provides electrical safety. The front door/ keypad assembly uses voltages no greater than 24 VDC and is completely safe to handle. Low voltage input signal connections are made on the back of the door/keypad assembly.

Opening the analyzer door exposes the power supply/relay board in the bottom of the enclosure. Make all line power electrical connections to this board. The relays are located on the backside of this board.

WARNING:

REMOVE LINE POWER BEFORE HANDLING THE POWER SUPPLY/RELAY BOARD TO AVOID ELECTRICAL SHOCK.

1.3 Retained Configuration Values

All user-entered configuration values are retained indefinitely, even if power is lost or turned off. The non-volatile analyzer memory does not require battery backup.

1.4 Locating Product Serial Number

Labels with the analyzer serial number are affixed to the top of the enclosure and on the backside of the door assembly. The serial number can also be conveniently displayed by pressing the **DIAG key**, selecting "Device Description," and pressing the **ENTER key**.

1.5 EMI/RFI Immunity

The standard analyzer has an aluminum enclosure and filters for line power and low-level signals, all of which provide substantial protection from most normally encountered electromagnetic interference. However, some applications require the utmost in protection. In these cases, the analyzer should be equipped with the EMI-hardened option that includes extra shielding, special shielded glass for the display, and CE certification. (An EMI upgrade kit is available for on-site retrofitting.) This protection exceeds U.S. standards and meets European IEC 801-series testing for electromagnetic and radio frequency emissions and susceptibility. Refer to Figure 1-1 and the specifications in Section 2.1 for details.

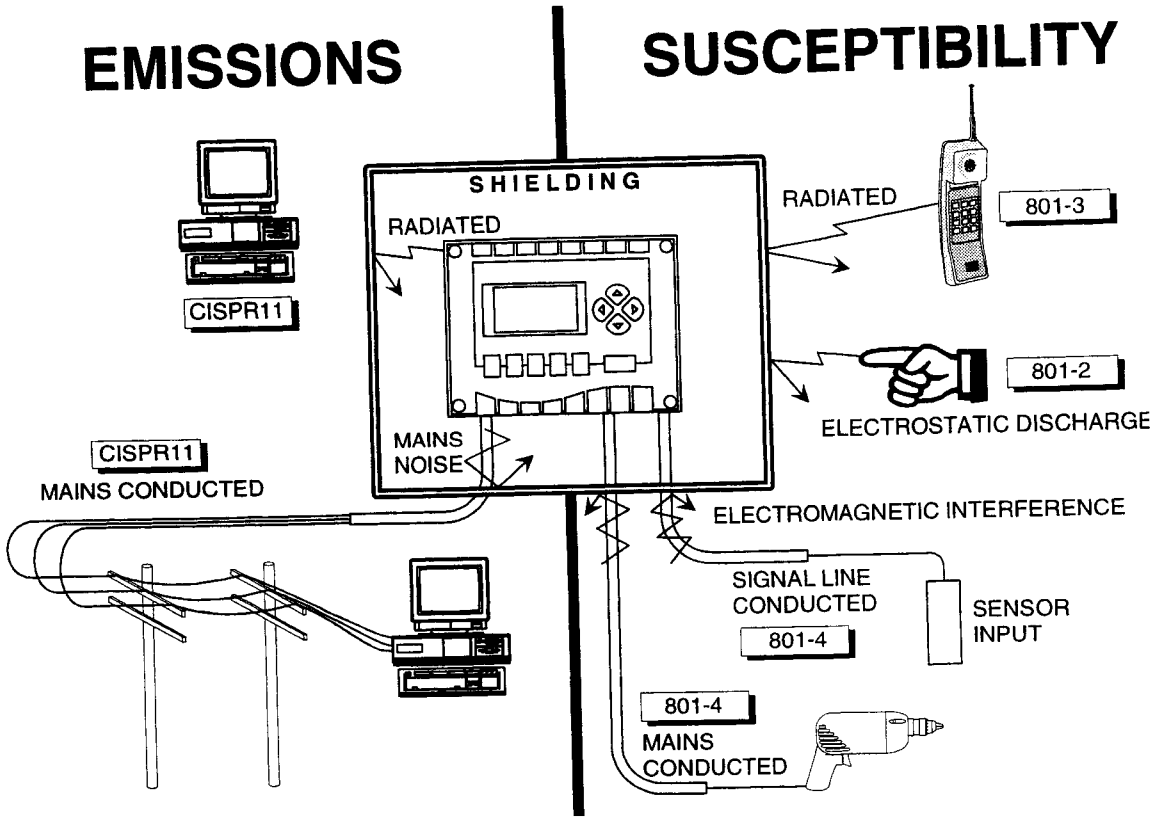


FIGURE 1-1 EMI/RFI Immunity Diagram

SECTION 2
SPECIFICATIONS

2.1 Operational

Display ..... Graphic dot matrix LCD, 128 x 64 pixels with LED backlighting; 1/2 inch (13 mm) main display character height; 1/8 inch (3 mm) auxiliary information character height; menu screens contain up to six full lines of text

D.O. Measurement	Selectable Ranges
Main Display	0.00-40.00 ppm or 0.0-200.0% saturation
Auxiliary Display Line	Measured D.O. shown in other scale not used for main display, and the following auxiliary information:
Temperature	0.0-50.0°C
mA Outputs (#1 and #2)	0.00-20.00 mA or 4.00-20.00 mA
Time	Hour/minute
Date	Month/day/year
Calibration Status	Displays next scheduled date for calibration
Sensor Status	Displays predicted date for sensor replacement
Relay Status	On or off
Diagnostic Warnings	See Table C for details
Error Messages	See Table C for details

Ambient Conditions ..... -22 to +140°F (-30 to +60°C); 0-95% relative humidity, non-condensing

Relays:

Types/Outputs: Standard ..... Three electromechanical relays (two SPDT and one SPST); U.L. rated 5A 115/230 VAC, 5A @ 30 VDC resistive

Optional ..... Three AC solid state relays (all SPST); U.L. rated 2A continuous; user must provide 24-250 VAC and 0.02 amp. RMS

or

Three DC solid state relays (all SPST); U.L. rated 2A continuous; user must provide 3-60 VDC

Functional Modes ..... Each relay (A, B and C) can be assigned to be driven by the measured D.O. (in ppm or % saturation) or temperature

Operating Modes: Control ..... Settings for fail safe on/off, high/low phasing, setpoint, deadband, on delay, and off delay

Alarm ..... Settings for fail safe on/off, high alarm point, high alarm point deadband, low alarm point, low alarm point deadband, on delay, and off delay

Indicators ..... Relay A, B and C annunciators indicate respective relay status

Temperature Compensation ..... Automatic, 0-50°C

Sensor-to-Analyzer Distance ..... 1000 ft. (305 m) maximum

Power Requirements ..... 105-250 VAC, 50/60 Hz. (20 VA max.); no jumper or switch settings required

D.O. Calibration Methods:

In the Process:

Probe Method ..... Enter D.O. value obtained from calibrated portable D.O. meter that has its sensor placed next to process D.O. sensor.

Sample Method..... Enter D.O. value of a process sample determined by laboratory analysis.

Saturated Method..... For use only when the process is known to be 100% saturated with air. The analyzer computes and displays the ppm value based on the atmospheric pressure and the temperature and salinity of the 100% saturated process.

In Water:

Probe Method ..... Same as "In the Process" Probe method except the sensor is in water.

Sample Method..... Same as "In the Process" Sample method except the sensor is in water.

Saturated Method ..... Same as "In the Process" Saturated method except the sensor is in water.

In Air Saturated Method ..... Same as "In the Process" Saturated method except that the sensor is in air, and the salinity factor is always zero.

Outputs: Analog ..... Two sets (#1 and #2) each with 12-bit resolution; each set consists of:

Isolated 0-5 VDC (1 megohm min. load)/
0-1 mA (100 ohms max. load)
- and -
Isolated 4-20 mA (900 ohms max. load)

NOTE: *Each output set can be assigned to represent the measured D.O. or temperature. Parameter values can be entered to define the endpoints at which the minimum and maximum mA output values are desired. Each output set can be selected to track the measurement, hold their present values, or transfer to preset values. The display indicates an error message for each 4-20 mA output loop that is open.*

TTL ..... Three isolated auxiliary TTL-level outputs for use as NAMUR diagnostics:

Output A: Instrument is "off line" for calibration or maintenance
Output B: One or more software or system alarms are in the "warn" state
Output C: One or more software or system alarms are in the "fail" state

NOTE: *TTL outputs can be wired for non-isolated or isolated operation, or as a DC relay coil driver. Isolated or relay coil driver operation requires an external voltage supply.*

Communication..... Field-installable, plug-in components for various protocols

(pending option)

Memory Backup (non-volatile) ..... All user settings are retained indefinitely in memory (EEPROM)

Logbook..... Non-volatile memory records up to 100 system events including calibrations, warning and failure messages, power-up/power down, and configuration activity; each event is logged with date and time of occurrence

Real-time Clock ..... Trickle-charged lithium battery maintains date and time when power is interrupted

EMI/RFI Immunity:

Standard..... Metal enclosure and filters for line power and low level signals provide substantial protection from most electromagnetic and radio frequency interference

Optional..... Extra shielding and special shielded glass for the display; exceeds U.S. and meets European standards for conducted and radiated emissions (CISPR11 Class A), protection from radiated EMI/RFI to a level of 10 volts/meter (IEC 801-3), electrostatic discharge (IEC 801-2), and conducted electromagnetic interference (IEC 801-4)

Electrical Certifications (optional)

General Purpose (pending).... CSA and NRTL

Division 2 (pending)..... CSA and NRTL (Groups A through G)

2.2 Analyzer Performance (Electrical, Analog Outputs)

Accuracy..... 0.10% of span

Sensitivity..... 0.05% of span

Stability..... 0.05% of span per 24 hours, non-cumulative

Non-Linearity..... 0.10% of span

Repeatability..... 0.05% of span or better

Temperature Drift..... Zero: 0.02% of span per °C;
Span: 0.02% of span per °C

2.3 Mechanical

Enclosure..... NEMA 4X; polycarbonate face panel, epoxy-coated high-quality cast aluminum door and case with four 1/2 inch (13 mm) conduit holes, nylon mounting bracket, and stainless steel hardware

Mounting Configurations..... Panel, surface, and pipe (horizontal and vertical) mounting

Net Weight..... 5.5 lbs. (2.5 kg) approximately

PART TWO - INSTALLATION

SECTION 1
UNPACKING

After unpacking, it is recommended to save the shipping carton and packing materials in case the instrument must be stored or re-shipped. Inspect the equipment and packing materials for signs of shipping damage. If there is any evidence of damage, notify the transit carrier immediately.

SECTION 2
MECHANICAL REQUIREMENTS

2.1 Location

1. Locate the analyzer within 1000 ft. (305 m) of the installed D.O. sensor. Typically, the junction box supplied with optional D.O. sensor mounting hardware is located between the sensor and analyzer. The integral 15 ft. (4.6 m) long sensor cable plugs directly into the junction box. To extend the distance from the analyzer to the junction box, use 6-conductor interconnect cable.

2. Mount the analyzer in a location that is:

   - Clean and dry where there is little or no vibration.
   - Protected from corrosive fluids.
   - Within ambient temperature limits (-22 to +140°F or -30 to +60°C).

CAUTION:

MOUNTING THE ANALYZER IN DIRECT SUNLIGHT MAY INCREASE THE AMBIENT TEMPERATURE ABOVE THE MAXIMUM LIMIT.

2.2 Mounting

Figure 2-1 illustrates the various ways to mount the analyzer using the supplied bracket and hardware. Determine how you want to mount the analyzer and attach the hardware in the specific way depicted in the illustration. For analyzer installation dimension details, refer to Figure 2-2.

NOTE: *Use the longest bolts (6-inch/152 mm) for panel mounting the analyzer. Use the 4-inch (102 mm)*

long bolts when pipe mounting the analyzer. Also, be sure that the ribbed side of the bracket faces towards the pipe. The short 3/4-inch (19 mm) bolts are used to fasten the nylon bracket to the back of the analyzer case.

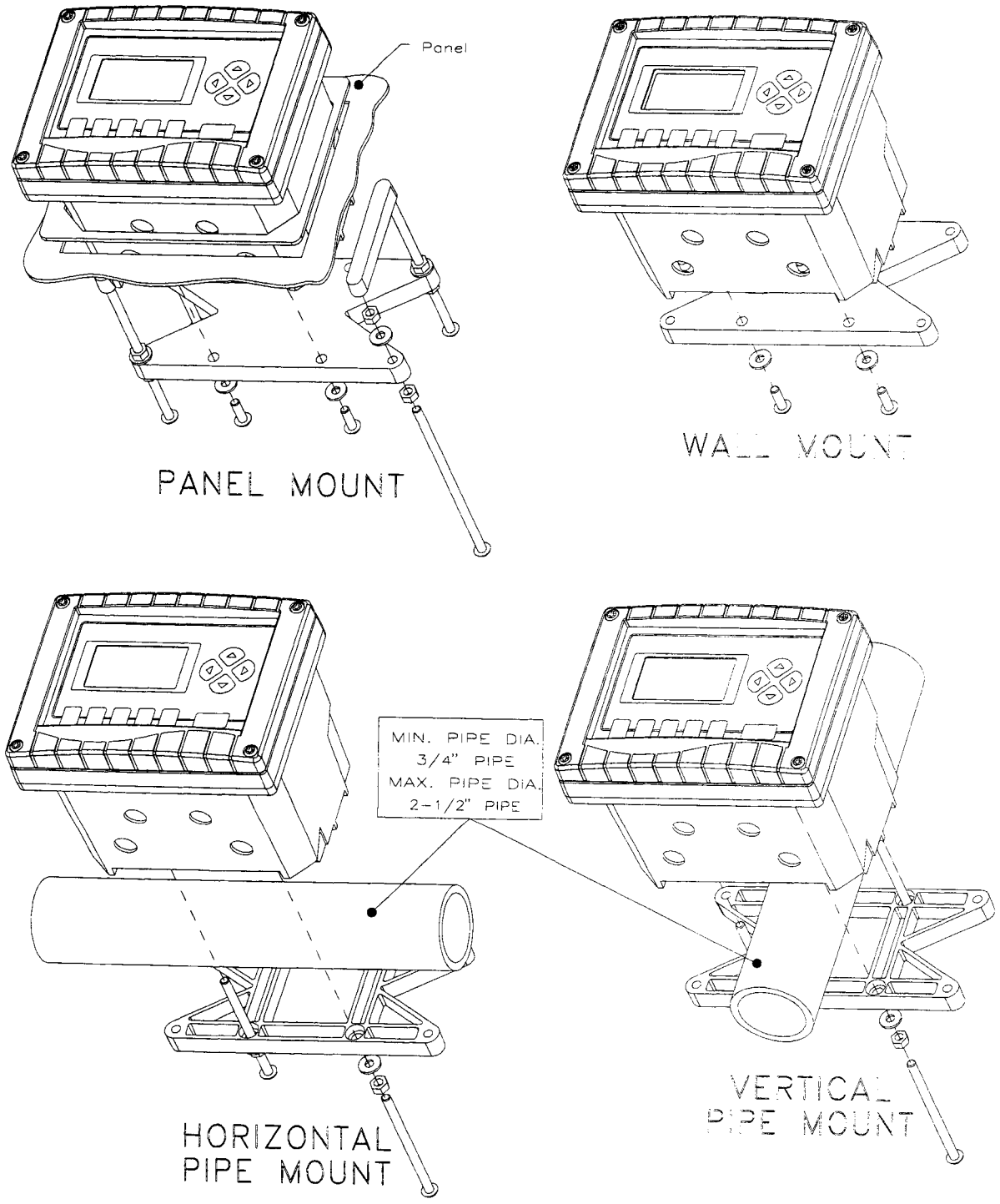


FIGURE 2-1 Analyzer Mounting Arrangements

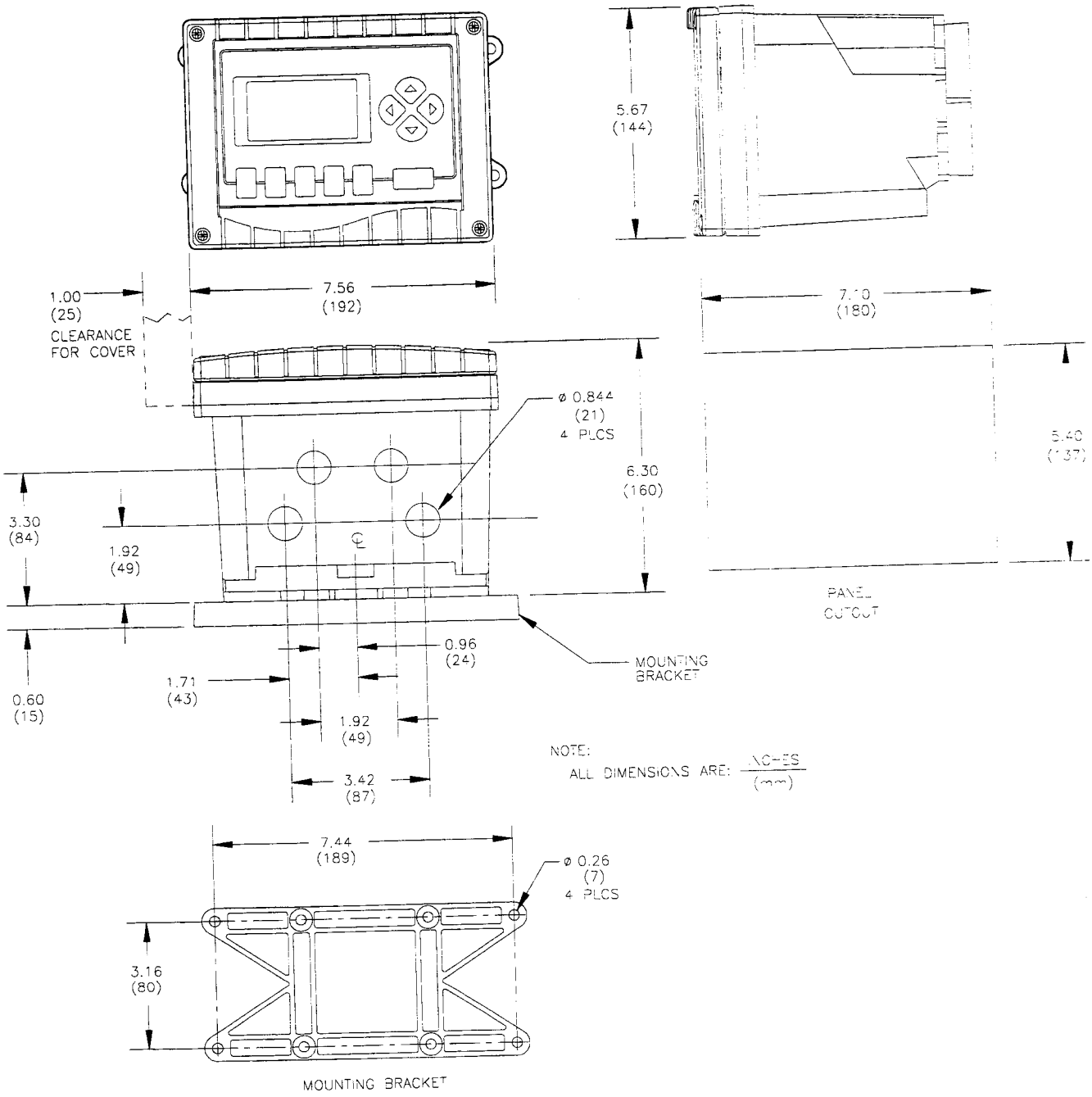


FIGURE 2-2 Analyzer Installation Dimension Details

2.3 Conduit Hole Requirements

Recommendation: Run all wiring to the analyzer in 1/2-inch, grounded metal conduit. If using only shielded cable, appropriate strain reliefs or cable grips are required. Seal unused cable entry holes with appropriate plugs.

NOTE: *Use NEMA 4-rated fittings and plugs to maintain the watertight integrity of the NEMA 4X enclosure.*

SECTION 3

ELECTRICAL CONNECTIONS

To access terminal strips for electrical c ctions, open the left-hinged enclosure door by unscre the four fas- teners. Figure 2-3 shows the terminal strip ngement and terminal designations (on backside of doo in bottom of analyzer enclosure).

NOTE: *All terminals are suitable for sing es up to 14 AWG (2.5 mm^2). Refer to the tern arrangement and designations that correspond the type of relays equipped in your analyzer.*

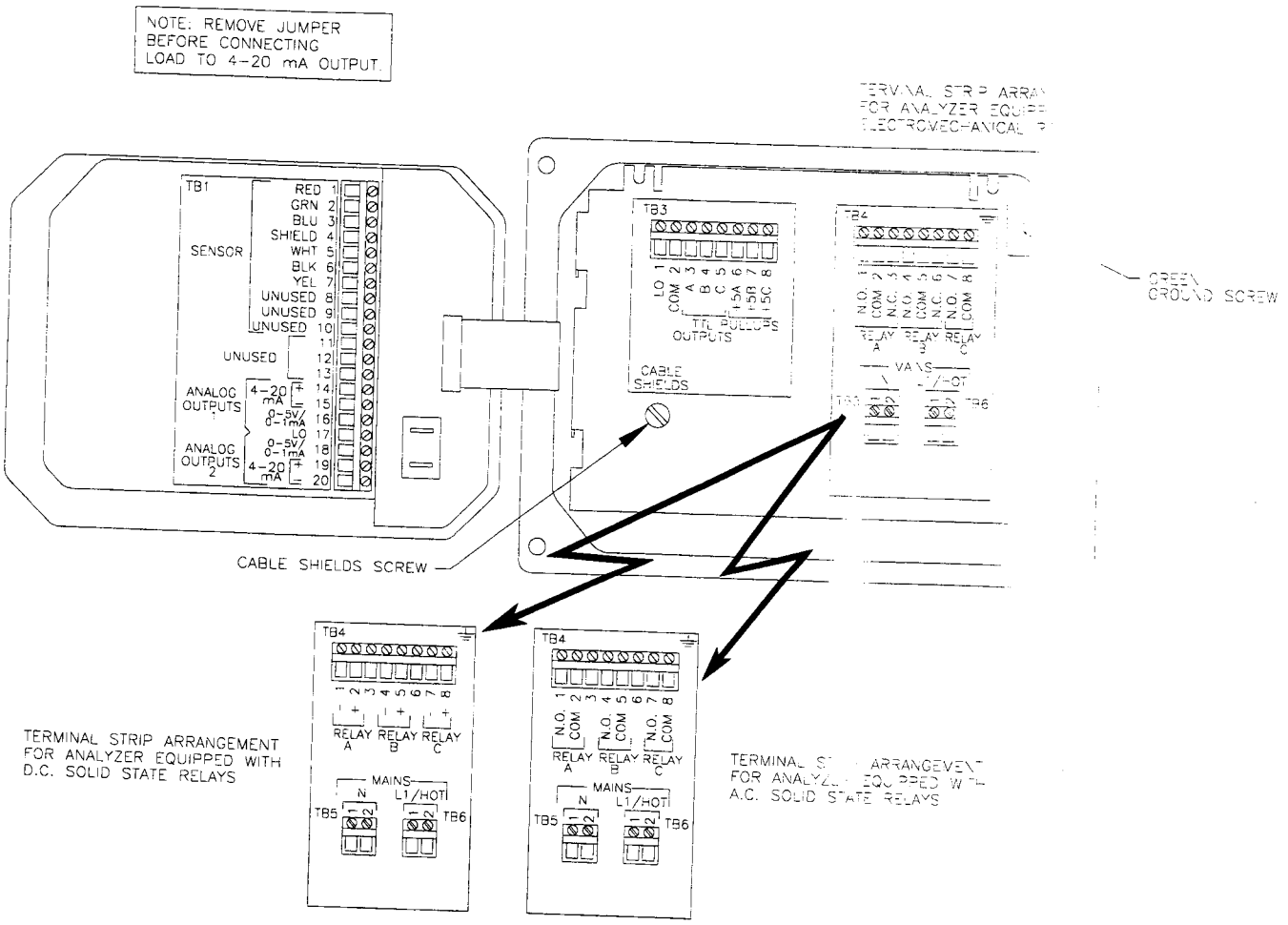


FIGURE 2-3 Analyzer Terminal Strip Designations

3.1 Membrane D.O. Sensor

Recommendation: Install the sensor before making electrical connections to the analyzer. For details on mounting the sensor and optional self-cleaning equipment, refer to the sensor instruction manual.

Wiring Tip! Route the analyzer-to-junction box interconnect cable in 1/2-inch, grounded metal conduit to protect it from moisture, electrical noise, and mechanical damage.

NOTE: *Do not route the analyzer-to-junction box interconnect cable in any conduit containing AC power wiring ("electrical noise" may interfere with the sensor signal).*

Refer to Figure 2-3 and connect the D.O. sensor:

1. Plug the sensor cable into the mating receptacle on the junction box supplied with any optional membrane D.O. sensor mounting hardware.

2. Route the 6-conductor interconnect cable from the junction box to the analyzer.

CAUTION:

FOR STEPS 3 AND 4, TWIST THE TWO SHIELD WIRES OF THE INTERCONNECT CABLE TOGETHER. THEN INSULATE THEM WITH PLASTIC TUBING OR TAPE TO PREVENT THEM FROM CONTACTING EARTH GROUND THROUGH THE ANALYZER ENCLOSURE OR THE JUNCTION BOX.

3. Connect the wires of the interconnect cable to terminals in the junction box, matching colors as indicated.

4. Connect the wires at the other end of the interconnect cable to analyzer TB1 Terminals 1 through 7, matching colors as indicated.

3.2 Analog Outputs

There are two sets (#1 and #2) of isolated analog outputs. Each set provides 0-5 VDC/0-1 mA and 4-20 mA signals. Each set can be assigned to represent the measured D.O. or temperature. Parameter values can be entered to define the endpoints at which the minimum and maximum mA output values are desired (Part Three, Section 5.5). Each output set can be selected to track the measurement, hold their present values, or transfer to preset values (Part Three, Section 5.6).

☞ **Wiring Tip!** Use high quality, shielded instrumentation cable for connecting the analog outputs. For best electromagnetic noise immunity, connect the cable shield to the "cable shields screw" shown in Figure 2-3.

Isolated 0-5 VDC/0-1 mA

This is a dual-purpose output. The 0-5 VDC output requires a minimum load of 1 megohm. The 0-1 mA output can drive a load of up to 100 ohms.

- For Output #1 "0-5 V/0-1 mA": Connect load (+) to TB1 terminal 16 and load (-) to TB1 "LO" terminal 17.
- For Output #2 "0-5 V/0-1 mA": Connect load (+) to TB1 terminal 18 and load (-) to TB1 "LO" terminal 17.

Isolated 4-20 mA

This output can drive a load of up to 900 ohms.

☞ ***NOTE:*** *Before connecting a load to a 4-20 mA output, remove the factory-installed jumper. When not using a 4-20 mA output, the jumper must be connected.*

- For Output #1 "4-20 mA": Connect load to TB1 terminals 14 and 15, matching polarity as indicated.
- For Output #2 "4-20 mA": Connect load to TB1 terminals 19 and 20, matching polarity as indicated.

3.3 Relay Outputs

The analyzer may be equipped with standard electromechanical relays or optional solid state AC or DC relays. For relay setup details, refer to Part Three, Section 5.3.

CAUTION:

DO NOT EXCEED THE CONTACT RATING FOR EACH RELAY (5A 115/230 VAC FOR ELECTROMECHANICAL RELAYS OR 2A CONTINUOUS FOR SOLID STATE RELAYS). WHEN SWITCHING LARGER CURRENTS, USE

AN AUXILIARY RELAY SWITCHED BY THE ANALYZER RELAY TO EXTEND ANALYZER RELAY LIFE. THIS SHOULD EXTEND THE LIFE OF THE RELAYS IN THE ANALYZER. WHEN USING RELAY OUTPUTS, MAKE SURE THAT LINE POWER WIRING TO THE ANALYZER IS ADEQUATE TO HANDLE THE CURRENT DRAW OF THE ANTICIPATED LOAD(S).

Electromechanical Relays

When equipped with this type of relay, two sets of SPDT relay outputs (Relays A and B) are provided at terminals 1 through 6 on TB4. One SPST Relay C output is provided at terminals 7 and 8 on TB4. **The relay outputs are not powered.** The line power used to power the analyzer may also be used to power control or alarm devices with these relay contacts. Refer to Figure 2-4 for a general wiring arrangement. Always check control wiring to insure that line power will not be shorted by the relay switching action, and that wiring conforms to local codes.

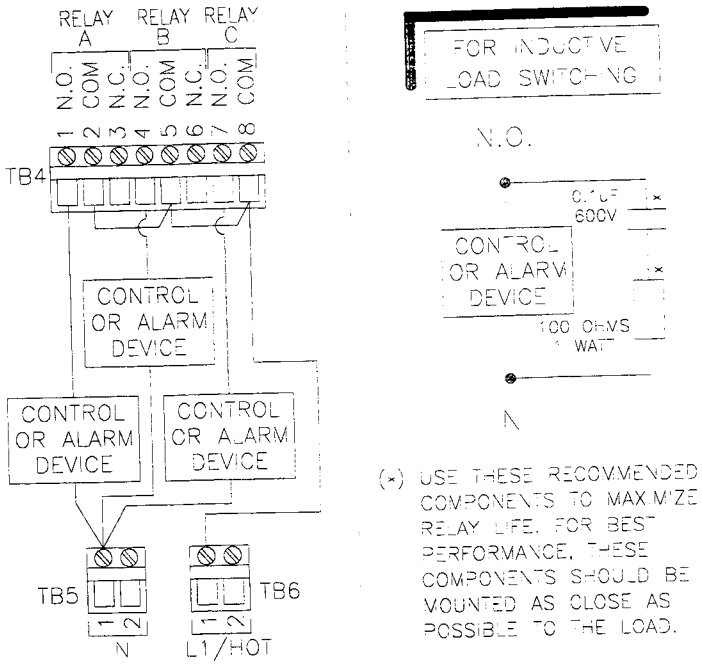


FIGURE 2-4 Connecting Control/Alarm Device(s) To Electromechanical Relay(s)

Solid State AC Relays (optional)

When equipped with this type of relay, three sets of SPST solid state AC relay outputs (Relays A, B and C) are provided at terminals 1 through 8 on TB4 – except terminals 3 and 6 which are unused. **The relay outputs are not powered.** The line power used to power the analyzer may also be used to power control or alarm devices with these relay contacts. Refer to Figure 2-5 for a general wiring arrangement. Always check control wiring to insure that line power will not be shorted by the relay switching action, and that wiring conforms to local codes.

☞ ***NOTE:*** *These solid state AC relay outputs require 24-250 VAC power with at least 0.02 amps RMS.*

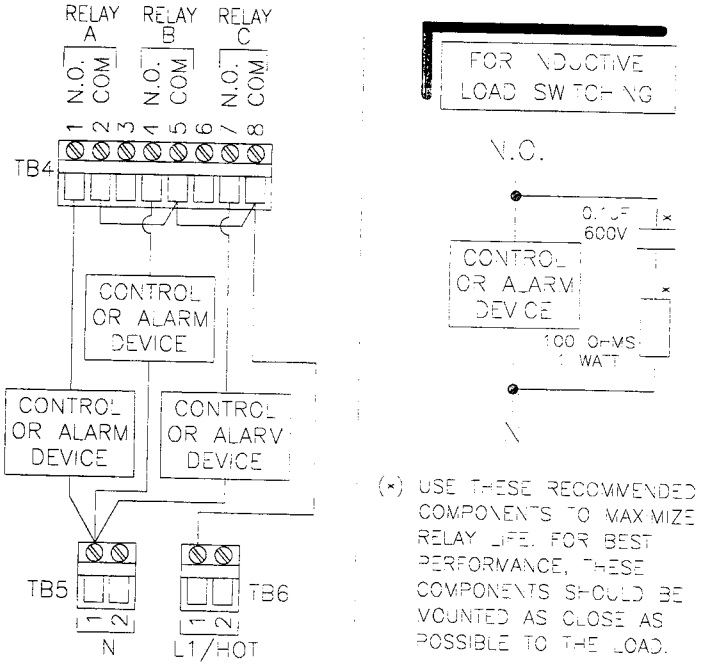


Figure 2-5 Connecting Control/Alarm Device(s) To Solid State AC Relay(s)

Solid State DC Relays (optional)

When equipped with this type of relay, three sets of SPST solid state DC relay outputs (Relays A, B and C) are provided at terminals 1 through 8 on TB4 – except terminals 3 and 6 which are unused. **The relay outputs are not powered.** You must supply DC power to the control or alarm devices using these relay contacts. Refer to Figure 2-6 for a general wiring arrangement. Always check control wiring to insure that the DC power source will not be shorted by the relay switching action, and that wiring conforms to local codes.

NOTE: *These solid state DC relay outputs require 3-60 VDC power.*

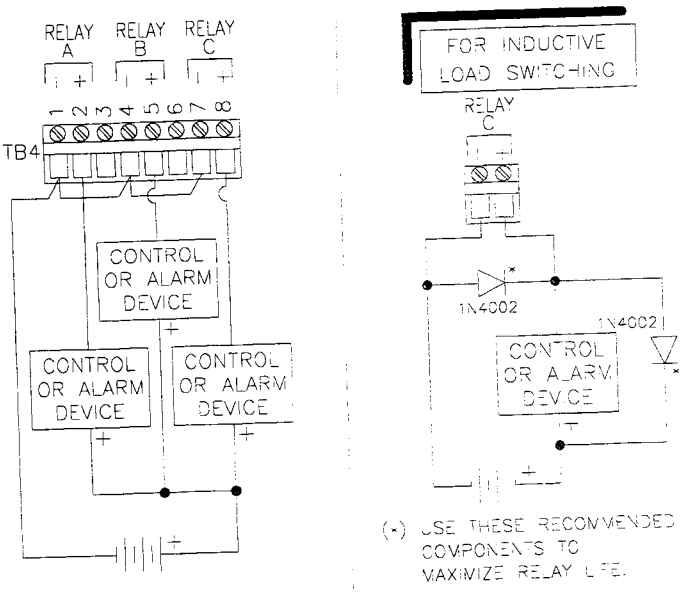


Figure 2-6 Connecting Control/Alarm Device(s) To Solid State DC Relays

3.4 TTL Outputs

Three sets of TTL outputs are provided at terminals 1 through 8 on TB3. They may be configured to operate as NAMUR diagnostic outputs by using the CONFIG menu and selecting "Relay/TTL Outputs" (Part Three, Section 5.3).

Wiring Tip! Use high quality, shielded instrumentation cable for connecting the TTL outputs. For best electromagnetic noise immunity, connect the cable shield to the "cable shields screw" shown in Figure 2-3.

The TTL outputs may be connected for internal or external power supply operation, or as a DC relay coil driver.

Internal-supply Logic Operation

Refer to Figure 2-7 for the wiring arrangement to use TTL Output A for logic signal operation from the analyzer's internal power supply. This connection provides +5 VDC for a logic "high" state and 0 VDC for a logic "low" state for Output A.

1. Jumper TB3 "LO" terminal 1 to TB3 "COM" terminal 2.

2. Jumper TB3 "Pullups +5A" terminal 6 to TB3 "TTL Outputs A" terminal 3.

3. Connect the external device to TB3 "TTL Outputs A" terminal 3 with its low reference connected to TB3 "LO" terminal 1.

☞ ***NOTE:*** *This connection is for TTL Output A. Follow the same steps for the other outputs using their respective terminals.*

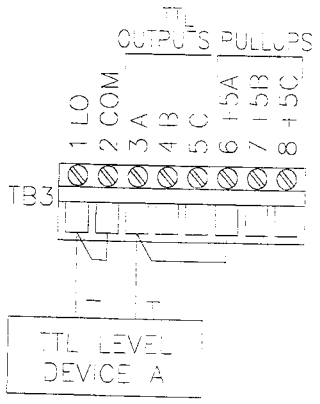


Figure 2-7 TTL Output Connections for Internal-supply Logic Operation

External-supply Logic Operation

Refer to Figure 2-8 for the wiring arrangement to use TTL Output A for logic signal operation from an external power supply. This connection requires an external voltage supply and a "pullup resistor".

1. Connect the external device's low reference to TB3 "COM" terminal 2.

2. Connect the external device's input to TB3 "TTL Outputs A" terminal 3.

3. Connect an apppropriate "pullup" resistor from the external device's input to the external device's positive voltage supply (24 VDC maximum).

☞ ***NOTE:*** *This connection is for TTL Output A. Follow the same steps for the other outputs using their respective terminals. Also, each TTL output can sink a maximum current of 20 mA.*

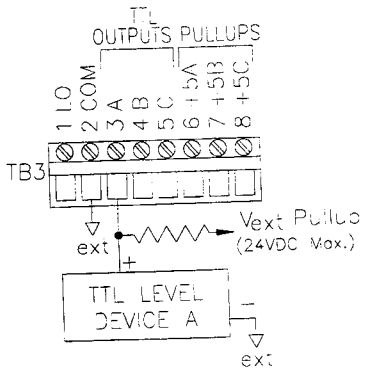


Figure 2-8 TTL Output Connections for External-supply Logic Operation

DC Relay Coil Driver Operation

Since the TTL outputs are open collector outputs, they may be used to switch current through a device such as a DC relay coil. Refer to Figure 2-9 for the wiring arrangement to use TTL Output A as a DC relay coil driver. This connection requires an external voltage supply and an appropriate diode.

1. Connect one side of the relay coil to TB3 "TTL Outputs A" terminal 3.
2. Connect the other side of the relay coil to an external positive voltage supply ($+V_{ext}$).
3. Connect a diode (1N4002 type), anode side towards TB3 terminal 3, across the relay coil.
4. Connect TB3 "COM" terminal 2 to an external ground.

☞ ***NOTE:*** *This connection is for TTL Output A. Follow the same steps for the other outputs using their respective terminals. Also, each TTL output can sink a maximum current of 20 mA.*

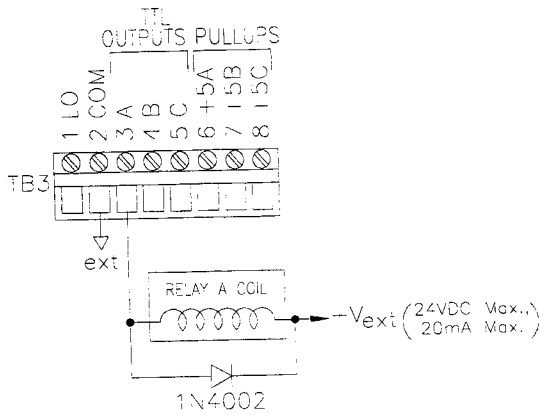


Figure 2-9 TTL Output Connections for DC Relay Coil Driver Operation

3.5 Line Power

Connect line power to analyzer terminals TB5 and TB6 using the standard three-wire connection arrangement. **Use wiring practices which conform to local codes** (example: National Electric Code Handbook in the U.S.A.).

WARNING:

MAKE SURE THAT LINE POWER IS NOT PRESENT WHILE CONNECTING LINE POWER WIRES TO THE "MAINS" TERMINALS ON TB5 AND TB6. ALSO, USE ONLY THE STANDARD THREE-WIRE GROUNDED WIRING ARRANGEMENT TO PREVENT AN UNSAFE CONDITION, AND TO ENSURE PROPER SYSTEM OPERATION.

1. Connect the ground wire to the analyzer green ground screw located to the right of TB4 (see Figure 2-3).

2. Connect the neutral (white) wire to one of the "N" terminals (1 or 2) on TB5. When the analyzer is equipped with the dual-fuse option, these terminals are fused with a 1/2 amp slow-blow fuse for protection.

3. Connect the hot (black) wire to one of the "L1/HOT" terminals (1 or 2) on TB6. These terminals are always fused with a 1/2 amp slow-blow fuse for protection, regardless of whether the analyzer is equipped with the single or dual-fuse option.

Recommendation: Install a nearby on-off type circuit breaker (15 amp maximum) to conveniently de-power the system. Also, do not route the sensor cable in any conduit containing AC power wiring ("electrical noise" may interfere with the sensor signal).

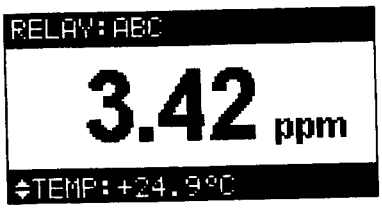
PART THREE - OPERATION

SECTION 1
THE USER INTERFACE

The analyzer user interface consists of an LCD display and a keypad with **MEAS**, **CAL**, **CONFIG**, **MAINT**, **DIAG**, **ENTER**, ⇦, ⇨, ⇧, **and** ⇩ **keys**.

1.1 LCD Display

The display shows screens containing text, numeric information and annunciators. Display text is concise but conversational and easy to understand. All annunciators appear on the measurement screen. An example of a typical MEASURE screen is:



1.2 Keypad Keys

Pressing the **MEAS key** always displays the MEASURE screen. The **CAL**, **CONFIG**, **MAINT**, and **DIAG keys** display their respective root (highest level) menus from which submenus can be selected and displayed.

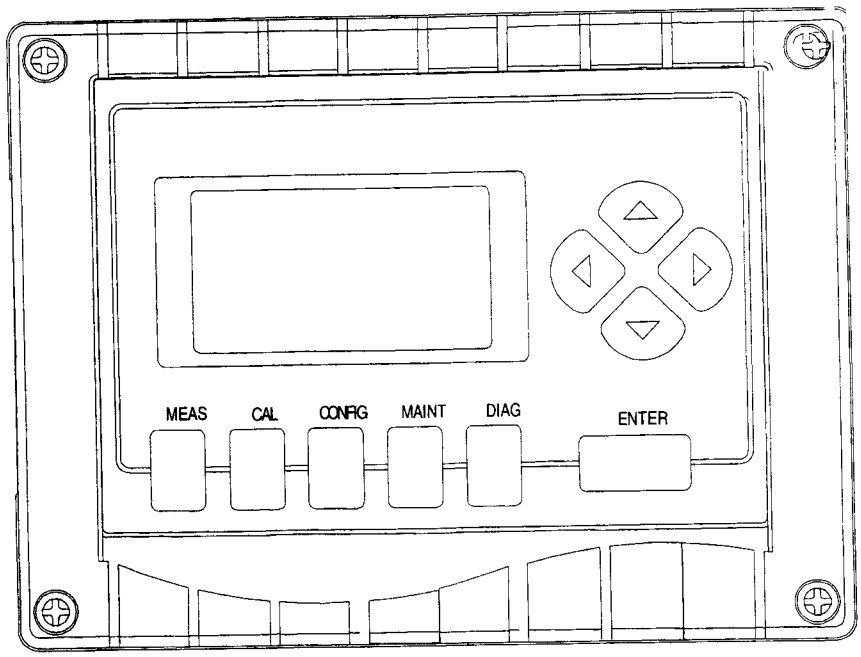


FIGURE 3-1 Analyzer Keypad

Displaying the MEASURE Screen

Pressing the **MEAS key** always returns the display to the MEASURE screen regardless of the displayed root menu or submenu. The bottom line on the MEASURE screen (shown in reverse video) displays auxiliary information such as temperature, date and time, current outputs, next scheduled date for calibration, etc. Pressing the ⇧ **or** ⇩ **key** scrolls upward or downward respectively between this information.

Displaying Root Menu Screens

With the MEASURE screen displayed, press the **CAL**, **CONFIG**, **MAINT** or **DIAG key** to display its corresponding root menu. Example: Pressing the **CONFIG key** displays the CONFIG root menu screen:

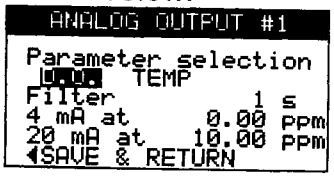
Pressing one of these same keys while its root menu is displayed always returns the display to the MEASURE screen. Pressing one of these same keys while one of their corresponding submenus is displayed returns the display to the last previous screen. This enables you to conveniently leave the displayed screen, or is a quick way back to the previous higher level screen.

Moving Within a Screen

The ⇦, ⇨, ⇧, **and** ⇩ **keys** enable selection within a screen. The ⇧ **and** ⇩ **keys** move up and down between lines and jog numeric values up and down (or toggle between + and - signs). The ⇦ **and** ⇨ **keys** move left and right within a line. The **ENTER key** confirms and enters data, selects submenus, and initiates displayed actions.

1.3 Entering Values

A line with an entry possibility usually has an identifying word or abbreviation as the first item. When scrolled to, this selected line is highlighted in reverse video. The ⇨ or **ENTER key** advances you to the entry field (number or word choice). The selected digit or word is also highlighted in reverse video as illustrated below:

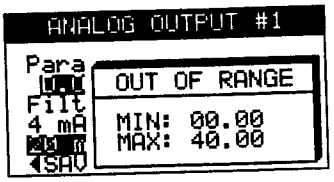


Viewing Selected Items

When viewing a menu with on/off choices, the current selection is in reverse video while those not selected are shown in normal video (see screen below). Numeric values that are not highlighted are shown in normal video.

Confirming Entries

When an item or numeric value has been adjusted as desired, it can be confirmed using the **ENTER key**. The analyzer checks each numeric entry to insure that it is within an acceptable range. If not, an "OUT OF RANGE" text box appears to display the acceptable range (shown below). To remove the text box from the screen, press the **ENTER key**. Then readjust the numeric entry to be within the acceptable range.



Storing Configuration Data

In the CAL, MAINT, and DIAG menus, the choices are selected by pressing the **ENTER key**. In the CONFIG menus, pressing the **ENTER key** only confirms choices (which may cause the display screen contents to change accordingly) but does not over-write pre-existing values.

Configuring the analyzer for relays, analog outputs, etc. usually requires entering a group of values for that function. Rather than storing and over-writing old values one at a time, the analyzer receives the entire group of entry values all at once. To store configuration data, simply:

1. Adjust the value for the first selected field.
2. Press the **ENTER key** to advance to the next field.
3. Repeat this sequence until the screen shows all desired values.
4. Press the **ENTER key** again to simultaneously enter the entire group of values.

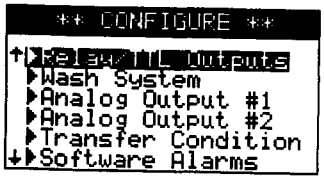
☞ ***NOTE:*** *For safety reasons, old values are not over-written until you exit the configuration screen by using the "SAVE AND RETURN" line. Exiting a configuration*

*screen by pressing the **MEAS** or **CONFIG key** aborts the entry routine, keeping pre-existing values the same.*

SECTION 2
MENU ORGANIZATION

The analyzer menu organization is essentially a tree structure. There are four main or "root" menus: CAL, CONFIG, MAINT, and DIAG. Access each of these root (highest level) menus by pressing its respectively named key. Each root menu has lower level submenus. Many of the submenus have sub-submenus, and so on.

On menu screens, a " ▶ " symbol pointing at a listed item indicates that a related lower level submenu can be accessed by pressing the **ENTER key**. The " ◀ " symbol pointing away from a "RETURN" or "SAVE & RETURN" bottom line indicates that you can backtrack to the previous related screen by pressing the **ENTER** or ⇦ **key**. Some lists are too long to completely fit on the screen. The "🡻" symbol at the list's bottom left indicates that you can scroll to the hidden bottom part of the list using the ⇩ **key**. The "🡹" symbol at the list's top left indicates that you can scroll to the hidden top part of the list using the ⇧ **key**.



SECTION 3
INSTRUMENT STARTUP

3.1 Adjusting Display Contrast

Depending on ambient lighting conditions, you may want to adjust the analyzer display contrast for best visibility. While pressing the **ENTER key**, simultaneously press the ⇧ **or** ⇩ **key** until attaining the desired contrast.

3.2 Initial Calibration

Before initially calibrating the analyzer, read Section 4 to learn about the first calibration and the different methods.

3.3 Initial Configuration

Before configuring the analyzer, read Section 5 to become familiar with all of the various configuration possibilities.

SECTION 4
THE CALIBRATION MENU

The CAL menu, accessed by pressing the **CAL key**, enables you to calibrate the analyzer for D.O. and temperature. Each type of calibration is performed using different submenus.

4.1 CAL Menu Structure

Refer to Figure 3-2 for the CAL root menu structure. If a passcode has been assigned (Section 5.9), you must successfully enter it to access the calibration menus.

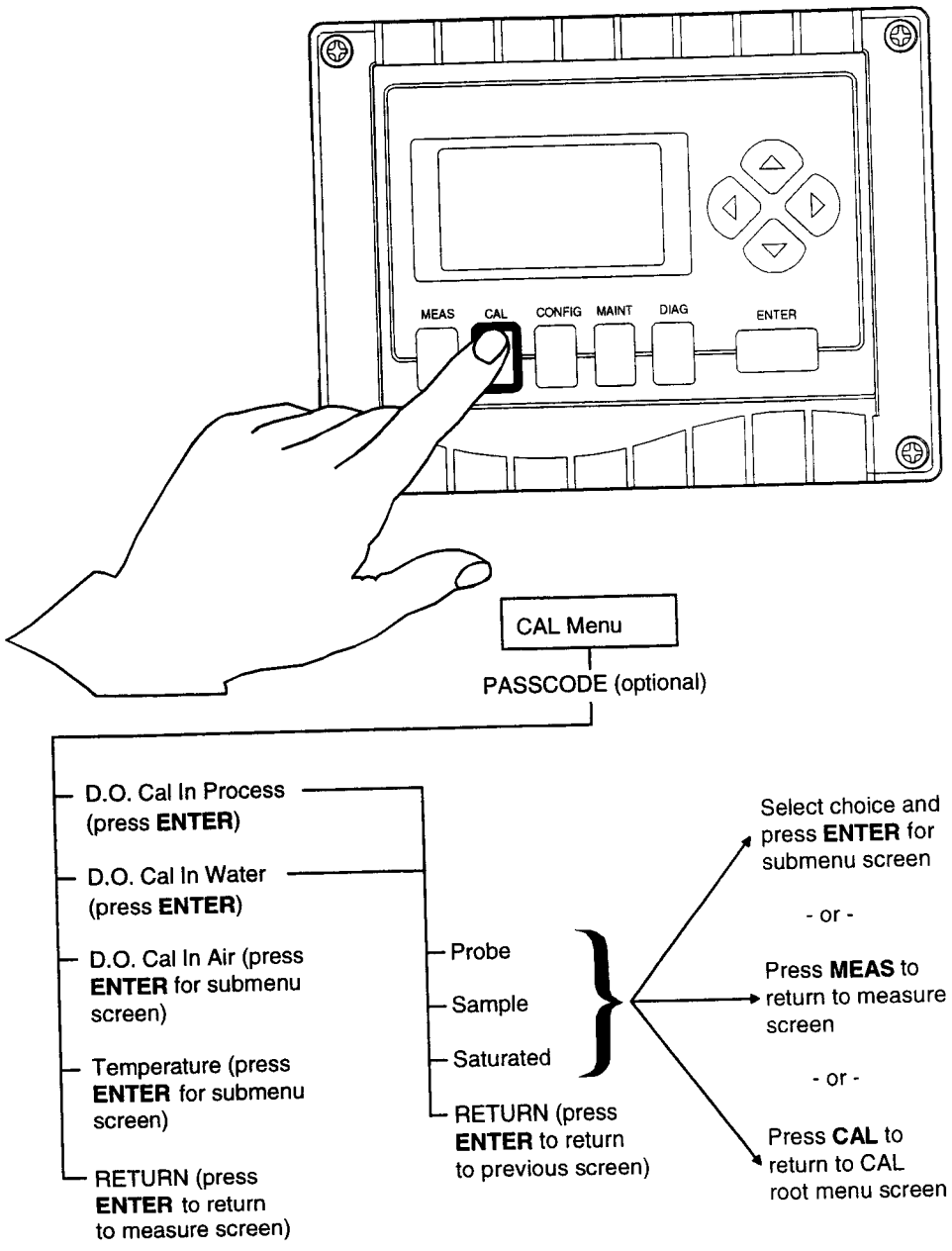


FIGURE 3-2 CAL Menu Structure

4.2 Things to Know About D.O. Calibration

Sensor Conditioning: Before initially calibrating the analyzer upon startup or after replacing the D.O. sensor membrane, always operate the sensor in a container of clean water for at least 12 hours to polarize the electrodes.

☞ ***NOTE:*** *Failure to properly condition a new membrane will result in significant measurement error.*

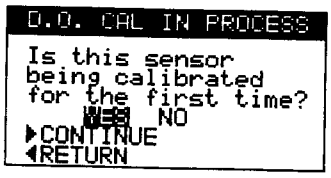
Since D.O. sensor performance degrades over time, you must calibrate periodically to maintain measurement accuracy. You can monitor the rate of degradation by looking at the sensor "slope" value. The sensor's first calibration always creates an approximate 100.0% baseline slope value from which subsequent calibrations are compared. Slope values of subsequent calibrations may be slightly more or less than 100.0%. The slope value may decrease dramatically if the sensor membrane becomes coated or fouled with debris. The system may still operate, but a low slope value usually indicates that the sensor requires cleaning or maintenance.

The exact slope values and maintenance intervals will vary considerably from application to application. They can only be determined by operating experience. Establish a regular maintenance schedule and monitor your slope values to determine their relevance to the maintenance intervals. Since the slope value is displayed at the end of each successful calibration, use the analyzer to assist you with this.

☞ **Calibration Tip!** For your convenience, the slope values for the last three calibrations are contained in the "Sensor Statistics" submenu in the DIAG root menu (see Part Three, Section 7.4). Establish a calibration schedule and monitor the slope values to determine appropriate calibration and maintenance intervals. After establishing these intervals, configure and enable the analyzer software alarms for the slope value to provide automatic warning and failure indications (Part Three, Section 5.7).

4.3 The Sensor's First D.O. Calibration

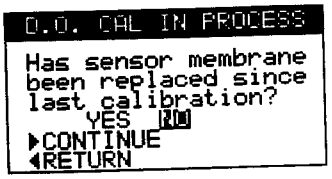
During any calibration, the analyzer will ask you if the sensor you are using is being calibrated for the first time:



By selecting yes, the analyzer establishes a "base line" of sensor statistics, from which subsequent calibrations are

compared, and resets the predict date for end-of-sensor life. The statistics for the first "base line" calibration and last three calibrations are stored in the "Sensor Statistics" submenu in the DIAG root menu. Statistics for only the last calibration are stored in the "Calibration Record" submenu in the DIAG root menu.

If you answer "no", the analyzer will additionally ask you:

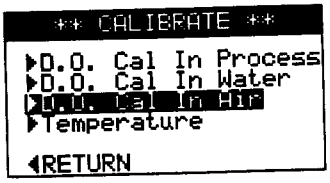


By selecting yes, the analyzer establishes a new base line, but does not reset the predict date. If you answer no, the base line and predict date remain unchanged.

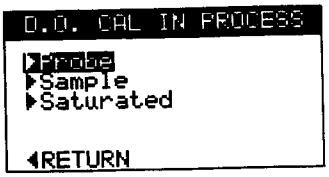
☞ ***NOTE:*** *After replacing the membrane of the sensor (via cartridge or cap), always perform a "first time" calibration to reset the predict date for the sensor.*

4.4 D.O. Calibration Methods

Calibrate the analyzer for dissolved oxygen measurement by selecting one of the three following submenus:



The "D.O. Cal In Process" and "D.O. Cal In Water" submenus are similar except that the sensor must be in the process when using the first submenu and in clean water when using the second. Both submenus provide the same three sub-submenus from which to choose a method:



- **Probe Method:** Enter a D.O. value obtained from a calibrated portable D.O. meter with its sensor placed next to the D63 system D.O. sensor.
- **Sample Method:** Enter a D.O. value obtained from a sample whose value was determined by laboratory analysis using the Winkler Method.

- **Saturated Method:** This method can only be used when the process or clean water is known to be 100% saturated with air. The analyzer computes and displays the ppm value based on the atmospheric pressure, and the temperature and salinity of the 100% saturated process or clean water.

☞ **Calibration Tip!** Omega highly recommends using the "D.O. Cal In Air" calibration method. When performed with one of the special calibration bags, provided with each GLI membrane D.O. sensor, this method:

- Ensures high calibration accuracy by providing a stable atmosphere at the sensor membrane.
- Provides considerable convenience even when using an optional self-cleaning system. It does not require a portable meter to determine the D.O. value.
- Provides high repeatability because the sensor is in a controlled environment.

The method you choose will likely depend upon two main factors: whether you want to remove the D.O. sensor from the process, and/or if you have the appropriate required equipment. The following table illustrates the seven available calibration methods relative to those deciding factors:

Table A – CALIBRATION METHODS

Deciding Factors	D.O. CAL IN PROCESS			D.O. CAL IN WATER			D.O. CAL IN AIR **(recommended method)**
	Probe	Sample	Saturated	Probe	Sample	Saturated	
Keep D.O. Sensor In The Process	Yes	Yes	Yes	No	No	No	No
Required Equipment	Calibrated portable D.O. meter	Chemical laboratory or kit for Winkler test	None, but process must be driven to 100% saturation	Calibrated portable D.O. meter	Chemical laboratory or kit for Winkler test	None, but clean water must be driven to 100% saturation	Special calibration bag (12 bags provided with each membrane D.O. sensor)

Decide which method to use and refer to the corresponding subsection for details. While performing the calibration, follow the easy instructions shown on the display screens.

Probe Method (in process or water)

General Procedure:

This procedure requires a calibrated portable D.O. meter.

1. Place the sensor of the portable D.O. meter in the process (or clean water) within 1 ft. (0.3 m) and at the same depth as the DOCN-72 system sensor.

2. Wait for the portable D.O. meter reading to stabilize (approximately 10 to 15 minutes).

3. Read and note the value measured with the portable D.O. meter.

4. Enter the noted value into the analyzer using the displayed "Cal Val" line.

☞ ***NOTE:*** *The "ppm" annunciator in the "Meas'd Val" line flashes if the measured D.O. reading is unstable. For best calibration accuracy, wait for the annunciator to stop flashing (D.O. reading is stabilized) before pressing the* ***ENTER key*** *to complete calibration. Calibration can be completed at any time while the annunciator is flashing, but measurement accuracy will be degraded.*

Sample Method (in process or water)

General Procedure:

1. After selecting the "Sample" method, the analyzer instructs you to "take" a sample and continue (by pressing the **ENTER key**).

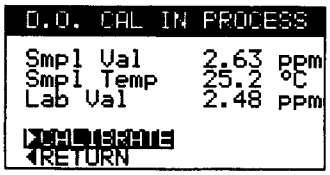
☞ ***NOTE:*** *"Take" means to actually obtain a sample in a container while the analyzer is simultaneously recording the D.O. value of the process (or clean water) during the time the sample was taken.*

2. While the analyzer is recording the D.O. value of the process (or clean water), the display shows "OK." When the MEASURE screen returns, the "SMPL" annunciator in the upper right corner will be on, indicating that the D.O. value of the process (or clean water) has been recorded and is now stored.

3. Determine the D.O. value of the sample in the laboratory using the Winkler method.

4. Press the **CAL key** (display shows sample calibration in progress).

5. Press the **ENTER key** to continue. The next screen (shown below) prompts you to key in the lab value (D.O. value of the sample determined in step 3).



NOTE: *There will probably be some difference between the sample (Smpl) value and the lab value. If you enter the lab value, that will become the calibration value. For example, suppose the analyzer's recorded sample value was 2.63 ppm and the lab value was 2.48 ppm. Also, suppose that while the value of the sample was being determined, the actual process (or clean water) value changed from 2.63 to 3.85 ppm. Now you enter 2.48 ppm to complete calibration. The reading on the measure screen will change to reflect the new calibration.*

If your process D.O. has a tendency to change rather quickly, it is very important that you take the sample and simultaneously initiate the analyzer's recording of the process (or clean water) D.O. value. Generally, the more time that elapses between doing these two things, the more calibration error that occurs.

6. After keying in the lab value, press the **ENTER key** to enter the value and select the "CALIBRATE" line. Press the **ENTER key** again to complete the calibration.

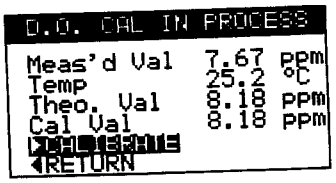
Saturated Method (in process or water)

General Procedure:

NOTE: *Before using this method to calibrate, you must aerate the process (or clean water) in which the membrane D.O. sensor is immersed so that it becomes 100% saturated.*

This method uses values you entered (or default values) on the "Solution" and "Atm. Pressure" sub-submenu screens in the "Main Parameter" submenu under the CONFIG root menu. For details on these entries, refer to Part Three, Section 5.2 under their respective subheadings.

After selecting the "Saturated" method, the analyzer computes the theoretical D.O. ppm value based on the measured temperature of the process (or clean water), and the atmospheric pressure and solution salinity values that were entered. The following screen appears:



This screen displays the measured ppm and temperature values of the process (or clean water), the computed theoretical (Theo.) value and a "Cal Val" which shows the same ppm value as the theoretical value. If you want to calibrate to a value other than the computed theoretical value, change the "Cal Val" line value.

☞ ***NOTE:*** *The "ppm" annunciator in the "Meas'd Val" line flashes if the measured D.O. reading is unstable. For best calibration accuracy, wait for the annunciator to stop flashing (D.O. reading is stabilized) before selecting the "CALIBRATE" line and pressing the* ***ENTER key*** *to complete the calibration. Calibration can be completed at any time while the annunciator is flashing, but measurement accuracy will be degraded.*

In Air Saturated Method
(GLI recommended calibration method)

General Procedure:

1. Remove the sensor from the process and thoroughly clean the sensor membrane. Refer to the sensor instruction manual for cleaning details.
2. Place the special calibration bag over the sensor's membrane end and secure the bag to the sensor body. Make sure that the sensor membrane is wet -- not dry.
3. Initiate the "D.O. Cal In Air" method. Follow the sequence of instructions shown on the analyzer display.
4. When the calibration data screen appears, wait for the "ppm" annunciator in the "Meas'd Val" line to stop flashing (approximately 15 minutes) and then press the **ENTER key** to complete the calibration.

4.5 Temperature Calibration

The analyzer is factory-calibrated for highly accurate temperature measurement. Only when the very highest accuracy is required is temperature calibration necessary. Follow the easy instructions shown on the display screens.

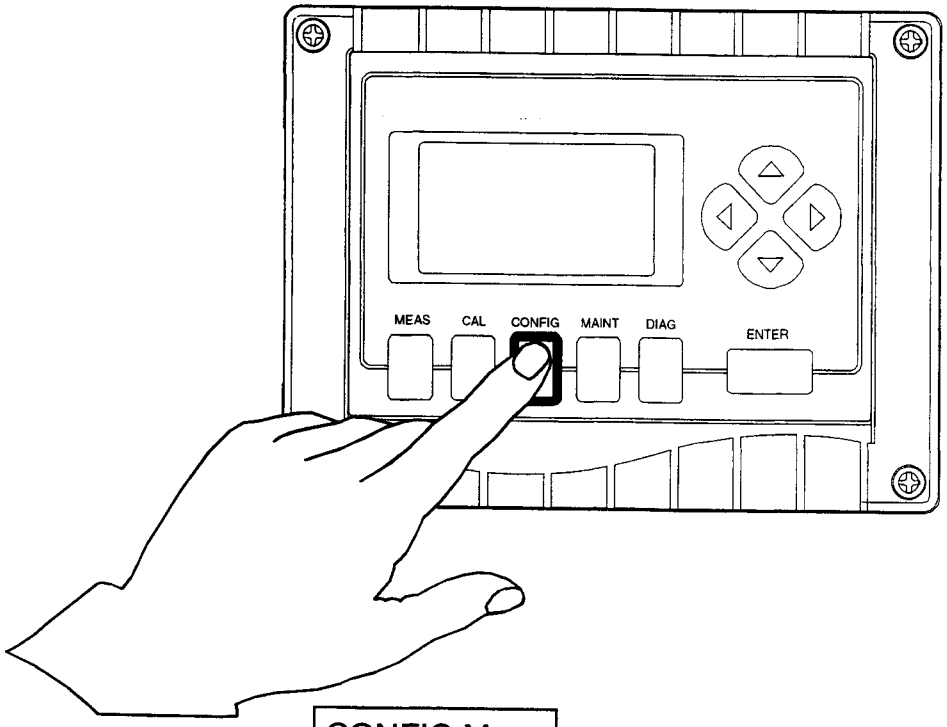
SECTION 5

THE CONFIGURATION MENU

The CONFIG root menu, accessed by pressing the **CONFIG key**, enables you to configure the analyzer to your application requirements.

5.1 CONFIG Menu Structure

Refer to Figure 3-3 for the CONFIG root menu structure. If a passcode has been assigned (Section 5.9), you must successfully enter it to access the configuration menus.



CONFIG Menu

PASSCODE (optional)

- Main Parameter
- Relay/TTL Outputs
- Wash System
- Analog Output #1
- Analog Output #2
- Transfer Condition
- Software Alarms
- Set Time/Date
- Set Passcode

Select choice and press **ENTER** for submenu screen

- or -

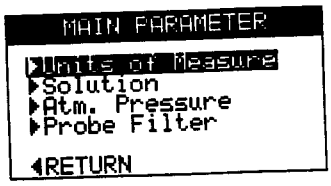
Press **MEAS** or **CONFIG** to return to measure screen

RETURN (press **ENTER** to return to measure screen)

FIGURE 3-3 CONFIG Menu Structure

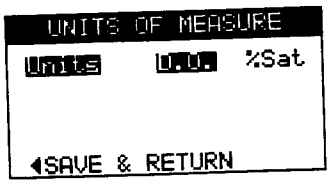
5.2 Initial Setup for Main Parameter

After selecting "Main Parameter" from the CONFIG root menu, use the following four submenus shown on the screen below to configure the analyzer to your application:



Units of Measure

Use the "Units of Measure" screen to select the measured D.O. readings to be displayed in ppm or % saturation:

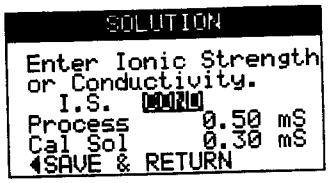


Solution

Do not use the "Solution" screen unless you intend to:

- Calibrate the analyzer using a "Saturated" method.
- Display the measured D.O. in % saturation.

In either case, enter the salinity of the process and/or the calibration solution, usually clean water, in ionic strength (millimols per liter) or conductivity (milliSiemens per cm). The analyzer uses these values and other factors to compute the theoretical ppm value for calibration.

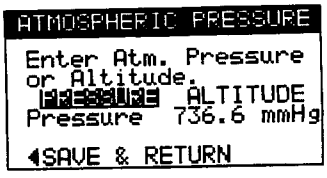


Atmospheric Pressure

Do not use the "Atmospheric Pressure" screen unless you intend to:

- Calibrate the analyzer using a "Saturated" method.
- Display the measured D.O. in % saturation.

In either case, enter the atmospheric pressure in millimeters of mercury or, if you prefer, the altitude in feet above sea level. The analyzer uses this value and other factors to compute the theoretical ppm value for calibration.



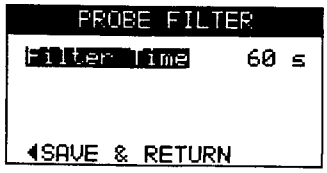
For your convenience, use the following table to convert inches of mercury to millimeters of mercury:

Table B -- ATMOSPHERIC PRESSURE CONVERSIONS

Inches of Hg	Millimeters of Hg
20.00	508.0
20.50	520.7
21.00	533.4
21.50	546.1
22.00	558.8
22.50	571.5
23.00	584.2
23.50	596.9
24.00	609.6
24.50	622.3
25.00	635.0
25.50	647.7
26.00	660.4
26.50	673.1
27.00	685.8
27.50	698.5
28.00	711.2
28.50	723.9
29.00	736.6
29.50	749.3
30.00	762.0
30.50	774.7
31.00	787.4
31.50	800.1

Probe Filter

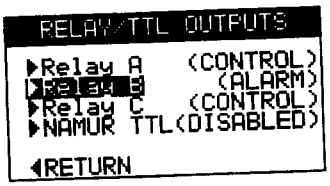
Use the "Probe Filter" screen to smooth out rapid changes in the measured D.O. reading. Suppose the analyzer reading is steadily showing 2.4 ppm, then suddenly jumps to 4.1 ppm for a fraction of a second, and returns to 2.4 ppm. By entering a value in seconds, the analyzer considers this to be a temporary upset and ignores most of this rapid change, resulting in a smoother measurement reading. The higher the entered value, the more the reading is filtered or "smoothed."



5.3 Setting Relays and TTL (NAMUR) Outputs

Relays

After selecting "Relay/TTL Outputs" from the CONFIG root menu, the following submenu shows the present mode for each relay and the NAMUR TTL outputs (in parenthesis):



After selecting the relay you want to configure (A, B, or C), a sub-submenu shows its settings. The function settings for a control relay differ slightly from those of an alarm relay. This screen shows function settings for a control relay.

Settings common to control/alarm relays are described below:

- **Parameter:** This selection assigns the relay to be driven by the measured D.O or temperature. Measurement units for all relay setup fields automatically correspond to the selection (ppm or % Sat for D.O.; °C for temperature).

- **Fail Safe:** Selecting "OFF" disables fail safe operation which energizes the relay when the analyzer annunciator is on. Conversely, selecting "ON" energizes the relay when the analyzer annunciator is off. This reverses normal relay operation to enable you to power pumps, valves, etc. such that if power is interrupted, the relay (in its de-energized state) puts the pump, valve, etc. in a "safe" condition. For example, suppose a horn is to be operated by Relay A. When the ppm D.O. gets too low, the horn sounds to notify everyone of the alarm condition. What if the power was inadvertently lost before the alarm could sound? The ppm D.O. might continue to fall but without a warning (the analyzer also has no power and is not operating). A better approach to this situation would be to use the fail safe function. Wire the horn to the NC contact of Relay A and select "Fail Safe ON". Now the horn will sound if the ppm D.O. gets too low – or if the power to the analyzer is interrupted (the relay will de-energize, closing the NC contacts and powering the horn).

- **Type:** This selection assigns the relay to operate in a control mode (display screen shows entries for setpoint, deadband, on delay, and off delay) or an alarm mode (display screen shows entries for high alarm, high deadband, low alarm, low deadband, on delay, and off delay).

  NOTE: *The "on delay" and "off delay" settings, common to both control and alarm modes, can be used to help eliminate overshoot when there are long process pipe runs or delays in mixing.*

  When you select a control mode for a relay, a "Phase" choice becomes available. Selecting "Phase HIGH" assigns the relay setpoint to respond to increasing measured value; conversely, "Phase LOW" assigns the relay setpoint to respond to decreasing measured value.

TTL (NAMUR) Outputs

The German NAMUR Committee has established standards for measurement and control in the chemical process industry. The TTL (NAMUR) outputs provided by the analyzer conform to these standards. Use the TTL (NAMUR) outputs as a set for diagnostic signaling. The signals that each output represents are:

TTL Output A:	Instrument is "off line" for calibration or maintenance.
TTL Output B:	One or more software or system alarms are in the "warn" state.
TTL Output C:	One or more software or system alarms are in the "fail" state.

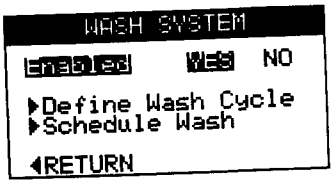
You can enable the TTL output set, operate the set in a "fail safe" mode, and assign the set an "on delay" time. For details regarding software alarms, refer to Section 5.7.

5.4 Establishing Wash System Operation

The wash system feature, when used in conjunction with an optional GLI air blast cleaning system, provides automatic control to air scrub (wash) the membrane of an on-line D.O. sensor. You can establish when the air blast wash occurs and the duration of the wash.

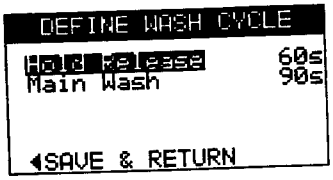
When you enable the analyzer wash system operation, Relay C is used to control the optional air blast cleaning system attached to the sensor. During the wash cycle, analog outputs #1 and #2 and the relays are automatically held, preventing upset of control or recording equipment connected to them. After the wash cycle is finished, the analog outputs and relays are returned to their configured "TRANSFER CONDITION" states unless you want to continue holding them for up to 999 seconds.

After selecting "Wash System" from the CONFIG root menu, use these two submenus to establish wash system operation:



Defining the Wash Cycle

Use the "Define Wash Cycle" submenu to define and enter the wash cycle:

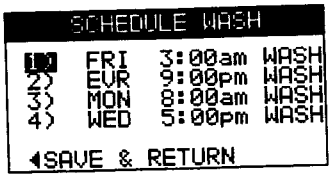


On this screen, the configuration choices are:

- **Hold Release:** Sets how long you want the analog outputs (#1 and #2) to remain in a "hold" mode (0-999 seconds) after the wash cycle is completed.
- **Main Wash:** Sets how long the air blast wash is to remain on (0-300 seconds). If "0" is entered, the wash cycle will not occur.

Scheduling Wash Events

The wash system operates on a timed basis. Use the "Schedule Wash" submenu to schedule when you want the defined wash cycle events to occur:



Up to 28 separate wash events may be entered. To schedule the defined wash cycle as an event, you enter a "day of week," "time of day," and "event type." Day of week selections include "SUN" through "SAT" or "EVR" which should be used for a wash event that occurs every day. Event type selections are "WASH" or "NONE." ("NONE" indicates an empty, unscheduled event, or an event that is intended to be deleted from the list.)

When the "Schedule Wash" submenu screen first appears, an empty, unscheduled event is shown as:

"1⟩ EVR 12:00 am NONE"

You must edit this event line to establish when the defined wash cycle event is to occur. To display another empty event line, press the **ENTER key**. Repeat this procedure until all desired events are established. To save (enter) all events at once, select the "SAVE & RETURN" line and press the **ENTER key**.

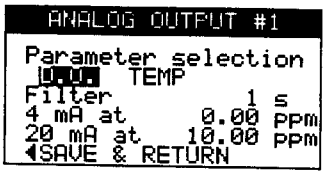
☞ ***NOTE:*** *Wash events do not have to be entered in chronological order. The next time you access this submenu screen, the analyzer automatically sorts the wash events and displays them in chronological order. Also, "EVR" (everyday) wash events are always listed before SUN through SAT wash events.*

Wash events inadvertently scheduled to occur at the same times will prompt the analyzer to delete the lower-listed wash event. Likewise, if an "EVR" (everyday) wash event occurs at the same time as a SUN through SAT wash event, the SUN through SAT wash event will be deleted, regardless of its position in the list.

To delete a presently scheduled wash event, simply change the event type to "NONE." The next time you access this submenu screen, that event will not appear.

5.5 Setting Analog Outputs (#1 and #2)

Each analog output (#1 and #2) is setup independently in the same way. After selecting "Analog Output #1" or "Analog Output #2" from the CONFIG root menu, use its respective submenu to configure the output. The submenu for Analog Output #1 is shown below:



On this screen, the configuration choices are:

- **Parameter selection:** This selection assigns the output to represent the measured D.O. or temperature.
- **Filter:** This is a time constant setting (in seconds) to filter or "smooth out" the 4-20 mA output. A minimum entry of "0 s" has no smoothing effect. A maximum entry of "999 s" provides maximum smoothing. Deciding what filter output time to use is a compromise. The higher the filter time, the longer the output signal response time will be to a change in the measured value.
- **4 mA at:** This entry (in ppm or % Sat for D.O.; °C for temperature) sets the low endpoint of the range at which 4 mA is provided.
- **20 mA at:** This entry (in ppm or % Sat for D.O.; °C for temperature) sets the high endpoint of the range at which 20 mA is provided.

5.6 Initial Setup for Transfer Condition

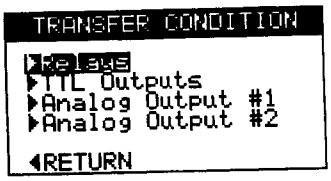
The "transfer mode" transfers the relay, TTL, and analog output functions from their present states to desired, preset states. The transfer mode is usually initiated during calibration or a maintenance procedure such as cleaning the sensor. The following example illustrates the usefulness of the transfer mode:

TRANSFER MODE EXAMPLE

Suppose during calibration you want:

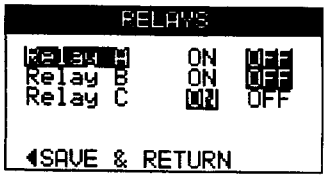
- Relays A and B to be off.
- Relay C to be on.
- TTL A output to be low.
- TTL B and C outputs to be high.
- Analog output #1 to transfer to 12.00 mA.
- Analog output #2 to be held at its present value.

After selecting "Transfer Condition" from the CONFIG root menu, use the following four submenus to set up transfer conditions for the respective analyzer functions to meet the specific requirements of your application:



Relays

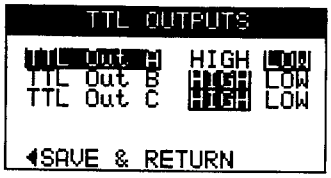
The "Relays" submenu sets their respective transfer conditions:



On this screen, "ON" sets the relay to be on during a transfer condition. Conversely, an "OFF" setting sets the relay to be off.

TTL Outputs

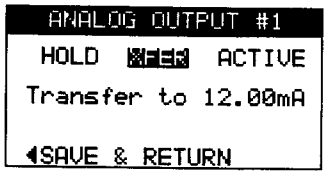
The "TTL Outputs" submenu sets their respective transfer conditions:



On this screen, "HIGH" sets the TTL output to be high during a transfer condition. Conversely, a "LOW" setting sets the TTL output to be low.

Analog Outputs #1 and #2

The "Analog Output #1" and "Analog Output #2" submenus set their respective transfer conditions:

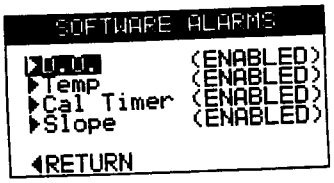


On this screen, the configuration choices are:

- **HOLD:** This selection holds the output values (4-20 mA and 0-5 VDC/0-1 mA) at their present values during a transfer condition.
- **XFER:** This selection transfers the 4-20 mA output value to a desired preset value, shown on the next line, during a transfer condition. (The 0-5 VDC/0-1 mA output values also transfer to values that correspond to the 4.00-20.00 mA value you enter.)
- **ACTIVE:** This selection allows the output values (4-20 mA and 0-5 VDC/0-1 mA) to continue tracking the measured value during a transfer condition.

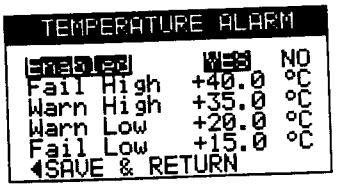
5.7 Setting Software Alarms

After selecting "Software Alarms" from the CONFIG root menu, use the following four submenus to set alarm limits for the respective software alarm functions:



All software alarm functions drive the TTL (NAMUR) Outputs A, B, and C.

The submenu screens for each of the software alarm functions -- except for the "Cal Timer Alarm" discussed later -- contain the same selection and entry fields as shown below.



Each software alarm function enables you to enter alarm limit values for fail high, warn high, warn low, and fail low. For example, suppose you want to set software alarms for the measured temperature because you need to know when the temperature gets too far from its normal 25°C. In this example, select "YES" to enable the temperature software alarm and enter appropriate values. Suppose they are:

Fail High: +40.0°C
Warn High: +35.0°C
Warn Low: +20.0°C
Fail Low: +15.0°C

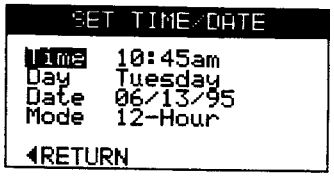
In this example, if the temperature increased to +36.0°C, the display would indicate "WARN" and the TTL (NAMUR) Output B, if enabled, would provide a warn signal for external use. If the temperature decreased to +12.0°C, the display would indicate "FAIL" and the TTL (NAMUR) Output C, if enabled, would provide a fail signal for external use.

In the "Cal Timer" submenu screen (shown on next page), enter the number of days you want to elapse before the next scheduled calibration. After this time expires, the analyzer displays a "WARN" alert and creates diagnostic message

80 (meaning cal date reached) which can be displayed by accessing the "Messages" submenu in the DIAG root menu.

5.8 Setting Analyzer Clock Time/Date

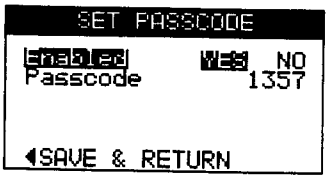
After selecting "Set Time/Date" from the CONFIG root menu, use this submenu to set the present time and date for the analyzer real-time clock (RTC):



NOTE: *In the "Mode" field, the "12-Hour" selection provides an am/pm time format. The "24-Hour" selection provides a military time format.*

5.9 Setting a Passcode

After selecting "Set Passcode" from the CONFIG root menu, use this submenu to set a passcode:



The entered passcode must be a 4-digit number.

CAUTION:

IF ENABLED, THE ASSIGNED PASSCODE MUST BE ENTERED TO ACCESS ANY OF THE ANALYZER ROOT MENUS (CAL, CONFIG, MAINT, AND DIAG). BE SURE TO WRITE DOWN THE PASSCODE AND STORE IT IN A SAFE PLACE. IF YOU ARE AN AUTHORIZED PERSON AND HAVE FORGOTTEN OR MISPLACED THE ASSIGNED PASSCODE, CONTACT THE GLI CUSTOMER SERVICE DEPT. FOR ASSISTANCE.

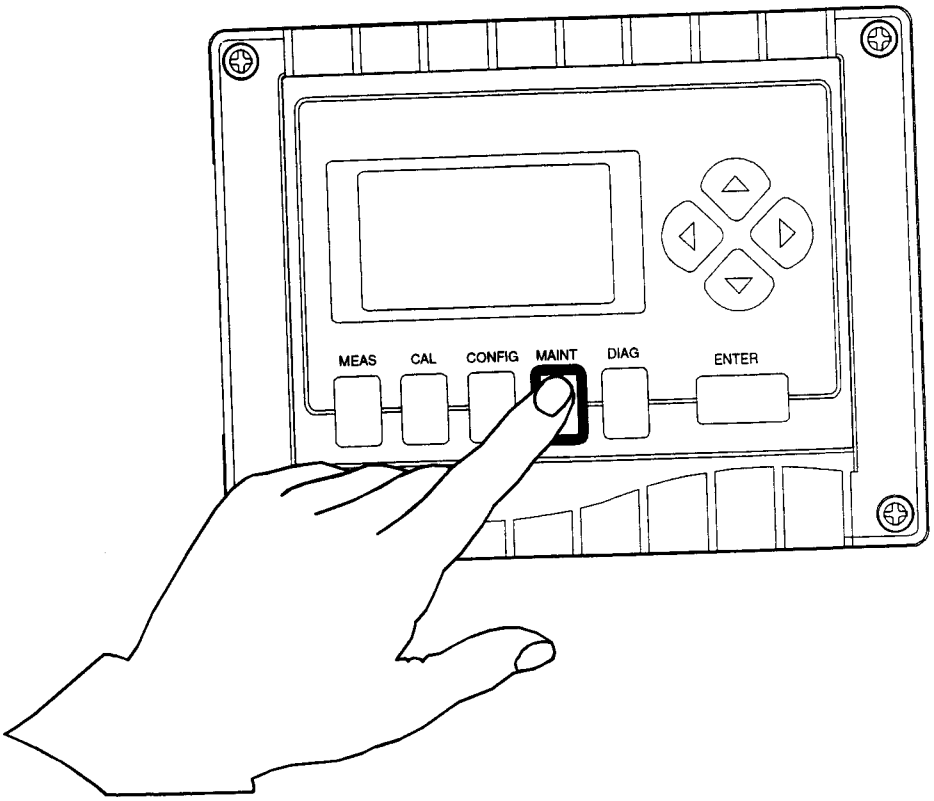
Record your passcode here ➨ __ __ __ __

SECTION 6
THE MAINTENANCE MENU

The MAINT root menu, accessed by pressing the **MAINT key**, enables you to manually control many of the analyzer functions when performing maintenance or system troubleshooting. You can then verify that the external devices connected to the analyzer are operating.

6.1 MAINT Menu Structure

Refer to Figure 3-4 for the MAINT root menu structure. If a passcode has been assigned (Section 5.9), you must successfully enter it to access the maintenance menus.



MAINT Menu

PASSCODE (optional)

- Hold/Xfer Outputs
- Sensor Maintenance
- Manual Analog Out
- Manual Relay/TTL
- Simulate D.O./Temp

RETURN (press **ENTER** to return to measure screen)

Select choice and press **ENTER** for submenu screen

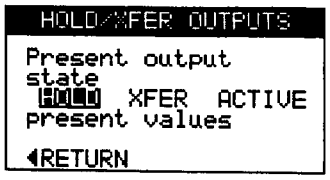
- or -

Press **MEAS** or **MAINT** to return to measure screen

FIGURE 3-4 MAINT Menu Structure

6.2 Holding/Transferring Analog Outputs

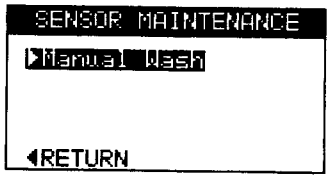
After selecting "Hold/Xfer Outputs" from the MAINT root menu, use the following submenu to manually change the output modes:



When cleaning the sensor or performing other maintenance tasks, you may want to hold the analog outputs at their present values or transfer them to values that will not adversely affect the connected device. By selecting "HOLD" or "XFER", the output values will respond accordingly even after exiting this submenu screen. The "HOLD" or "XFER" annunciator will be displayed on the MEASURE screen to remind you that this condition exists. To cancel this manual output mode, select the "ACTIVE" mode using this same submenu screen.

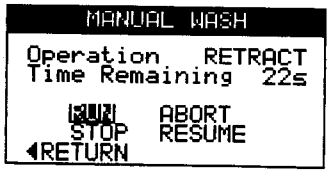
6.3 Manually Operating Wash Cycle

This section is only relevant when using the automatic wash system feature in conjunction with the optional self-cleaning equipment for the membrane D.O. sensor. After selecting "Sensor Maintenance" from the MAINT root menu, the following screen appears:



With this screen displayed, press the **ENTER key** to access the "Manual Wash" submenu.

Use the following "Manual Wash" submenu screen to manually control the defined wash cycle which was previously established in Part Three, Section 5.4 under the subheading "Defining The Wash Cycle."

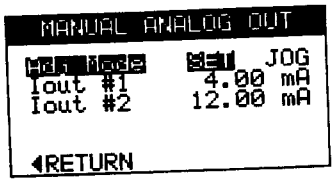


Select "RUN" and press the **ENTER key** to hold the analog outputs at their present values and to start the defined wash cycle (Relay C output). The "Operation Time Remaining"

counts down the time entered for the defined wash cycle. The analog outputs remain in a "hold" mode until the hold release time, entered for the defined wash cycle, expires.

6.4 Manually Setting Analog Output Values

After selecting "Manual Analog Out" from the MAINT root menu, use the following submenu to manually control the analog output sets:

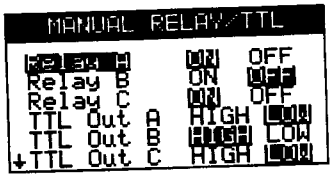


You can "set" or "jog" the analog output values. By selecting "SET," you can adjust the 4-20 mA value for each output set. (The 0-5 VDC/0-1 mA values are also automatically adjusted to values that correspond to the 4.00-20.00 mA value you enter.) By selecting "JOG," you can jog the 4-20 mA value for each output set up or down by respectively holding down the ⇧ **key** or ⇩ **key**.

☞ ***NOTE:*** *The set or jogged output values override and clear any configured "HOLD" or "XFER" output mode. When exiting this screen, the modes for outputs #1 and #2 automatically default to the "ACTIVE" mode.*

6.5 Manually Operating Relays/TTL Outputs

After selecting "Manual Relay/TTL" from the MAINT root menu, use the following submenu to manually operate the relays and TTL outputs:

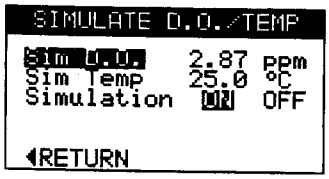


By operating the relays and TTL outputs, you can manually activate the devices connected to them.

☞ ***NOTE:*** *The selected relay and TTL output states shown on this screen temporarily override any configured "TRANSFER CONDITION" states. When exiting this screen, the relays and TTL outputs automatically return to their previously configured states.*

6.6 Simulating D.O. and Temperature Values

After selecting "Simulate D.O./Temp" from the MAINT root menu, use the following submenu to simulate D.O. and temperature values:



Simulating D.O. and °C values is useful when setting up and verifying complex control schemes. **Example:** Suppose you have set an alarm relay to sound a horn when the measured D.O. falls below 3 ppm. By using a simulated D.O. value, you can verify this situation without actually upsetting the process value. A "SIM" annunciator will be displayed on the MEASURE screen to remind you of this condition.

SECTION 7
THE DIAGNOSTIC MENU

7.1 Predictive Membrane D.O. Sensor Diagnostics

The analyzer can predict the date (month/year) for the end of the membrane D.O. sensor operating life. This predictive diagnostic feature operates automatically and continuously. You do not need to enable or configure this feature.

The analyzer calculates the predictive diagnostic end date based on the consumption of the silver electrode in the sensor. For the sensor to operate properly, a chemical reaction must occur between the process and this electrode. This chemical reaction slowly consumes the silver electrode. Over time, the silver electrode is entirely consumed, making the sensor inoperable. The analyzer monitors this rate of silver electrode consumption and other factors to forecast the date when the sensor will need to be replaced.

☞ ***NOTE:*** *Under normal operating conditions, the sensor should operate properly for well over 10 years.*

When you replace the membrane of the sensor (via cartridge or cap) and perform a "first time" calibration, the predictive diagnostic feature automatically resets to an initial forecast of 10 years.

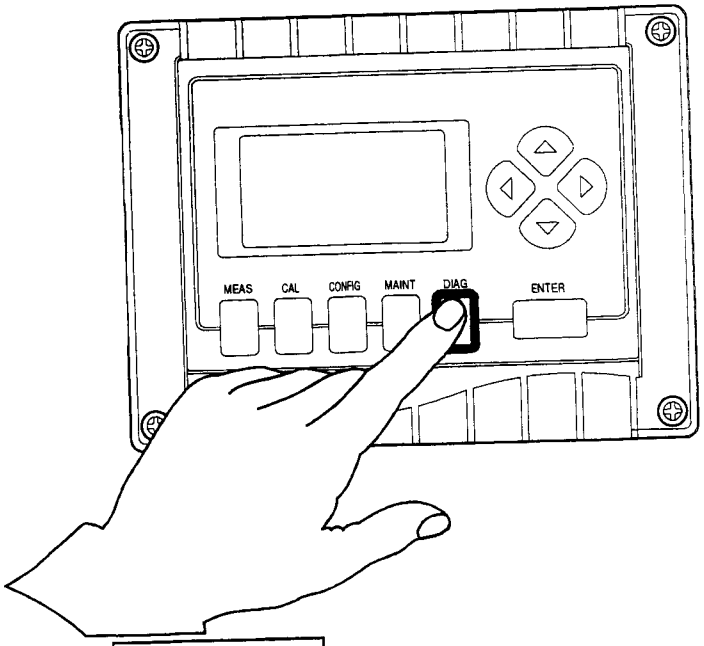
You can display the "PREDICT: month/year" date on the bottom line of the MEASURE screen by scrolling with the ⇧ **or** ⇩ **key**. Until you perform a "first time" calibration, the display indicates "PREDICT: 0/00." After the first calibration, the display will indicate the month in which you performed this calibration and the analyzer's initial ten-year prediction.

As the sensor is used, the end-of-sensor-life predict date is automatically updated based on the process D.O. value, the temperature, and other factors. When the predict date expires, the analyzer displays a "WARN" alert and creates diagnostic message #34 (predicted fail date) which can be displayed by accessing the "Messages" submenu in the DIAG root menu. When the DOE-72-RC sensor cartridge is replaced (or the complete DOE-72 sensor is replaced), and the system is re-calibrated with a "first time" calibration, this warning message is cleared.

7.2 DIAG Menu Structure

The DIAG root menu, accessed by pressing the **DIAG key**, enables you to diagnose problems with the analyzer or measurement system.

Refer to Figure 3-5 for the DIAG root menu structure. If a passcode has been assigned (Section 5.9), you must successfully enter it to access the diagnostic menus.



DIAG Menu

PASSCODE (optional)

- Messages
- Calibration Record
- Sensor Statistics
- Logbook
- Hardware Test
- Device Description
- Factory Assistance

Select choice and press **ENTER** for submenu screen

- or -

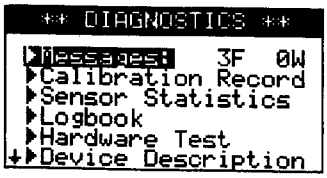
Press **MEAS** or **DIAG** to return to measure screen

RETURN (press **ENTER** to return to measure screen)

FIGURE 3-5 DIAG Menu Structure

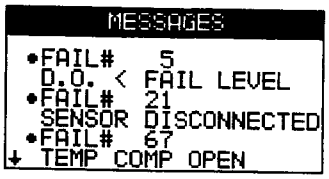
7.3 Messages

When an analyzer or system problem occurs, the analyzer alerts you by displaying "WARN" or "FAIL" on the MEASURE screen. To understand what this means, you must access the "Messages" submenu from the DIAG root menu:



On the example screen above, the "3F 0W" shown to the right of the "Messages" line indicates that there are three fail and no warn messages in the list. Messages are generated from the analyzer diagnostics and its software alarms.

Accessing the "Messages" submenu displays a message list screen similar to this example screen:



All messages in the list are also stored in the logbook (Section 7.5). All messages consist of an identification number and concise text describing the problem. (The " > " symbol in the message list means greater than; the " < " symbol means less than.) The following list shows, in numerical order, all possible messages and their causes/remedies.

☞ ***NOTE:*** *Messages with identification numbers higher than #128 are "logbook-only" messages pertaining to system events. To view these messages, you must access the "Logbook" submenu.*

Table C -- DIAGNOSTIC MESSAGE LIST

Message #	Displayed Message	Cause/Remedy
# 2	D.O. > WARN LEVEL	Measured D.O. exceeded software alarm's preset warn high level.
# 3	D.O. > FAIL LEVEL	Measured D.O. exceeded software alarm's preset fail high level.
# 4	D.O. < WARN LEVEL	Measured D.O. exceeded software alarm's preset warn low level.
# 5	D.O. < FAIL LEVEL	Measured D.O. exceeded software alarm's preset fail low level.
# 6	D.O. OVER RANGE	Sensor D.O. signal value is too large. Sensor may be faulty, incorrectly connected, or have a shorted cable, or analyzer may have a faulty scaling card. Check wiring.
# 8	D.O. UNDER RANGE	Sensor D.O. signal value is too small. Sensor may be faulty, incorrectly connected, or have a shorted cable, or analyzer may have a faulty scaling card. Check wiring.
# 10	SAT > WARN LEVEL	Measured % Sat. exceeded software alarm's preset warn high level.

Continued on next page.

Table C – DIAGNOSTIC MESSAGE LIST (continued)

Message #	Displayed Message	Cause/Remedy
# 11	SAT > FAIL LEVEL	Measured % Sat. exceeded software alarm's preset fail high level.
# 12	SAT < WARN LEVEL	Measured % Sat. exceeded software alarm's preset warn low level.
# 13	SAT < FAIL LEVEL	Measured % Sat. exceeded software alarm's preset fail low level.
# 14	WARNING: SLOPE HIGH	Measured slope exceeded software alarm's preset warn high level.
# 15	FAILURE: SLOPE HIGH	Measured slope exceeded software alarm's preset fail high level.
# 16	WARNING: SLOPE LOW	Measured slope exceeded software alarm's preset warn low level.
# 17	FAILURE: SLOPE LOW	Measured slope exceeded software alarm's preset fail low level.
# 21	SENSOR DISCONNECTED	This condition is determined indirectly. If sensor electrodes are disconnected and its temperature compensator is open, it is likely that the sensor is disconnected. Check all wiring from sensor to analyzer.
# 27	MEMBRANE PUNCTURED	Clean and inspect sensor membrane for possible tears or holes. Replace membrane if necessary. De-power analyzer (or momentarily disconnect the sensor's blue wire) to clear the error message.
# 29	REGENERATION NEEDED	Clean and inspect sensor membrane for possible tears or holes. Replace membrane if necessary via cartridge or cap. (For older DOE-72 sensor, also add electrolyte.) Regardless of model, de-power analyzer (or momentarily disconnect the sensor's blue wire) to clear the error message. If the error message will not clear, clean sensor electrodes and re-clear message again.
# 31	SENSOR POWER HIGH	The analyzer scaling card may be malfunctioning.
# 33	SENSOR POWER LOW	Sensor may be incorrectly wired. Check all wiring from sensor to analyzer.
# 34	PREDICTED FAIL DATE	Sensor is near the end of its operational life. To clear the message, replace the cartridge on DOE-72-RC (or the complete DOE-72 sensor) and calibrate the measurement system.
# 65	TEMP COMP SHORTED	Temperature compensator is shorted. Compensator may be faulty, incorrectly connected, or sensor cable may be shorted. Check wiring. Replace the compensator in the sensor if necessary.
# 67	TEMP COMP OPEN	Temperature compensator is open. Compensator may be faulty, incorrectly connected, or sensor cable may be open. Check wiring. Replace the compensator in the sensor if necessary.
# 68	TEMP > WARN LEVEL	Measured °C exceeded software alarm's preset warn high level.
# 69	TEMP > FAIL LEVEL	Measured °C exceeded software alarm's preset fail high level.
# 70	TEMP < WARN LEVEL	Measured °C exceeded software alarm's preset warn low level.
# 71	TEMP < FAIL LEVEL	Measured °C exceeded software alarm's preset fail low level.
# 72	TEMP > 50C	Measured temperature is greater than +50°C. The process temperature may be too high or the sensor's temperature compensator may be faulty. Check process conditions and/or the compensator.
# 75	TEMP < -10C	Measured temperature is less than -10°C. The process temperature may be too low or the sensor's temperature compensator may be faulty. Check process conditions and/or the compensator.
# 80	CAL DATE REACHED	Time has exceeded cal timer alarm's preset time. Calibrate now.
# 83	LOOP 1 OPEN	Load in analog output #1 loop is too high or loop is open. Check 4-20 mA loop wiring. If not used, short output to clear the message.
# 85	LOOP 2 OPEN	Load in analog output #2 loop is too high or loop is open. Check 4-20 mA loop wiring. If not used, short output to clear the message.
# 100	TIME/DATE RESET	Real-time clock has reset. If internal battery is discharged (from analyzer not being powered for many months) and the analyzer is then powered, the clock will reset. Clear the message by setting the time/date in the CONFIG menu.
# 102	BATTERY LOW	Internal battery powering the real-time clock is not properly charged. If the analyzer has been powered for several days and the message remains, the battery may be faulty. Return the analyzer for repair.

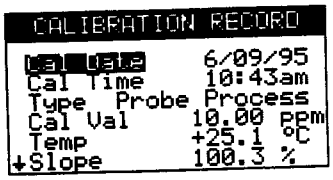
Continued on next page.

Table C – DIAGNOSTIC MESSAGE LIST (continued)		
Message #	Displayed Message	Cause/Remedy
# 113	SCAL EE ERROR	Analyzer scaling card is faulty. Return the analyzer for repair.
# 115	SCAL EE QUEUE FULL	Analyzer scaling card is faulty. Return the analyzer for repair.
# 117	SYS EE ERROR	Analyzer µP board is faulty. Return the analyzer for repair.
# 121	LGBK EE ERROR	Analyzer µP board is faulty. Return the analyzer for repair.
# 123	LGBK EE QUEUE FULL	Analyzer µP board is faulty. Return the analyzer for repair.
"LOGBOOK-ONLY" MESSAGES (event occurrences from this point on)		
# 128	Power Down	This event occurred on the date shown at the indicated time.
# 130	Power Up	This event occurred on the date shown at the indicated time.
# 132	Dead-Man Timeout	Analyzer display remained in a screen other than the measurement screen for more than 30 minutes. If, after 30 minutes, no keys were pressed, dead-man timer returns display to measurement screen.
# 134	MEAS Menu Active	This event occurred on the date shown at the indicated time.
# 136	CAL Menu Active	This event occurred on the date shown at the indicated time.
# 138	MAINT Menu Active	This event occurred on the date shown at the indicated time.
# 140	CONFIG Menu Active	This event occurred on the date shown at the indicated time.
# 142	DIAG Menu Active	This event occurred on the date shown at the indicated time.
# 156	Relay A Changed	This event occurred on the date shown at the indicated time.
# 158	Relay B Changed	This event occurred on the date shown at the indicated time.
# 160	Relay C Changed	This event occurred on the date shown at the indicated time.
# 162	NAMUR Changed	This event occurred on the date shown at the indicated time.
# 166	Iout #1 Changed	This event occurred on the date shown at the indicated time.
# 168	Iout #2 Changed	This event occurred on the date shown at the indicated time.
# 170	Relay Xfer Changed	This event occurred on the date shown at the indicated time.
# 172	TTL Xfer Changed	This event occurred on the date shown at the indicated time.
# 174	Iout #1 Xfer Change	This event occurred on the date shown at the indicated time.
# 176	Iout #2 Xfer Change	This event occurred on the date shown at the indicated time.
# 178	Temp Alarm Changed	This event occurred on the date shown at the indicated time.
# 180	Meas Screen Changed	This event occurred on the date shown at the indicated time.
# 182	Time Changed	This event occurred on the date shown at the indicated time.
# 184	Date Changed	This event occurred on the date shown at the indicated time.
# 186	Meas'd Units Change	This event occurred on the date shown at the indicated time.
# 188	Conductivity Change	This event occurred on the date shown at the indicated time.
# 190	Pressure Changed	This event occurred on the date shown at the indicated time.
# 192	Probe Filter Changed	This event occurred on the date shown at the indicated time.
# 200	Temp Cal OK	This event occurred on the date shown at the indicated time.
# 202	Bad Temp Cal	This event occurred on the date shown at the indicated time.
# 204	D.O. Cal OK	This event occurred on the date shown at the indicated time.
# 206	Bad D.O. Cal	This event occurred on the date shown at the indicated time.
# 208	Sensor First Cal	This event occurred on the date shown at the indicated time.
# 210	Membrane First Cal	This event occurred on the date shown at the indicated time.
# 216	Wash Cycle Changed	This event occurred on the date shown at the indicated time.
# 220	Wash Schedule Changed	This event occurred on the date shown at the indicated time.
# 222	Passcode Changed	This event occurred on the date shown at the indicated time.
# 230	D.O. Alarm Changed	This event occurred on the date shown at the indicated time.
# 232	Cal Timer Change	This event occurred on the date shown at the indicated time.
# 234	Zero Alarm Changed	This event occurred on the date shown at the indicated time.
# 236	Slope Alarm Changed	This event occurred on the date shown at the indicated time.
# 250	Incorrect Passcode	This event occurred on the date shown at the indicated time.

7.4 Calibration Record (for last calibration)

The analyzer creates a record containing information about the last calibration. This includes the calibration's date and time, the type of method used for calibration (in air method, or probe, sample or saturated method in the process or in water), the ppm calibration value used, the temperature during calibration, and the measured slope.

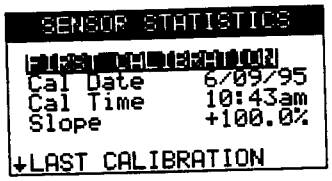
After selecting "Calibration Record" from the DIAG root menu, a screen similar to this example screen appears:



7.5 Sensor Statistics (for first and last three calibrations)

The analyzer creates sensor statistics records for the first calibration and the last three (most recent) calibrations. The data contained in these records is similar to the data in the calibration record.

After selecting "Sensor Statistics" from the DIAG root menu, a screen similar to this example screen appears:

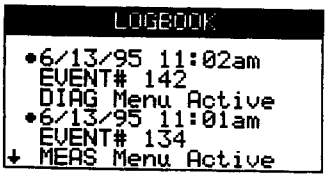


Items in the FIRST CALIBRATION record include the date and time of the calibration, and the sensor slope, which for the first calibration, is always +100.0%. The other calibration records (LAST CALIBRATION, 2 CALIBRATIONS AGO and 3 CALIBRATIONS AGO) contain the same items, but the displayed slope values are the differences between those calibrations and the first calibration. For example, suppose the slope for the last calibration was actually +80.0%. The displayed slope for the last calibration would then be "-20.0%" (the negative difference between the +100.0% first calibration and the +80.0% last calibration).

7.6 The Logbook

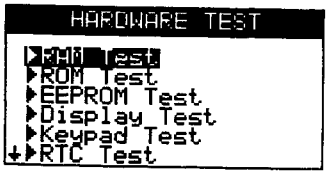
The analyzer logbook creates a "log" of up to 100 events. An event is generally defined as "something that happened involving the analyzer." Any diagnostic message shown in Table C -- Diagnostic Message List in Section 7.2 can be contained in the logbook. When the logbook's 100-event capacity is exceeded, the analyzer automatically deletes the oldest event while adding the newest event.

After selecting "Logbook" from the DIAG root menu, a screen similar to this example screen appears:



7.7 Analyzer Hardware Tests

After selecting "Hardware Test" from the DIAG root menu, use this submenu to manually test the analyzer's operating hardware, memory, display, keypad, and real-time clock (RTC):



If any test fails, return the analyzer to the factory for repair.

NOTE: *During hardware tests, the analyzer continues to normally measure and control without interruption.*

7.8 Device Description

To find the analyzer's complete model number, serial number, software version and other related information, select "Device Description" from the DIAG root menu. A screen similar to this example screen appears:

PART FOUR - SERVICE AND MAINTENANCE

SECTION 1
GENERAL INFORMATION

1.1 Inspecting Sensor Cable and Analyzer-to-Junction Box Interconnect Cable

If a measurement problem exists and you suspect the sensor cable and/or the analyzer-to-junction box interconnect cable, inspect both cables for physical damage. Disconnect the analyzer-to-junction box cable at both ends and check its wires for internal shorts using an ohmmeter.

1.2 Removing/Attaching Analyzer Door

To remove the analyzer door:

1. Loosen the four screws on the analyzer front bezel and swing open the door.
2. Disconnect the ribbon cable connector from the backside of the door.
3. While holding the door, slide the door release lever (Figure 4-1) upward to release the door from the hinge.

To attach the analyzer door, refer to Figure 4-1 and:

1. With the door in the open position, hold the spring-loaded door release lever upward, carefully position the hinge slots onto the hinge until the hinge is fully seated, and release the lever.

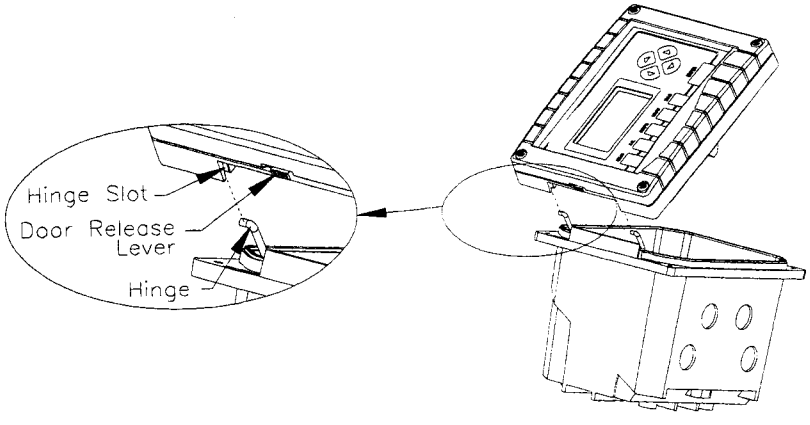


FIGURE 4-1 Analyzer Door Attachment Details

2. After the door is attached, connect the ribbon cable connector to the backside of the door. To prevent accidentally crimping the cable, push any excess cable into the opening by the connector.

3. Close the door and tighten the four screws on the analyzer's front bezel.

1.3 Replacing Relays

WARNING:

DISCONNECT LINE POWER TO AVOID POSSIBLE ELECTRICAL SHOCK.

1. After disconnecting line power, loosen the four screws on the analyzer front door, and swing the door open. Disconnect the ribbon cable connector.

2. If the analyzer:

   - Is not equipped with the EMI-hardened option, disregard this step, and proceed with step 3.

   - Has the EMI-hardened option:

     A. Remove the screw holding the thin metal divider between TB3 and TB4, and remove the divider.

     B. Loosen (but do not remove) the two screws securing the thin metal bracket that shields the ribbon cable connector. Remove the bracket by sliding it to the right from under the screws and pulling it outward.

3. Remove the two screws above the terminal strips and carefully extract the power supply board assembly.

4. On the outer perimeter of the component side of the board, unsolder the four tabs holding the metal cover (on terminal strip side) to access the relay pins.

5. Unsolder the defective relay. Replace it with an equivalent relay (see Part Five for relay part number).

6. Reinstall the power supply board assembly following the previous steps in reverse order.

1.4 Replacing Fuse(s)

Depending on whether the analyzer is equipped with the single or dual fusing option, it will have one or two 1/2 amp fuses (250 VAC; type M or T slow-blow; 5mm x 20 mm size).

WARNING:

DISCONNECT LINE POWER TO AVOID POSSIBLE ELECTRICAL SHOCK.

1. After disconnecting line power, remove the power supply board assembly by performing steps 1 through 3 in the previous "Replacing Relays" Section 1.3.

2. Remove the blown fuse and replace it with a fuse (part number 7F1048) or an equivalent.

3. Reinstall the power supply board assembly following steps 1 through 3 in the previous Section 1.3, but in reverse order.

SECTION 2
PRESERVING MEASUREMENT ACCURACY

2.1 Keeping Sensor Clean

To maintain measurement accuracy, periodically clean the sensor. Operating experience will help you determine when to clean the sensor. Use the recommended procedure described in the sensor instruction manual.

2.2 Keeping Analyzer Calibrated

Depending on the circumstances of the application, system calibration should be performed periodically to maintain measurement accuracy.

Maintenance Tip! Upon startup, frequently check the system until operating experience can determine the optimum time between calibrations that provides acceptable measurement results.

Calibrate the analyzer using one of the methods described in Part Three, Section 4.4. **Recommendation:** Use the "D.O. Cal In Air" method because it is the most convenient method to use, and provides the best calibration accuracy.

2.3 Avoiding Electrical Interference

Do not run the sensor cable and analyzer-to-junction box interconnect cable in the same conduit with line power.

Maintenance Tip! Excess cable should not be coiled near motors or other equipment that may generate electrical or magnetic fields. Cut cables to proper length during installation to avoid unnecessary inductive pickup ("electrical noise" may interfere with sensor signal).

SECTION 3
TROUBLESHOOTING

3.1 Ground Loops

The analyzer may be affected by a "ground loop" problem (two or more electrically grounded points at different potentials).

Symptoms Indicating A Possible Ground Loop:

- Analyzer reading is offset from the actual value by a consistent amount, or ....
- Analyzer reading is frozen on one value, or ....
- Analyzer reading is "off scale" (upscale or downscale).

Although the source of a ground loop is difficult to determine, there are several common causes.

Common Causes of Ground Loops:

- Components, such as recorders or computers, are connected to non-isolated analog outputs.
- Not using shielded cabling or failure to properly connect all cable shields.
- Moisture or corrosion in a junction box.

Determining If Ground Loop Exists

The following simple test can help to determine if there is a ground loop:

1. With the analyzer in the D.O. measurement mode, put the sensor in a non-conductive container (plastic or glass) filled with process or clean water whose D.O. value is known. Note the analyzer reading.
2. Connect one end of a wire to a known earth ground, such as the analyzer ground or a water pipe. Place the other end of this wire into the process or clean water next to the sensor.
3. Note the analyzer reading now and compare it with the reading taken in step 1. If the reading changed, a ground loop exists.

Finding Source of Ground Loop

Sometimes the source of a ground loop is easy to find, but it usually takes an organized approach to isolate the problem.

Troubleshooting Tip! Use a systematic troubleshooting method. If possible, start by grounding all shields and electrical grounds at one stable point. One at a time, turn off all pumps, motors, and switches that are in contact with the process. Each time you do this, check if the ground loop still exists. Since the process media being measured is electrically conductive, the source of the ground loop may not be readily apparent.

3.2 Isolating Measuring System Problem

Part Three, Section 7 provides details on the analyzer's many system diagnostics capabilities. However, if the measuring system is not functioning properly, a few simple checks can isolate the element of the measurement system that is causing the problem (analyzer, analyzer-to-junction box interconnect cable, or sensor).

General Problems

1. Verify that line power exists at the analyzer MAINS terminals (TB5 and TB6).

2. Check the analyzer ribbon cable and make sure its mating connectors are properly connected.

Specific Problems

Possible Causes for D.O. Reading Going to Zero:

- **Bad Cables** (broken, shorted or corroded)

  Inspect the analyzer-to-junction box interconnect cable and the D.O. sensor cable for breaks or shorts.

- **Malfunctioning Sensor:**

  Inspect the sensor for a damaged or fouled membrane.

- **Inoperative Analyzer**

  Use this checkout procedure, requiring a 1% 30K ohm (approx.) resistor and a 1.5 volt battery or a DC voltage source, to confirm that the analyzer is operating properly.

  1. Disconnect the sensor wires from the analyzer at terminals 1 through 7 on TB1.

2. Connect the 30K ohm resistor across analyzer terminals 6 (BLK) and 7 (YEL) on TB1.

3. Connect the "+" side of the 1.5 volt battery to analyzer terminal 4 (SHIELD) on TB1 and the "-" side of the battery to analyzer terminal 1 (RED) on TB1.

4. Verify that the measured D.O. reading is approximately 15 ppm.

5. Verify that the measured temperature is approximately 25°C.

If the readings are correct, the analyzer is operating properly. If not, the analyzer is probably malfunctioning.

Possible Cause for No Analyzer Display:

Open Fuse on Analyzer Power Supply Board Assembly

When line power exists at the analyzer MAINS terminals (TB5 and TB6) and the display remains unlit, the fuse may be open. If so, replace the 1/2 amp fuse (see Part Four, Section 1.4 for details).

Miscellaneous Sensor Problems:

For details on sensor service and maintenance problems, refer to the sensor instruction manual.

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RETURN REQUESTS/INQUIRIES

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

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

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

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

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

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
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M3706/0303