Instruction

MI 611-169
February 2016

873DO Series
Electrochemical Analyzers
for Dissolved Oxygen Measurement

Style C

Foxboro®
by Schneider Electric

Contents

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1. Introduction

Quick Start

The purpose of this section is to outline the three basic steps to allow the user quick access to the 873DO Analyzer and 871DO-C dissolved oxygen probe for dissolved oxygen measurements. The three steps are Wiring, Checking Factory Configuration, and Calibration. Details for these procedures, as well as additional configuration choices, are found in the text of this manual.

Sensor Wiring

Wiring installation must comply with any existing local regulations.

The 873DO Analyzer is available in a plastic or metal enclosure. Follow the wiring instructions for the type of enclosure you have. Additional information may be found on page 26 of this manual. After wiring the sensor to the analyzer, allow the sensor to polarize at least a half hour before calibrating (remove protective cap and allow sensor to stabilize while exposed to air).

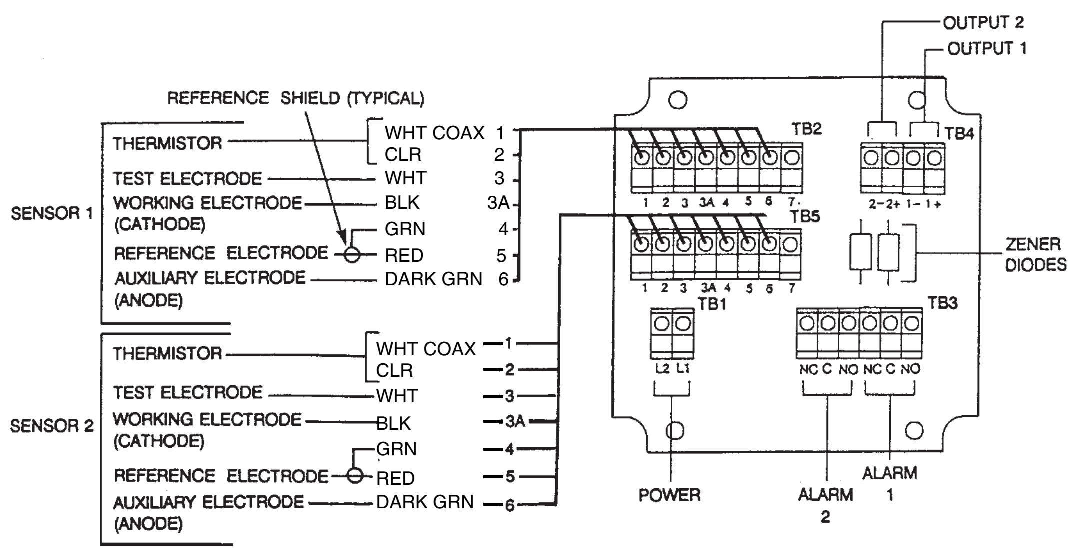

Figure 1. Wiring of Metal Enclosure

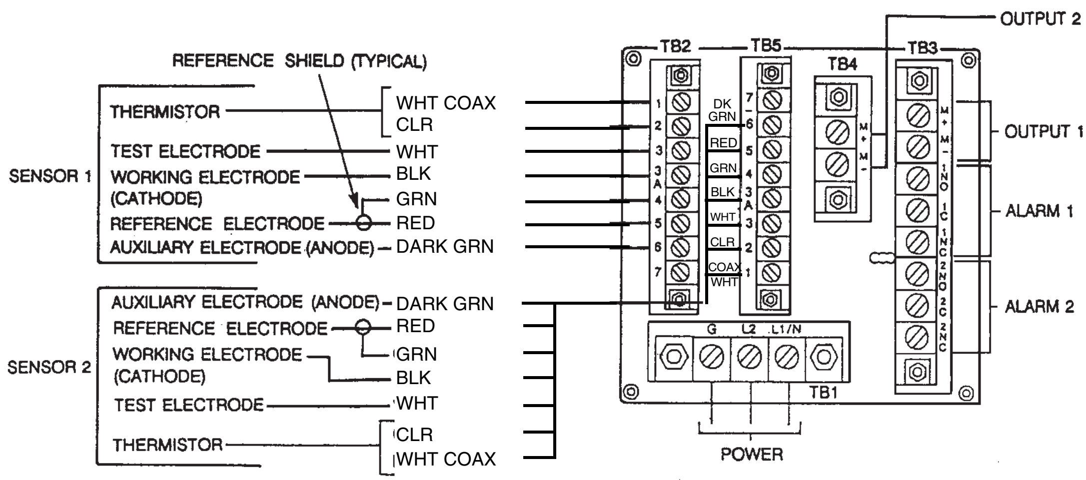

Figure 2. Wiring of Plastic Enclosure

Checking Factory Configurations

Refer to the analyzer label and Configuration Entries in Table 3, “Configuration Setup Entries,” on page 37 and Table 12, “Basic Setup Entry Selection,” on page 55. There is space provided to make any notations you wish in the last column of each table.

Calibration

Your analyzer was calibrated at the factory with a current source. Individual 871DO sensors do not act as predictably and will require calibration with the analyzer. The analyzer is factory configured for an air calibration with an electronic zero (this may be changed if desired). To verify that the sensor is working properly, press and hold the Shift and the µA keys. The display will show the sensor current in air. A stable current value between 6 and 8 µA is expected at temperatures between 65° and 80°F. If the reading is stable, proceed with the calibration.

“Air Calibration with Electronic Zero” on page 76 outlines the steps of this simple calibration technique.

Looking for More Information

For more detailed information, refer to the following sections of this manual:

For installation information, refer to “Installation” on page 19. For dimensional information, refer to DP 611-163.
For detailed explanation of the controls and indicators, refer to “Operation” on page 29.
For detailed configuration instructions, refer to “Configuration” on page 35.
For detailed calibration instructions, refer to “Calibration” on page 73.

If you need additional help, please contact Global Customer Support.

General Description

The 873DO Analyzer in conjunction with an 871DO Sensor, measures, displays, and transmits the concentration of dissolved oxygen in aqueous solutions. Its measurement display may be read in either ppm, percent saturation, or percent air (%). Solution temperature is also measured by the 873DO and is used for automatic temperature compensation and may be displayed whenever the user wants.

The Analyzer provides an isolated output signal proportional to the measurement for transmission to an external receiver. Both the plastic general purpose panel-mounted and the field-mounted (metal enclosure) analyzers can transmit two output signals.

Instrument Features

Some of the features of the 873DO Electrochemical Analyzer are:

- Plastic General Purpose or Metal Field-Mounted Enclosure
- Dual Sensor Input
- Dual Alarms
- Dual Analog Outputs
- EEPROM Memory
- Instrument Security Code
- Hazardous Area Classification, Metal Enclosure Only
- Front Panel Display
- Front Panel Keypad
- Application Flexibility
- Storm Door Option

Enclosures

The plastic enclosure is intended for panel mounting in general purpose locations, and mounts in 1/4 DIN size panel cutout. It meets the enclosure ratings of NEMA 1, CSA Enclosure 1.

The metal enclosure is intended for field locations and may be either panel, pipe, or surface mounted. The housing is extruded aluminum coated with a tough epoxy-based paint. The enclosure is watertight, dusttight, and corrosion-resistant, meeting the enclosure rating of NEMA 4X, CSA Enclosure 4X, and IEC Degree of Protection IP-65, and fits in a 92 x 92 mm (3.6 x 3.6 in) panel cutout (1/4 DIN size). The metal enclosure provides protection against radio frequency interference (RFI) and electromagnetic interference (EMI).

Dual Alarms

Dual independent, Form C dry alarm contacts, rated 5 A noninductive 125 V ac/30 V dc, are provided. The alarm status is alternately displayed with the measurement on the LED (light-emitting diode) display.

⚠ CAUTION

When the contacts are used at signal levels of less than 20 W, contact function may become unreliable over time due to the formation of an oxide layer on the contacts. See "Alarm Contact Maintenance" on page 99.

No Battery Backup Required

Non-volatile EEPROM memory is employed to protect all operating parameters and calibration data in the event of power interruptions.

Instrument Security Code

A combination code lock method, user configurable, provides protection of operational parameters from accidental or unauthorized access.

Hazardous Area Classification

The field-mounted, epoxy-painted, aluminum enclosures are designed to meet the requirements for Class I, Division 2, Groups A, B, C and D hazardous locations. See "Product Safety Specifications" on page 18.

Front Panel Display

The instrument's display consists of a four-digit bank of red LEDs with decimal point, and an illuminated legend area to the right of the LEDs (see Figure 3). The 14.2 mm (0.56 in) display height provides visibility at a distance up to 6 m (20 ft) through a red protective window on the front panel.

The measurement value is the normally displayed data. If other data is displayed due to prior keypad operations, the display automatically defaults to the measurement value 10 seconds (called "Timing Out") after the last keypad depression.

If no fault or alarm conditions are detected in the instrument, the measurement value is steadily displayed. If fault or alarm conditions are detected, the display alternates displaying the measurement value and a fault or alarm message at a 1 second rate.

Front Panel Keypad

The instrument's front panel keypad consists of eight keys. Certain keys are for fixed functions; and other keys are for split functions. The upper function (green legends) of a split function key is actuated by pressing the shift key in conjunction with the split function key. Refer to Figure 3.

Application Flexibility

The 873 Analyzer offers application flexibility through its standard software package. The software, run on the internal microprocessor, allows the user to define and set operating parameters particular to his application. These parameters fall into four general categories: Measurement Units, Alarm Configuration, Diagnostics, and Output Characterization. These parameters are retained in the EEPROM nonvolatile memory. Following power interruptions, all operating parameters are maintained.

Storm Door Option

This door is attached to the top front surface of the enclosure. It is used to prevent accidental or inadvertent actuation of front panel controls, particularly in field mounting applications. The transparent storm door allows viewing of the display and is hinged for easy access to the front panel controls.

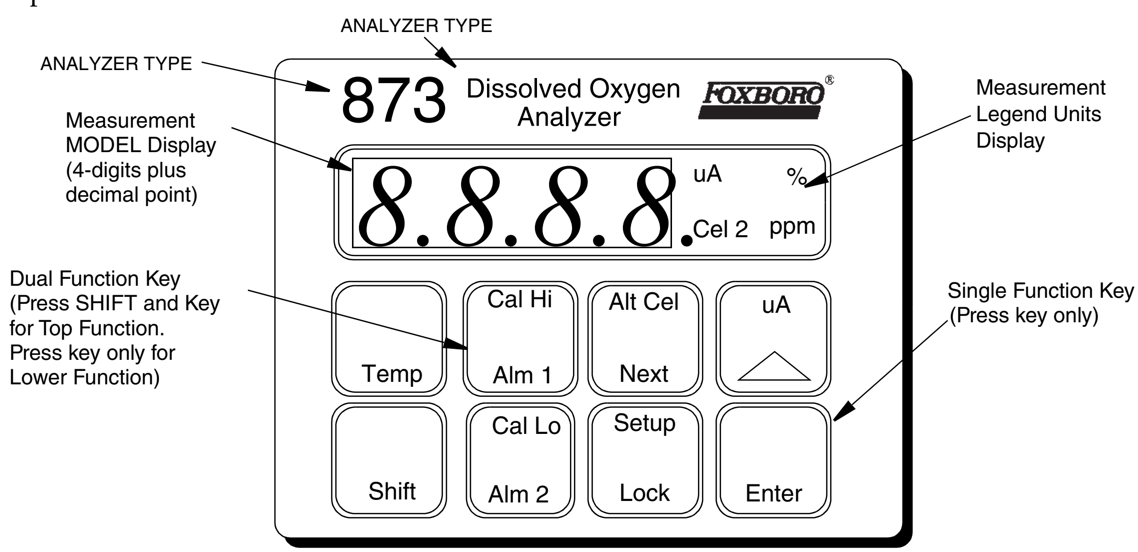

Figure 3. Front Panel Display and Keypad

Analyzer Identification

A data label is located on the side surface of the enclosure. This data label provides Model Number and other information pertinent to the particular Analyzer purchased. Refer to Figure 4.

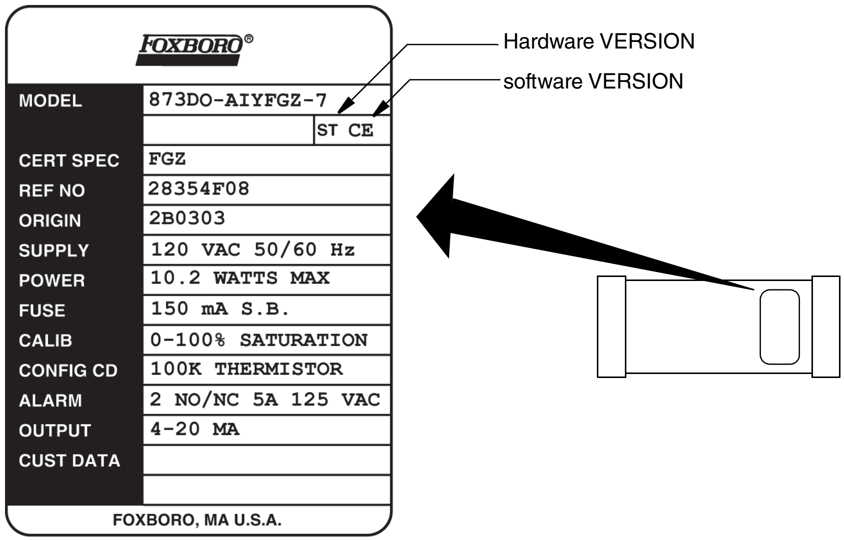

Figure 4. Data Label Location

Standard Specifications

Supply Voltages	–A 120 V ac –B 220 V ac –C 240 V ac –E 24 V ac –J 100 V ac
Supply Frequency	50 or 60, ±3 Hz
Output Signal	I 4 to 20 mA isolated T 0 to 10 V dc isolated E 0 to 20 mA isolated
Ambient Temperature Limits	–25 to +55°C (–13 to +131°F)
Measurement Ranges	0 to 100.0% Oxygen Saturation 0 to 25.00% Oxygen in Air 0 to 100.0 ppm 0 to 100.0(no units)
Temperature Measurement Range	–17 to +120°C (0 to 250°F) w/100 KW thermistor
Temperature Compensation Range	0 to 50°C (32 to 122°F)
Relative Humidity Limits	5 to 95%, noncondensing
Accuracy of Analyzer	±0.5% of upper range limit
Analyzer Identification	Refer to Figure 4.
Dimensions	Plastic Enclosure 92(H) x 92(W) x 183(L) mm Metal Enclosure 92(H) x 92(W) x 203(L) mm
Enclosure/Mounting Options	–P Plastic General Purpose Panel Mount –W Metal Field Panel Mount –X Metal Field Surface Mount –Y Metal Field Pipe Mount –Z Metal Field Movable Surface Mount
Approximate Mass	
Plastic General Purpose Enclosure	0.68 kg (1.5 lb)
Metal Field Enclosure (with Brackets)	
Panel Mounting	1.54 kg (3.4 lb)
Pipe Mounting	2.31 kg (5.1 lb)
Fixed Surface Mounting	2.22 kg (4.9 lb)
Movable Surface Mounting	3.13 kg (6.9 lb)
Instrument Response (Analyzer Only)	Two seconds maximum (when zero measurement damping is selected in Configuration Code). Temperature response is 15 seconds maximum.
Measurement Damping	Choice of 0, 10, 20, or 40 second, configurable from keypad. Damping affects displayed parameters and analog outputs.
Alarms	‣ Two alarms configurable via keypad ‣ Individual set points continuously adjustable 0 to full scale via keypad ‣ Hysteresis selection for both alarms; 0 to 99% of full scale value, configurable via keypad. ‣ Dual timers for both alarms, adjustable 0 to 99 minutes, configurable via keypad. Allows for on/off control with delay. Timers can be set to allow oxygen feed, then delay for oxygen concentration control.
Alarm Contacts	Two independent, nonpowered Form C contacts, rated 5 A noninductive, 125 V ac/30 V dc (minimum current rating 1 A). Inductive loads can be driven with external surge-absorbing devices installed across contact terminations. **CAUTION**: When the contacts are used at signal levels of less than 20 W, contact function may become unreliable over time due to the formation of an oxide layer on the contacts. See “Alarm Contact Maintenance” on page 99.

Alarm Indication	Alarm status alternately displayed with measurement on LED display.
RFI Susceptibility	(When all sensor and power cables are enclosed in a grounded conduit.)
Plastic General Purpose Enclosure:	< 0.5 V/m from 27 to 1000 MHz
Metal Field Enclosure:	10 V/m from 27 to 1000 MHz
Electromagnetic Compatibility (EMC)	The 873DO Analyzer, 220 V ac or 240 V ac systems, with a metal enclosure complies with the requirements of the European EMC Directive 89/336/EEC when the sensor cable, power cable, and I/O cables are enclosed in rigid metal conduit. See Table 1. The analyzer with a plastic enclosure complies with European EMC Directive 89/336/EEC when mounted in a solid metal console or cabinet and the I/O cables extending outside the console or cabinet are enclosed in rigid metal conduit. See Table 1.

Product Safety Specifications

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
FM for use in general purpose (ordinary) locations.	---	FGZ
FM nonincendive for use in Class I, II, Division 2, groups A, B, C, D, F, and G, hazardous locations.	For instruments with metal enclosure only. Temperature Class T6.	FNZ
CSA (Canada) for use in general purpose (ordinary) locations.	24 V, 100 V, and 120 V ac (Supply Option -AI, -E, -J) only.	CGZ
CSA (Canada) suitable for use in Class I, Division 2, Groups A, B, C, and D, hazardous locations.	For instruments with metal enclosure only. 24 V, 100 V, and 120 V ac (Supply Option -A, -E, -J) only. Temperature Class T6.	CNZ

— NOTE

The Analyzer has been designed to meet the electrical descriptions listed in the table above. For detailed information on status of the agency approvals, contact Global Customer Support.

⚠ CAUTION

1. When replacing covers on the 873 metal case, use Loctite (Part No. S0106ML) on the threads for the front cover and Lubriplate (Part No. X0114AT) on the threads for the rear cover. Do not mix.
2. Exposure to some chemicals may degrade the sealing properties of Polybutylene Teraethalate and Epoxy Magnacraft 276XAXH-24 used in relays K1 and K3. These materials are sensitive to acetone, MEK, and acids. Periodically inspect relays K1 and K3 for any degradation of properties and replace if degradation is found.

2. Installation

Mounting to a Panel – Plastic Enclosure 873DO-_ _ P

The plastic enclosure is mounted to a panel as described below (see Figure 5).

1. Size panel opening in accordance with dimensions specified on DP 611-162.
2. Insert spring clips on each side of Analyzer.
3. Insert Analyzer in panel opening until side spring clips engage on panel.
4. From rear of panel (and Analyzer), attach and tighten the top and bottom mounting screws until Analyzer is securely held in place.

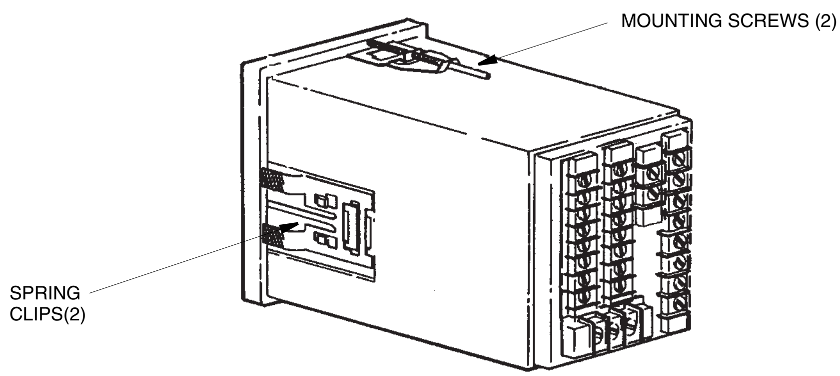

Figure 5. Mounting to Panel - Plastic Enclosure

Mounting to a Panel - Metal Enclosure 873DO-_ _ W

The metal enclosure can also be mounted to a panel. The procedure is as follows.

1. Refer to DP 611-162 for panel cutout data.
2. Make cutout in panel in accordance with DP 611-162.
3. Insert Analyzer through panel cutout and temporarily hold in place. (Rear bezel will have to be removed for this procedure.)
4. From rear of panel, slide plastic clamp onto enclosure until clamp latches (two) snap into two opposing slots on longitudinal edges of enclosure. See Figure 6.
5. Tighten screws (CW) on clamp latches until enclosure is secured to panel.
6. Reassemble rear bezel to enclosure using four screws.

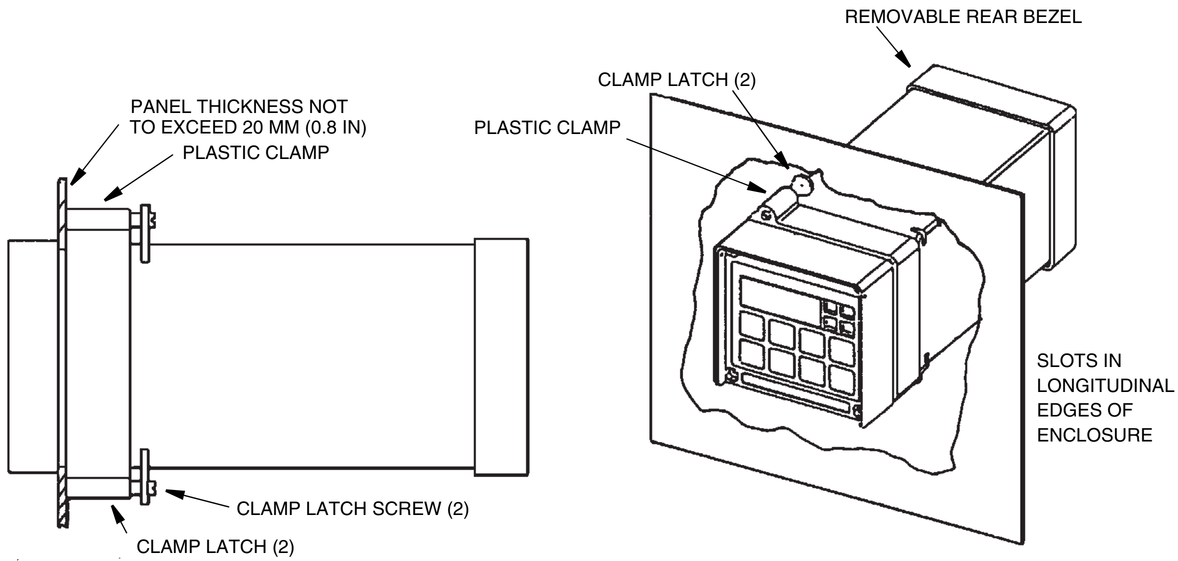

Figure 6. Mounting to Panel - Metal Enclosure

Mounting to Pipe (Metal Enclosure Only)873DO-_ _Y

1. Locate horizontal or vertical DN 50 or 2-inch pipe.
2. Assemble universal mounting as follows:
   a. Place hex bolts (5) through spacer (3) into support bracket (2).
   b. Slide nylon washers (11) over bolts (5).
   c. Slide bolts through pipe mounting bracket (1) and fasten assembly tightly with hardware designated 7, 6, and 13.
   d. Attach pipe mounting bracket (1) to pipe using U-bolts (12) using hardware designated 6, 7, and 13.
3. Slide Analyzer into support bracket and slide strap clamp (4) onto Analyzer. Using two screws, nuts, and washers, attach strap clamp to support bracket to secure Analyzer.
4. Lift entire assembly of Step 3, and using two U-clamps, nuts, and washers, secure mounting bracket to pipe.

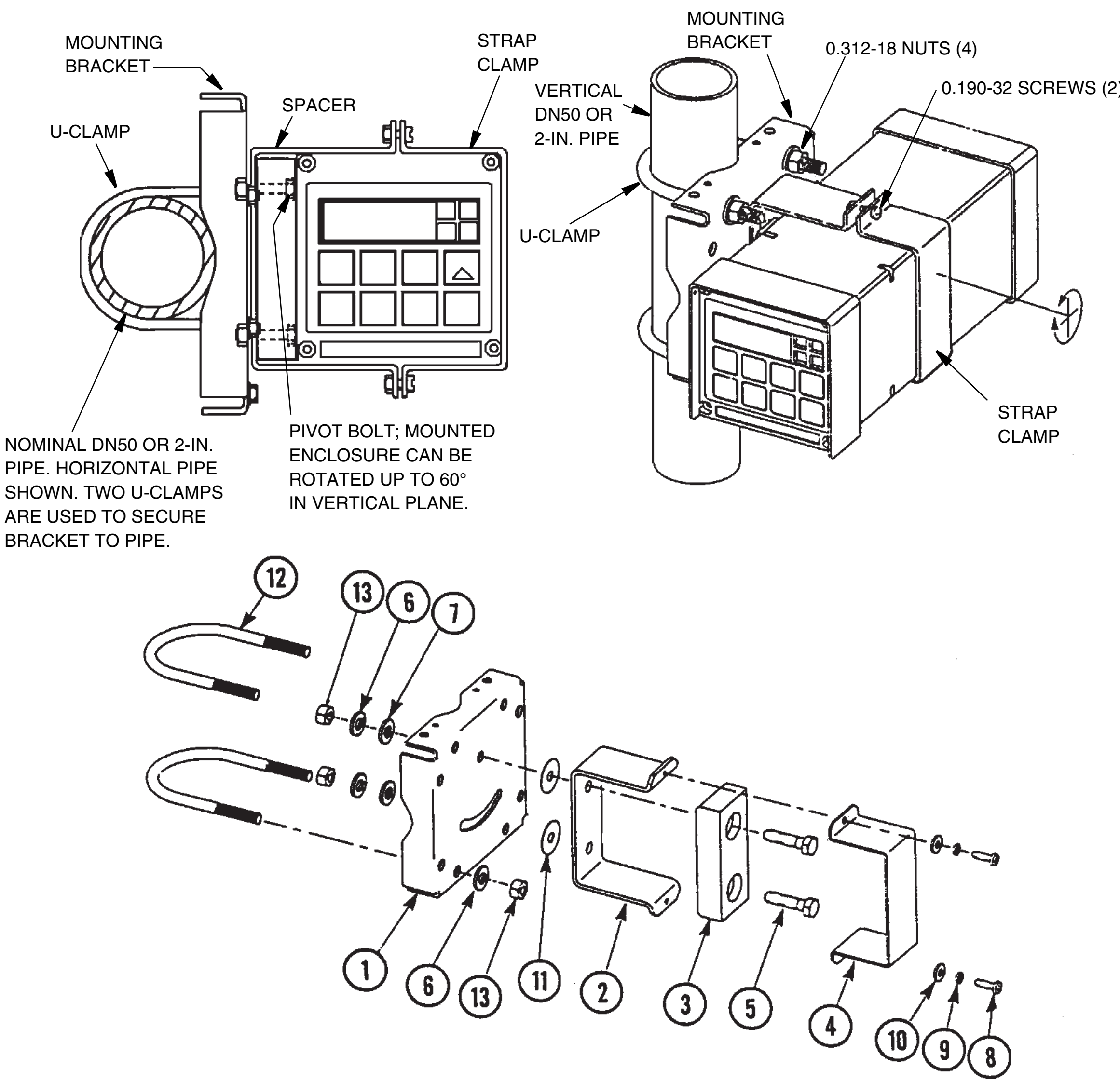

Figure 7. Metal Enclosure - Pipe Mounting

Mounting to Surface, Fixed Mount (Metal Enclosure Only) 873DO-_ _ X

1. Locate mounting surface for Analyzer.
2. Referring to Figure 8, use mounting bracket as template for drilling four holes into mounting surface. Notice that holes in mounting bracket are 8.74 mm (0.344 in) in diameter. Do not attach mounting bracket to surface at this time.
3. Assemble universal mounting as follows:
   a. Place hex bolts (5) through spacer (3) into support bracket (2).
   b. Slide nylon washers (11) over bolts (5).
   c. Slide bolts through universal mounting bracket (1) and fasten assembly together with hardware designated 7, 6, and 12.
   d. Attach universal mounting bracket (1) to wall.
4. Slide Analyzer into support bracket and slide strap clamp (4) onto Analyzer. Using two screws, nuts, and washers, attach strap clamp to support bracket to secure Analyzer.
5. Lift entire assembly of Step 4, align mounting bracket holes with mounting surface holes, and use four bolts, nuts, and washers to attach mounting bracket to surface.

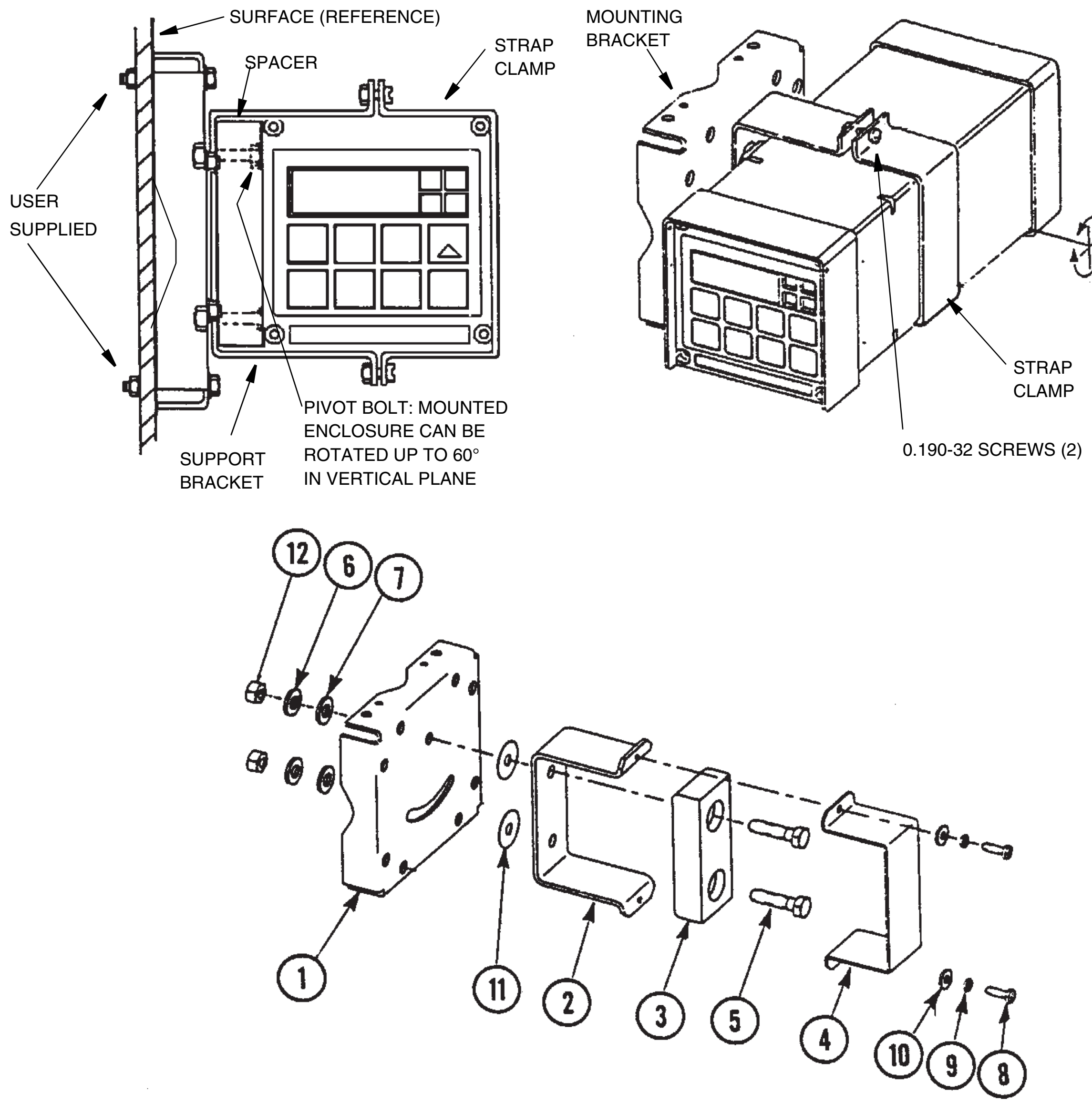

Figure 8. Metal Enclosure - Fixed Mount

Mounting to Surface, Movable Mount (Metal Enclosure Only) 873DO-_ _ Z

1. Locate surface on which you wish to mount the Analyzer. Also refer to PL 611-016.
2. Referring to Figure 9, use wall bracket (12) as template for drilling four holes into mounting surface. Notice that the holes in the wall bracket are 9.53 mm (0.375 in) in diameter.
3. Attach wall bracket (12) to surface using four bolts, washers, and nuts.
4. Assemble universal mounting as follows:
    a. Place hex bolts (5) through spacer (3) into support bracket (2).
    b. Slide nylon washers (11) over bolts (5).
    c. Slide bolts through universal mounting bracket (1) and fasten assembly finger tight with hardware designated 9, 10, and 16.
5. Slide Analyzer into support bracket and slide strap clamp (4) onto Analyzer. Using two screws, nuts, and washers, attach strap clamp to support bracket to secure Analyzer.
6. Lift entire assembly of Step 5, align mounting bracket and wall bracket pivot bolt holes, and then insert pivot bolt through wall and mounting bracket into nylon washer and locking nut.
7. Rotate bracket and Analyzer assembly in horizontal plane to desired position and lock in place using screw and washer.

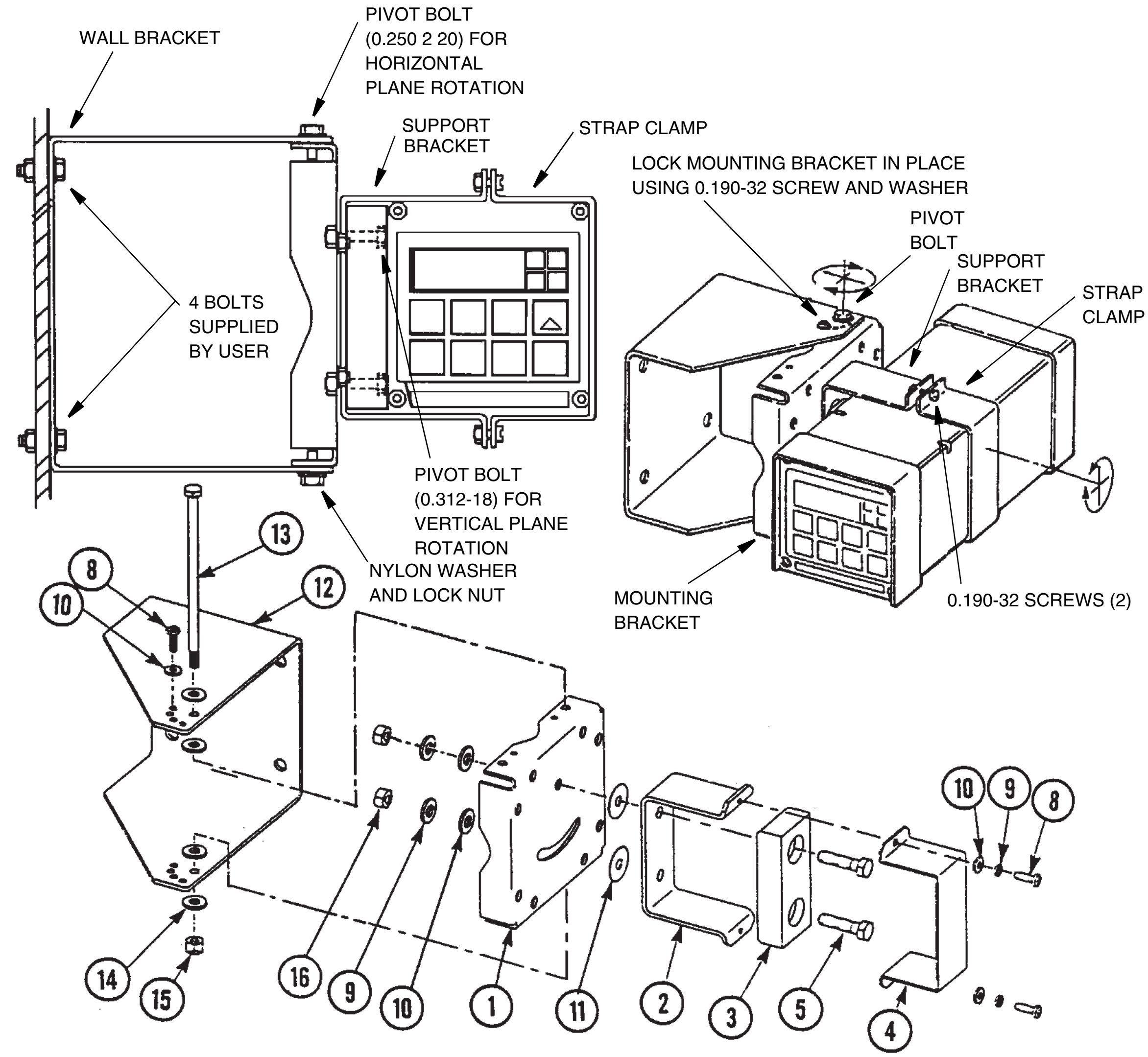

Figure 9. Metal Enclosure - Movable Mount

Wiring of Plastic Enclosure

Wiring installation must comply with any existing local regulations.

1. Remove optional rear cover assembly, if present.
2. Connect Alm 1 and 2 wires to TB3 as shown in Figure 10. Failsafe operation requires connections be made between NC and C and the alarms to be configured active. Refer to “General Information About Alarms” on page 42.
3. Connect wires from external circuit for Analyzer measurement output 1 to terminals TB3(+) and TB3(–). Refer to Figure 10.

   Connect wires from Analyzer measurement or temperature output 2 to terminals TB4(+) and TB4(-).
4. Remove factory-installed jumper assembly from terminal block TB2 and TB5 and discard.
5. Connect sensor wires to Analyzer terminal blocks TB2 and TB5 in accordance with Figure 10. If a single sensor is used with this Analyzer, it may be wired to either sensor input. See “User Notes” on page 93 for help with configuring the 873 for single or dual sensor use.
6. Connect power wires to terminal block TB1 as shown in Figure 10.
7. Attach optional rear panel cover, if present.

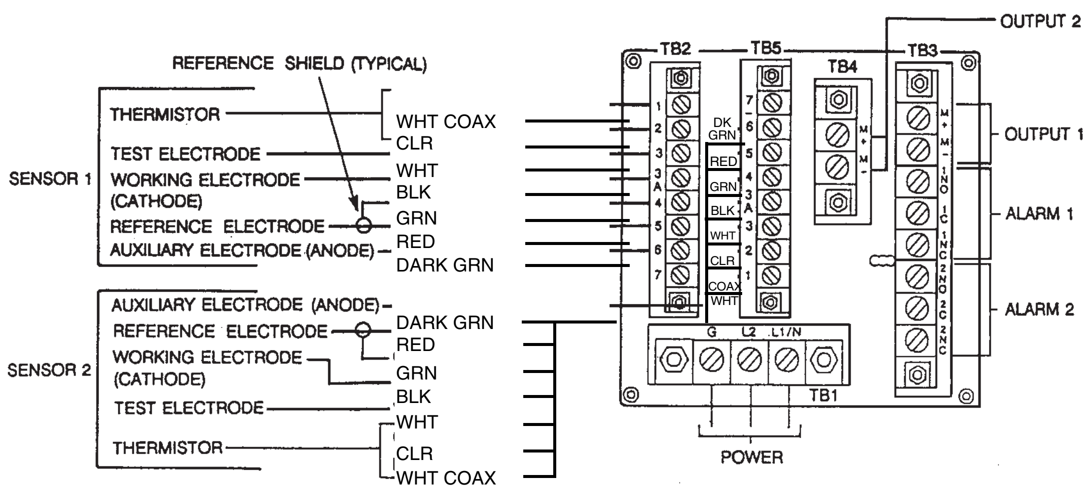

Figure 10. Rear Panel Wiring - Plastic Enclosure

Wiring of Metal Enclosure

— NOTE —

1. Wiring installation must comply with any existing local regulations.
2. To maintain enclosure tightness such as NEMA 4X, CSA Enclosure 4X, or IEC Degree of Protection IP-65, wiring methods and fittings appropriate to the rating must be used. Table 1 lists the recommended parts.

3. Alarm wires should run through the same conduit as the analog output wires. Sensor wires and power wires should be run through separate conduits.

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1. Remove back cover to access terminal/power board.
2. Connect Alarm 1 and 2 wires to TB3 as shown in Figure 11. Failsafe operation requires connections to be made between contacts NC and C, and the alarms to be configured active. Refer also to “General Information About Alarms” on page 42.
3. Connect wires from external circuits for Analyzer temperature or measurement outputs to terminal TB4.
4. Connect sensor wires to Analyzer terminal block TB2 as shown in Figure 11.

   If a single sensor is used with this Analyzer, it may be wired to either sensor input. See “User Notes” on page 93 for help with configuring the 873 for single or dual sensor use.
5. Connect power wires to terminal block TB1, as indicated in Figure 11. The earth (ground) connection from the power cord should be connected to the ground stud located in the bottom of the case. The stud grounds the instrument and is mandatory for safe operation.

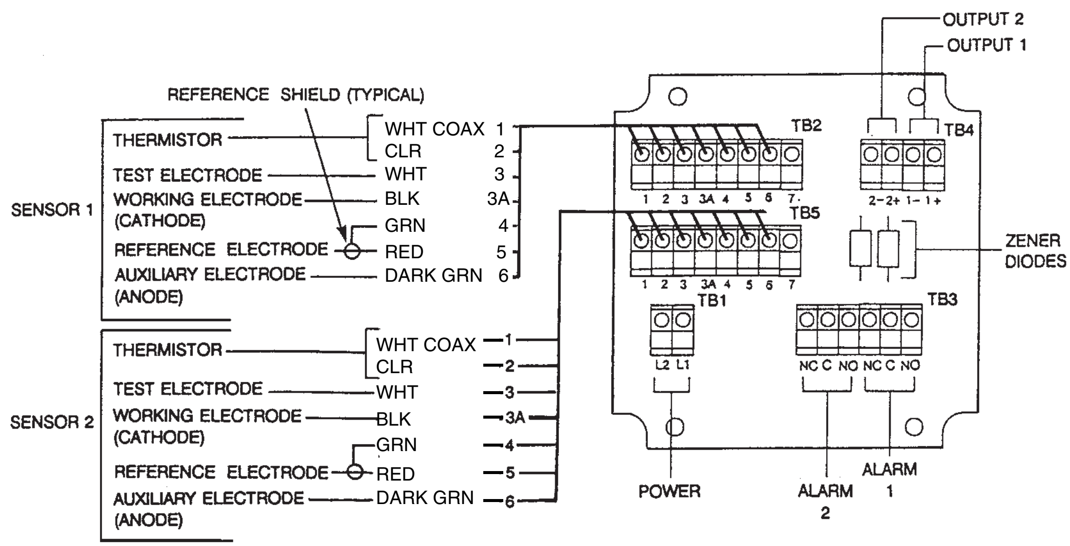


Figure 11. Rear Panel Wiring - Metal Enclosure

Table 1. Recommended Conduit and Fitting (Due to Internal Size Restraints)

	Conduit	Fitting
Rigid Metal	1/2-inch Electrical Trade Size	T&B* #370
Semi-rigid Plastic	T&B #LTC 050	T&B* #LT 50P or T&B #5362
Semi-rigid Plastic, Metal Core	Anaconda Type HC, 1/2-inch	T&B* #LT 50P or T&B #5362
Flexible Plastic	T&B #EFC 050	T&B* #LT 50P or T&B #5362

*Thomas & Betts Corp., 1001 Frontier Road, Bridgewater, NJ 08807-0993

— NOTE

It is recommended that sensor and interconnect cable be run in 1/2 inch conduit for protection against moisture and mechanical damage. Do not run power or control wiring in the same conduit.

3. Operation

Overview

The 873 functions in two modes, OPERATE and CONFIGURE (Setup).

In the OPERATE Mode, the instrument automatically displays its measurement and outputs proportional analog signals. Also, while in the OPERATE Mode, a user may read all the parameter settings and the solution temperature.

In the CONFIGURE Mode, any previously entered parameters may be modified. All 873 Analyzers are shipped configured, either with factory default settings or user defined parameters, as specified.

To use either mode you must understand the functions of both the keypad and display.

Display

The instrument display, Figure , is presented in two parts, a measurement/settings display and backlit engineering units. There are eight possible automatic measurement displays as follows:

- ♦ Measurement of CELL 1 expressed as % oxygen in air.
- ♦ Measurement of CELL 1 expressed in ppm.
- ♦ Measurement of CELL 1 expressed in % Saturation.
- ♦ Ratio between CELL 1 and CELL 2, expressed in %:

$$\frac{\text{CELL 2}}{\text{CELL 1}} \times 100 = \%$$

Example:

CELL 1 is measuring 5.0 ppm DO. CELL 2 is measuring 4.5 ppm DO. Ratio would read 90.0%.

- ♦ Measurement of CELL 2 expressed as % oxygen in air.
- ♦ Measurement of CELL 2 expressed in ppm.
- ♦ Measurement of CELL 2 expressed in % Saturation.
- ♦ The difference between CELL 1 and CELL 2, expressed in % or ppm:

$$\text{CELL 1} - \text{CELL 2} = \% \text{ or ppm}$$

Example:

CELL 1 is measuring 100% saturated oxygen in water. CELL 2 is measuring 95.0% saturated oxygen in water. Difference would read 5.0%.

To read anything other than the measurement or to make a configuration or calibration change, requires keypad manipulations.

Keypad

The keypad, Figure , consists of eight keys, five of which are dual function keys. The white lettered keys represent normal functions while the green lettered keys represent the alternate function. To operate the white lettered function keys, just push them. To operate the green lettered keys, the **Shift** key must first be pushed and held. All key functions are described in Table 2.

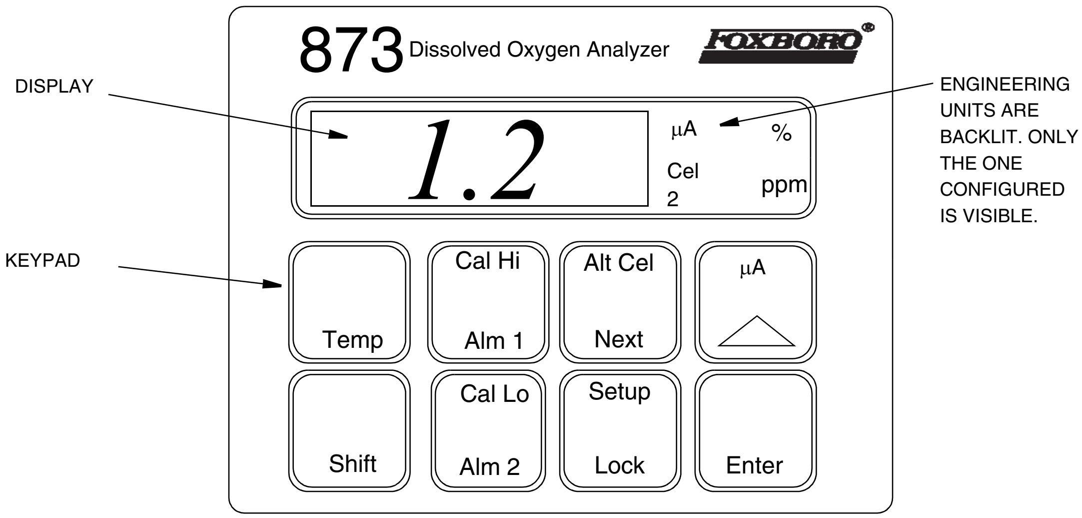


Figure 12. Model 873DO Keypad and Display

Table 2. Keypad Functions

Key	Function
Shift	**Shift**: Press and hold prior to pressing any dual-function key, to activate upper function on dual function key. It is ignored when pressed with single function keys or when pressed alone. However, holding the **Shift** key will delay the 10-second time-out to allow longer viewing of a value or code.
μ A △	μ **A**: Press key to display sensor current level (μA) without temperature correction. When pressing key while in Ratio or Difference modes, the first depression will allow CELL 1's value to be viewed; subsequent pressing of the key before time out will allow CELL 2's value to be viewed. **Increment**: Press to increase the value of the flickering number appearing on display. Each depression causes the value to increase by one. When 9 or the highest number in the configuration sequence is reached, the sequence repeats.
Temp	**Temperature**: Causes the process medium temperature or manually set value to appear on the display. A rounded value with legend "C" or "F" shown alternates with a tenths place digit. Manual temperature compensation (period shown after legend) may be altered in this mode by entering a new value. The value may not be changed in the Automatic mode.
Enter	**Enter:** Used to display the value or code of a setup entry. It is also used to select a parameter or code by entering the value or code into memory.
Alt Cel / Next	**Alternate CELL**: Pressing key when CELL 1 is displayed shows Cel 2 value. Pressing key when CELL 2 is displayed shows Cel 1 value. Pressing key once when Ratio or difference is displayed (before timeout) shows Cel 1 value; pressing it a second time shows Cel 2 value. **Next**: Used to select one of the four display digits similar to a cursor except that it causes the digit to flicker. Also used to select the next entry choice of the setup function.
Setup / Lock	**Setup**: Used to select and access the analyzer's configuration parameters and values. **Lock**: Used to display the lock status and lock or unlock the analyzer.
Cal Lo / Alm 2	**Cal Lo**: Used to set the desired lower calibration level during bench calibration. **Alarm 2**: Used to display the setpoint value for the relay associated with this alarm.
Cal Hi / Alm 1	**Cal Hi**: Used to set the desired upper calibration level during bench calibration. **Alarm 1**: Used to display the setpoint level for the relay associated with this alarm.

— NOTE —

1. Pressing **Next** and Δ simultaneously allows you to step backward through the Setup program or digit place movement. Note, however, that you cannot reverse number count by this procedure.
2. Pressing and holding **Shift** and **Enter** simultaneously overrides the 10-second wait between Setup entries

Operate Mode

Once the 873 Analyzer is powered, it is in the Operate Mode. The instrument first conducts a self-diagnostic, then automatically displays the measurement.

While in the Operate Mode, the user may view the measurement, view the temperature, and view all the parameter settings as configured in the Configuration Setup Entries and Basic Setup Entries.

Temp Key

To *view* the process temperature, push **Temp** and the display changes from the dissolved oxygen measurement to the process medium temperature or manually adjusted temperature.

From the measurement mode, when dual sensors are used, push **Next** and, while holding, press **Temp** to display Cel 2's process medium temperature or manually adjusted temperature. The Cel 2 legend will be illuminated. The temperature cannot be changed by this procedure.

The display is a rounded whole number with the temperature units (C or F) alternating with tenths of degrees. Once the 873 is unlocked ("Unlocking Analyzer Using Security Code" on page 36), the **Temp** key, used in conjunction with the increment (Δ) key, allows the temperature to be changed from °C to °F or vice versa, as well as allowing the use of manual temperature compensation at a given temperature (decimal shown after temperature). When **Temp** is pushed, the process temperature is displayed on the readout. Pushing Δ causes the display to sequence from the displayed value through the following sequence example:

(1) 77.F	(2) 77.F.	(3) 25.C	(4) 25.C.
or	or	or	or
77.0	77.0	25.0	25.0

When the decimal point after the C or F is present, the measurement is temperature compensated *manually* at the temperature displayed. To change that temperature, use **Next** and Δ to display the new value; then push **Enter**. Automatic temperature compensation cannot be adjusted by this procedure. See "Startup Setup Parameters" on page 74. To return to automatic compensation, sequence the display to remove the decimal point after C or F.

View Setup Entries

Setup Entries may be viewed at any time. To *view* any of the Setup Entries, follow the procedures given in the Configuration Setup Entries or Basic Setup Entries section but do not “Unlock” the instrument.

When viewing the Setup Entries, you may page through the parameters as rapidly as you wish (**Shift** + **Setup**, **Next** one or more times). However, once **Enter** is pushed (**Enter** must be pushed to read a parameter value), you must wait 10 seconds (value is displayed for 10 seconds) for the parameter symbol to reappear. If the parameter value was not entered, pressing **Shift** and **Enter** together will circumvent the 10 second wait between Setup entries. The parameter symbols also appear for 10 seconds. If another key is not pushed in 10 seconds, the display defaults to the measurement. This feature is called “timing out.” To avoid “timing out” on any display, push and hold **Shift**.

To make *changes* to any Configuration Setup Parameter, refer to “**Configuration**” **on page 35**.

4. Configuration

Overview

This instrument is shipped with either factory settings (default values) or user defined settings, as specified per Sales Order. Table 3, “Configuration Setup Entries,” on page 37 lists all the parameters that are more frequently changed, and Table 12, “Basic Setup Entry Selection,” on page 55 lists the parameters that are calibration oriented. Both tables list the displayed symbol, the page number to read about the parameter, a description of the display, the factory default value, and a space to write user values.

Configuration is the keypad manipulation of some parameters to make the Analyzer function to the user's specifications. This section explains how to input and change specific data through the **keypad**. Because reconfiguration may also involve **wiring** or **jumper** changes, care must be taken to ensure that all three items are checked before the Analyzer is placed into service either at startup or after any changes are made.

All 873 parameters are entered as 4-digit numerical codes. The code is chosen from tables shown with each parameter. There are several parameters that are entered as direct 4-digit values. Therefore, no table is supplied for those parameters.

Successful configuration requires four simple steps:

- Write down all your parameters in the spaces provided on the configuration tables.
- Unlock the instrument.
- Enter the 4-digit codes.
- Lock the instrument.

Configure Mode

The Configure Mode is protected through two levels of security, one level for “Configuration Setup Entries” and a second for “Basic Setup Entries”. Any configuration change starts with unlocking the instrument. Unlocking is accomplished by inputting a security code through the keypad.

Security Code

There are two levels of security in the Analyzer; both use the same passcode. The first level of security protects against unauthorized change of Temp, Alm 1, Alm 2, Cal Lo, Cal Hi, and all the “Configuration Setup Entries” (of which there are 19) (refer to “Configuration Setup Entries” on page 36). The second level of security protects the remaining 27 setup entries, called “Basic Setup Entries,” 24 of which can be changed in the field (refer to “Basic Setup Entries” on page 55).

Any of the parameter codes or setpoints can be viewed when the Analyzer is in the locked state. When displaying a parameter in the locked state, none of the digits flicker, and an attempt to change the parameter results in the message Loc on the display.

When the unit is unlocked at the first level (see “Unlocking Analyzer Using Security Code” on page 36), the unit will remain unlocked until a positive action is taken to lock the unit again (see “Locking Analyzer Using Security Code” on page 36).

However, when the unit is unlocked using the bL entry at the second level of security (see “Unlocking Basic Setup Entries (bL)” on page 56), it will remain unlocked only as long as any of the Basic Setup Entries are being accessed. As soon as the Analyzer defaults to the current measurement value, the second level of security automatically locks again, so an unlock procedure is required to reaccess the Basic Setup Entries.

Unlocking Analyzer Using Security Code

1. Press **Lock**. Display will read Loc.
2. Press **Next** and then use the **Next** and increment (Δ) keys until security code is displayed (0800 from factory).
3. Press **Enter**. Analyzer will read uLoc, indicating unlocked state.

Locking Analyzer Using Security Code

1. Press **Lock**. Display will read uLoc.
2. Press **Next** and then use the **Next** and increment (Δ) keys until security code is displayed (0800 from factory).
3. Press **Enter**. Analyzer will read Loc, indicating locked state.

Configuration Setup Entries

The configuration setup entries consist of 19 parameters. These parameters are process oriented and access to them is passcode protected. Table 3 lists each parameter (in the same sequence as seen on the display), the page on which a complete description can be found, its applicable symbol, factory default, and a space for recording your setting. Descriptions of each parameter are given in the text that follows.

Table 3. Configuration Setup Entries

Displayed Symbol	Reference (Page No.)	Parameters and Values Accessed	Factory Default	User Settings
CELL	38	Configuration of Display, Analog Outputs	1113	
Hold	39	Holds and sets the Analog Output Value in Hold	0000	
Cd	40	Compensation and Damping - Damping Factor - Temperature Compensation	0001	
AC1	43	Alarm 1 Control - Measurement Selection - Low/High/Instrument plus Passive/Active State - % Hysteresis	1403	
Att1	49	Alarm 1 Trigger Timer	00.00	
AFt1	45	Alarm 1 Feed Time	00.00	
AdL1	45	Alarm 1 Delay Time	00.00	
AC2	48	Alarm 2 Control - Measurement Selection - Low/High/Instrument plus Passive/Active State - % Hysteresis	1203	
Att2	49	Alarm 2 Trigger Timer	00.00	
AFt2	49	Alarm 2 Feed Time	00.00	
AdL2	49	Alarm 2 Delay Time	00.00	
UL	52	User-defined Upper Measurement Limit - Both CELLS	per sales order	
LL	52	User-defined Lower Measurement Limit - Both CELLS	0.00	
UtL	53	User-defined Upper Temperature Limit - Both CELLS	100.0	
LtL	53	User-defined Lower Temperature Limit - Both CELLS	0.00	
HO1	54	100% Analog Output - Channel 1	per sales order	
LO1	54	0% Analog Output - Channel 1	0.00	
HO2	54	100% Analog Output - Channel 2	100°C	
LO2	55	0% Analog Output - Channel 2	0°C	

To change any of the Configuration Setup parameters, use the following procedure:

1. Unlock Analyzer (see “Unlocking Analyzer Using Security Code” on page 36).
2. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
3. Press **Next** one or more times until the parameter to be changed is displayed.
4. Press **Enter**.
5. Use **Next** and ∆ until the desired code or value is displayed.
6. Press **Enter**.
7. Lock Analyzer (see “Locking Analyzer Using Security Code” on page 36).

NOTE

To prevent timeout at any time during this procedure, press and hold the **Shift** key.

CELL Display and Output Configuration (CELL)

The CELL 4-digit code selects the measurement displayed and configures the analog output assignment. See Table 5.

Digit 1 Configuration:

When CELL 1 is displayed (first digit a 1), no CELL legend is displayed.

When CELL 2 is displayed (first digit a 2), the legend Cel 2 is displayed.

Ratio is displayed when the first digit of this code is 7. It is defined mathematically as

$$\frac{\text{CELL 2}}{\text{CELL 1}} \text{ x } 100 \text{ (\% legend lit.)}$$

Difference is displayed when the first digit of this code is 9. It is defined mathematically as

CELL 1 – CELL 2 = Difference (in units you are using in your measurement)

When 2 is displayed as first digit of the code, and 0 is the second digit of the code, **Alt Cel** displays CELL 1's value. When 7 or 9 is used as the first digit of this code, **Abso** refers to CELL 1's value. **Alt Cel** will alternate between Cel 1 and Cel 2 with repeated pressings.

Table 4. Relationship of CELL Code to Alt Cel and* μA *Key Function

CELL Code Digits One and Two	Press Alt Cel to display values of:	Press μA to display μA value of:
1 0	CELL 2	CELL 1
2 0	CELL 1	CELL 2
7 0	CELL 1 and 2	CELL 1
9 0	CELL 1 and 2	CELL 1
1 1	-	CELL 1
2 1	-	CELL 2

Digit 2 Configuration:

SINGLE CELL OPERATION: The second digit of this code must be 1, if one of the two sensor channels is not used. In single sensor operation, all pertinent parameters in other setup configurations must also be configured to the CELL channel chosen, even if they are not used. These include output selection (see digits 3 and 4 of CELL code), and Alarm Selection (AC1 and AC2). If the alarms and analog output(s) will not be used, these must be set outside the operating limits of the measurement, thus preventing error codes from occurring. In this mode, the Alt CELL feature is not functional. See "User Notes" on page 93.

DUAL CELL OPERATION: The second digit of this code should be 0 when Ratio or Difference modes are used, or whenever the user configures either alarm or output of both sensors. See User Notes on page 93.

Digits 3 and 4 Configurations:

Two analog outputs are available on the 873DO. Signal assignments for these outputs are shown in Table 5.

Possible combinations for the signal assignments of the two outputs include:

- ♦ Dissolved Oxygen Sensor 1 and Temperature Sensor 1
- ♦ DO Sensor 1 and DO Sensor 2
- ♦ Ratio and Temperature Sensor 1
- ♦ Difference and Dissolved Oxygen Sensor 1

For specific information on sensor setup, see “User Notes” on page 93.

Table 5. CELL Code – Display and Output Configuration

Digit 1	Digit 2	Digit 3	Digit 4
DISPLAY	OPERATION	OUTPUT 1	OUTPUT 2
1 - Cell 1 2 - Cell 2 7 - Ratio 9 - Difference	0 - Interrogate both channels 1 - Ignore nonconfig-ured channel	1 - Dissolved Oxygen Cell 1 2 - Dissolved Oxygen Cell 2 3 - Temp Cell 1 4 - Temp Cell 2 7 - Ratio 9 - Difference	1 - Dissolved Oxygen Cell 1 2 - Dissolved Oxygen Cell 2 3 - Temp Cell 1 4 - Temp Cell 2 7 - Ratio 9 - Difference

Holding the Analog Output (HOLD)

The HOLD 4-digit code is used to freeze the output(s) at a particular value. The selections are shown in Table 6. When the first digit of this code is 1, 2, or 3, the display flashes between the word HOLD and the current measurement value. The outputs are set at a user selected value corresponding to a % of the analog output range. The percentage is set by the last three digits of the HOLD code. While in one of the HOLD modes, the Analyzer will continue to monitor and display the measurement. The sensor may be cleaned or replaced, and the system calibrated, while in this mode.

If an alarm is configured as a High, Low, or Instrument alarm (AC1 or AC2; second digit in code is 1-6), the alarm status while in the HOLD mode may be selected by the first digit in the HOLD code.

If , for instance, an alarm is configured as a HOLD alarm (AC1 or AC2; second digit is 7 or 8), the alarm will trigger when the HOLD is activated. This feature allows a control room or alarm device (light, bell, etc.) to know the Analyzer is in a HOLD mode, not a “RUN” mode. The ALARM will be activated when HOLD is implemented when the first digit in the HOLD code is 1, 2, or 3.

Example 1: HOLD at a Percent of the Analog Output

For an analog output of 4 to 20 mA, 50% (050) will always equal 12 mA, and 0% will equal 4 mA.

Or, to HOLD on the value being displayed at the present time, the value displayed must be converted to a percent value by the following equation:

$$\frac{(\text{Value displayed - L01})}{\text{H01 - L01}} \times 100$$

Example 2: HOLD at the Value Presently Read on the Display

The presently displayed value for DO Sensor 1 is 6 ppm. H01 is set at 15 ppm, L01 is set at 0.5 ppm. To hold the output at 6 ppm, the last two digits of HOLD must be 38.

$$\frac{6.0 - 0.5}{15.0 - 0.5} \times 100 = \frac{5.5}{14.5} \times 100 = 38$$

The HOLD code should read 1038, 2038, or 3038, as applicable. See “Output #1's 100% Analog Value (H01)” on page 54 and “Output #1's 0% Analog Value (L01)” on page 54 for a description of H01 and L01.

If two outputs are present, both will HOLD at 38% (038) of their analog output ranges.

Table 6. HOLD Code - Hold Analog Output Values

Digit 1	Digits 2, 3, and 4
0 = No HOLD HOLD On, Analog Output on HOLD 1 - Alarms held in present state 2 - Alarms held in off state 3 - Alarms held in on state	000 to 100% of Analog Output Range

Compensation and Damping (Cd)

Cd consists of a 4-digit code pertaining to measurement damping, and the type of ppm temperature compensation desired. Damping time refers to the interval over which all measurement readings are averaged. Damping affects dissolved oxygen and temperature measurements as well as analog outputs. The ppm temperature compensation (digits 3 and 4) is utilized when the FSC is in the 100 ppm Full Scale Range only (see “The Full Scale Range (FSC)” on page 57. The function of digits 3 and 4 is ignored when FSC is set to other Full Scale Range selections, although temperature compensation for changes in membrane oxygen transport continue. The ppm temperature compensation is used during sensor calibration (“Calibration” on page 73) and when measuring ppm in processes that change temperature. Table 7 lists the three temperature compensation options. Temperature compensations applied are based upon Standard Oxygen Solubility values. See Table 19 on page 80.

00 — Configure the last two digits of the Cd code to 00 to provide temperature compensation for oxygen solubility in fresh water. This setting must be used for the air calibration technique; it allows the analyzer to relate the current from the sensor to a 100% Oxygen saturated solution (air) and convert this to a concentration (ppm) that would be observed in a saturated fresh water sample (at the temperature the sensor/analyzer reads).

01 — Configure the last two digits of the Cd code to 01 to provide temperature compensation for oxygen solubility in fresh water. This setting must be used for a solution calibration technique, thus allowing the sensor current to be related to a ppm value displayed on the analyzer. If the process temperature changes after the calibration, the reading will be temperature compensated to a concentration based on a fresh water temperature table.

02 Configure the last two digits of the Cd code to 02 to provide temperature compensation for oxygen solubility in salt water. This setting must be used for a solution calibration technique, thus allowing the sensor current to be related to a ppm value displayed on the analyzer. If the process temperature changes after the calibration, the reading will be temperature compensated to a concentration based on a salt water temperature table.

Table 7. Cd Code – Compensation and Damping

Digit 1	Digit 2	Digits 3 and 4
DAMPING	NOT USED	TEMPERATURE COMPENSATION
0 - none 1 - 10 seconds 2 - 20 seconds 3 - 30 seconds	0	00 - % Saturation (for Air Cal) 01 - Pure Water (for Solution Cal) 02 - Salt Water (for Solution Cal)

General Information About Alarms

Two independent, Form C dry alarm contacts, rated at 5A noninductive, 125 V ac/30 V dc are provided. The alarm status is alternately displayed with the measurement on the local LED display on a 1 sec cycle. Alarms are configured using the AC1 or AC2 code as Low, High, Hold, or instrument watchdog alarms, with active or passive relays, having a deadband or time delay.

⚠ CAUTION

When the contacts are used at signal levels of less than 20 W, contact function may become unreliable over time due to the formation of an oxide layer on the contacts. See "Alarm Contact Maintenance" on page 99.

Wiring of Alarms

Alarm relay locations may be found in "Wiring of Plastic Enclosure" on page 26 and "Wiring of Metal Enclosure" on page 26 of this instruction. See Figure 13.

Alarms relays in the 873DO Analyzer may be configured active or passive. An active relay is energized when the analyzer is powered and the local display does not indicate an alarm state.

The external device may be wired to the analyzer in either of two ways:

- ♦ between NC and C, or
- ♦ between NO and C.

Figure 13 illustrates all possible wiring and configuration of these relays.

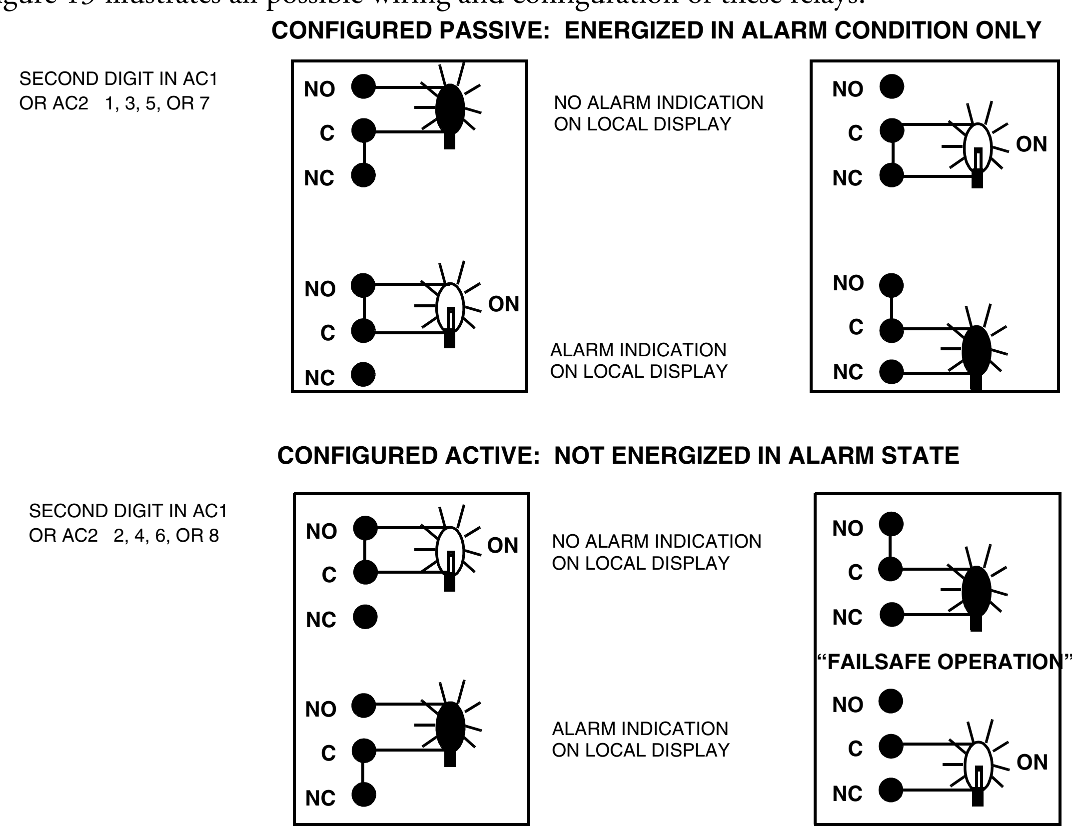


Figure 13. Possible Alarm Wiring and Configuration Choices

— **NOTE**

1. Alarm setpoints will have to be reset if any changes are made to FSC.
2. Upon powering the Analyzer, the alarm operation is delayed for a time period proportional to the damping time set in the Cd code (damping selection). Alarms will remain “OFF” until the measurement has stabilized.

Check that the alarm (1 and 2) is configured as desired. Refer to “Alarm 1 Control (AC1)” on page 43 and “Alarm 2 Control (AC2)” on page 48.

Setting Alarm Setpoints

— **NOTE**

This procedure is relevant only when the alarms are configured as measurement Low and/or High Alarms. When the alarms are configured as Watchdog or Hold alarms, alarm level settings have no relevance.

1. Unlock Analyzer (see “Unlocking Analyzer Using Security Code” on page 36).
2. To set alarm 1, press **Alm1**. Then use **Next** and Δ to achieve the desired value on the display. Press **Enter**.
3. To set alarm 2, press **Alm2**. Then use **Next** and Δ to achieve the desired value on the display. Press **Enter**.
4. Lock Analyzer (see “Locking Analyzer Using Security Code” on page 36).

— **NOTE**

If use of the alarms is not desired, set the Alm1 and Alm2 values outside of normal measurement range.

Alarm 1 Control (AC1)

The AC1 4-digit code configures the alarm designated as “Alm 1”. See Table 8. There are three configurable parameters associated with each alarm. The first digit of this code allows the alarm to be configured to correspond to one of two alarm measurement selections. The second digit of this code configures the alarm as a Measurement alarm, Instrument alarm, or Hold alarm.

When used as a measurement alarm, four configurations are possible. These are as a low passive or active, or a high passive or active alarm, i.e., digit 2 is 1-4.

A *low alarm* relay will trip on decreasing measurement.

A *high alarm* relay will trip on increasing measurement.

Passive or active (failsafe) configurations are also chosen by this digit choice. In the active (failsafe) configuration, a loss of power to the Analyzer will result in a change from active to passive relay state, providing contact closure and an indication of a power problem. Correct wiring of the contacts is necessary for true failsafe operation. For wiring information, refer to “Wiring of Plastic Enclosure” on page 26 and “Wiring of Metal Enclosure” on page 26 of this document.

As an alternative to a measurement alarm, Alarm 1 has the option of being used as an Instrument Alarm. In this “Watchdog” state, the alarm can communicate any diagnostic error present in the system. When used as a diagnostic alarm, the alarm cannot be used as a conventional measurement alarm. However, one of the configurable diagnostic parameters is “measurement error,” so when programmed properly, alarm 1 can report either diagnostic or measurement problems. Set digit 2 in this code as either 5 or 6, as applicable.

When alarm 1 is configured as a diagnostic error communicator, it will report any system problem. It cannot, however, selectively report a given problem. The type of hardware/software conditions that will cause an alarm include:

- A/D converter error
- EEPROM checksum error
- RAM error
- ROM error
- Processor task time error (watchdog timer)

In addition to these diagnostics, the user may program several temperature and measurement error limits which, if exceeded, will cause an alarm condition. These programming options are explained in “User-Defined Upper Measurement Limit (UL)” on page 52 and “User-Defined Lower Temperature Limit (LtL)” on page 53.

NOTE

In addition to these diagnostics, special signals are provided from 871DO sensors that are used to relate sensor diagnostic information for membrane coating, breakage, or electrolyte problems. These diagnostics are not programmable to the alarm contacts but are displayed locally only. See pages 68 through 71 for information about programming these diagnostics.

Refer to the “Error Codes” on page 87, for identifying error messages.

Alarm 1 may also be configured and used as a HOLD alarm. When used as a HOLD alarm, Alarm 1 cannot be used as a conventional measurement alarm. When Alarm 1 is configured as a HOLD alarm (AC1; 2nd digit 7 or 8), the alarm will trigger when the HOLD is activated. This feature will allow a control room or alarm device (light, bell, etc.) to know the Analyzer is in a HOLD mode, not a “RUN” mode. The alarm will be activated when HOLD is implemented when the first digit in the HOLD code is 1, 2, or 3. A HOLD alarm overrides the HOLD state (on, off, current) normally enacted when the unit is placed in HOLD.

Finally, the alarm hysteresis (deadband) may be varied from 0 to 99% of the full scale measurement value in increments of 1%. If the % legend is visible, hysteresis may be set from 0.0 to 9.9% concentration.

Table 8. AC1 Code - Alm 1 Configuration

Digit 1	Digit 2	Digits 3 and 4
MEASUREMENT SELECTION	CONFIGURATION	HYSTERESIS
1 - Dissolved Oxygen CELL 1 2 - Dissolved Oxygen CELL2 3 - Temp CELL 1 4 - Temp CELL 2 7 - % Ratio 9 - Difference	1 = Low/Passive 2 = Low/Active 3 = High/Passive 4 = High/Active 5 = Instrument/Passive 6 = Instrument/Active 7 = HOLD/Passive 8 = HOLD/Active	00 to 99% of Full Scale 0.0 to 9.9% (% mode)

Alarm Timers (Att1, AFt1, and AdL1)

There are three timers associated with the Alarm 1:

1. *Att1 (Alarm 1 Trigger Time)*
   Programmable timer to prevent alarm from ever triggering for a time set by this parameter.
2. *AFt1 (Alarm 1 Feed Time)*
   Programmable timer to keep alarm ON for a time period set in this parameter after it has been initially activated.
3. *AdL1 (Alarm 1 Delay Time)*
   Programmable timer to keep the alarm OFF for the time set in this parameter after it has been kept ON by parameter AFt1.

Each of these timers will be explained fully in the following paragraphs and their relationships illustrated in Figure 14 and the flow diagram in Figure 15. If timed alarm actuation is utilized, concentration hysteresis set in parameter AC1 is ignored.

Alarm 1 Trigger Timer (Att1) may be used with or without the other alarm timers (AFt1 and AdL1). Att1 is used when Alarm 1 is configured as a Measurement alarm only (High or Low, D.O. or Temperature). The purpose of this timer is to prevent the alarm from triggering, thus allowing spurious transients, such as an air bubble or other glitch in the measurement from tripping the alarm. After the timer has counted down, that alarm will activate *only* if the measurement has remained in an alarm state during the *entire* trigger time. Att1 resets any time the measurement passes through the alarm setpoint. Table 9 shows the code designation.

Alarm 1 Feed Time (AFt1) and Alarm 1 Delay Time (AdL1) may be used when Alarm 1 is configured as a Measurement alarm for Dissolved Oxygen or Temperature. Alarm Feed Time 1 (AFt1) works in conjunction with Alarm Delay Time 1 (AdL1) to provide timed control over the Alarm 1 relay (although AFt1 may be used without AdL1). These parameters should be used together. Both parameters will take precedence over the alarm hysteresis set in AC1.

When Alarm 1 Feed Time (AFt1) is activated, Alarm 1 will stay ON for the amount of time set in this function regardless of what the measurement value is in relationship to the alarm setpoint. This means that Alarm 1 will remain ON even if the measurement goes out of alarm. Table 9 shows the code designation.

Example:

05.15 means 5 minutes, 9 seconds

Alarm1 Delay Time (AdL1) is activated by entering a time in the code parameter AdL1. On time-out of AFt1, the alarm will be deactivated for this time period. The alarm will *not* reactivate for the time period set in AdL1 regardless of what the measurement value is in relation to setpoint. After time-out of AdL1, the 873 reverts to a normal run mode. If the instrument has remained in an alarm state for the entire time period (AFt1 + AdL1), the sequence of AFt1 and AdL1 repeats itself. Table 9 shows the code designation.

Example:

20.50 means 20 minutes, 30 seconds

Table 9. Att1, AFt1, and AdL1 Time Codes

Digits 1 and 2	Digit 3	Digit 4
00 to 99 minutes	0 to 9 tenths of minutes	0 to 9 hundredths of minutes

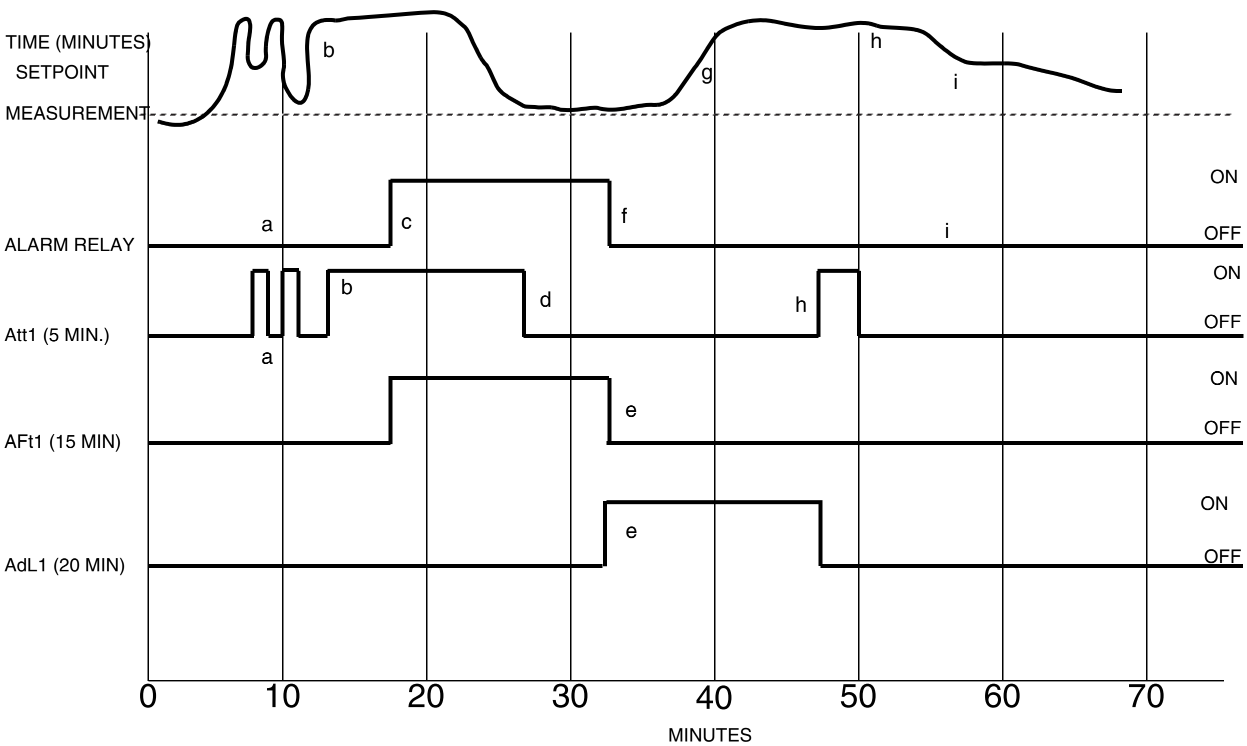


Figure 14. ON/OFF relationship between Att1, AFt1, and AdL1

NOTES: Example illustrated as High Alarm.

a. Measurement did not remain above setpoint for timer period set in Att1. Alarm relay remains inactive. Att1 reset when measurement fell below alarm setpoint.

b. Measurement stays above alarm setpoint continuously for time set by Att1. After time set in Att1, alarm relay becomes activated (c) for time period set by parameter AFt1.

c. Timer Att1 reset when measurement fell below setpoint (d).

d. Upon time-out of AFt1, timer AdL1 will deactivate Alarm 1 relay (f) for the time period set by this parameter. The alarm remains deactivated even if measurement (g) exceeds the alarm setpoint in this period of time.

e. The measurement is exceeding the alarm setpoint at the end of AdL1; the timer Att1 resets, and alarm relay remains off. The measurement does not exceed the alarm setpoint for the entire period Att1 (l), the alarm relay does not activate. If the measurement had exceeded the setpoint for the entire sum of times (AFt1 + AdL1), the feed timer (AFt1) would have been reactivated.

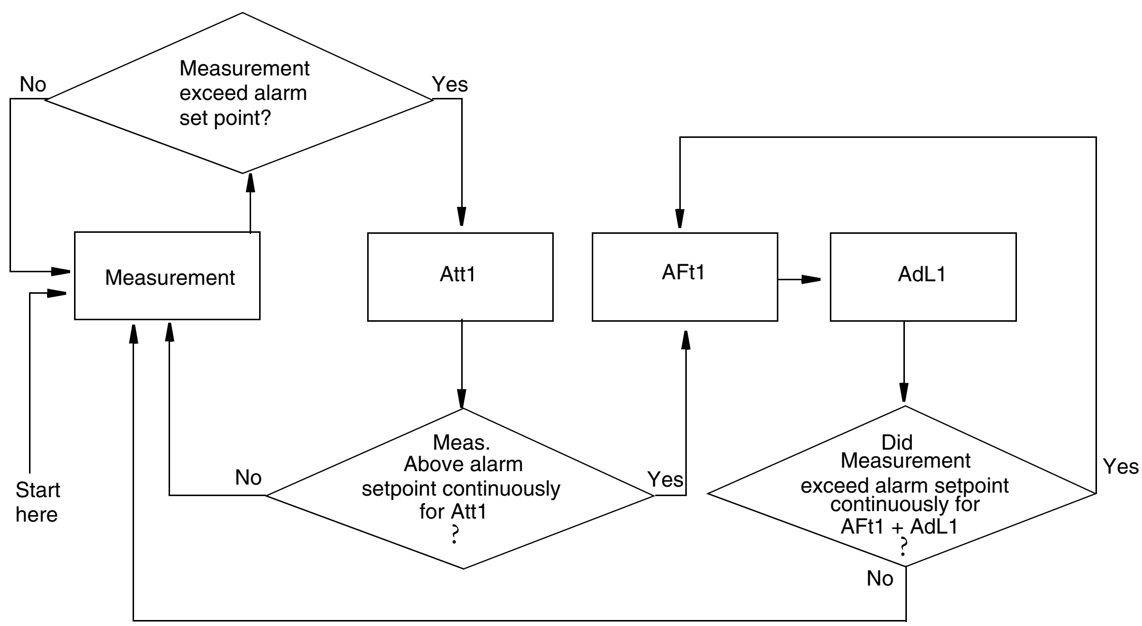


Figure 15. Flow Diagram for Alarm Timer Logic

Alarm 2 Control (AC2)

The AC2 4-digit code configures the alarm designated as “Alm 2”. See Table 10. There are three configurable parameters associated with each alarm. The first digit of this code allows the alarm to be configured to correspond to one of six alarm measurement selections. The second digit of the code configures the alarm as a Measurement alarm, Instrument alarm, or HOLD alarm.

When used as a measurement alarm, four configurations are possible. These are as a low passive or active, or a high passive or active alarm. Set Digit 2 as 1-4, as applicable.

A low alarm relay will trip on decreasing measurement.

A high alarm relay will trip on increasing measurement.

Passive or active (failsafe) configurations are also chosen by this digit choice. In the active (failsafe) configuration, a loss of power to the Analyzer will result in a change from active to passive relay state, providing contact closure and an indication of a power problem. Correct wiring of the contacts is necessary for true failsafe operation. For wiring information, consult page 26 and page 26 of this document.

As an alternative to a measurement alarm, the alarm 2 has the option of being used as an Instrument Alarm. In this “Watchdog” state, the alarm can communicate any diagnostic error present in the system. When used as a diagnostic alarm, the alarm 2 cannot be used as a conventional measurement alarm. However, one of the configurable diagnostic parameters is “measurement error,” so when programmed properly, alarm 2 can report either diagnostic or measurement problems. Set Digit 2 in this code as either 5 or 6, as applicable.

When the Alarm 2 is configured as a diagnostic error communicator, it will report any system problem. It cannot, however, selectively report a given problem. The type of hardware/software conditions which will cause an alarm include:

- A/D converter error
- EEPROM checksum error
- RAM error
- ROM error
- Processor task time error (watchdog timer)

In addition to these diagnostics, the user may program several temperature and measurement error limits which, if exceeded, will cause an alarm condition. These programming options are explained in“User-Defined Upper Measurement Limit (UL)” on page 52 through “User-Defined Lower Temperature Limit (LtL)” on page 53.

— NOTE

In addition to these diagnostics, diagnostic information for membrane coating, breakage, or electrolyte problems in the 871DO is available. See pages 68 through 71 for programming these parameters. These diagnostics cannot be programmed to the alarm relays. The sensor diagnostic error messages are only displayed locally.

Refer to the “Error Codes” on page 87 for identifying error messages.

Alarm 2 may also be configured and used as a HOLD alarm. When used as a HOLD alarm, alarm 2 cannot be used as a conventional measurement alarm. When alarm 2 is configured as a HOLD alarm (AC2; 2nd digit 7 or 8), the alarm will trigger when the HOLD is activated. This feature will allow a control room or alarm device (light, bell, etc.) to know the Analyzer is in a HOLD mode, not a "RUN" mode. The ALARM will be activated when HOLD is implemented when the first digit in the HOLD code is 1, 2, or 3.

A HOLD alarm overrides the HOLD state (on, off, current) normally enacted when the unit is placed in HOLD.

Finally, the alarm hysteresis (deadband) may be varied from 0 to 99% of the full scale measurement value in increments of 1%. If the % legend is visible, hysteresis may be set from 0.0 to 9.9% concentration.

Table 10. AC2 Code - Alarm 2 Control

Digit 1	Digit 2	Digits 3 and 4
MEASUREMENT SELECTION	CONFIGURATION	HYSTERESIS
1 - Dissolved Oxygen CELL 1 2 - Dissolved Oxygen CELL 2 3 - Temp CELL 1 4 - Temp CELL 2 7 - % Ratio 9 - Difference	1- Low/Passive 2 = Low/Active 3 = High/Passive 4 = High/Active 5 = Instrument/Passive 6 = Instrument/Active 7 = HOLD/Passive 8 = HOLD/Active	00 to 99% of Full Scale 0.0 to 9.9 (% mode)

Alarm Timers (Att2, AFt2, and AdL2)

Three timers are associated with the Alarm 2:

1. *Att2 (Alarm 2 Trigger Timer):* Programmable timer to prevent alarm from ever triggering for a time set by this parameter.
2. *AFt2 (Alarm 2 Feed Time):* Programmable timer to keep alarm ON for the time period set in this parameter after it has been initially activated.
3. *AdL2 (Alarm 2 Delay Time):* Programmable timer to keep the alarm OFF for the time set in this parameter after it has been kept ON by parameter AFt2.

Each of these timers is explained fully in the following paragraphs and their relationships illustrated in Figure 16 and the flow diagram in Figure 17. If timed alarm actuation is utilized, concentration hysteresis set in parameter AC2 is ignored.

Alarm 2 Trigger Timer (Att2) may be used with or without the other alarm timers (AFt2 and AdL2). Att2 is used when Alarm 2 is configured as a Measurement alarm only (High or Low, D.O. or Temperature). The purpose of this timer is to prevent the alarm from triggering, thus allowing spurious transients, such as an air bubble or other glitch in the measurement, from tripping the alarm. After the timer has counted down, that alarm will activate *only* if the measurement has remained in an alarm state during the *entire* trigger time. Att2 resets whenever the measurement passes through the alarm setpoint. Table 11 shows the code designation.

Alarm 2 Feed Time (AFt2) and Alarm 2 Delay Time (AdL2) may be used when Alarm 2 is configured as a Measurement alarm for Dissolved Oxygen or Temperature. Alarm Feed Time 2 (AFt2) works in conjunction with Alarm Delay Time 2 (AdL2) to provide timed control over the Alarm 2 relay (although AFt2 may be used without AdL2). These parameters should be used together. Both parameters will take precedence over the alarm hysteresis set in AC2.

When Alarm 2 Feed Time (AFt2) is activated, Alarm 2 will stay ON for the amount of time set in this function regardless of what the measurement value is in relationship to the alarm setpoint. This means that Alarm 2 will remain ON even if the measurement goes out of alarm. Table 11 shows the code designation.

Example:

05.15 means 5 minutes, 9 seconds

Alarm 2 Delay Time (AdL2) is activated by entering a time in the code parameter AdL2. Upon time-out of AFt2, the alarm will be deactivated for this time period. The alarm will *not* reactivate for the time period set in AdL2 regardless of what the measurement value is in relation to setpoint. After time-out of AdL2, the 873 reverts to a normal RUN mode. If the instrument has remained in an alarm state for the entire time period (AFt2 + AdL2), the sequence of AFt2 and AdL2 repeats itself. Table 11 shows the code designation.

Example:

20.50 means 20 minutes, 30 seconds

Table 11. Att2, AFt2, and AdL2 Time Codes

Digits 1 and 2	Digit 3	Digit 4
00 to 99 minutes	0 to 9 tenths of minutes	0 to 9 hundredths of minutes

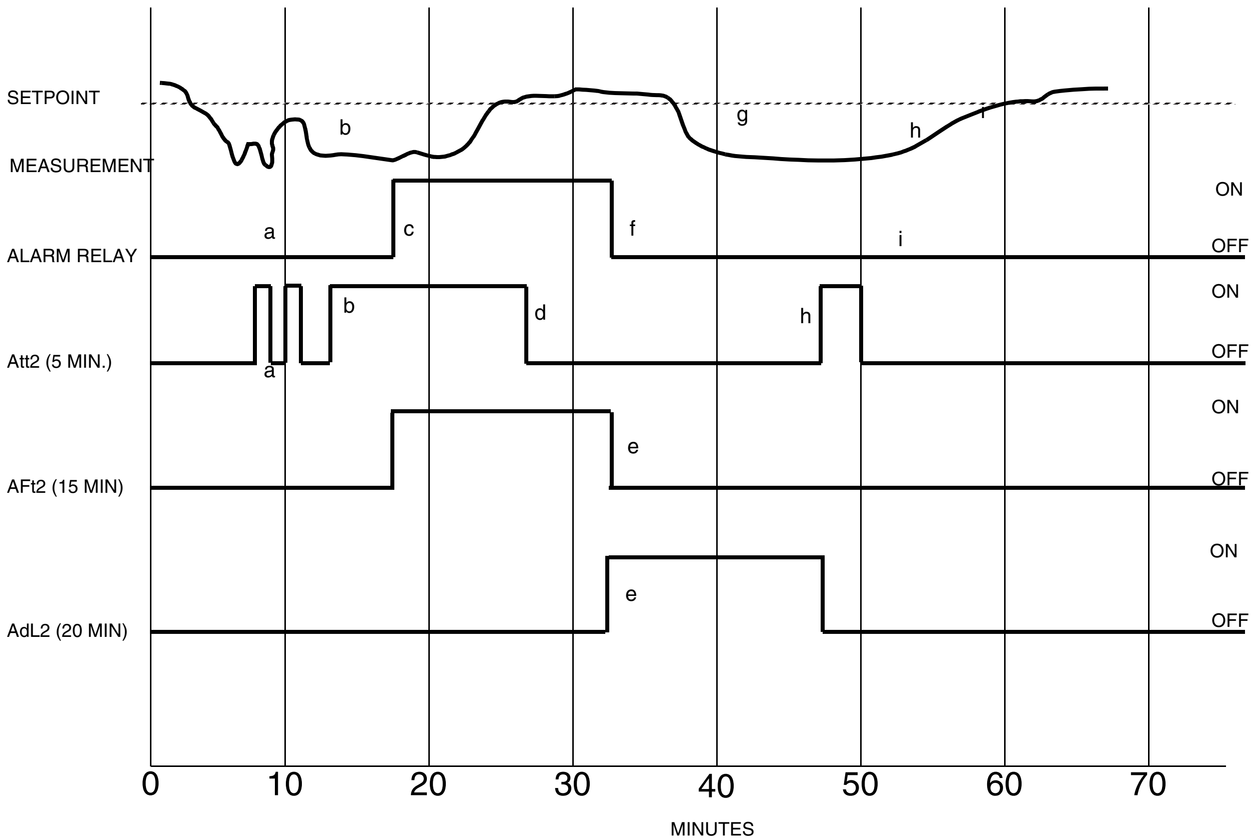


Figure 16. ON/OFF Relationship between Att2, AFt2, and AdL2

NOTES: Example illustrated as Low alarm.

a. Measurement did not remain below setpoint for timer period set in Att2. Alarm relay remains inactive. Att2 reset when measurement went above alarm setpoint.

b. Measurement stays below alarm setpoint continuously for time set by Att2. After time set in Att2, alarm relay becomes activated (c) for time period set by parameter AFt2.

c. Timer Att2 reset when measurement went above setpoint (d).

d. Upon time-out of AFt2, timer AdL2 will deactivate Alarm 2 relay (f) for the time period set by this parameter. The alarm remains deactivated even if measurement (g) falls below the alarm setpoint in this period of time.

e. The measurement has transgressed the alarm setpoint at the end of AdL2; the timer Att2 resets, and alarm relay remains off. The measurement does not remain below the alarm setpoint for the entire period Att2 (l), the alarm relay does not activate. If the measurement had remained below the setpoint for the entire sum of times (AFt2 + AdL2), the feed timer (AFt2) would have been reactivated.

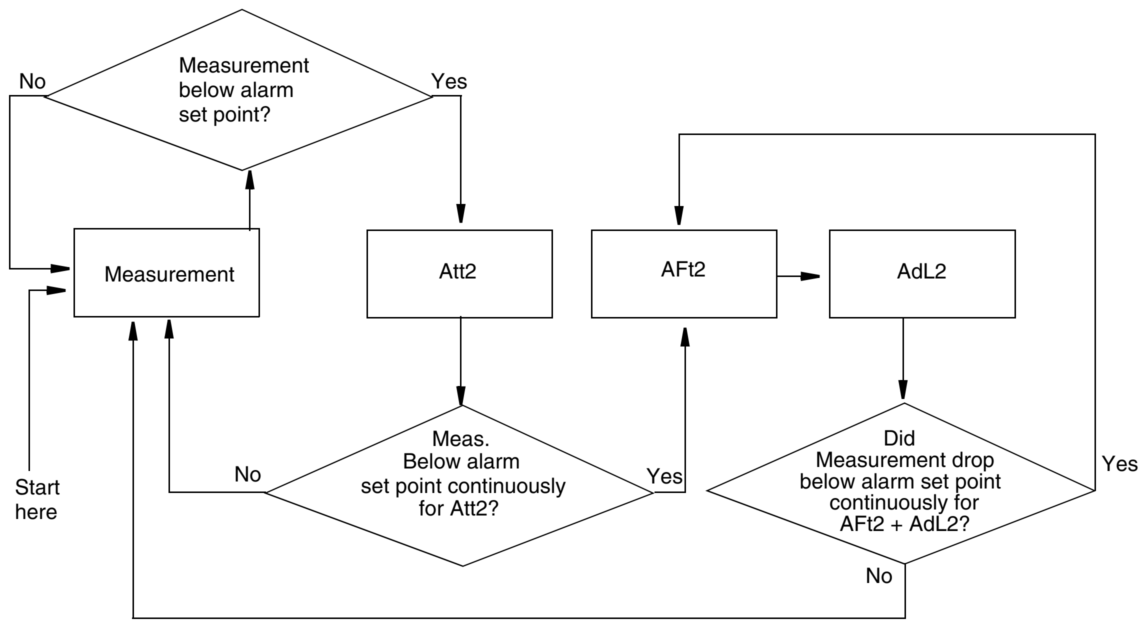


Figure 17. Flow Diagram for Alarm Timer Logic

User-Defined Upper Measurement Limit (UL)

The UL parameter enables the user to define an upper measurement limit which, if exceeded, gives an error message on the display (see "Error Codes" on page 87), and when used in conjunction with either alarm configured as instrument (watchdog) alarm (AC1 or AC2 digit 2 is 5 or 6), provides a relay contact. The value set by this code defines the measurement limit for *both* sensors.

By setting UL at a value that could never be achieved in a normal process situation, the activation of a UL Alarm would indicate either a severe process upset or sensor miscalibration. The upper limit on UL is 999.9 ppm or 999.9%.

— NOTE —
The UL value is preconfigured which is equal to the specified full scale measurement per Sales Order.

User-Defined Lower Measurement Limit (LL)

The LL parameter is similar to the previously described UL parameter, except that it allows programming of a lower measurement limit. A value of 0 is a good choice for LL but this parameter may be set lower to prevent an alarm code from flashing. The lower limit on LL is -99.9 (ppm, %). The value set by this parameter is related to *both* sensors.

— NOTE —
To make the display read -99.9, first display 099.9, then change the first digit to a negative sign.

User-Defined Upper Temperature Limit (UtL)

This parameter enables the user to define an upper temperature measurement value which, if exceeded, gives an error message on the display (“Error Codes” on page 87) and when used in conjunction with the configurable alarms (AC1 or AC2 digit 2 is 5 or 6), provides a relay contact.

The UtL function may be used in a few different ways. First, the user may wish to alarm on high process temperature. For example, in a supply line which is normally between 70°F and 90°F, the user may wish to set UtL to 100°F to indicate a problem with the temperature control. Another use of UtL is as a sensor diagnostic tool. If the thermistor in the 871DO Sensor develops a fault, it may produce erroneous temperature readings at either extreme of the temperature scale. By setting UtL at a temperature outside of any conceivable process temperature, an alarm will indicate a problem with the 871DO Sensor thermistor. The upper limit on UtL is 200°C or 392°F. The value set for this parameter defines the limit for both sensors.

User-Defined Lower Temperature Limit (LtL)

This parameter is similar to the previously described UtL parameter, except that it allows programming of a lower temperature measurement limit. The lower limit on LtL is –20°C or -5°F. The LtL value is preconfigured to be 0°C. The value set for this parameter defines the limit for both sensors.

— NOTE —

To make a minus sign appear, on the display requires a digit other than zero to be present on the display.

Example:

To make the display read -20 C°, first display 020.°C, then change the first digit to a negative sign.

Scaling the Analog Outputs

The 873DO Analyzer has dual isolated analog output signals, model code selected as 0 to 20 mA, 4 to 20 mA, or 0 to 10 V dc. For the current outputs, the maximum load is 800 Ω (18 volts compliance). For the voltage output, the minimum load resistance is 1 kΩ. Each output signal is linearly proportional to the measured variable. The dissolved oxygen output signal is linearly proportional to the displayed variable, either ppm, percent saturation (%), percent oxygen in air (%), difference or ratio.

— NOTE —

The analog outputs should be configured after the FSC and Cd parameters have been set.

Example:

The user may be measuring water in the range of 80% to 100% saturation and may want to assign the minimum analog output level (e.g., 4 mA) to a value of 80% saturated water and the maximum analog output level (e.g., 20 mA) to a value of 100% saturated water.

The user may wish to “reverse” the analog output signal in some situations.

Example:

In the previous example, 20 mA may be assigned to the 100% saturated water and 4 mA assigned to the 80% saturated water. No special procedures need to be followed to accomplish a reverse output.

The maximum output span that should be set on the Analyzer is the FSC value. The minimum output span that should be set on the Analyzer is 10% of the FSC value. Although it is physically possible to set the Analyzer for a smaller span, loss of accuracy is possible. The analog output could develop steps instead of following the measurement in a continuum as the last digit changes.

Output #1's 100% Analog Value (H01)

H01 enables the user to assign a measurement value to the maximum analog output (either 10 V or 20 mA dc).

Example:

A user may wish to retransmit 4 to 20 mA dc over a dissolved oxygen concentration of 0.0 to 15 ppm. This parameter would then allow the assignment of the 20 mA dc output to a value of 15 ppm. The FSC must be in ppm units, and Digit 3 of the CELL Code must first be set to 1 or 2 to have this parameter have Dissolved Oxygen units. See page 38. The H01 value is preconfigured to be equal to the specified full scale measurement per sales order.

Output #1's 0% Analog Value (L01)

L01 enables the user to assign a measurement value to the minimum analog output (either 0 V, 0 mA, or 4 mA dc). In the example above, the user would assign the minimum analog output of 4 mA dc to a value of 0.0 ppm, provided FSC has units of ppm and Digit 3 of CELL is 1 or 2. See "CELL Display and Output Configuration (CELL)" on page 38. The 0% value is preconfigured to be equal to 0 (% or ppm, as applicable).

Output #2's 100% Analog Value (H02)

H02 configures the second output to 100% of the analog output. The parameter is similar to H01. H02 value ties to CELL Code Digit 4.

Example:

Output 2 has been configured to correspond to temperature of CELL 1 (CELL Code 1113). You wish to have 20 mA correspond to 40°C. Once in H02 mode, use **Next** and Δ to display 40°C. The correct units will appear if CELL is configured correctly. Press **Enter**.

Output #2's 0% Analog Value (L02)

L02 configures the second output to 0% of the analog output. This parameter is similar to L01. L02 value ties to CELL Code Digit 4.

Example:

Output 2 has been configured to correspond to the temperature transducer of CELL 1 (CELL Code 1113). You wish to have 4 mA correspond to 0°C. Once in L02 mode, use Next and Δ to display 0°C. The correct units will appear if CELL is configured properly. Press **Enter**.

Basic Setup Entries

The Basic Setup entries consist of 25 configurable parameters. These parameters are calibration oriented and access to them has two levels of passcode protection. Changes to most of these parameters require the analyzer to be recalibrated. DO NOT make any changes before reading the following text for each parameter.

Table 12 lists each parameter, with its applicable symbol, in the same sequence as seen on the display. Procedures that use these parameters are: Unlocking Basic Setup Entries, Changing Ct, Selecting the Full Scale Range, Changing the Full Scale Range, Setting Active or Electronic Zero, Setting Altitude, Calibrating the Current Channel, Changing the Security Code, Calibrating the Temperature Circuitry, Changing the Analog Output, and Using Sensor Diagnostics.

Table 12. Basic Setup Entry Selection

Display Symbol	Section	Parameter and Value Accessed58	Factory Default	User Settings
bL	56	Basic Setup Lock Control	0800	
Ct	56	Sensor CELL Type	0004	
FSC	57	Full Scale Value	100 ppm	
SEr0	58	Zero Calibration	0001	
ALt	59	Altitude Calibration	0000	
PC	59	Probe Calibration	0000	
LCC	61	Lock Change Code	0800	
tCF1	62	Temperature CELL Factor CELL 1	25.00	
tEC1	62	Temperature Electronics Calibration CELL 1	25.00	
tCF2	62	Temperature CELL Factor CELL 2	25.00	
tEC2	62	Temperature Electronics Calibration CELL 2	25.00	
LC01	63	Low Calibration Analog Output 1	00.00	
HC01	63	High Calibration Analog Output 1	100.0	
LC02	63	Low Calibration Analog Output 2	00.00	
HC02	63	High Calibration Analog Output 2	100.0	
PdE	70	Probe Diagnostic Enable	0000	
dLC	70	Diagnostic Learning Control	0000	
FOt	70	Fouling Diagnostic Tolerance	0050	
CAt	70	Membrane Cap Diagnostic Tolerance	0020	
bUt	71	Bubble Diagnostic Tolerance	0020	
dt	71	Diagnostic Interval Timing	0060	

Table 12. Basic Setup Entry Selection

dOFF	71	Diagnostic Off Window Timing	2.000	
don	71	Diagnostic On Window Timing	2.000	
FdLL	71	Fouling Diagnostic Lower Limit	001.0 µA	
dr	71	Drive Voltage Setting	00.70	

Display Symbols Sft, SOH, and SOL appear in the display but are not configurable.

Unlocking Basic Setup Entries (bL)

To change any of the Basic Setup Entries, use the following procedure.

— NOTE
To avoid "timing out" on any display, push and hold Shift.

1. Unlock Analyzer at the first security level (see "Unlocking Analyzer Using Security Code" on page 36).
2. Press **Shift** and while holding, press **Setup**. Release finger from both keys.
3. Press **Next** nineteen times until bL is displayed; press **Enter** , LOC appears.
4. Press **Next**.
5. Use **Next** and Δ until security code is displayed (0800 from factory).
6. Press **Enter**. ULOC appears on the display.
7. When display returns to bL, press **Next** one or more times until parameter to be changed appears on the display. Press **Enter**.
8. Use **Next** and Δ until the desired value is displayed. Press **Enter**.
9. When display defaults to the current measurement value, the analyzer is automatically locked at the second level (bL) of security.
10. Lock Analyzer (see "Locking Analyzer Using Security Code" on page 36).

Changing CELL Type (Ct)

The code Ct electronically configures the 873DO analyzer to apply a polarizing voltage to the correct inputs of the type of sensor connected. When two sensors are connected to a single analyzer both sensors must be the same type, as the same CELL type configuration will be applied to both sensors. The sensors will have to be recalibrated after changing Ct. See the section on Calibration on page 73.

Procedure to Change Ct:

Unlock bL by following procedure in "Unlocking Basic Setup Entries (bL)" on page 56. When the display returns to bL after the ULOC code, press **Next** once. The Ct code will be displayed. Press **Enter**. The present Ct code will be displayed. The Ct code is changed by depressing Δ . The code alternates between 0002, 0003, and 0004 with repeated pressing of Δ . All other entries result in ERR being displayed upon attempting to **Enter** them. The analyzer then defaults to the last acceptable entry. When the correct value is displayed, press **Enter.**

The 873DO Analyzer was primarily designed to be used with 871DO sensors using a 3-electrode potentiostat configuration and diagnostics. The Ct used with 871DO sensors is 0004. Ct should be 0003 when 3-electrode CELLS (without diagnostics) are used. Ct should be set to 0002 for 2-electrode sensor use. In the Ct = 0002 configuration, the voltage required for polarization is applied between the working and auxiliary electrodes, and the current generated is drawn through the auxiliary electrode. In this case, the auxiliary serves as a reference and anode in the circuit. In the Ct = 0003 or 0004 configuration, the polarization voltage applied to the working electrode is relative to the reference electrode, but the current generated is drawn through the auxiliary electrode.

The Full Scale Range (FSC)

Selecting the Full Scale Range (FSC)

The FSC parameter allows the user to select one of several possible ranges to monitor the process. The FSC range choices are:

100.0 ppm	(mg/l)
100.0%	(percent saturation)
25.0%	(percent of air)
100.0	(no units)

The 100.0 ppm FSC requires additional temperature compensation be set via the Cd Setup parameter (see "Compensation and Damping (Cd)" on page 40). When used in this mode, the legend ppm is illuminated, and the analyzer reads out in these concentration units with either fresh or salt water oxygen solubility temperature corrections applied.

When the FSC 100.0 Percent Saturation is chosen, the % legend is illuminated. This scale is indistinguishable from the % air FSC or Ratio measurement from the front display. Temperature corrections are applied for the composite membrane characteristics only.

The FSC 25.0 Percent Air is used to compare the dissolved oxygen reading with the content of the air. Dry air at 1 Atmosphere consists of 20.95% oxygen, so measurements in this mode are all displayed as a percentage of air. Temperature corrections are applied for the composite membrane characteristics only.

The fourth FSC is 100.0 with no illuminated units. The only temperature corrections applied are for the composite membrane characteristics. The sensor may be calibrated in any units the user wishes. Additional temperature corrections may be applied by the user via a user supplied computer system.

The following rules are applicable to all FSCs chosen:

- When two sensors are connected to a single analyzer, both sensors must utilize the same FSC.
- FSC should be chosen and entered before any Configuration Setup Entries are set.
- After changing FSC, Configuration Setup Entries must be checked and altered.

- Pressing **Enter** in FSC mode (even if range was not changed) requires the unit to be recalibrated before use. If the range is set at the desired FSC, allow unit to time out. Do not press **Enter.**
- The FSC value is preconfigured to 100 ppm.

Changing the Full Scale Range

The procedure to change FSC is as follows.

1. Unlock Analyzer (see “Unlocking Analyzer Using Security Code” on page 36).
2. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
3. Press **Next** several times until the code bL (Basic Setup Lock) is displayed (bL will be the twentieth message to be displayed).
4. Press **Enter**, then use **Next** and Δ until personal security code is displayed (0800 from factory). Press **Enter**.
5. When display returns to bL, press **Next** twice. The code FSC (Full Scale Range Change) will be displayed.
6. Press **Enter**. The present full scale range will be displayed.

⚠ CAUTION

If this is your desired FSC, allow unit to time out. **Do Not Press Enter**. Entering any FSC causes Er 4 to flash on the display, necessitating a calibration.

7. Press Δ until the desired range is displayed. Press **Enter**.

— NOTE —

Calibration is required after full scale range is changed. Error code Er 4 flashes until calibration is accomplished.
Refer to the section on Calibration on page 73.

Setting Active or Electronic Zero (SErO)

The function of this parameter is to allow the user a choice in the way **Cal Lo** is set during a standardization.

When the Setup parameter SErO is 0000, the Analyzer requires and utilizes the actual current output of the sensor in zero oxygen to calibrate **Cal Lo**. The sensor has to be placed in a solution void of oxygen, or in an oxygen free gas (nitrogen) for the **Cal Lo** value to be calibrated.

When the Setup parameter SErO is 0001, the Analyzer uses an electronic value for zero current, irrespective of the sensor's residual current at zero oxygen, to set the **Cal Lo** during calibration. This is typically a good approximation for the 871DO sensor's output in a zero oxygen situation. The residual currents found on functioning sensors in zero oxygen situations are very low, and this approach greatly simplifies the calibration procedure.

<u>Procedure to Change SErO</u>:

Unlock bL by following procedure in “Unlocking Basic Setup Entries (bL)” on page 56. When the display returns to bL after the ULOC code, press **Next** three times. The SErO code will be displayed. Press **Enter**. The present SErO code will be displayed. The SErO code is changed by depressing Δ . The code alternates between 0000, and 0001 with repeated pressing of Δ . When the correct value is displayed, press **Enter**.

The 873DO analyzer is preconfigured to read 0001 for this parameter. Sensors will require recalibration after changing this parameter. See "Calibration" on page 73.

Setting Altitude

The function of the parameter **Alt** is to set the altitude at which the 873DO and 871DO sensor will be physically located, in order for air calibration in ppm to be compensated correctly. The number should be entered as feet above or below sea level. The range that this parameter may be set is –999 to 9999 feet.

The 873DO analyzer is preconfigured to read 0000 for this parameter unless ordered differently. Sensors may require recalibration after changing this parameter. See the section on Calibration on page 73.

Calibrating the Current Channel (Probe Calibration; PC)

The parameter PC allows current calibration to be performed on the 873DO analyzer.

— NOTE —

This procedure does not deal with analog output calibrations. The sensor current is read when the user depresses **Shift** and **µA** keys.

⚠ WARNING

This procedure is performed at the factory and should <u>not</u> have to be repeated. Care must be taken to ensure that the precision current source does not exceed 10 V dc on the output terminals when current is demanded, and that no load exists on the source.

<u>Hint</u>:

If you wish to verify current values, short terminals 5 and 6, then install known resistors between terminals 3A and 5 and calculate the expected current reading according to Ohm's Law; E=IR. The factory set applied voltage is .700 V.

$$\frac{.7\ \text{V}}{\text{Resistance}} = \text{Current in Amp}$$

10–6 Amp = 1 µA. "Test with Resistors" on page 84 contains the entire procedure.

<u>Required</u>:

Precision current source (0 to 20 µA). See Figure 18

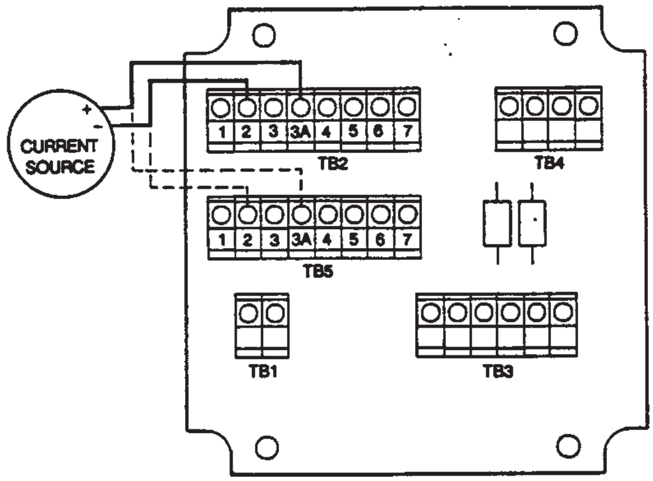


Figure 18. Current Source

Procedure:

1. Disconnect sensor leads from terminals 2 and 3A of both sensors.
2. Connect current source + to 3A and – to 2 (ground).
3. Unlock Analyzer using security code (see "Unlocking Analyzer Using Security Code" on page 36).
4. Press **Shift** and while holding press **Setup**. Release fingers from both keys.
5. Press **Next** twice to display Cd; press **Enter**.
6. Press **Next** and Δ until the display reads 0000. Press **Enter**.
7. When the display returns to Cd, press **Next** several times until the code bL is displayed. Press **Enter**.
8. Unlock bL by following procedure in "Unlocking Basic Setup Entries (bL)" on page 56.
9. When the display returns to bL after the ULOC code, press **Next** three times. The SErO code will be displayed. Press **Enter**. The present SErO code will be displayed. The SErO code is changed by depressing Δ . The code alternates between 0000, and 0001 with repeated pressing of Δ .
10. When 0000 is displayed, press **Enter**.
11. When the display returns to SErO, press **Next** two times to display the parameter PC. Press **Enter**.
12. Use **Next** and Δ until the display reads 0001. Press **Enter**.
13. Set the current source for 0 μA.
14. Press **Shift** and while holding press **Cal Lo**. Release fingers from both keys.
15. Use **Next** and Δ until the display reads 000.0. Press **Enter.**
16. Set the current source to 20 μA.

17. Press **Shift** and while holding, press **Cal Hi**. Release fingers from both keys.
18. Use **Next** and Δ until the display reads 20.0. Press **Enter**.
19. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
20. Unlock bL by following procedure in "Unlocking Basic Setup Entries (bL)" on page 56. When the display returns to bL after the ULOC code, press **Next** three times. The SErO code will be displayed. Press **Enter**. Set this parameter to the desired value (see "Setting Active or Electronic Zero (SErO)" on page 58). Press **Enter**.
21. When the display returns to SErO, press **Next** two times to display the parameter PC. Press **Enter**.
22. Use **Next** and Δ until the display reads 0000. Press **Enter.**
23. Change Cd code to desired values. See "Compensation and Damping (Cd)" on page 40.
24. Disconnect current source and reconnect sensor. Sensor servicing and/or standardization may be required. Consult sensor instructions or the section on Calibration on page 73.
25. Lock Analyzer using security code (see "Locking Analyzer Using Security Code" on page 36).

Changing the Security Code (LCC)

The following procedure is used to change the security code to another 4-digit code.

— NOTE —

If existing security code is forgotten, a new security code cannot be entered using this procedure. In this case, contact Global Customer Support.

1. Leave power on.
2. Press **Lock**. Display will show either Loc or uLoc.
3. If uLoc is displayed, proceed to Step 4.

   If Loc is displayed, unlock the analyzer using "Unlocking Analyzer Using Security Code" on page 36. Display will read uLoc.
4. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
5. Press **Next** several times until the code bL (Basic Setup Lock) is displayed. Press **Enter**.
6. Then use **Next** and Δ until existing security code is displayed (0800 from factory).
7. Press **Enter**.
8. When display returns to bL, press **Next** several times until the code LCC (Lock Code Change) is displayed.
9. Press **Enter**, then use the **Next** and increment (Δ) keys until new desired security code is displayed.
10. Press **Enter**. The new code will have to be used on all future entries.
11. Lock the Analyzer using the procedures explained in "Locking Analyzer Using Security Code" on page 36.

Calibrating the Temperature Circuitry (tEC1, tEC2)

Temperature Electronics Calibration for the 873DO Analyzer is performed at the factory. It should not be necessary to perform these procedures in the field unless:

1. You suspect a problem with the temperature calibration.
2. You wish to verify temperature electronics calibration.

   This procedure only calibrates the analyzer. To compensate the temperature reading for sensor cable length, see “Determining tCF” on page 75 and “Entering a tCF Value” on page 76.

Required: Two 100 kΩ precision resistors.

Procedure for Thermistor Temperature Electronic Calibration:

1. Disconnect sensor lead connections 1 and 2 from TB2 and TB5.
2. Connect a precision 100 kΩ resistor between the sensor terminals: 1 and 2 on TB2 and TB5. See Figure 19.
3. Unlock Analyzer using security code.
4. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
5. Press **Next** several times until the code bL (Basic Setup Lock) is displayed (bL will be the twentieth message displayed).
6. Press **Enter**, then use **Next** and Δ until the personal security code is displayed (0800 from factory).
7. Press **Enter**.
8. When display returns to bL, press **Next** eight times until tEC1 is displayed.
9. Press **Enter**. The value 25.00 will be displayed.
10. Press **Enter.** When display returns to tEC1, press **Next** twice until tEC2 is displayed.
11. Press **Enter**. The value 25.00 will be displayed.
12. Press **Enter**. Disconnect 100 kΩ resistors from terminals 1 and 2 on TB2 and TB5.
13. Reconnect Sensor leads to terminals 1 and 2 of TB2 and TB5.
14. Lock Analyzer.

This completes the thermistor temperature electronics calibration

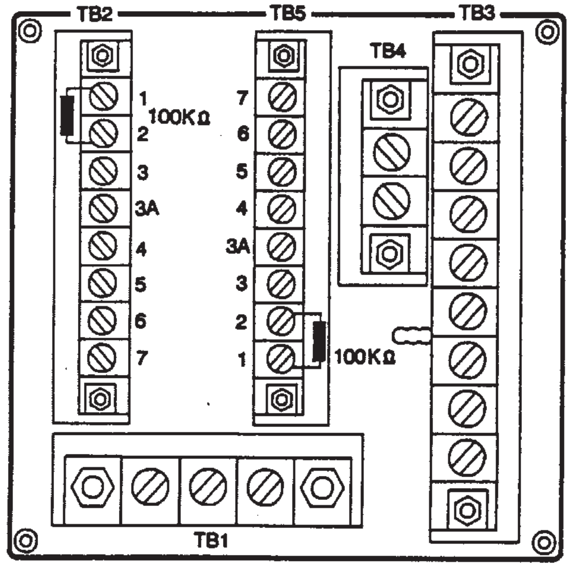


Figure 19. Thermistor Temperature Simulation (Plastic Enclosure Shown)

Changing the Analog Output

To change one or both of your analog outputs from a voltage to current output or vice versa, jumpers must be moved and a recalibration performed. If changing from 4-20 mA to 0-20 mA or vice versa, proceed to "Analog Output Calibration (LC01, HC01, LC02, HC02)" on page 66.

To Reposition Jumpers

1. Remove power to the unit.
2. *On plastic General Purpose version:* Remove optional rear cover. Remove the four screws holding back panel in place.

   On metal Field-Mounted version: Remove the four front corner screws holding the display panel in place. Remove rear cover. Disconnect the green earth (ground) cable; then feed wire from sensor and power connection through seals to allow free movement of circuit boards.

⚠ CAUTION

The four front screws are self-tapping and have a limited number of installation cycles. Do not repeatedly remove and tighten these screws.

3. Slide circuit assembly out to access the upper circuit board designated AS700DX-03. Plastic version slides out from the rear of its housing. Metal version slides out from the front of its housing.
4. Refer to Figure 20 to identify jumper locations.
5. Use Table 13 to locate appropriate jumper positions.

Table 13. Jumper Positions for the Various Analog Outputs

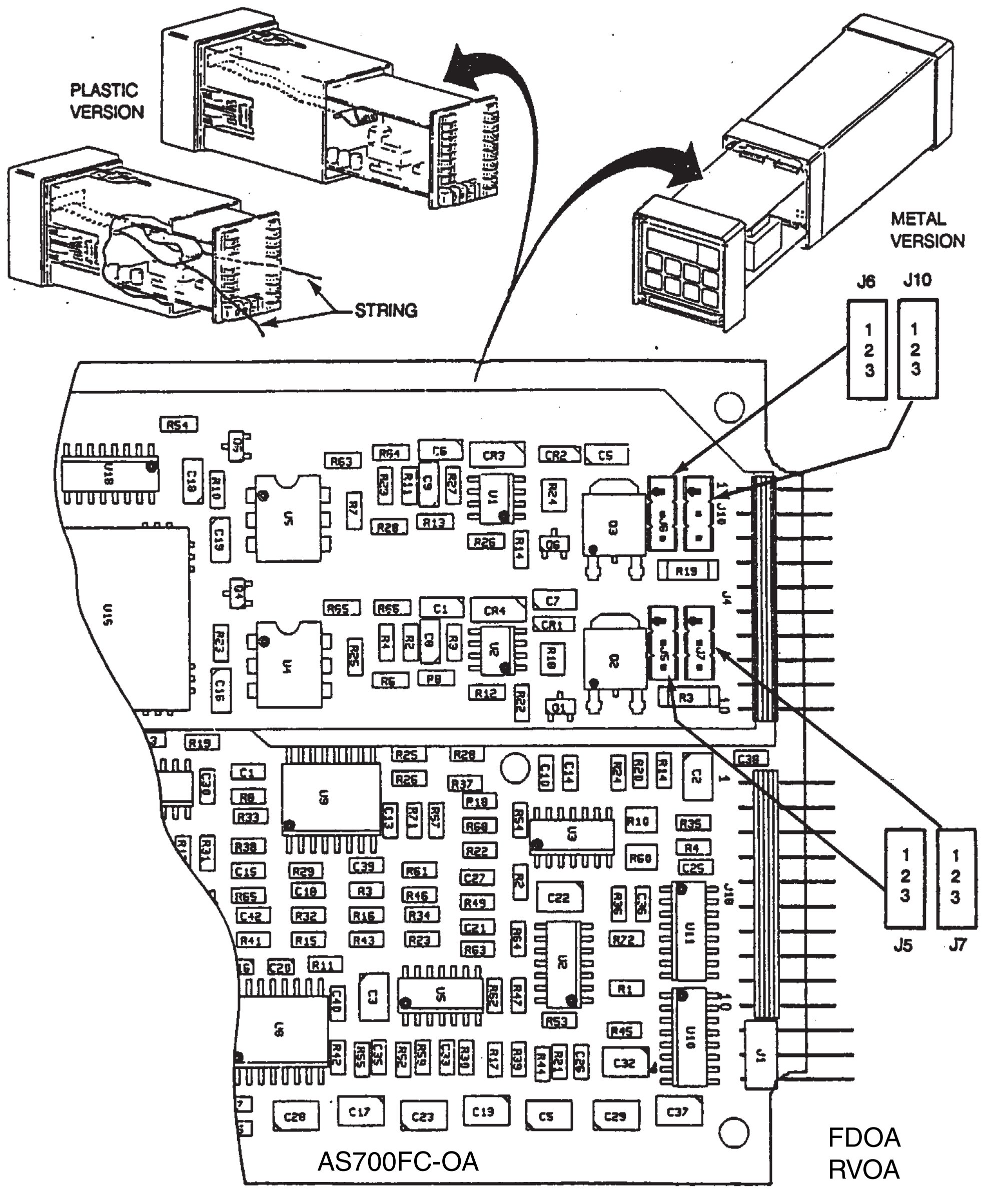
	Output	J5	J6	J7	J10
Current	4-20 mA or 0-20 mA	2-3	2-3	2-3	2-3
Voltage	0-10 V dc	1-2	1-2	1-2	1-2

6. Move each jumper to its appropriate position.
7. Replace board assembly inside unit.

⚠ CAUTION

On the plastic version, a string must be rigged through the loop in the ribbon cable such that when the board assembly is slid into the housing, the string/ribbon cable may be pulled back simultaneously, thus preventing damage to the cable. See Table 20.

8. Replace cover. On metal enclosures, use Loctite (Part No. SO106ML) on the threads of the front bezel screws, and Lubriplate (Part No. X0114AT) on threads of the rear cover screws.
9. An analog output calibration will now be necessary. Refer to “Analog Output Calibration (LC01, HC01, LC02, HC02)” on page 66.
10. Make appropriate changes to the analyzer identification label.



Jumper Positions for the Various Analog Outputs					
	Output	J5	J6	J7	J10
Current	4-20 mA or 0-20 mA	2-3	2-3	2-3	2-3
Voltage	0-10 V dc	1-2	1-2	1-2	1-2

Figure 20. Jumpers for Changing Analog Output

Analog Output Calibration (LC01, HC01, LC02, HC02)

This procedure is used to calibrate the analog outputs. This has been done at the factory and should not require recalibration unless type of output has been changed. An ampmeter or voltmeter is required. This procedure is used to change from 0 to 20 mA to 4 to 20 mA or vice versa.

1. Connect an ammeter/voltmeter to the analog output terminals.

   Metal Enclosure: For LCO1 and HCO1, connect to Channel 1 output terminal TB4. For LC02 and HC02, connect to Channel 2 output terminals. See Figure 21 and “Wiring of Metal Enclosure” on page 26.

   Plastic Enclosure: For LC01 and HC01 connect to M+M- on TB3. For LC02 and HC02 connect to M+M- of TB4. See “Wiring of Plastic Enclosure” on page 26.

2. Unlock the Analyzer using the security code.
3. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
4. Press **Next** several times until the code bL is displayed. Press **Enter.**

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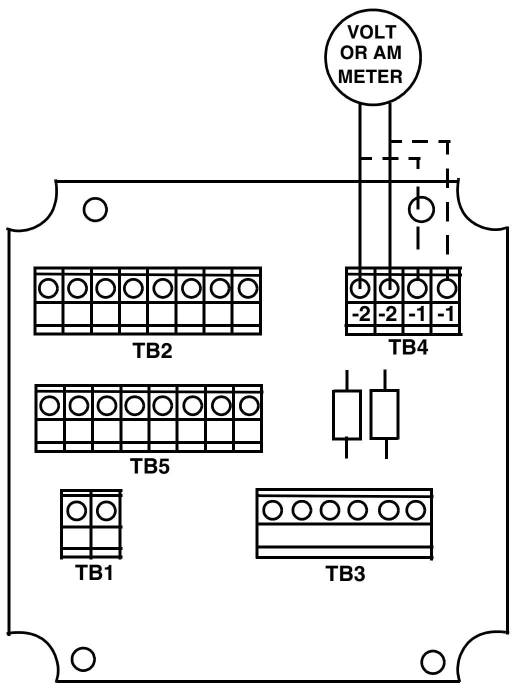

Figure 21. Analog Output Calibration (Metal Enclosure Shown)

5. Use **Next** and Δ until the personal security code is displayed (0800 from the factory). Press **Enter**.
6. When display returns to bL, press **Next** until LC01 is displayed. Press **Enter**.
7. Calculate the low % input required by using the following formula:

$$\% = \frac{\text{Observed Reading} - \text{Desired Reading}}{\text{Analog High}} \times 100$$

Example:

$$\frac{(3.78\ -4.00\text{mA})}{(20.00\ \text{mA})}\ \text{x}\ 100 = -1.1\%$$

8. Use **Next** and Δ until the calculated value from Step 7 is displayed. Press **Enter**.

— **NOTE**

1. Steps 7 and 8 may need to be repeated until observed value is equal to the desired value.
2. To make a minus sign appear on the display, a digit other than zero must be present on the display.

Example:

To make the display read –5.0%, first display 005.0% and <u>then</u> change the first digit to a negative sign.

9. When the display returns to LC01, press **Next** once to display HC01. Press **Enter**.
10. Calculate the high % required using the following formula:

$$\% = \frac{\text{Observed Reading}}{\text{Desired Reading}}\ \text{x}\ 100$$

Example:

$$\frac{10.42\ \text{V}}{10.00}\ \text{x}\ 100 = 104.2\%$$

11. Use **Next** and Δ until the calculated value from Step 10 is displayed. Press **Enter**. If necessary, repeat Steps 10 and 11 until observed value is equal to the desired value.
12. Move ammeter to second set of output terminals. Repeat Steps 3 - 5. Then press **Next** until LC02 is displayed. Press **Enter.**
13. Calculate the low % input required by using the following formula:

$$\% = \frac{\text{Observed Reading - Desired Reading}}{\text{Analog High}}\ \text{x}\ 100$$

Example:

$$\frac{(3.78 - 4.00\ \text{mA})}{20.00\ \text{mA}}\ \text{x}\ 100 = -1.1\%$$

14. Use **Next** and Δ until the calculated value from Step 13 is displayed. Press **Enter**.

— **NOTE**

1. Steps 13 and 14 may need to be repeated until observed value is equal to desired value.
2. To make a minus sign appear on the display, a digit other than zero must be present on the display.

Example:

To make the display read –5.0%, first display 005.0% and then change the first digit to a negative sign.

15. When the display returns to LC02, press **Next** once to display HC02. Press **Enter**.
16. Calculate the high % required using the following formula:

$$\% = \frac{\text{Observed Reading}}{\text{Desired Reading}} \times 100$$

Example

$$\frac{10.42\ \text{V}}{10.00} \times 100 = 104.2\%$$

17. Use **Next** and Δ until the calculated value from Step 16 is displayed. Press **Enter**.

— NOTE —

Repeat Steps 16 and 17 until observed value is equal to the desired value.

18. Lock Analyzer using procedure in "Locking Analyzer Using Security Code" on page 36.

This completes the Analog Output Calibration Procedure.

Using Sensor Diagnostics

There are nine basic setup parameters that deal with the three special sensor diagnostics found with the 871DO/873DO system. These are listed in Table 15 in the order they appear in the menu, along with the factory set code.

Table 16 illustrates the Probe Diagnostics Error Codes that are displayed locally alternating with the measurement. Diagnostics for detection of membrane fouling (COAt), membrane breakage (CAP), and loss of internal electrolyte (bubL) may be set independently.

When two DO Sensors are used and an error code has flagged, it may become necessary to determine which sensor is producing the sensor error code. Press **Shift** and **Temp** simultaneously. Table 14 explains the digit coding displayed.

Once an error has been flagged, the sensor must be serviced. Refer to *Sensor Manual MI 611-200*, Section 4.1.

The error message disappears after the next diagnostic evaluation determines no sensor faults.

— NOTE —

Factory set values for FOt, CAt, bUt, dt, dOFF, don, and FdLL, as shown in Table 15, should not be changed by the user without consultation with Global Customer Support.

To utilize all of the sensor diagnostic features, the following criteria must be met:

- A Foxboro 871DO Dissolved Oxygen Sensor must be used.
- CELL Type Parameter (Ct) must be set to 4. (See "Changing CELL Type (Ct)" on page 56.)

- ♦ Probe Diagnostic Enable (PdE) must be set to 0111.

Sensor diagnostics are performed at intervals set by dt in minutes. During the diagnostics, the display reads tESt (TEST), and the analog output values are held at their current value.

NOTE
The diagnostics overrides the measurement and any user interface while self-test is functioning.

Three consecutive unacceptable diagnostic evaluations will flag a COAt error code. A single erroneous diagnostic evaluation will flag the CAP or bubL code.

Table 14. Determining Which Sensor is Erroring

Digit Displayed	Sensor Erroring
1	Sensor wired to CELL 1 channel
2	Sensor wired to CELL 2 channel
12	Both sensors contributing

Table 15. Setup Parameters

Parameter	Description	Code
PdE	Probe Diagnostics Enable	0000
dLc	Diagnostic Learning Control	0000
FOt	Fouling Diagnostic Tolerance	0050
CAt	Membrane Cap Diagnostic Tolerance	0020
bUt	Bubble Diagnostic Tolerance	0020
dt	Diagnostic Interval Timing	0060
dOFF	Diagnostic OFF Window Timing	2.000
don	Diagnostic On Window Timing	2.000
FdLL	Fouling Diagnostic Lower Limit	1.000

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Table 16. Diagnostics Error Codes

Error Code	Cause
COAt	Membrane of the sensor has become coated and requires cleaning or servicing.
CAP	Electrolyte inside the sensor has changed concentration. The most likely cause of this is membrane damage or another source of process ingress into the electrolyte.
bubL	Excessive electrical resistance has formed between the auxiliary and test electrodes. Possible sources include an air bubble forming inside the electrolyte or excess AgCl has formed on the anode from normal usage.

Probe Diagnostics Enable (PdE)

This parameter allows the unique diagnostic features of the 871DO probe to be turned on or off. This parameter is also used to disable the error code from flashing while servicing the probe. Table 17 shows PdE configurations for using the Fouling, Membrane Breakage, and Electrolyte diagnostics

Table 17. Probe Diagnostics Enable (PdE)

Digit 1	Digit 2	Digit 3	Digit 4
	COAt diagnostics	CAP diagnostics	bubL diagnostics
Fixed at 0; Not Utilized	0 - Diagnostics Off 1 - Diagnostics On	0 - Diagnostics Off 1 - Diagnostics On	0 - Diagnostics Off 1 - Diagnostics On

This 4-digit code is Factory set to 0000.

Diagnostic Learning Control (dLC)

This parameter is used to "teach the analyzer" what the particular sensor has as normal operating characteristics. Table 18 shows dLC configurations of this parameter.

Table 18. Diagnostic Learn Modes

Digit 1	Digit 2	Digit 3	Digit 4
Fixed at 0; Not Utilized	0 - Fixed Limits 1 - Learned Limits	0 - Learn Off 1 - Learn On	0 - Normal Operation 1 - Reset Learn Function

After calibration and startup, set PdE to 0111 and dLc to 0110. In this mode all diagnostics are enabled and the Analyzer learns the normal operational characteristics of the probe being utilized. It is necessary for the Analyzer to learn over several Diagnostic Timing Intervals (see "Diagnostic Timing (dt)" on page 71). With dt set at 0060, a learn duration of 12 to 24 hours will therefore provide 12 to 24 cycles of data. At the end of the learn duration, digit 3 is set back to 0 (dLc = 0100).

Fouling Diagnostic Tolerance (FOt)

The FOt parameter is set as a percentage. Setting this parameter creates an acceptable envelope of values around the nominal value that will not trigger an error message. A tolerance of 0050% creates an envelope of +/- 50% around the nominal value.

This 4-digit code is factory set to 0050.

Membrane Cap Diagnostic Tolerance (CAt)

The CAt parameter is set as a percentage. Setting this parameter creates an acceptable envelope of values around the nominal value that will not trigger an error message. A tolerance of 0010% creates an envelope of +/- 10% around the nominal value.

This 4-digit code is factory set to 0020.

Bubble Diagnostic Tolerance (bUt)

The bUt parameter is set as a percentage. Setting this parameter creates an acceptable envelope of values around the nominal value that will not trigger an error message. A tolerance of 0010% creates an envelope of +/- 10% around the nominal value.

This 4-digit code is factory set to 0020.

Diagnostic Timing (dt)

The dt parameter is set as a time in minutes. dt refers to the interval of time between the diagnostic test cycle. All diagnostic tests are performed together either simultaneously or in rapid sequence. When all three diagnostics are invoked, approximately 5 seconds pass. The dt interval then restarts. The dt should not normally be set to less than 20 minutes.

This 4-digit code is factory set to 60 minutes.

Diagnostic Off Window Timing (dOFF)

The dOFF parameter is set as a time in seconds. dOFF defines a time interval that the unit must wait after switching from the WORKING electrode to the TEST electrode before data collection begins. The maximum dOFF time is 9.999 seconds.

This 4-digit code is factory set to 2 seconds.

Diagnostic On Window Timing (don)

The don parameter is set as a time in seconds. "don" defines a time interval that the unit collects data for diagnostic purposes. The maximum don time is 9.999 seconds.

This 4-digit code is factory set to 2 seconds.

Fouling Diagnostic Lower Limit (FdLL)

The FdLL parameter is set as a current in microamps. FdLL defines the lower current value that will be allowed when the COAt diagnosis is employed.

This 4-digit code is factory set to 1 μA.

Drive Voltage (dr)

The dr parameter is set as a voltage. It may be set within the range of +/- 1.50 volts. The applied voltage required for the reduction of O_2 is 700 mV.

This 4-digit code is factory set to +0.70 V.

— NOTE —

This parameter may be set to zero if a galvanic type probe is used, but should not otherwise be altered.

5. Calibration

Calibration of a Sensor on the 873DO - General Information

The 873DO Analyzer and sensor should be calibrated periodically to maintain optimum measurement accuracy.

Calibration is also a good way to determine if a sensor is functioning properly.

Under no circumstances should a sensor be used on an analyzer for measurement or control without a calibration being performed first. This includes new installations as well as after servicing.

The user must make several decisions and entries *before* calibrating the sensor. These are typically entered only once upon initial start-up of the system, and include:

Choice of Units: the analyzer can display units of ppm, percent saturation, or percent air.

Type of Zero Calibration: Cal Lo (typically at zero oxygen) can be set electronically within the analyzer, or with the sensor in a zero oxygen environment.

Altitude: the elevation above sea level at which the unit will be operated must be entered into the 873DO prior to sensor calibration.

Solution or Air Calibration: the method in which the sensor will be calibrated must also be entered into the 873DO prior to sensor calibration. The sensor may be calibrated suspended in the air or in a solution. A grab sample calibration with laboratory analysis or calibrated portable analyzer will be required to determine the dissolved oxygen concentration in order to calibrate a functioning sensor in the process solution.

In addition to measurement calibration, a procedure must be implemented to correct temperature measurements that differ from actual values (such as when sensor cable length and/or connections may add resistance to the reported values; see “Temperature CELL Factor (tCF1, tCF2)” on page 75). *This is extremely important for temperature correction to be applied to the measurement correctly.*

The preceding measurement parameters should be implemented prior to the sensor calibration. In addition, the following guidelines should be observed:

- Sensors should be thoroughly cleaned before calibration.
- Sufficient time for sensor and thermo-compensator thermal equilibrium must be allowed. The temperature should display the correct temperature of the medium in which it is placed. The sensor should be kept out of direct sunlight during an air calibration.
- The correct ppm value should be used during solution calibrations. Pressure and temperature affect the oxygen concentration. Use reliable methods and equipment to determine oxygen values before calibrating the process sensor.
- Sufficient time for steady state of the sensor membrane (polarization) must be allowed when doing a calibration.

⚠ CAUTION

On metal units, do not remove four front panel screws and remove electronics package for calibration. The self-tapping screws have a limited number of installation cycles and will not function properly with repeated use.

Three different sensor calibration procedures are given in this manual. “Air Calibration with Electronic Zero” on page 76 is easily implemented when the sensor is removed from the process, such as after maintenance. This technique offers the advantage of simplicity. Additional standard solutions, gases, or equipment are not required. This is a single point calibration with an electronic instrument zero providing the low calibration point and water saturated air providing the Cal Hi (span). “Solution Calibration with Electronic Zero” on page 78 is also a single point calibration procedure. The advantage of this method is the sensor remains installed in the process. An electronic instrument zero provides the zero calibration point, and the span is set by changing the display to agree with the dissolved oxygen value obtained by another method. “Solution Calibration with Solution Zero” on page 79 is the most rigorous calibration technique. The method may be used to check electrode function at two known dissolved oxygen levels. A sample devoid of oxygen is used to set (or check) the Cal Lo value (zero). A second solution with known dissolved oxygen concentration is required to span the analyzer (Cal Hi). The technique can be used after performing sensor maintenance as the sensor must be removed from the process.

Startup Setup Parameters

Units, Zero, Altitude, and Calibration Type Setup

1. Unlock analyzer (see“Unlocking Analyzer Using Security Code” on page 36).
2. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
3. Press **Next** several times until the code bL (Basic Setup Lock) is displayed.
4. Press **Enter**, and then use **Next** and Δ until personal security code is displayed (0800 from factory).
5. Press **Enter**.
6. When display returns to bL, press **Next** two times until the entry FSC is displayed.
7. Press **Enter**, then use **Next** and Δ until the desired unit of measurement is displayed. See “The Full Scale Range (FSC)” on page 57.
8. Press **Enter**.
9. When display returns to FSC, press **Next** once. The code SErO will be displayed. See “Setting Active or Electronic Zero (SErO)” on page 58.
10. Press **Enter**, then use Δ to make display read the desired code.
11. Press **Enter**.
12. When display returns to SErO, press **Next** once. The code Alt will be displayed. See “Setting Altitude” on page 59.
13. Press **Enter**, then use Δ and **Next** to make display read the Altitude (in feet above sea level) at which the sensor will be operated.

14. Press **Enter**.
15. Allow unit to time out. Er 4 should be flashing.
16. For ppm FSC only: Determine if a solution or air calibration will be used. Press **Shift** and while holding, press **Setup**. Release fingers from both keys. Press **Next** until Cd is displayed. Press **Enter**, then use Δ to make display read the desired code. 0000 is used for an air calibration. 0001 or 0002 is used for a solution calibration.
17. Wire sensor(s) to analyzer. See "Wiring of Plastic Enclosure" on page 26 or "Wiring of Metal Enclosure" on page 26.
18. When using two sensors, configure pertinent parameters to appropriate values. See "User Notes" on page 93 and "Configuration" on page 35 for additional setup information.

Temperature CELL Factor (tCF1, tCF2)

An accurate temperature signal is required for proper temperature compensation. The temperature CELL factors (tCF1 and tCF2) are used to offset a small deviation from ideality due to cable resistance. The procedures found in "Determining tCF" on page 75 and "Entering a tCF Value" on page 76 are recommended to correct for these offsets. A 100 kΩ thermistor circuit is used for automatic temperature compensation on the 873DO Analyzer.

Determining tCF

1. Place the Dissolved Oxygen sensor and an accurate Centigrade thermometer (with .1 C resolution) into a container of liquid. The CELL code should reflect the sensor being used. See "CELL Display and Output Configuration (CELL)" on page 38. Allow the sensor to reach thermal equilibrium.
2. Press **Temp**. Put the analyzer into Automatic Temperature Compensation, no decimal after the C. If there is a decimal after the "C", it should be removed. Press Δ once after pressing **Temp**; then press **Enter**.
3. Read the temperature displayed on the 873 to the hundredths place. When **Temp** is pressed, the present temperature value with tenths place will alternate with the "C" legend. The value read by the 873 must now be viewed to the hundredths place. Press **Temp** followed by **Next** five times. Only three numbers may be viewed on the display, and the first digit will not be visible (e.g., 25.20 will be displayed as 5.20).
4. Determine the difference in values between the two temperature devices (e.g., the thermometer reads 24.70°C, and the 873 says (2) 5.20C; the 873 is reading higher by .50C).
5. Subtract this value from 25.00 (e.g., 25.00 –.50 = 24.50). This is the TCF value to be entered.

— NOTE

If the 873 value is less than the thermometer, the difference should be added to 25.00.

6. This procedure should be repeated with the second sensor, if used. See CELL code ("CELL Display and Output Configuration (CELL)" on page 38).

Entering a tCF Value

1. Unlock Analyzer (see“Unlocking Analyzer Using Security Code” on page 36).
2. Press **Shift** and while holding, press **Setup**. Release fingers from both keys.
3. Press **Next** several times until the code bL (Basic Setup Lock) is displayed.
4. Press **Enter**, and then use **Next** and Δ until personal security code is displayed (0800 from factory).
5. Press **Enter**.
6. When display returns to bL, press **Next** several times until the entry tCF1 or tCF2 (depending upon the sensor you wish to calibrate) is displayed.
7. Press **Enter** and then use **Next** and Δ until desired value (see “Determining tCF” on page 75) is displayed.
8. Press **Enter**.
9. Recheck any differences that exist between a thermometer and temperature displayed on the 873.
10. Lock Analyzer using procedure in “Locking Analyzer Using Security Code” on page 36.

Air Calibration with Electronic Zero

— **NOTE**

The following start-up parameters must be set first (see “Startup Setup Parameters” on page 74).

(If FSC = 100 ppm)

FSC 100%, 25% 100 ppm, 100	→	SEr0 0001	→	ALt	→	tCF	→	Cd 0000

1. Unlock Analyzer if locked (see “Unlocking Analyzer Using Security Code” on page 36).
2. Remove the DO sensor from the process. Clean and inspect the sensor. Provide maintenance if required (consult sensor instructions).
3. Wait until the sensor has reached thermal equilibrium with the air.
4. Check and adjust the CELL code of the unit. Refer to “CELL Display and Output Configuration (CELL)” on page 38. The code should be 1XXX if sensor 1 is being calibrated, and 2XXX if sensor 2 is being calibrated.
5. Check and adjust the Cd code of the unit. Refer to “Compensation and Damping (Cd)” on page 40. Set this code to read “0000”.

6. Press **Shift** and while holding, press **Cal Lo**. Release fingers from both keys. The display will say 000.0%. Press **Shift** *for a full ten seconds* to freeze display at 000.0% and allow electronics to stabilize fully. Release finger from **Shift** . Press **Enter**. (Press **Enter** only once.)
7. Suspend sensor in the air a few inches above water to ensure water vapor saturation. The sensor should be free from direct sunlight or vibration. Wait several minutes after the zero calibration to ensure that the sensor has reestablished equilibrium before proceeding.

— NOTE

If the air is not saturated with water vapor, the calibration may be in error, yielding lower concentrations in solution than are actually present.

8. Press **Shift** and while holding, press **Cal Hi.** Release fingers from both keys.
9. If FSC is 100%, 25%, or 100 (no units), the value entered at the time of the previous calibration will be displayed. Use **Next** and Δ until display reads the correct value. Press **Enter**.

   If FSC is 100 ppm, the value 100% will be displayed, and cannot be altered. Press **Enter**.

— NOTE

ppm FSC; when calibration is complete the unit will automatically default to the ppm equivalent with fresh water temperature compensation for the altitude entered and temperature measured. See Table 19 on page 80 for value expected at sea level at 760 torr. If salt water compensation is required, the Cd code will require adjustment. See “Compensation and Damping (Cd)” on page 40.

10. Repeat Steps 2 through 9 on second sensor.
11. Set display damping if desired. Check and adjust the Cd code of the unit. Refer to “Compensation and Damping (Cd)” on page 40.
12. Lock Analyzer (see “Locking Analyzer Using Security Code” on page 36).

Solution Calibration with Electronic Zero

— NOTE —

The following start-up parameters must be set first (see “Startup Setup Parameters” on page 74):

						(If FSC = 100 ppm)		
FSC 100%, 25% 100 ppm, 100	→	SEr0 0001	→	ALt	→	tCF	→	Cd 000X 0001 0002

1. Unlock Analyzer if locked (see “Unlocking Analyzer Using Security Code” on page 36).
2. Analyze oxygen concentration using a grab sample with laboratory analysis or portable analyzer and sensor used directly in the process.
3. Ensure that the sample and process are at the same temperature and altitude. The portable analyzer should be calibrated correctly and located as close to the process sensor as possible.
4. Check and adjust the CELL code of the unit. Refer to “CELL Display and Output Configuration (CELL)” on page 38. The code should be 1XXX if sensor 1 is being calibrated, and 2XXX if sensor 2 is being calibrated.
5. Check and adjust the Cd code of the unit. “Compensation and Damping (Cd)” on page 40. Set this code to read 000X if the FSC is 100%, 25%, or 100 (no units). Set this code to 0001 or 0002 (fresh or salt water temperature compensation) if FSC is 100 ppm.
6. Press **Shift** and while holding, press **Cal Lo**. Release fingers from both keys. The display will say 000.0 (with appropriate units displayed). Press **Shift** *for a full ten seconds* to freeze display at 000.0 and allow electronics to stabilize. Release finger from **Shift** . Press **Enter**. Wait several minutes after the zero calibration to ensure that the sensor has reestablished equilibrium before continuing.
7. Press **Shift** and while holding, press **Cal Hi**. Release fingers from both keys.
8. The value entered at the time of the previous calibration will be displayed. Use the **Next** and Δ until display reads the concentration of oxygen determined by the alternate analysis. Press **Enter**.
9. Repeat Steps 2 through 9 on second sensor if connected.
10. Set display damping if desired. Check and adjust the Cd code of the unit. Refer to “Compensation and Damping (Cd)” on page 40.
11. Lock Analyzer (see “Locking Analyzer Using Security Code” on page 36).

Solution Calibration with Solution Zero

— NOTE

The following start-up parameters must be set first (see “Startup Setup Parameters” on page 74):

						(If FSC = 100 ppm)		
FSC 100%, 25% 100 ppm, 100	→	SEr0 0000	→	ALt	→	tCF	→	Cd 000X 0001 0002

1. Unlock Analyzer if locked (see “Unlocking Analyzer Using Security Code” on page 36).
2. Remove the DO sensor from the process. Clean and inspect the sensor. Provide maintenance if required (consult sensor instructions).
3. Check and adjust the CELL code of the unit. Refer to “CELL Display and Output Configuration (CELL)” on page 38. The code should be 1XXX if sensor 1 is being calibrated, and 2XXX if sensor 2 is being calibrated.
4. Check and adjust the Cd code of the unit. Refer to “Compensation and Damping (Cd)” on page 40. Set this code to read 000X if the FSC is 100%, 25%, or 100 (no units). Set this code to 0001 or 0002 (fresh or salt water temperature compensation) if FSC is 100 ppm.
5. Freshly prepare a small quantity of 5% sodium sulfite solution in a small bottle that is sealable (2.5 g sodium sulfite/50 ml deionized water). The sodium sulfite will consume the oxygen in the water, providing an oxygen-free environment in which to zero the sensor. Keep the bottle sealed until ready to use. Do not reuse the solution or store longer than one week.
6. Place the 871DO sensor into the solution with the membrane side down. Angle sensor to rest on the edge of the membrane cap, not on the permeable membrane surface. *Do not damage the membrane.* Allow the sensor to sit undisturbed in the oxygen-free solution for at least 10 minutes.
7. Press **Shift** and while holding, press **Cal Lo**. The display will show the last value entered into this parameter. Release fingers from both keys. Using **Next** and Δ make the display read 000.0 (with appropriate units displayed). Press **Enter**.
8. Remove sensor from the sodium sulfite solution and rinse.
9. Place sensor in second solution with known oxygen concentration. This may be the process sample which was analyzed by a portable analyzer (as close to the process sensor as possible), a laboratory analysis of a grab sample, or a “standard”, a water sample with known concentration of oxygen. The volume of the sample should be generous and stirred, for oxygen is consumed during the determination. Allow the sensor to sit at least 10 minutes and proceed only after stable readings are noted.
10. Press **Shift** and while holding, press **Cal Hi**. Release fingers from both keys.

11. The value entered at the time of the previous calibration will be displayed. Use **Next** and Δ until display reads the concentration of oxygen determined by the alternate analysis method. Press **Enter**.
12. Repeat Steps 2 through 11 on second sensor, if connected.
13. Set display damping if desired. Check and adjust the Cd code of the unit.
14. Lock Analyzer (see "Locking Analyzer Using Security Code" on page 36).

Oxygen Solubility Tables

This table illustrates the relationship between the solubility of oxygen in air-saturated fresh water at 760 torr (1 ATM) as a function of temperature. Changes in altitude and salt concentration will affect these values.

Table 19. Oxygen Solubility Tables

Temp °C	Temp °F	Fresh Water (ppm)
0	32.0	14.6
1	33.8	14.2
2	35.6	13.8
3	37.4	13.4
4	39.2	13.1
5	41.0	12.7
6	42.8	12.4
7	44.6	12.1
8	46.4	11.8
9	48.2	11.5
10	50.0	11.3
11	51.8	11.0
12	53.6	10.7
13	55.4	10.5
14	57.2	10.3
15	59.0	10.1
16	60.8	9.8
17	62.6	9.6
18	64.4	9.4
19	66.2	9.2
20	68.0	9.1
21	69.8	8.9
22	71.6	8.7
23	73.4	8.6
24	75.2	8.4
25	77.0	8.2

Temp °C	Temp °F	Fresh Water (ppm)
26	78.8	8.2
27	80.6	8.0
28	82.4	7.8
29	84.2	7.7
30	86.0	7.6
31	87.8	7.4
32	89.6	7.4
33	91.4	7.2
34	93.2	7.1
35	95.0	7.0
36	96.8	6.9
37	98.6	6.8
38	100.4	6.7
39	100.4	6.6
40	104.0	6.5
41	105.8	6.4
42	107.6	6.3
43	109.4	6.2
44	111.2	6.1
45	113.0	6.0
46	114.8	5.9
47	116.6	5.8
48	118.4	5.7
49	120.2	5.6
50	122.0	5.5

6. Diagnostics

Using the 873DO Analyzer to Troubleshoot a Sensor or Analyzer Problem

Table 20. Error Codes

873 Error Code	Description	Remedy
Er 1	Instrument Fault	Enter LCC twice to restart the analyzer. Disconnect sensor and re-power analyzer. Try sensor on another unit or other channel.
Er 2	Temperature Error; the temperature sensor used on the 873 is a 100 k W thermistor. At temperatures around 25°C (77°F), it should read 100 k W. The sensor or 873 Analyzer may be at fault.	Verify that instrument is functioning properly. (1) Check temperature on both channels in automatic temperature compensation mode (See “Temp Key” on page 32). Compare to range set in UtL and LtL. Adjust range if necessary. (2) Substitute resistors across terminals 1 and 2 of TB2 and TB5 (see Table 21) or measure the resistance between wires 1 and 2 of sensor (brown and clear). If the resistance between 1 and 2 of the sensor is reading a value which deviates greatly from correct resistance, it is not functioning properly and should be replaced. For the short term, if the process measurement does not change temperature, or if the process has very wide accuracy specifications, manual temperature operation may be chosen.
Er 4	Er 4 flashes when the 873 Analyzer is not calibrated after changing the Ct code or FSC.	Calibration with sensor is necessary. Both channels must be calibrated. See “Calibration” on page 73.
COAt	Sensor membrane has become coated with a film.	Clean sensor. Replace membrane. Reset PdE; relearn dLC (see page 70).
CAP	Sensor membrane has become damaged. Process ingress into electrolyte reservoir.	Replace membrane. Examine membrane, replace if necessary. Replace electrolyte. Reset PdE; relearn dLC (see page 70).
bubL	Loss of electrolyte. Excess AgCl buildup on auxiliary electrode.	Examine membrane, replace if necessary. Replace electrolyte. Replace sensor. Reset PdE; relearn dLC (see page 70).

Additional Troubleshooting

Temperature measurement inaccuracies may also occur with the 873DO or 871DO Sensor that may be undetectable using the 873DO Analyzer alone. Table 21 will help troubleshoot these problems. Note, however, when precision resistors are employed, tCF values must be set to 25.00 for accurate temperature display.

Table 21. Temperature vs. Resistance Values

C	F	100KΩ Thermistor Resistance
–5	23	461.550 kΩ
0	32	351.020 kΩ
10	50	207.850 kΩ
20	68	126.740 kΩ
25	77	100.000 kΩ
30	86	79.422 kΩ
40	104	51.048 kΩ
50	122	33.591 kΩ
60	140	22.590 kΩ
70	158	15.502 kΩ
80	176	10.837 kΩ
90	194	7.7077 kΩ
100	212	5.5693 kΩ
105	221	4.7604 kΩ
110	230	4.0829 kΩ
120	248	3.0334 kΩ
130	266	2.2811 kΩ
150	302	1.3319 kΩ

— NOTE —

1. Resistance checks of sensor leads should be taken between Wires 1 and 2 (brown and clear).
2. Resistor substitution of Sensor Leads 1 and 2 should be made to Terminals 1 and 2 of strips TB2 and TB5 on the 873DO Analyzer.

Table 22 has additional troubleshooting symptoms and remedies that are undetectable using the 873DO Analyzer alone.

Table 22. Troubleshooting Symptoms

Problem	Cause	Remedy
Display LEDs not functioning	Wiring/Power Connection Analyzer Defective	-Verify that line power and wiring are correct. -Replace.
Sensor/873DO cannot be calibrated	Defective sensor	-Replace electrolyte. -Replace membrane cap. -Replace sensor. -Verify patch cable OK.
Reading sensitive to sensor motion	Recent membrane cap replacement Insufficient membrane tension	-Allow more time before calibrating sensor. Wire sensor to 873 power analyzer, and allow time for sensor to polarize. -Replace membrane cap.
Temperature reading is incorrect	Calibration incorrect Thermistor or wire broken	-Adjust tCF1 or tCF2. -Check sensor leads 1 and 2 vs. values in Table 21. -Also, see Er 2 in Table 20.
Slow response	Electrolyte depleted Membrane coated or Insufficient membrane tension Sensor inoperative	-Replace electrolyte in sensor. -Replace electrolyte and membrane cap. -Replace sensor.
Reading extremely high	Damaged membrane Ground loop	-Replace electrolyte and membrane cap. -See below.
Dual sensors calibrate OK in air but are erratic in process	Ground loop	-Check membrane for leakage. Replace cap. -Check for electrolyte leakage above cap. Replace O-ring. -Check electrolyte vent for leakage. Reseal vent cap.
Noisy signal	May be flow related Insufficient membrane tension	-Check Analyzer noise by simulating sensor signal with a resistor (See “Electronic Test for Verification of Operation of the 873DO Analyzer” on page 84). -Increase damping. -Reorient sensor. -ECS cleaner not adjusted correctly. -Solution extremely turbulent. Reorient sensor and place in weir. -Replace membrane cap.
Accuracy	Sensor membrane coated	-Accuracy of sensor may be affected by coating or films. Consult sensor MI for cleaning recommendations.
Reading extremely high. Current (μA) elevated also.	Application problem Older style analyzer Older style sensor	-Replace electrolyte and membrane cap. -Verify analyzer is Style CE. -Verify Style B; 871DO - C Style B sensor.

Electronic Test for Verification of Operation of the 873DO Analyzer

The following procedure is included to aid in troubleshooting an installation. The procedure verifies cable and analyzer integrity. It should not be used to calibrate a sensor or analyzer, but only to eliminate the cable and analyzer as contributors to a troublesome installation.

Test with the CELL Simulator (Part No. BS806KM)

When cables with quick disconnect connectors are in use, use CELL Simulator (Part No. BS806KM) and the procedure below.

1. Disconnect the sensor from the patch cord.
2. Place the Analyzer into manual temperature compensation with the display reading 25.0C. or 77.0F. A decimal must be present after the C or F. See “Temp Key” on page 32.
3. Press **Shift** and while holding, press **µA.** The display should read 0.0 ±.5 µA.
4. Connect the CELL simulator to the patch cord.
5. Place the Analyzer into the automatic temperature compensation mode. No decimal should be present after the measurement unit. See “Temp Key” on page 32. Press **Temp.** Depending upon the tCF value that is input into the Analyzer, the temperature should read close to 25C or 77F. If tCF has been adjusted for long cable lengths, the temperature value displayed may vary. The value displayed should be stable. Allow unit to time out.
6. Press **Shift** and while holding, press **µA**. The display should read 18.7 ±.5 µA.
7. If the Analyzer passes this test, the sensor would be suspect in the installation.

This procedure should be repeated with the second sensor cable, if used. Adjust CELL code to alternate sensor. See “CELL Display and Output Configuration (CELL)” on page 38.

Test with Resistors

When sensors are connected directly to the analyzer, a junction box is employed, or the cable and analyzer did not pass the procedure above, the procedure below should be used.

Five resistors are required: 100 kΩ, 300 Ω, 35 kΩ, 0 Ω (short), and one resistor between 35 k and 175 kΩ . Use Figure 22 as a connection guide throughout the following steps.

— NOTE —

To perform the following test on CELL 1, the first digit in the CELL parameter must be 1 (i.e., 1XXX).
To perform the test on CELL 2, the first digit in the CELL parameter must be 2 (i.e., 2XXX).

1. Disconnect the sensor or the patch cord from the Analyzer.
2. Place the Analyzer into manual temperature mode with the display reading 25.0 C. or 77.0 F. A decimal must be present after the C or F. See “Temp Key” on page 32.

3. Place the following resistors on the terminal board:
   a. Place 300 Ω between 3 and 3A.
   b. Place 35 kΩ between 3A and 6.
   c. Place a short (0 Ω) between 5 and 6.
4. Record the value of PdE.
5. Set PdE to 0111.
6. Record the value of dt.
7. Set dt to 0002.
8. Record the value of dLc.
9. Set dLc to 0111.
10. Press **Enter**.
11. Set dLc to 0110.
12. Set dt to 0001.
13. Wait for three to five test cycles to pass.
14. Set dt to 0002.
15. Set dLc to 0100.

bubL Diagnostics

16. Remove the short between 5 and 6.
    a. Wait for one test cycle to pass.
    b. Look for error code bubL.
17. Replace the short between 5 and 6.
    a. Wait for one test cycle to pass.
    b. The error code should disappear.

CAP Diagnostics

18. Remove the 300 Ω resistor between 3 and 3A.
    a. Wait for one test cycle to pass.
    b. Look for error code CAP.
19. Replace the 300 Ω resistor between 3 and 3A.
    a. Wait for one test cycle to pass.
    b. The error code should disappear.

COAt Diagnostics

20. Set PdE to 0101.
21. Remove the 300 Ω resistor between 3 and 3A.
22. Place a short between 3 and 5.

a. Wait for four test cycles to pass.

b. Look for error code COAt.

23. Remove the short between 3 and 5.

 a. Wait for one test cycle to pass.

 b. The error code should disappear.

Current Diagnostics

24. Set PdE to 0000.
25. Remove the 35 kΩ resistor between 3A and 6.
26. Install a resistor between 3A and 6 with a resistance in the range of 35 k to 175 kΩ .. Press **shift** <µA>**.** Display should read: 0.7/(resistance) = µA +/- 0.5 µA.

 a. .Calculate the current value that should be present by using the formula:

$$\frac{.700}{\text{Resistor Value (in k}\Omega)} \times 1000 = \mu A$$

Examples:

$$\frac{.7}{35} \times 1000 = 20\ \mu A$$

$$\frac{.7}{175} \times 1000 = 4\ \mu A$$

 b. Press **Shift** and while holding, press **µA**. The display should read the calculated value ±.5 µA.

Temperature Diagnostics

27. Install 100kΩ between 1 and 2.
28. Place the Analyzer into the automatic temperature mode. See “Temp Key” on page 32.
29. Press **Temp**. With a 100 kΩ resistor, the display should read approximately 25 C or 77 F.
30. Remove all resistors and shorts.
31. Re-enter the values recorded for PdE, dt, and dLc.
32. If the Analyzer passes these tests, the sensor (or cable) would be suspect in the problem installation.
33. This procedure should be repeated with the second sensor CELL channel, if used. Adjust CELL code to alternate sensor. See “CELL Display and Output Configuration (CELL)” on page 38.

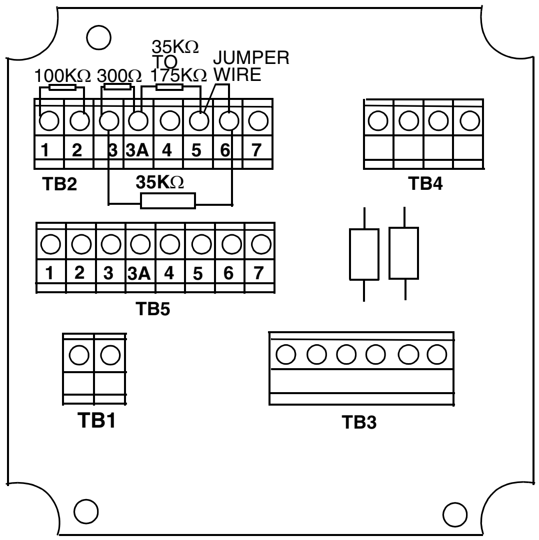

Figure 22. Test Resistors

Error Codes

When the Analyzer is operating normally, the measurement value is displayed constantly. If error or alarm conditions exist, the display alternates between the measurement value and the error/alarm message at a one second rate. The alternate (error/alarm) messages are shown in Table 23.

Table 23. Error/Alarm Messages

Alternate Display	Condition	Priority	Action Required to Clear Error Message
Er 1	Instrument fault, RAM/ROM, software watchdog timer	1 (Highest)	1. Reenter LCC using procedure on page 61. 2. Power down unit. Then reapply power. 3. On plastic unit, verify that metal shorting strip used in shipping has been removed from terminal block.
Er 2	User-defined temperature range error or temperature measurement error	6	1. Change user-defined temperature limits, UtL or LtL. 2. Replace sensor. 3. Place temperature in manual mode (e.g., 25.C.). 4. See “Using the 873DO Analyzer to Trouble-shoot a Sensor or Analyzer Problem” on page 81.
Er 3	User-defined measurement range error	7	1. Change user-defined measurement limits, UL or LL. 2. Replace sensor. 3. Ground loop (see Table 22).
Er 4	Measurement calibration incorrect	2	Recalibrate sensors on both channels.
AL 1	Alarm 1 condition triggered	9	
AL 2	Alarm 2 condition triggered	9	
A1A2	Both alarms are triggered simultaneously	8	
....	Measurement over or under range of analog output limits	10	
Err	Incorrect code or parameter attempted	2	Check code and reenter.
COAt	Membrane fouled	4	1. Clean sensor. 2. Replace membrane.
CAP	Broken membrane; process ingress into electrolyte	3	Replace membrane cap and electrolyte.
bubL	AgCl coating on auxiliary electrode Air bubble in electrolyte Low electrolyte	5	Replace sensor. Refill electrolyte.

— NOTE —

If two or more errors exist simultaneously, the Analyzer flashes only the error with highest priority. If the highest priority error is cleared and a lower priority error still remains, the Analyzer then flashes the highest priority error of the remaining errors.

Detachable Configuration Field Sheet

Configuration Setup Entries

Symbol	Parameters and Values Accessed	User Settings
CELL	Configuration of Display, Analog Outputs	
Hold	Hold and sets the Analog output value in Hold	
Cd	Compensation and Damping – Damping Factor – Temperature Compensation	
AC1	Alarm 1 Control – Measurement Selection – Low/High/Instrument plus Passive/Active State – % Hysteresis	
Att1	Alarm 1 Trigger Timer	
AFt1	Alarm 1 Feed Time	
AdL1	Alarm 1 Delay Time	
AC2	Alarm 2 Control – Measurement Selection – Low/High/Instrument plus Passive/Active State – % Hysteresis	
Att2	Alarm 2 Trigger Timer	
AFt2	Alarm 2 Feed Time	
AdL2	Alarm 2 Delay Time	
UL	User-Defined Upper Measurement Limit - Both CELLs	
LL	User-Defined Lower Measurement Limit - Both CELLs	
UtL	User-Defined Upper Temperature Limit - Both CELLs	
LtL	User-Defined Lower Temperature Limit - Both CELLs	
HO1	100% Analog Output - Channel 1	
LO1	0% Analog Output - Channel 1	
HO2	100% Analog Output - Channel 2	
LO2	0% Analog Output - Channel 2	

Basic Setup Entry Selection

Symbol	Parameter and Value Accessed	User Settings
bL	Basic Setup Lock Control	
Ct	Sensor CELL Type	
FSC	Full Scale Value	
SEr0	Zero Calibration	
ALt	Altitude Calibration	
PC	Probe Calibration	
LCC	Lock Change Code	
tCF1	Temperature CELL Factor CELL 1	
tEC1	Temperature Electronics Calibration CELL 1	
tCF2	Temperature CELL Factor CELL 2	
tEC2	Temperature Electronics Calibration CELL 2	
LC01	Low Calibration Analog Output 1	
HC01	High Calibration Analog Output 1	
LC02	Low Calibration Analog Output 2	

HC02	High Calibration Analog Output 2	
PdE	Probe Diagnostic Enable	
dLC	Diagnostic Learning Control	
FOt	Fouling Diagnostic Tolerance	
CAt	Membrane Cap Diagnostic Tolerance	
bUt	Bubble Diagnostic Tolerance	
dt	Diagnostic Interval Timing	
dOFF	Diagnostic Off Window Timing	
don	Diagnostic On Window Timing	
FdLL	Fouling Diagnostic Lower Limit	
dr	Drive Voltage Setting	

CELL Code - Display and Output Configuration

Digit 1	Digit 2	Digit 3	Digit 4
DISPLAY		OUTPUT 1	OUTPUT 2
1-CELL 1 2-CELL 2 7-Ratio 9-Difference	0-Interrogate both channels 1-Ignore non- configured channel	1-Dissolved Oxygen CELL 1 2-Dissolved Oxygen CELL 2 3-Temp CELL 1 4-Temp CELL 2 7-Ratio 9-Difference	1-Dissolved Oxygen CELL 1 2-Dissolved Oxygen CELL 2 3-Temp CELL 1 4-Temp CELL 2 7-Ratio 9-Difference

HOLD Code - Hold Analog Output Values

Digit 1	Digits 2, 3, and 4
0 – No Hold Hold ON, Analog Output on Hold 1 – Alarms held in present state 2 – Alarms held in off state 3 – Alarms held in on state	000 to 100% of Analog Output Range

Cd Code - Compensation and Damping

Digit 1	Digit 2	Digits 3 and 4
Damping		ppm Temperature Compensation
0 = none 1 = 10 seconds 2 = 20 seconds 3 = 40 seconds	0	00=% Saturation 01=Pure Water 02=Saltwater

AC1 and AC2 Codes - Alarm Control

Digit 1	Digit 2	Digits 3 & 4
MEAS. SELECTION	CONFIGURATION	HYSTERESIS
1 – Diss. Oxygen CELL 1 2 – Diss. Oxygen CELL 2 3 – Temp CELL 1 4 – Temp CELL 2 7 – % Ratio 9 – Difference	1 – Low/Passive 2 – Low/Active 3 – High/Passive 4 – High/Active 5 – Instrument/Passive 6 – Instrument/Active 7 – Hold/Passive 8 – Hold/Active	00 to 99% of Full Scale 0.0 to 9.9% (% mode)

AFt1, AdL1, AFt2, AdL2, Att1 and Att2 Time Codes

Digits 1 and 2	Digit 3	Digit 4
00 to 99 minutes	0 to 9 tenths of minutes	0 to 9 hundredths of minutes

Error/Alarm Messages

Alternate Display	Condition	Priority	Action Required to Clear Error Message
Er 1	Instrument fault, RAM/ROM, software watchdog timer	1 (Highest)	1. Reenter LCC using procedure onpage 61. 2. Power down unit. Then reapply power. 3. On plastic unit, verify that metal shorting strip used in shipping has been removed from terminal blocks.
Er 2	User-defined temperature range error or temperature measurement error	6	1. Change user-defined temperature limits, UtL or LtL. 2. Replace sensor. 3. Place temperature in manual mode (e.g., 25.C.). 4. See Section 6.
Er 3	User-defined measurement range error	7	1. Change user-defined measurement limits, UL or LL. 2. Replace sensor. 3. Ground loop (see Table 22).
Er 4	Measurement calibration incorrect	2	1. Recalibrate sensors on both channels.
AL 1	Alarm 1 condition triggered	9	
AL 2	Alarm 2 condition triggered	9	
A1A2	Both alarms are triggered simultaneously	8	
2222	Measurement over or under range of analog output limits	10	
Err	Incorrect code or parameter attempted	2	Check code and reenter.
COAt	Membrane fouled	4	1. Clean sensor. 2. Replace membrane.
CAP	Broken membrane; process ingress into electrolyte	3	Replace membrane cap and electrolyte.
bubL	AgCl coating on auxiliary electrode Air bubble in electrolyte Low electrolyte	5	Replace sensor. Refill electrolyte.

NOTE: If two or more errors exist simultaneously, the Analyzer flashes only the error with highest priority. If the highest priority error is cleared and a lower priority error still remains, the Analyzer then flashes the highest priority error of the remaining errors.

7. User Notes

Single Sensor Use

This section allows fault-free setup of the 873DO for single sensor use. Because two sensor inputs are available on the 873 Analyzer, proper configuration is required to prevent errors from flagging. After wiring the sensor, follow the steps below to determine the pertinent configuration code assignments. Error codes will occur if the unit is configured improperly.

CELL 1 Configuration

1. Wire Sensor to TB2 (see Figure 10 or Figure 11);
   CELL 1 terminals 1, 2, 3, 3A, 4, 5, 6.
2. Choose CELL Code.

Digit			
1	2	3	4
1	1	1 or 3	1 or 3

3. Will you be using Analog output(s)?

   If Yes, set to desired values.
   If No, set to values below.

   See Section:

   H01 on page 54 H01 = 999.9

   L01 on page 54 L01 = -9.9
4. Will you be using Alarms?

AC1

Digit			
1	2	3	4
1 or 3	X X	X X	X X

AC2

Digit			
1	2	3	4
1 or 3	X X	X X	X X

If Yes, set digits 2, 3, and 4 as desired.

If No, set AC1 = 1300
set AC2 = 1100

set Alm1= 999.9
set Alm2= –9.9

CELL 2 Configuration

1. Wire Sensor to TB5 (see Figure 10 or Figure 11);
   CELL terminals 1, 2, 3, 3A, 4, 5, 6.
2. Choose CELL Code.

Digit			
1	2	3	4
2	1	2 or 4	2 or 4

3. Will you be using Analog output(s)?

   If Yes, set to desired values.
   If No, set to values below.

   See Section:

   H02 on page 54 H02 = 999.9

   L02 on page 55 L02 = -9.9
4. Will you be using Alarms?

AC1

Digit			
1	2	3	4
2 or 4	X X	X X	X X

AC2

Digit			
1	2	3	4
2 or 4	X X	X X	X X

If Yes, set digits 2, 3, and 4 as desired.

If No, set AC1 = 2300
set AC2 = 2100

set Alm1= 999.9
set Alm2= –9.9

Dual Sensor Use

If two sensors are to be used for individual measurements, and the analog outputs used for the two process measurements, configure, the CELL Code as indicated below. Sensor 1's measurement value would be displayed; both measurements would be output.

CELL Code

Digit			
1	2	3	4
1	0	1	2

The two alarms could be configured as LOW Alarms, one for each of the measurements.

Alarm 1 for Sensor 1

AC1

1	2	3	4	Digit
1	2	X	X	Code

Alarm 2 for Sensor 2

AC2

1	2	3	4
2	2	X	X

Ratio:

For Ratio measurements, set CELL code as indicated below.

CELL Code

Digit			
1	2	3	4
7	0	X	X

Where XX means any values.

Set digits 3 and 4 as desired. If the Analog outputs will be used, set H01, L01 and H02, L02 to the proper values. If an output will not be used, set to:

H01 and H02 = 999.9; L01 and L02 = –9.9.

Difference:

For Difference measurements, set CELL code as indicated below.

CELL Code

Digit			
1	2	3	4
9	0	X	X

Where XX means any values.

Set digits 3 and 4 as desired. If the Analog outputs will be use to set H01, L01 and H02, L02 to the proper values. If an output will not be used, set to:

H01 and H02 = 999.9; L01 and L02 = –9.9.

— NOTE —
Calibrate individual sensors per Section 5 before setting up Ratio or Difference measurements.

Redundant Sensor Operation

— NOTE —
Calibrate individual sensors per “Calibration” on page 73 before setting up Redundant Sensors.

In extremely critical processes where an error in measurement could cause serious effects, two sensors can be used as a check of measurement. CELL 1 will be designated the primary CELL from which measurement is taken and analog output follows. The CELL code should be set:

CELL Code

Digit			
1	2	3	4
1	0	1 or 3	1 or 3

Set the analog outputs as desired (digits 3 and 4 of CELL code) to functions of CELL 1's operation. H01 and L01, H02 and L02 should be set appropriately.

Configure an alarm, Alm1 or Alm2, to difference measurements.

AC1

Digit			
1	2	3	4
9	X	X	X

or

AC2

Digit			
1	2	3	4
9	X	X	X

Determine acceptable difference between the two sensors before alarming.

Set Alm1 and Alm2 and wire Alarm terminals to appropriate Alarm device. The 873 will alarm on sensor difference values that are out of the user's acceptable range.

Example:

An acceptable difference between the two sensors is 2 ppm. You want to Alarm if the difference is greater than 2 ppm. Set Alm1 to 2 ppm.

AC1

1	2	3	4
9	4	0	0

Alm2 may be used to alarm the primary sensor on CELL 1. You may want to Alarm if the concentration drops below 2 ppm. Set AC2 as shown and Alm2 to 2 ppm.

AC2

1	2	3	4
1	2	0	0

Backup Sensor Operation

— NOTE
Calibrate individual sensors per “Calibration” on page 73 before setting up Redundant Sensors.

In certain applications, a second or backup sensor is installed but is not configured. Configure CELL 1 as the primary sensor. Use the left column below. If the measurement from CELL 1 is suspect at any time, simply enable CELL 2 as the primary CELL using the right column configuration information.

CELL 1 Configuration

1. Wire Sensor to TB2 - CELL 1 terminals 1, 2, 3, 3A, 4, 5, 6.
2. Choose CELL Code.

Digit			
1	2	3	4
1	1	1 or 3	1 or 3

3. Will you be using Analog output(s)?

   If Yes, set to desired values.
   If No, set to values below.

   <u>See Section</u>:

   H01 on page 54 H01 = 999.9
   L01 on page 54 L01 = -9.9

4. Will you be using Alarms?

AC1

Digit			
1	2	3	4
1 or 3	X X	X X	X X

AC2

Digit			
1	2	3	4
1 or 3	X X	X X	X X

   If Yes, set digits 2, 3, and 4 as desired.

   If No, set AC1 = 1300
   set AC2 = 1100

   set Alm1 = 999.9
   set Alm2 = –9.9

CELL 2 Configuration

1. Wire Sensor to TB5; CELL terminals 1, 2, 3, 3A, 4, 5, 6.
2. Choose CELL Code.

Digit			
1	2	3	4
2	1	2 or 4	2 or 4

3. Will you be using Analog output(s)?

   If Yes, set to desired values.
   If No, set to values below.

   See Section:

   H02 on page 54 H02 = 999.9
   L02 on page 55 L02 = -9.9

4. Will you be using Alarms?

AC1

Digit			
1	2	3	4
2 or 4	X X	X X	X X

AC2

Digit			
1	2	3	4
2 or 4	X X	X X	X X

If Yes, set digits 2, 3, and 4 as desired.

If No, set AC1 = 2300
set AC2 = 2100

set Alm1 = 999.9
set Alm2 = –9.9

8. Alarm Contact Maintenance

The alarm relay contacts are selected to switch loads equal to or greater than 20 watts. The minimum contact current is 1 ampere. The silver alloy contacts rely on the very slight arc generated during switching to eliminate oxide layers that form on the contacts. When the contacts are used at low (signal) levels, contact function may become unreliable over time due to the formation of an oxide layer on the contacts.

When contacts must be used at low levels, attention must be paid to contact condition. The maximum contact resistance for new relays is 100 milliohms. Values above this level or unstable values indicate deterioration of the contact surface as noted above and may result in unreliable alarm function.

The contact surfaces can be restored as follows:

1. Disconnect the alarm wiring from the analyzer.
2. Connect a resistive load of 20 W or more (up to the maximum rating of the contacts) as shown in Figure 23 so that both NO and NC contacts are exercised.
3. Use the analyzer to switch the alarm relay several times.
4. Disconnect the load installed in Step 2 and reconnect the wiring removed in Step 1.
5. Check to ensure that the alarms are functioning properly.

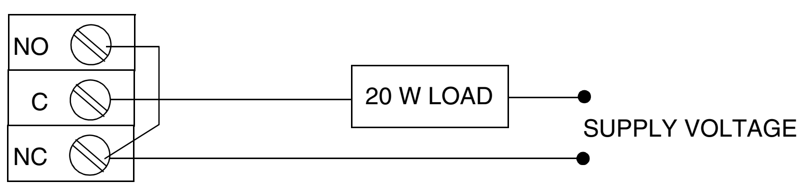

Figure 23. Alarm Contact Reconditioning Circuit

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