Instruction

MI 611-193
June 2004

873AEC Ace Series Electrochemical Analyzers for Electrodeless Conductivity Measurement

Style A

(873APH Version Shown)

Invensys®
FOXBORO®

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1. Introduction

Quick Start

The purpose of this section is to give you the basic steps to quickly begin using your 873AEC Electrochemical Analyzer.

- Step 1 - Wiring
- Step 2 - Verify Analyzer Identification
- Step 3 - Verify Valid Measurements

Step 1 - Wiring

! CAUTION

Wiring installation must comply with any existing local regulations.

The 873A Analyzer is supplied in two types – plastic enclosure or metal enclosure. Follow the wiring instructions for the type of enclosure that you have. More wiring information can be found in the sections on “Wiring of Plastic Enclosure” on page 18 and “Wiring of Metal Enclosure” on page 19.

Wiring of Plastic Enclosure (General Purpose Version)

1. Remove optional rear cover assembly BS805QK, if present.
2. Connect ALM 1 and ALM 2 alarm wires to terminal block TB3 as shown in Figure 1. Failsafe operation requires connections to be made between contacts NC and C. For details see “Wiring of Alarms” on page 21.
3. Connect wires from external circuit to analog output terminals TB3 (M+) and TB3 (M–). Refer to Figure 1.
4. Remove factory-installed jumper assembly from terminal block TB2 and discard.
5. Connect sensor wires to analyzer terminal block TB2 as shown in Figure 1.

NOTE

Only 871EC and 871FT type sensors can be used with the 873AEC Analyzer. Model 1210 sensors cannot be used with the 873A Analyzer. Remove spade lugs from 871EC sensor wires, and tin the leads. Be careful that sleeves with numbers do not fall off.

6. Connect power wires to terminal block TB1 as shown in Figure 1.
7. Attach optional rear panel cover, if present.

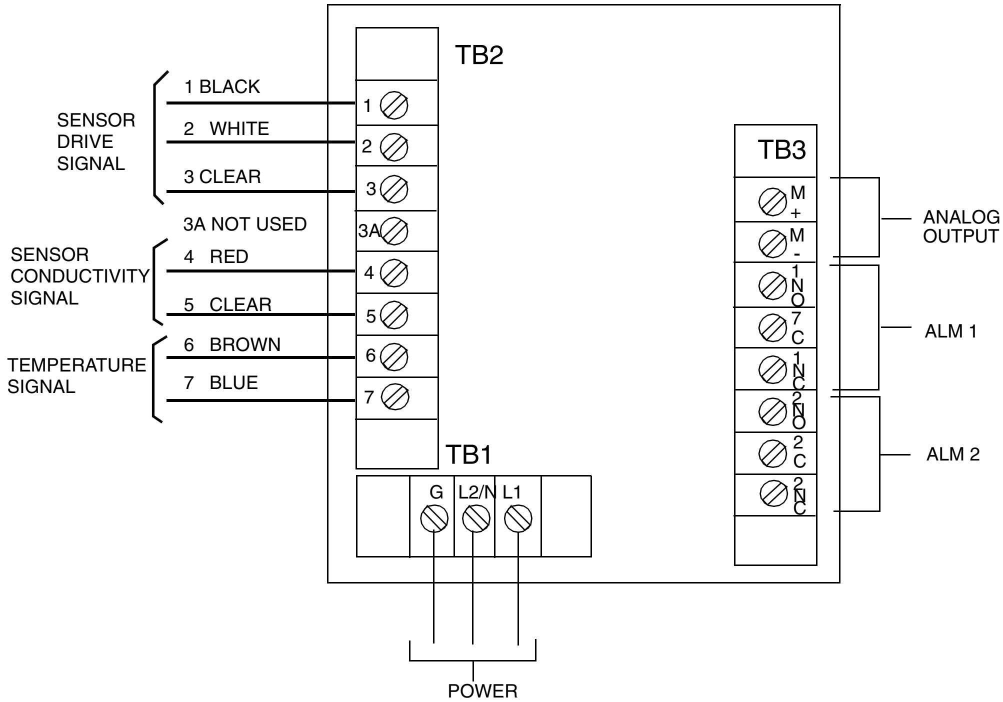

Figure 1. Rear Panel Wiring - Plastic Enclosure

Wiring of Metal Enclosure (Field-Mounted Version)

NOTE

1. To maintain the enclosure tightness rating, such as NEMA 4X, CSA Enclosure 4X, or IEC Degree of Protection IP-65, wiring methods and fittings appropriate to the ratings must be used.
2. Alarm wires should run with the power wires. Sensor wires should run with analog output wires.

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1. Remove back cover to access terminal/power board.
2. Connect ALM 1 and ALM 2 Alarm wires to terminal block TB3 as shown in Figure 2. Failsafe operation requires connections to be made between contacts NC and C. For details see “Wiring of Alarms” on page 21.
3. Connect wires from external circuit for analog output to terminal block TB4.
4. Connect sensor wires to analyzer terminal block TB2 as shown in Figure 2.

NOTE

Only 871EC and 871FT type sensors can be used with the 873AEC Analyzer. Model 1210 sensors cannot be used with the 873A Analyzer. Remove spade lugs from 871EC sensor wires, and tin the leads. Be careful that sleeves with numbers do not fall off. Recommended exposed wire length is 0.63 to 0.75 in (16 to 19 mm).

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5. Connect power wires to terminal block TB1 as indicated in Figure 2. The earth (ground) connection from the power cord should be connected to the ground stud located in the bottom of the case.

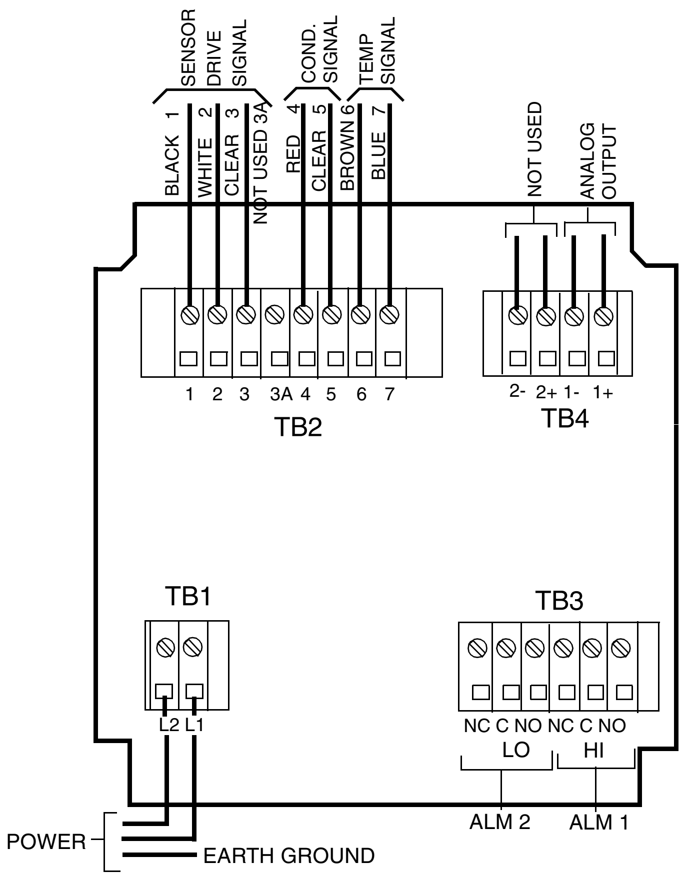


Figure 2. Rear Panel Wiring - Metal Enclosure

Step 2 - Verify Analyzer Identification

Verify the information shown on the data label on the side of the instrument. Note especially the range shown beside "**CALIB**." This range should encompass your desired measurement range.

To reconfigure your instrument, refer to Table 5, "User Configuration Setup Entries," on page 29.

Step 3 - Verify Valid Measurements

Your analyzer was calibrated at the factory. Therefore, you should not have to calibrate it. However, it is good practice to perform a zero calibration in air. For complete calibration information, see "Calibration" on page 39.

To perform a zero calibration in air, do the following:

1. Suspend the clean dry sensor in the air. An open loop (Infinite Resistance) is used to calibrate at 0 µS/cm or 0 mS/cm.
2. Wait at least 15 seconds for the electronics to stabilize, then perform the **Cal Lo** procedure.

3. Press **Shift + Cal Lo**.
4. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the value 0 µS/cm or 0 mS/cm, as applicable is displayed.
5. Press **Enter**.

Sensor Notes

For proper installation and to provide maximum sensor accuracy, the electrodeless sensors require sufficient solution in all directions around the sensor in order to avoid sidewall effects. Small bore sensors must be centered in a minimum 3 inch (7.5 cm) I.D. pipe and large bore sensors in a 6 inch (15 cm) I.D. pipe. If placing a sensor in a container for calibration, centering the sensor in the solution is still required. The use of Invensys Foxboro Flow-Through 871FT Sensors eliminates this requirement.

Table 1. Pipe Diameters

Sensor Type	Minimum Pipe I.D.
Small Bore: NL, TF, PN, PX, SP, HP	3 inch (7.5 cm)
Large Bore: RE, LB, UT, BW, EV, AB	6 inch (15 cm)
Flow-Through	N/A

All electrodeless sensors can become magnetized if they come in close proximity to a magnetic source such as motors. If this occurs, the measurement values obtained are affected, with the effects being most noticeable at low conductivity ranges (such as less than 500 µS/cm).

For this reason, Invensys Foxboro recommends that any sensor to be used in a low conductivity application first be degaussed to eliminate any possibility that the sensor magnetized either during shipping or on site. This can be easily accomplished. Invensys Foxboro routinely degausses all electrodeless sensors prior to shipment.

For a White Paper detailing this procedure and the effects, please contact Invensys Foxboro at 1-508-549-4730 or by FAX at 1-508-549-4734.

Looking for More Information?

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

For installation information, refer to “Installation” on page 11. For dimensional information, refer to DP 611-163.

For detailed explanation of the controls and indicators, refer to “Operation” on page 23.

For detailed configuration instructions, refer to “Configuration” on page 29.

For detailed calibration instructions, refer to “Calibration” on page 39.

If you need additional help, please call the Electrochemical Service Center at 1-508-549-4730 in the U.S.A. or call your local Invensys Foxboro representative.

General Description

The 873AEC Analyzer interprets the conductivity of aqueous solutions. Its measurement display may be read in either µS/cm, mS/cm, or percent (%). Solution temperature is also measured by the 873AEC for automatic temperature compensation and may be displayed at any time. It provides an isolated output signal proportional to the measurement for transmission to an external receiver.

Instrument Features

Described below are some of the features of the 873AEC Electrochemical Analyzer:

- Plastic or Metal Enclosure
- Dual Alarms
- Analog Output
- EEPROM Memory
- Hazardous Area Classification on Metal Enclosure
- 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 and CSA Enclosure 1.

The metal enclosure is intended for field locations and may be 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 ratings of NEMA 4X, CSA Enclosure 4X, and IEC Degree of Protection IP-65. The unit 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 49.

No Battery Backup Required

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

Hazardous Area Classification

The metal versions are designed to meet the Factory Mutual and the Canadian Standards Association requirements for Class I, Division 2 hazardous locations. See Table 2 for details.

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 smoke-tinted, nonreflective, 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 about four minutes 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.

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 873A 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 three general categories: Measurement Range, Alarm Configuration, 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 door allows viewing of the display and is hinged for easy access to the front panel controls.

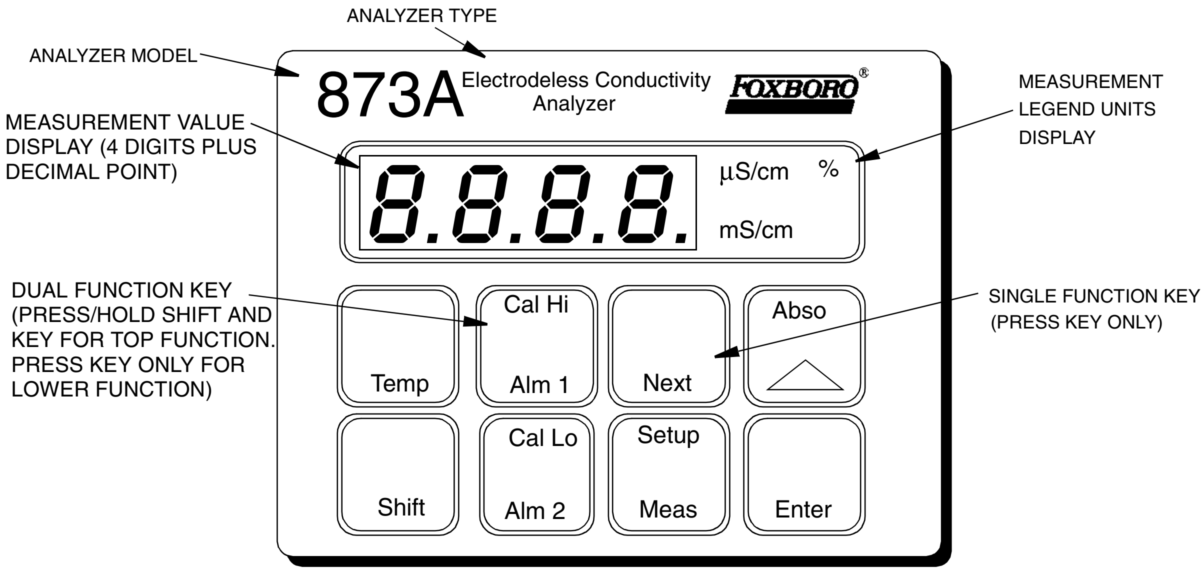


Figure 3. Front Panel Display and Keypad

Analyzer Identification

A data label is located on the side surface of the enclosure. This data label provides Model No. and other information pertinent to the particular analyzer purchased. Refer to Figure 4.

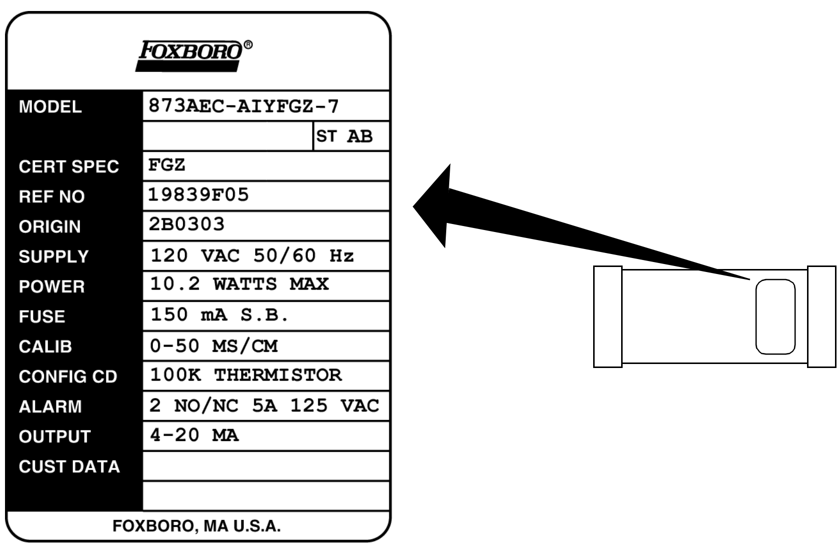


Figure 4. Data Label

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

4 to 20 mA isolated
0 to 10 V dc isolated
0 to 20 mA isolated

Ambient Temperature Limits

–25 to +55°C (–13 to +131°F)

Measurement Ranges

50, 100, 200, and 500 µS/cm; 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, and 2000 mS/cm; depends on sensor used. Chemical concentration ranges are available for several electrolytes:

NaCl, dilute at 25°C
HCl, 0-15%
H_2SO_4, 0-25%
H_2SO_4, 99.5-93% at 50°C (122°F)
NaOH, 0-15% at 25°C (77°F)
NaOH, 0-20% at 100°C (212°F)

Temperature Measurement Range

–17 to +199°C (0 to 390°F) w/100 Ω RTD
–17 to +121°C (0 to 250°F) w/100 kΩ thermistor

Temperature Compensation Range

See Table 6.

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 [3.6 (H) x 3.6 (W) x 7.2 (L) inches]
Metal Enclosure: 92(H) x 92(W) x 259(L) mm [3.6 (H) x 3.6 (W) x 10.2 (L) inches]

Enclosure/Mounting Options

–P	Plastic General Purpose/Panel Mount
–W	Metal Field Mount/Panel Mount
–X	Metal Field Mount/Surface Mount
–Y	Metal Field Mount/Pipe Mount
–Z	Metal Field Mount/Movable Surface Mount

Approximate Mass

Plastic Enclosure:	0.68 kg (1.5 lb)
Metal 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

Two seconds maximum. Temperature response is 15 seconds maximum.

Measurement Damping

In Measure mode, damping is set at 10 seconds. Damping affects displayed parameters and analog outputs.

Alarms

- Two alarms configurable via keypad.
- Individual set points continuously adjustable 0 to full scale via keypad.

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 49.

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 Enclosure: < 0.5 V/m from 27 to 1000 MHz
Metal Enclosure: 10 V/m from 27 to 1000 MHz

Electromagnetic Compatibility (EMC)

The Model 873AEC Electrochemical Analyzer, 220 V ac or 240 V ac systems with metal enclosure, comply 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 3).

The plastic case units are intended for mounting in solid metal consoles or cabinets. The plastic case units will comply with the European EMC Directive 89/336/EEC when mounted in a solid metal enclosure and the I/O cables extending outside the enclosure are enclosed in solid metal conduit (see Table 3).

Product Safety Specifications

Table 2. Product Safety Specifications

Testing Laboratory, Type 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, Division 2, Groups A, B, C, and D and Class II, Division 2, Groups F and G hazardous locations.	Instruments with metal enclosure (codes W, X, Y, and Z) only. Temperature Class T6.	FNZ
CSA (Canada) for use in general purpose (ordinary) locations.	Supply Voltage 24 V, 100 V, and 120 V ac (codes -A, -E, -J) only.	CGZ
CSA (Canada) suitable for use in Class I, Division 2, Groups A, B, C, and D, hazardous locations.	Instruments with metal enclosure (codes W, X, Y, and Z) only. Supply Voltage 24 V, 100 V, and 120 V ac (codes -A, -E, -J) only.	CNZ

— NOTE

The analyzer has been designed to meet the electrical safety descriptions noted in the table above. For detailed information or status of testing laboratory approvals and certifications, contact your Invensys Foxboro representative.

— ⚠ CAUTION

1. When replacing covers on the 873A 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 873AEC-_ _ 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.

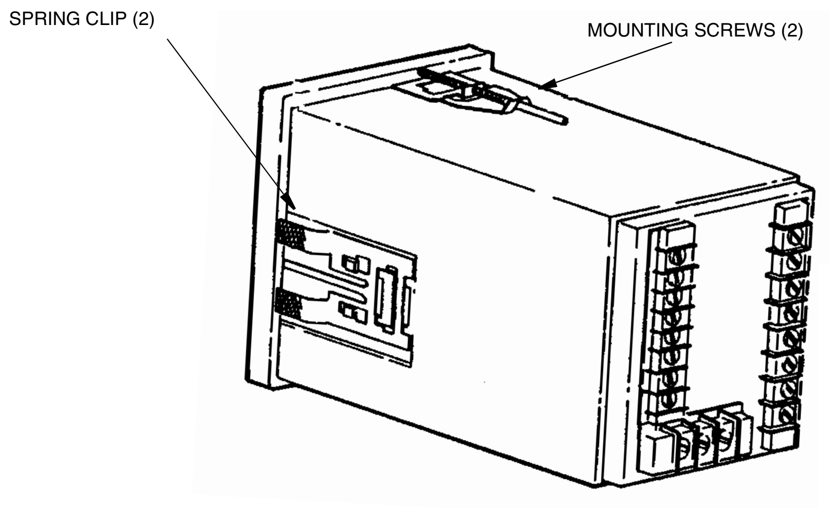


Figure 5. Mounting to Panel - Plastic Enclosure

Mounting to a Panel – Metal Enclosure 873AEC-_ _ W

The metal enclosure is mounted to a panel as described below:

1. Size panel opening in accordance with dimensions specified on DP 611-162.
2. Insert the analyzer through the panel cutout and temporarily hold in place. The rear bezel will have to be removed to perform this procedure.)
3. From the rear of the panel, slide the plastic clamp onto the enclosure until the two clamp latches snap into two opposing slots on longitudinal edges of the enclosure. See Figure 6.
4. Tighten screws (clockwise) on the clamp latches until the enclosure is secured to panel.
5. Reassemble the rear bezel to the enclosure using four screws.

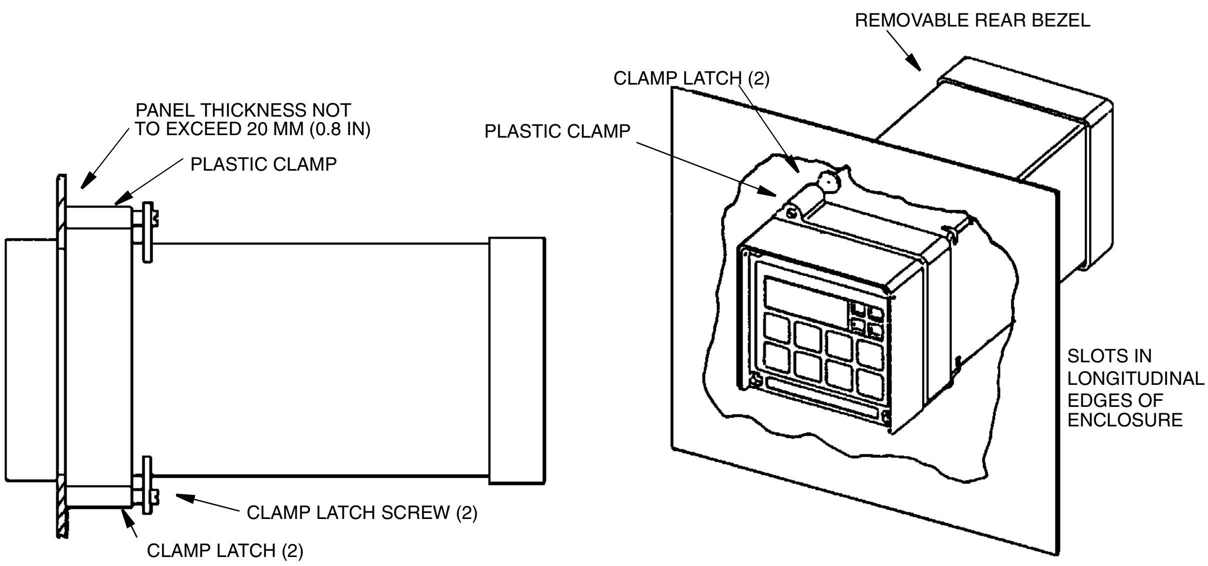


Figure 6. Mounting to Panel - Metal Enclosure

Mounting to a Pipe – Metal Enclosure, 873AEC-_ _ 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) and hardware designated 6 and 13.

3. Slide the analyzer into support bracket (2) and slide strap clamp (4) onto analyzer. Using two screws, nuts, and washers, attach the strap clamp to the support bracket to secure the analyzer.
4. Lift entire assembly of Step 3, and using two U-clamps (12), nuts (13), and washers (6), secure mounting bracket (1) to pipe.

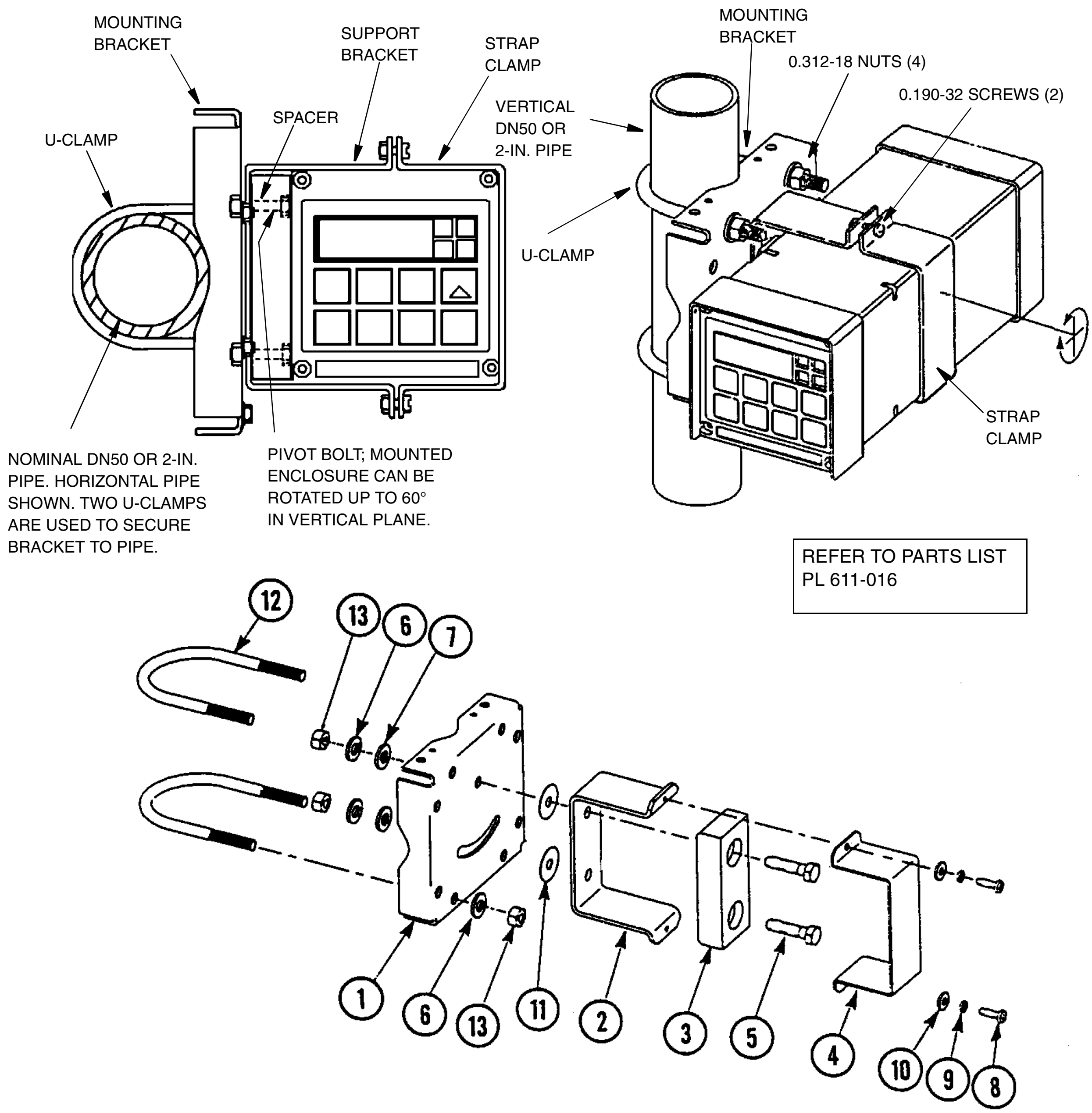


Figure 7. Metal Enclosure - Pipe Mounting

Mounting to a Surface, Fixed Mount – Metal Enclosure, 873AEC-_ _ X

1. Locate the mounting surface for the analyzer.
2. Referring to Figure 8, use mounting bracket (1) as a template for drilling four holes into the mounting surface. Notice that holes in the mounting bracket are 8.74 mm (0.344 in) in diameter. Do not attach the mounting bracket to the 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 the analyzer into support bracket (2) and slide strap clamp (4) onto the analyzer. Using two screws, nuts, and washers, attach the strap clamp to the support bracket to secure the analyzer.

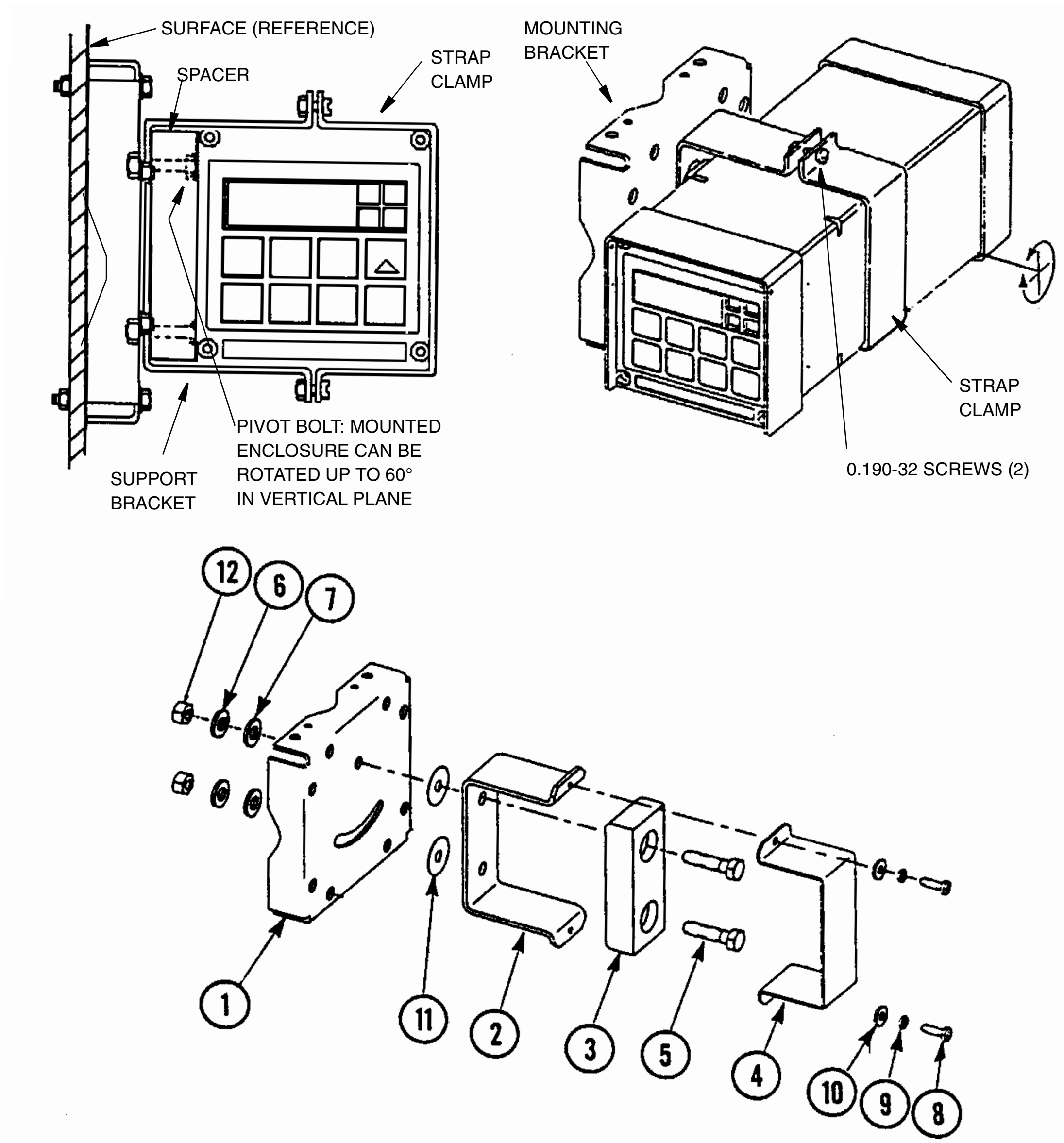


Figure 8. Metal Enclosure - Fixed Mount

Mounting to a Surface, Movable Mount – Metal Enclosure, 873AEC-_ _ Z

1. Locate the mounting surface for 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 (2) and slide strap clamp (4) onto the analyzer. Using two screws, nuts, and washers, attach the strap clamp to the support bracket to secure the analyzer.
6. Lift entire assembly of Step 5, align mounting bracket (1) and wall bracket pivot bolt holes, and then insert pivot bolt (13) through wall and mounting brackets into nylon washer (14) and locking nut (15).
7. Rotate bracket and analyzer assembly in horizontal plane to desired position and lock in place using the screw and washer.
8. Tilt the analyzer to the desired angle and lock in place with the hardware fastened finger tight in Step 4c.

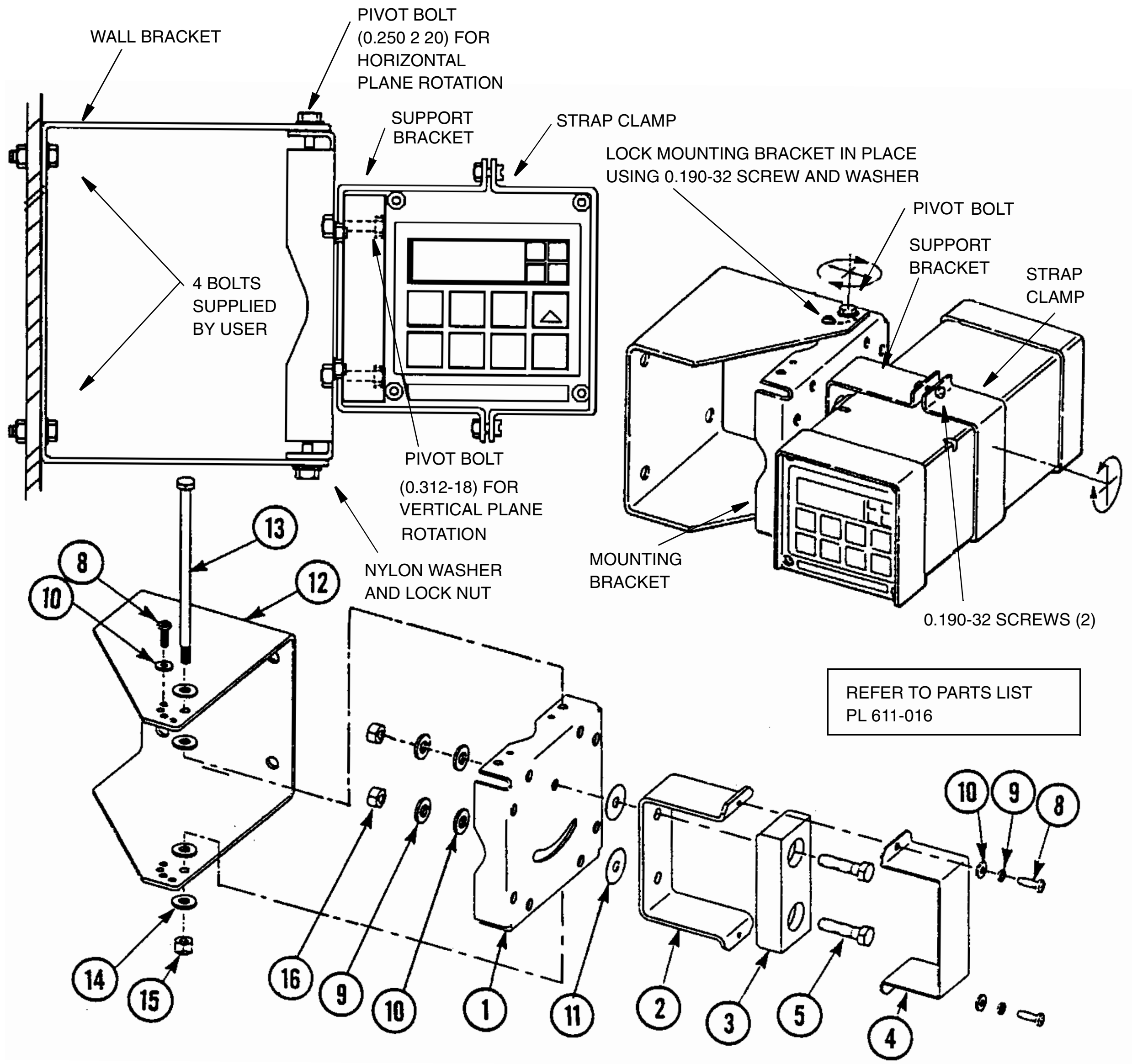


Figure 9. Metal Enclosure - Movable Mount

Wiring of Plastic Enclosure

⚠ CAUTION

Wiring installation must comply with any existing local regulations.

1. Remove optional rear cover assembly BS805QK, if present.
2. Connect ALM 1 and ALM 2 alarm wires to TB3 as shown in Figure 10. Failsafe operation requires connections to be made between contacts NC and C. Also see "Wiring of Alarms" on page 21.
3. Connect wires from external circuit for analog output to terminals TB3 (M+) and TB3 (M–). Refer to Figure 10.
4. Remove factory-installed jumper assembly from terminal block TB2 and discard.
5. Connect sensor wires to analyzer terminal block TB2 as shown in Figure 10.

NOTE

Only 871EC and 871FT type sensors can be used with the 873AEC Analyzer. Model 1210 sensors cannot be used with the 873A Analyzer. Remove spade lugs from 871EC sensor wires, and tin the leads. Be careful that sleeves with numbers do not fall off.

6. Connect power wires to terminal block TB1 as shown in Figure 10.
7. Attach optional rear panel cover, if present.

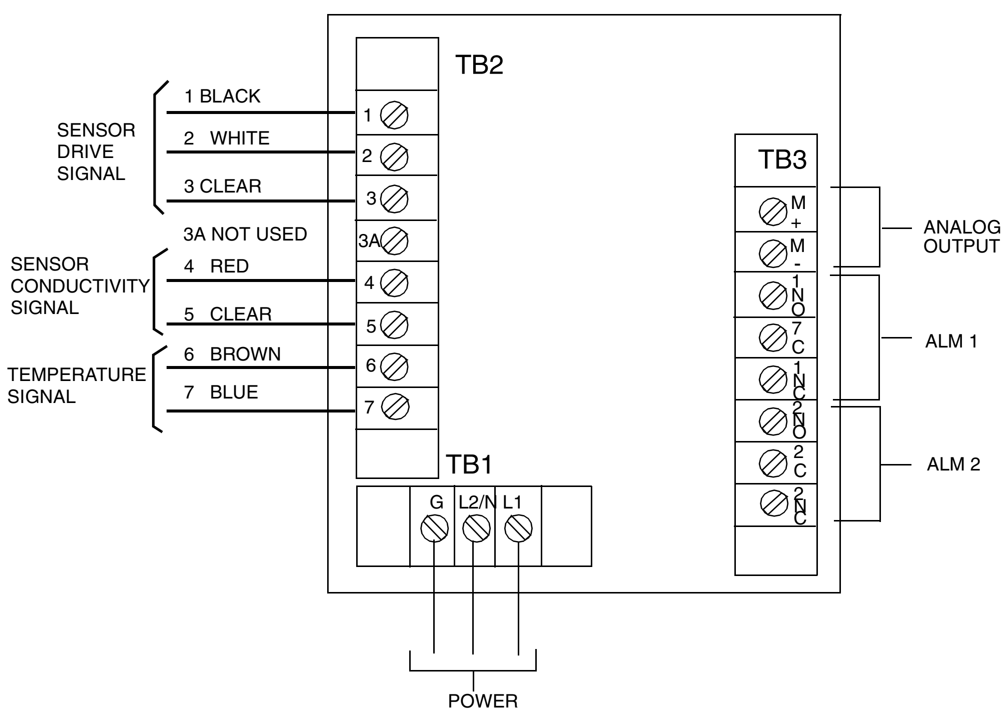


Figure 10. Rear Panel Wiring - Plastic Enclosure

Wiring of Metal Enclosure

⚠ CAUTION

Wiring installation must comply with any existing local regulations.

NOTE

1. To maintain the enclosure tightness rating, such as NEMA 4X, CSA Enclosure 4X, or IEC Degree of Protection IP-65, wiring methods and fittings appropriate to the ratings must be used. Table 3 identifies appropriate parts.
2. Alarm wires should run with the power wires. Sensor wires should run with analog output wires.

1. Remove back cover to access terminal/power board.
2. Connect ALM 1 and ALM 2 alarm wires to TB3 as shown in Figure 11. Failsafe operation requires connections to be made between contacts NC and C. Also see “Wiring of Alarms” on page 21.
3. Connect wires from external circuit for analog output to terminal block TB4.
4. Connect sensor wires to analyzer terminal block TB2 as shown in Figure 11.

NOTE

Only 871EC and 871FT type sensors can be used with the 873AEC Analyzer. Model 1210 sensors cannot be used with the 873A Analyzer. Remove spade lugs from 871EC sensor wires, and tin the leads. Be careful that sleeves with numbers do not fall off. Recommended exposed wire length is 0.63 to 0.75 in (16 to 19 mm).

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.

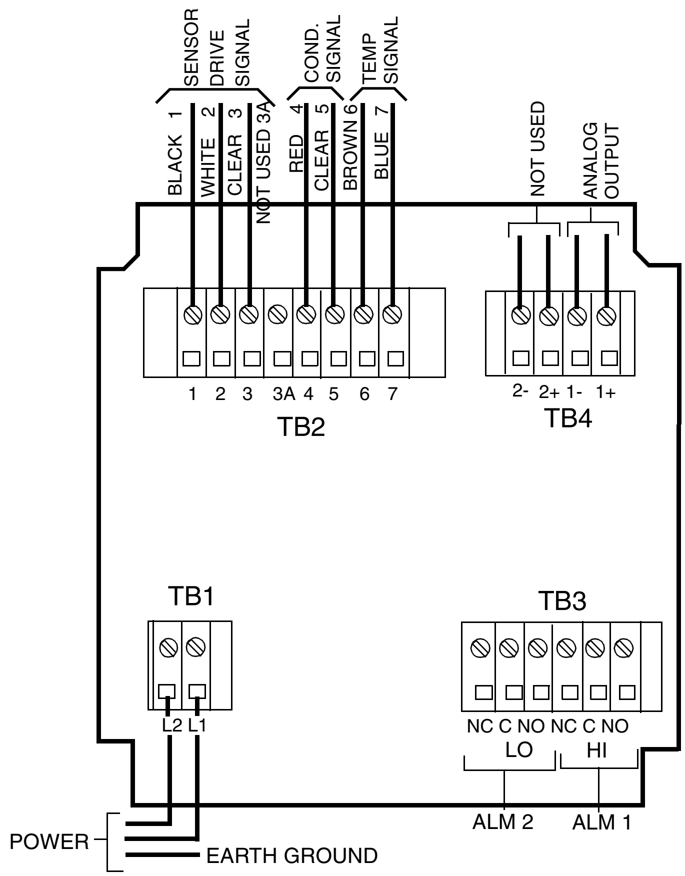


Figure 11. Rear Panel Wiring - Metal Enclosure

Table 3. Recommended Conduit and Fitting (Due to Internal Size Restraints)

Material	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

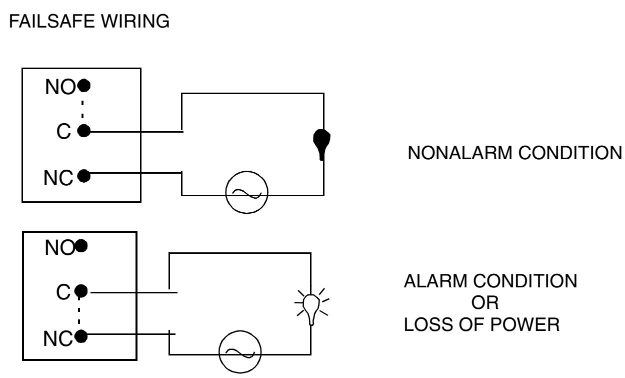
*Thomas & Betts Corp., 1001 Frontier Road, Bridgewater, NJ 08807-0993

Wiring of Alarms

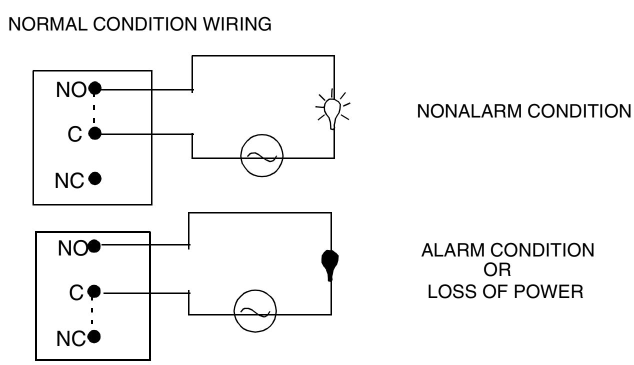
Alarm relays in the 873A Analyzer are "active" relays. This means that the relay is energized when the analyzer is powered and there is no alarm condition.

You can wire an external device (e.g., light bulb) to the analyzer in either of two ways. Each alarm relay provides a contact closure which can be used as a switch to turn an externally powered device on or off.

- Between NC and C so that the external device is activated when there is an alarm condition or a loss of power to the analyzer. This is referred to as "failsafe."



- Between NO and C so that the external device is activated in the normal condition (i.e., instrument is powered and no alarm condition exists.



⚠ 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 49.

3. Operation

Overview

The 873A functions in two main modes, OPERATE and CONFIGURE.

As soon as the 873A Analyzer is powered, it is in the OPERATE mode. The instrument first conducts a self diagnostic, then automatically displays the measurement and outputs a proportional analog signal. Any error or alarm condition is alternately displayed with the measurement on the LED display. If two or more errors/alarms exist simultaneously, the analyzer will flash only the one with the highest priority. If the highest priority error/alarm is cleared and a lower priority error/alarm still remains, the analyzer will then flash the highest priority of those remaining.

Also, while in the OPERATE Mode, you may view the process temperature and all the parameter settings configured in the Configuration Setup Entries.

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

Utilizing either mode requires understanding the functions of both the display and keypad.

Display

The display, Figure 12, is presented in two parts, a measurement/settings display and a backlit engineering units display. There are three possible automatic measurement displays as follows:

- The measurement expressed in µS/cm;
- The measurement expressed in mS/cm;
- The % concentration expressed in %.

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

Keypad

The keypad, shown in Figure 12, consists of eight keys, four of which are dual function. The white lettered keys represent normal functions and the green lettered keys represent alternate functions. To operate a white lettered function key, just press the key. To operate a green lettered function key, press/hold the **Shift** key and then press the function key. The notation used to describe this operation is **Shift +** (key). All key functions are described in Table 4.

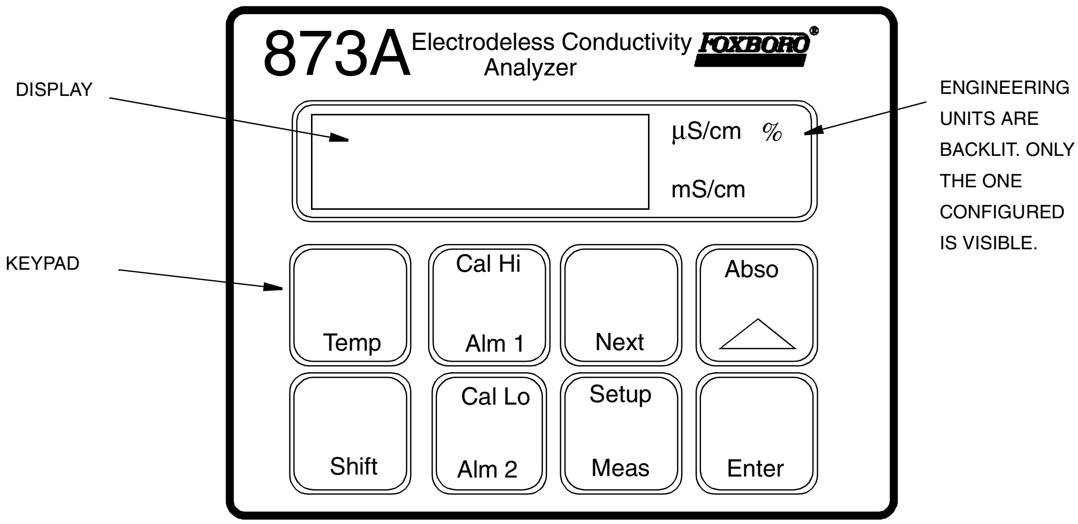


Figure 12. Display and Keypad

Table 4. Keypad Function

Key	Function
Shift	**Shift:** Press and hold this key to actuate the green dual-function keys.
Abso △	**Absolute**: Press key to display conductivity value without temperature correction. **Increment**: Press this key to increase the display count. Each press increases the value by one. Press and hold to increase the count at a rate of approximately one per second. When 9 is reached, display goes to 0.
Temp	**Temp**: Causes the process medium temperature or manually set value to appear on the display. A rounded value with legend (C or F) shown will alternate 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**: Press this key to display the value or code of a setup entry. You can also use this key to select a parameter or code by entering the value or code into memory.

Table 4. Keypad Function (Continued)

Key	Function
Next	**Next:** Used to select one of the four display digits similar to a cursor except causes digit to flicker. Also used to select the next entry choice of the setup function.
Setup Meas	**Setup:** Press/hold **Shift** and press this key to access the configuration entry function. **Meas:** Press this key at any time to return to Measure mode from other modes.
Cal Lo Alm 2	**Cal Lo:** Press/hold SHIFT and press this key to access the lower calibration function of the analyzer. (Shifts y-intercept or offset voltage). **Alm 2:** Press this key to display and/or change the set point of Alarm 2.
Cal Hi Alm 1	**Cal Hi:** Press/hold SHIFT and press this key to access the upper calibration function of the analyzer. (Changes slope or gain of analyzer). **Alm 1:** Press this key to display and/or change the set point of Alarm 1.

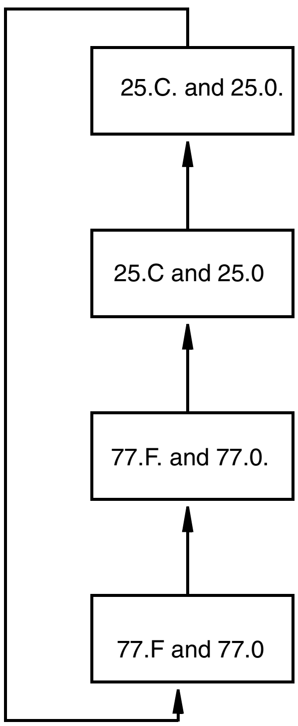
— NOTE

Pressing **Next** and Δ simultaneously allows the user to step backward through the Setup program or digit place movement. One cannot reverse number count by this procedure.
Pressing **Shift** and **Enter** simultaneously circumvents the wait between Setup entries.

To View Process Temperature

To view the process temperature from the measurement mode, press the **Temp** key. The display changes from the measurement to the process temperature or manually adjusted temperature. The display is a rounded whole number with the temperature units (C or F) alternating with tenths of degrees and no units.

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 pressed, the process temperature is displayed on the readout. Pressing Δ causes the display to sequence from the displayed value through the following sequence:



When the decimal point after the C or F is present, the process will be temperature compensated *manually* at the temperature displayed. If another manual compensation temperature is desired, use **Next** and Δ to change the display to the desired temperature; then press **Enter**. The process will then be compensated to the new displayed temperature. To return to automatic compensation, sequence the display to remove the decimal point after C or F. Automatic temperature compensation cannot be adjusted by this procedure. See “Temperature Cell Factor (tCF) Adjustments” on page 42 for adjusting temperature in the automatic mode.

— **NOTE**

To make a minus sign appear on the display, make sure that a number other than zero is present on the display and change the first digit of the number to a minus sign.

For example, to make the display read -20°C, first display 020.°C, and then change the first digit to a minus sign.

To View Setup Entries

Setup Entries may be viewed at any time. To view any of the Setup Entries, do the following:

1. Press **Shift + Setup**.
2. If necessary, press **Next** until the desired parameter to be viewed is displayed.
3. Press **Enter**.

When viewing the Setup Entries, you may page through the parameters as rapidly as you wish (**Shift** + **Setup** and then **Next** one or more times). However, once **Enter** is pressed (**Enter** must be pressed to read a parameter value), you must wait (value is displayed for approximately four minutes) for the parameter symbol to reappear.

— NOTE

Pressing **Shift + Enter** overrides this wait.

The parameter symbols appear for about four minutes also. If another key is not pressed in this period, the display defaults to the measurement.

To make changes to any Configuration Setup parameter, refer to “Configuration” on page 29.

4. Configuration

User Configuration Setup Entries

This instrument is shipped with either factory default settings or user-defined settings, as specified per sales order. Table 5 lists all the parameters that can be changed. It lists the displayed symbol, a description of the display, the factory default value and a space to write user settings.

Table 5. User Configuration Setup Entries

Displayed Symbol	Parameters and Values Accessed	Factory Default	User Settings
U_tC	Units and Temperature Compensation	Per S.O.	
AL_1	Alarm 1 Off/Hi/Lo Active	1oFF	
AL_2	Alarm 2 Off/Hi/Lo Active	2oFF	
Aohi	Analog Output High (100%)	FSC	
Aolo	Analog Output Low (0%)	00.00	
SEnS	Sensor	Per S. O.	
FSC	Full Scale Value	Per S. O.	
tCF	Temperature Cell Factor	25.00	
LAdJ	Analog Out Electronics Lower Calibration	4.000 mA	
HAdJ	Analog Out Electronics Upper Calibration	20.00 mA	

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

1. Press **Shift + Setup**.
2. If necessary, Press **Next** until the desired parameter to be changed is displayed.
3. Press **Enter**.
4. Use **Next** and ∆ until the desired code or value is displayed.
5. Press **Enter**.
6. Press **Meas** to return to the measure mode.

Units and Temperature Compensation (U_tC)

This procedure is used to set the instrument's temperature compensation, units of measure, and damping.

1. Press **Shift + Setup**.
2. If necessary, press **Next** until "U_tC" appears on the display.
3. Press **Enter.**
4. Press **Next** until desired U_tC state is displayed. See Table 6.

5. Press **Enter** to set state.
6. Press **Meas** to return to the measure mode or **Shift + Enter** to return to setup menu item “U_tC”.

Table 6. U_tC Settings

U_tC State	Meaning	Process Temp Range	Reference Temp
NACL	Dilute NaCl solution with water subtraction. For dilute solutions and pure water. Measure units Conductance with 10 second damping.	32 to 392°F	25°C (77°F)
HCL	Hydrochloric Acid (HCl). From dilute solutions up through 15%. Measure units Conductance with 10 second damping.	14 to 252°F	25°C (77°F)
HC.L %	Hydrochloric Acid (HCl). From dilute solutions up through 15%. Measure units % Concentration with 10 second damping.	14 to 252°F	25°C (77°F)
h2So	Sulfuric Acid (H_2SO_4). From dilute solutions up through 25%. Measure units Conductance with 10 second damping.	32 to 216°F	25°C (77°F)
h2.So %	Sulfuric Acid (H_2SO_4). From dilute solutions up through 25%. Measure units % Concentration with 10 second damping.	32 to 216°F	25°C (77°F)
H2SO	Sulfuric Acid (H_2SO_4). From 93% to 99.55%. Measure units Conductance with 10 second damping.	122 to 249°F	50°C (122°F)
H2.SO %	Sulfuric Acid (H_2SO_4). From 93% to 99.55%. Measure units % Concentration with 10 second damping.	122 to 249°F	50°C (122°F)
nAoh	Sodium Hydroxide (NaOH). From dilute solutions through 15%. Measure units Conductance with 10 second damping.	31 to 250°F	25°C (77°F)
nA.oh %	Sodium Hydroxide (NaOH). From dilute solutions through 15%. Measure units % Concentration with 10 second damping.	31 to 250°F	25°C (77°F)
NAOH	Sodium Hydroxide (NaOH). From dilute solutions through 20%. Measure units Conductance with 10 second damping.	147 to 252°F	100°C (212°F)
NA.OH %	Sodium Hydroxide (NaOH). From dilute solutions through 20%. Measure units % Concentration with 10 second damping.	147 to 252°F	100°C (212°F)
bCAL	No temperature Compensation. Absolute electrodeless conductivity with no damping. This should be used during calibration.	N/A	N/A

Alarms

General Information About Alarms

Dual Independent, Form C dry alarm contacts, rated at 5A noninductive, 125 V ac/30 V dc are provided. Each of the two alarms is configured as off or as a high or low alarm. A low alarm relay will trip on decreasing measurement. A high alarm relay will trip on increasing measurement. Therefore, combinations of high, low, high/low, low/low, and high/high alarms are possible. The alarm deadband is always set at 1% of the full scale measurement value.

⚠ 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 49.

Correct wiring of the contacts is necessary for failsafe operation. See “Wiring of Alarms” on page 21 for wiring information.

Alarm conditions (AL 1, AL 2, or A1A2) are alternately displayed with the measurement on the LED display.

NOTE

Upon powering the instrument: Alarm operation is delayed for a time period proportional to the 10 second factory set damping time. Alarms will remain “OFF” until the measurement has stabilized.

Alarm Configuration

You can configure each alarm to be a high alarm, a low alarm or in the off state.

To configure Alarm 1:

1. Press **Shift** + **Setup**.
2. If necessary, press **Next** until “AL_1” appears on the display.
3. Press **Enter.**
4. Press **Next** until desired alarm state is displayed.

AL_1 states	1oFF	1_Hi	1_Lo

5. Press **Enter** to set state. The configured state appears on the display (e.g., 1_Lo).
6. Press **Meas** to return to measure or **Shift** + **Enter** to return setup menu item “AL_1”.

To configure Alarm 2:

1. Press **Shift** + **Setup**.
2. If necessary, press **Next** until “AL_2” appears on the display.
3. Press **Enter.**
4. Press **Next** until desired alarm state is displayed.

AL_2 states	2oFF	2_Hi	2_Lo

5. Press **Enter** to set state. The configured state appears on the display (e.g., 2_Hi).
6. Press **Meas** to return to measure mode or **Shift + Enter** to return setup menu item "AL_2".

Setting Alarm Level(s)

This procedure is relevant only when the alarms were configured as Low or High Alarms as explained in the previous section. When the alarms are configured as Off, alarm level settings have no relevance.

To set the level of Alarm 1:

1. Press **Alm 1**.
2. Use the **Next** key to select each digit and the ∆ key to change the value of the digit selected.
3. Press **Enter**.

To set the level of Alarm 2:

1. Press **Alm 2**.
2. Use the **Next** key to select each digit and the ∆ key to change the value of the digit selected.
3. Press **Enter**.

Press **Meas** to return to measure mode.

Output

Scaling the Analog Output

The 873AEC Analyzer has one analog output. The output is linearly proportional to the displayed variable, either µS/cm, mS/cm, or percent (%). The maximum span that should be set on the analyzer is the FSC (full scale) value. The minimum span that should be set is 10% of the FSC value. Although it is physically possible to set the analyzer for a smaller range, a loss of accuracy is possible. The analog output could develop steps instead of following the measurement in a continuum.

The analog output signal may be scaled so as to improve sensitivity of the analog output in the range of interest.

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

Analog Output 100% Value (Aohi)

This enables the user to assign a measurement value to the maximum analog output (either 10 V or 20 mA dc). For example, a user may wish to retransmit 4 to 20 mA dc over a conductivity range of only 10 to 15 µS/cm. This parameter would allow the assignment of the 20 mA dc output to a value of 15 µS/cm.

1. Press **Shift + Setup**.
2. If necessary, press **Next** until "Aohi" appears on the display.

3. Press **Enter.**
4. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the value 15.00 µS/cm is displayed.
5. Press **Enter.**
6. Press **Meas** to return to measure or **Shift + Enter** to return setup menu item “Aohi”.

— NOTE

Invensys Foxboro preconfigures the 100% value to be equal to the specified full scale measurement per sales order.

Analog Output 0% Value (Aolo)

This enables the user to assign a measurement value to the minimum analog output (either 0 V, 0 mA or 4 mA dc). In the above example, the user would assign the minimum analog output to a value of 10 µS/cm.

1. Press **Shift + Setup**.
2. If necessary press **Next** until “Aolo” appears on the display.
3. Press **Enter**.
4. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the value 10.00 µS/cm is displayed.
5. Press **Enter**.
6. Press **Meas** to return to measure or **Shift** + **Enter** to return setup menu item “Aolo”.

Analog Output Calibration (LAdJ, HAdJ)

This procedure is used to calibrate the Analog output. This has been done at the factory and should not require recalibration unless the type of output has been changed. An ammeter or voltmeter is required.

1. Connect an ammeter/voltmeter to the analog output terminals. See Wiring section “Wiring of Plastic Enclosure” on page 18 and “Wiring of Metal Enclosure” on page 19.
2. Press **Shift + Setup**.
3. If necessary, press **Next** until “LAdJ” or “HAdJ” appears on the display.
4. Press **Enter**, the display will show “Linc”.
5. Press **Next** to select the desired adjustment value:
   - Linc - Large increment ~ +0.3 mA or ~ +0.15V
   - inc - increment ~ +0.025 mA or ~ +0.01V
   - Sinc - Small increment smallest possible + adjustment 1/20 the size of inc
   - LdEc - Large decrement ~ -0.3 mA or ~ -0.15 V
   - dEc - decrement ~ -0.025 mA or ~ -0.01 V
   - SdEc - Small decrement smallest possible - adjustment 1/20 the size of dEc

6. Press **Enter** to change analog output and observe the new reading on your meter.
7. Repeat Steps 5 and 6 until desired meter value is observed.
8. Press **Meas** to return to measure or **Shift + Enter** to return setup menu item "LAdJ" or "HAdJ".

Changing Sensors (SEnS)

The 873A EC Analyzer can be used with the following 871EC sensors.

Table 7. SEnS Settings

SEnS Value	871EC Sensor Types
1	UT/LB
2	RE/BW/EV
3	AB/1F/2E
4	SP/HP
5	TF
6	NL
7	PN/PX/1D
8	1C
9	1G/1H
10	1E
11	2G/2H4/4G
12	2J
13	2D
14	143F/3G
15	3E

1. Press **Shift + Setup**.
2. If necessary press **Next** until "SEnS" appears on the display.
3. Press **Enter**.
4. Press **Next** until desired "SEnS" value is displayed.
5. Press **Enter**.
6. Press **Meas** to return to measure or **Shift + Enter** to return setup menu item "SEnS".

Selecting a Full Scale Range (FSC)

Selecting FSC for Measurements in Conductance Units (µS/cm or mS/cm)

- Determine the lowest conductivity reading expected.
- Determine the highest conductivity reading expected.
- Determine the type of sensor being used.
- Use Table 8 and Table 9 to choose appropriate full scale range.

Table 8. Full Scale Range Settings, Invasive Sensors

Full Scale Range	Sensor Type						
	UT/ LB	EV [(a)]	RE BW/AB [(a)]	SP HP [(b)]	TF [(b)]	NL [(b)]	PN PX [(b)]
0 to 50 µS/cm	yes	no	no	no	no	no	no
0 to 100 µS/cm	yes	no	no	no	no	no	no
0 to 200 µS/cm	yes	yes	no	no	no	no	no
0 to 500 µS/cm	yes	yes	no	no	no	no	no
0 to 1 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 2 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 5 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 10 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 20 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 50 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 100 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 200 mS/cm	yes	yes	yes	yes	yes	yes	yes
0 to 500 mS/cm	no	yes	yes	yes	yes	yes	yes
0 to 1000 mS/cm	no	yes	yes	yes	yes	yes	yes
0 to 2000 mS/cm	no	no	no	yes	yes	yes	yes

(a) Minimum lower measurement: 100µS/cm

(b) Minimum lower measurement: 500 µS/cm

.

Table 9. Minimum and Maximum Full Scale Range Settings, Flow-Through Sensors

Conductivity Range	Sensor Type									
	2C/ 1D/ 1E	2D	2E	2F/ 4E	2G/2H 4F/4G	2J	1C/3E 3F/3G	1F/ 1G 1H	1J	4H/4J 3H/3J
0 to 50 µS/cm				yes	yes	yes			yes	tbd
0 to 100 µS/cm				yes	yes	yes		yes	yes	
0 to 200 µS/cm			yes	yes	yes	yes		yes	yes	
0 to 500 µS/cm	yes	yes	yes	yes	yes	yes		yes	yes	
0 to 1000 µS/cm	yes	yes	yes	yes	yes	yes	yes	yes	yes	
0 to 50 mS/cm	yes	yes	yes	yes	yes	yes	yes	yes	yes	
0 to 100 mS/cm	yes	yes	yes	yes	yes		yes	yes	yes	
0 to 200 mS/cm	yes	yes	yes	yes			yes	yes	yes	
0 to 500 mS/cm	yes	yes	yes				yes	yes	yes	
0 to 1000 mS/cm	yes	yes					yes	yes		
0 to 2000 mS/cm	yes						yes			

Selecting FSC for Measurements in Concentration Units(%)

Each 873AEC Analyzer has the following standard % concentration calibration curves.

Table 10. Concentration Curves

Calibration Curve	Reference Temperature
Hydrochloric Acid (HCl); 0 to 15%	25°C
Sulfuric Acid (H_2SO_4); 0 to 25%	25°C
Sulfuric Acid (H_2SO_4); 99.5 to 93%	50°C
Sodium Hydroxide (NaOH); 0 to 15%	25°C
Sodium Hydroxide (NaOH); 0 to 20%	100°C
Sodium Chloride (NaCl); dilute	25°C

Any % concentration measurement which falls inside the bounds of the calibration curves shown above can be accomplished with an 873AEC unit configured appropriately.

It is not necessary to accommodate the highest conductance value in the full standard range. It is ONLY necessary to choose a full scale range high enough to accommodate the highest conductance value in the specific application.

Determine the highest equivalent conductance at reference temperature for the % concentration readings expected. Refer to Table 11 for a listing of many common electrolytes. Determine the type sensor being used. Refer to Table 8 and Table 9 to choose an appropriate full scale range.

Table 11. Percent Concentration and Equivalent mS/cm Conductivity

Percent Concentration	Conductivity mS/cm	Ref. Temp. °C
0 to 3% NaOH	0 to 145	25
0 to 5% NaOH	0 to 223	25
0 to 10% NaOH	0 to 355	25
0 to 15% NaOH (c)	0 to 410	25
0 to 20% NaOH (a,c)	0 to 1260	100
0 to 3% HCl	0 to 285	25
0 to 5% HCl	0 to 432	25
0 to 10% HCl	0 to 697	25
0 to 15% HCl (c)	0 to 819	25
0 to 3% H_2SO_4	0 to 136	25
0 to 5% H_2SO_4	0 to 219	25
0 to 10% H_2SO_4	0 to 425	25
0 to 15% H_2SO_4	0 to 592	25
0 to 20% H2SO4	0 to 716	25
0 to 25% H_2SO_4 (c)	0 to 790	25
99.5 to 93% H_2SO_4 (b,c)	65.3 to 232.3	50

a. Reference temperature = 100°C (212°F)
Thermistor value = 5569.3 Ω
RTD Value = 138.5 Ω

b. Suppressed-zero conductivity = 65.3 mS/cm
Reference temperature = 50°C (122°F)
Thermistor value = 33591 Ω
RTD Value = 119.4 Ω

c. Standard Ranges. Refer to Table 6, "U_tC Settings," on page 30.

Changing the Full Scale (FSC)

This parameter allows the user to select one of several possible ranges. The analyzer accuracy is 0.5% of the FSC chosen. Thus, for best accuracy, the FSC should be set as low possible while still allowing all measurement values to fall within it.

On the lower ranges, the analyzer displays values to the thousandths place.

The analyzer is capable of displaying values greater than that set by the FSC ranges. For example, when the FSC is on the 0 to 5.000 mS/cm range, it can display up to 9.999 mS/cm.

Procedure to change FSC:

1. Press **Shift + Setup**.
2. If necessary, press **Next** until "FSC" appears on the display.
3. Press **Enter**.
4. Press **Next** until the desired value is displayed.
5. Press **Enter**.
6. Press **Meas** to return to the measure mode.

— NOTE
SEnS must be entered correctly before the FSC is changed.

5. Calibration

Electronic Bench Calibration

This procedure is used to calibrate the 873AEC Analyzer with precision resistors and theoretical sensor signal values. In many cases this calibration produces sufficient accuracy for the user's application.

Required:

Precision resistors corresponding to the High Cal value, a 100 kΩ or 110 Ω resistor temperature simulation, or a decade resistance box are required for this procedure.

Procedure:

1. Remove power to analyzer.
2. Access sensor terminal block TB2 by removing four screws from back cover to connections on metal field-mounted unit.
3. Connect sensor leads 1-5 to terminal block TB2. NOTE: 3A is not used. If sensor is being calibrated in the field, remove sensor from process medium. Clean and dry off. Disconnect leads 6 and 7.
4. Verify the Temperature Circuit Calibration:
   a. Determine which type temperature compensation your analyzer is set up for by checking the CONFIG CD entry on the data label affixed to the analyzer (see Figure 4.

— NOTE

Sensor types LB, NL, RE, EV, TF and SP use a 100 kΩ thermistor for automatic temperature compensation. Sensors UT, BW and HP use a 100 Ω RTD for automatic temperature compensation and are recommend for all measurements at elevated temperature.

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   b. Connect the appropriate resistor across terminals 6 and 7 on terminal block TB2.
   c. Apply power to analyzer
5. Put unit in Automatic Temperature mode.
   a. Press **Temp**, no decimal point should be visible after the "C" or "F" legend. If there is it must be removed.
   b. Press Δ once after pressing **Temp.**
   c. Press **Enter**. This removes the decimal point.
6. Reset "tCF" parameter to 25.00 (the theoretical temperature transducer value). See "Determining Temperature Cell Factor (tCF)" on page 42.
   a. Press **Next** until "tCF" is displayed.
   b. Press **Enter**.

c. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the display reads 25.00.

d. Press **Enter**.

e. Press **Temp**. The display should read **approximately** 25°C or 77°F. If the display does not read these values, verify that the correct resistor is being used and ensure that it is correctly installed. If these measures do not improve the value, return unit to Invensys Foxboro.

7. Verify and reset "SEnS" parameter.

 a. Press **Shift + Setup**.

 b. Press **Next** until "SEnS" is displayed.

 c. Press **Enter**.

 d. Press **Next** until desired "SEnS" value is displayed; see "Changing Sensors (SEnS)" on page 34.

 e. Press **Enter**.

 f. Press **Shift + Enter** to return to "SEnS".

8. Reset the "FSC" parameter. Even if the existing Full Scale value is the desired value, it is necessary to reenter the value.

 a. Press **Next** until "FSC" is displayed.

 b. Press **Enter**.

 c. Press **Next** until desired value is displayed; see "Selecting a Full Scale Range (FSC)" on page 34.

 d. Press **Enter**, even if the desired value is displayed.

 e. Press **Shift + Enter** to return to "FSC."

9. Set the "U_tC" parameter to "bCAL" to have unit with no damping and to utilize absolute temperature compensation.

 a. Press **Next** until "U_tC" is displayed.

 b. Press **Enter**.

 c. Press **Next** until "bCAL" is displayed.

 d. Press **Enter**.

 e. Press **Meas** to return to the measure mode. The error message "**LCAL**" will begin to flash on the display.

Zero And Span Calibration

1. Suspend the clean dry sensor in the air. An open loop (Infinite Resistance) is used to calibrate at 0 μS/cm or 0 mS/cm.

2. Wait at least 15 seconds for the electronics to stabilize, then perform the **Cal Lo** procedure.

 a. Press **Shift + Cal Lo**.

b. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the value 0 µS/cm or 0 mS/cm, as applicable is displayed.

c. Press **Enter**. When the instrument returns to measure mode it should flash the Error message "**HCAL**".

3. Route resistance loop from a decade resistance box through sensor as shown in Figure 13.

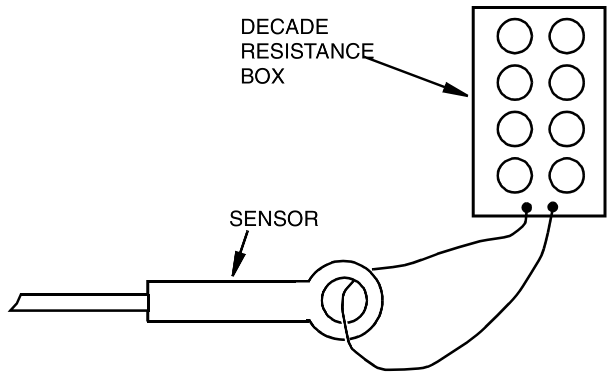

Figure 13. Connection of Loop Resistance

4. Calculate the Resistance Input required for **Cal Hi** value. The **Cal Hi** value should fall with the range of the FSC that has been chosen and closest to the process control point for the most accuracy. The cell factor is required for this calculation.

Table 12. Sensor vs. Cell Factor

Sensor Type	Cell Factor
EV, AB	0.45
NL	2.35
TF	2.31
SP, HP	2.15
RE, LB, UT, BW	0.873
PN, PX	2.45
Flow-Through	See MI 611-202

$$\text{Resistance Input in ohms} = \frac{\text{Cell Factor} \times 1000}{(\text{Cal Hi Value in mS/cm})}$$

5. Set decade box to calculated resistance input. Wait at least 15 seconds. Then perform the **Cal Hi** procedure.

a. Press **Shift + Cal Hi**.

b. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the desired **Cal Hi** value is displayed.

c. Press **Enter**.

d. Press **Meas** to return to measure mode.

6. Reset “U_tC” parameter to desired state.

a. Press **Shift** + **Setup**.

b. Press **Next** until “U_tC” is displayed.

c. Press **Enter**.

d. Press **Next** until desired state is displayed.

e. Press **Enter**.

f. Press **Meas** to return to measure mode.

Temperature Cell Factor (tCF) Adjustments

An accurate temperature signal is required for proper temperature compensation, especially when measuring over a large temperature gradient. The Temperature Cell Factor (**tCF**) is used to offset a small deviation from the ideal. This procedure ***must*** be used when extension cables are used.

Determining Temperature Cell Factor (tCF)

1. Place the 871EC sensor and an accurate Celsius thermometer (with 0.10°C resolution) into a container of water. Allow the system to reach thermal equilibrium (several minutes).
2. Press **Temp**. Then using the Δ key, put the analyzer into Automatic Temperature Compensation with a Celsius readout (no decimal point after the C). See “To View Process Temperature” on page 26. Press **Enter**. The current temperature is displayed as a whole number with the unit C alternating with the value expressed to the tenths place.
3. The value read by the 873A must now be viewed to the hundredths place. To do this, press **Temp** and then press **Next** five times. Because only three digits plus the decimal may be viewed on the display, the first digit will not be visible (e.g. 25.20 will be displayed as 5.20).
4. Determine the temperature difference of the two devices by subtracting the 873A reading from the thermometer reading; e.g., the thermometer reads 24.70°C and the 873A says (2)5.20°C; the difference is 24.70°C – 25.20°C = –0.50°C.
5. Add this value to 25.00°C (e.g., 25.00°C + (–0.50°C) = 24.50°C. This is your temperature cell factor. Now that you’ve determined the tCf, enter it as described in the next section.

Entering a tCF Value

1. Press **Shift** + **Setup**.
2. Press **Next** until “tCF” appears on the display.
3. Press **Enter.**

4. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the desired value is displayed.
5. Press **Enter**.
6. Recheck any differences that exist between the thermometer and temperature displayed on the 873A, using the technique described in the previous section.

Standardization Using a Known Solution

Standardization is a procedure used to set the analyzer/sensor system to agree with the accepted value of a standard solution. Standardization should be performed:

- After a bench/dry calibration as a final check before operation.
- To offset wall effects.
- Once per month for a new installation; more or less frequently for an old installation as dictated by historical need.
- When the measurement value is in doubt.

Because the 873A Analyzer is calibrated at Invensys Foxboro, and unless a recalibration is performed prior to initial installation, a standardization procedure is the final step necessary before operation of the system.

Before performing standardization procedures with a solution, verify that the temperature signal from the sensor is correct. The section on "Temperature Cell Factor (tCF) Adjustments" on page 42 contains a procedure to offset temperature errors.

There are two kinds of standardization procedures: in-line and off-line.

In-Line Type Standardization

The in-line standardization requires the 871EC sensor to remain in the process piping. A sample of process fluid is removed and measured off-line using a second conductivity analyzer. The two measurement values are compared, and the 873A Analyzer is adjusted as necessary to agree with the off-line device.

Advantages

- Fast
- Compensates for installation related measurement effects, such as pipe wall effects.

Disadvantages

- Relies on accuracy of second analyzer.
- Sample may change temperature, keep reacting, absorb CO_2, etc.
- One point check only.

In-Line Standardization Procedure

1. Perform appropriate calibration.
   a. If correcting for a shift in system zero (such as might be present if a sensor becomes magnetized), then press **Shift + Cal Lo** or,
   b. If correcting for a shift in system span (such as might be present if a sensor is too close to a pipe or vessel wall), then Press **Shift + Cal Hi**.
2. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the display reads the value of the known solution.
3. Press **Enter**.
4. Press **Meas** to return to measure mode.

Off-Line Type Standardization

The off-line type of standardization requires the 871EC Sensor to be removed from the process. The 873A/871 system is then checked in either a process sample or with standard conductivity solutions. If checked against a process sample, the use of a second conductivity analyzer is required to verify the value of the solution.

Advantages

- Several different values may be checked.
- Eliminates the need of a second analyzer.

Disadvantages

- Takes more time.
- Requires that the sensor be removed from the process.
- Does not compensate for installation related measurement effects.

Procedure

1. Remove sensor from process medium. Refer to Sensor Master Instruction. Wash the immersion end in distilled water.
2. Dry the sensor completely and let it sit for five minutes to ensure that it has reached room temperature. Verify by pressing **Temp** key. Display should read temperature of area.
3. Perform following calibration:
   a. With the sensor dry and in air, press **Shift + Cal Lo**.
   b. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the display reads 0.
   c. Or, for nonzero calibration, the sensor may be immersed in a known solution of low conductivity. Press **Shift + Cal Lo**.

4. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the display reads the known solution's conductivity.
5. Press **Enter**.
6. Press **Meas** to return to measure mode.
7. Immerse the sensor in the known solution of higher known value. Allow sufficient solution in all directions around the sensor in order to avoid sidewall effects. Small bore sensors must be centered in a minimum 3 inch (7.5 cm) I.D. container and large bore sensors in a 6 inch (15 cm) I.D. container. Allow the sensor to stabilize for at least ten minutes. Ensure that there are no air bubbles trapped in the sensor "donut".

Table 13. Container Diameters

Sensor Type	Minimum Container I.D.
Small Bore: NL, TF, PN, PX, SP, HP	3 inch (7.5 cm)
Large Bore: RE, LB, UT, BW, EV, AB	6 inch (15 cm)
Flow-Through	N/A

8. Press **Shift + Cal Hi**.
9. Use the **Next** key to select each digit and the Δ key to change the value of the digit selected until the display reads the known solution's conductivity.
10. Press **Enter**.
11. Press **Meas** to return to measure mode.
12. Remove the sensor from the known solution. Wash the immersion end with distilled water.

6. Diagnostics

Troubleshooting

Table 14. Troubleshooting Symptoms

Symptom	Approach
Noisy Signal	May be flow related. 1. Check analyzer noise by simulating sensor signal with a resistor. 2. Reorient sensor.
Conductivity Decreases	Gas bubbles may be trapped or sensor coated.
Temperature Reads Incorrectly	1. Check to see if correct tCF is being used. Extension cables and junction box use will require a new tCF be determined. 2. Verify that your 873A is set up for proper temperature transducer. See "Electronic Bench Calibration" on page 39.
Accuracy	1. Accuracy is the sensor may be affected by deposits from the process liquid. Consult sensor MI for cleaning recommendations. 2. Check for wall effects (see "Standardization Using a Known Solution" on page 43).

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 15.

Table 15. Error/Alarm Messages

Alternate Display	Condition	Priority	Action Required to Clear Message
Er 1	Instrument Fault, RAM/ROM, software watchdog timer.	1 (Highest)	Power down unit.
Err	Incorrect code of parameter entered.	2	Check code and reenter.
t Er	Temperature out of range.	3	1. Replace sensor. 2. Place temperature in manual mode (e.g., 25.C.
LCAL	Low calibration required.	4	Use bench calibration procedure to recalibrate analyzer.

Table 15. Error/Alarm Messages (Continued)

Alternate Display	Condition	Priority	Action Required to Clear Message
HCAL	High calibration required.	4	Use bench calibration procedure to recalibrate analyzer.
A1A2	Both alarm relays activated,	5	1. Measurement returns to within alarm bounds. 2. Alarm 1 and Alarm 2 are turned off.
Al 1	Alarm 1 relay activated.	6	1. Measurement returns to within alarm bounds. 2. Alarm 1 is turned off.
Al 2	Alarm 2 relay activated.	6	1. Measurement returns to within alarm bounds. 2. Alarm 2 is turned off.

— NOTE

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

7. 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 load of 20 W or more as shown in Figure 14 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.

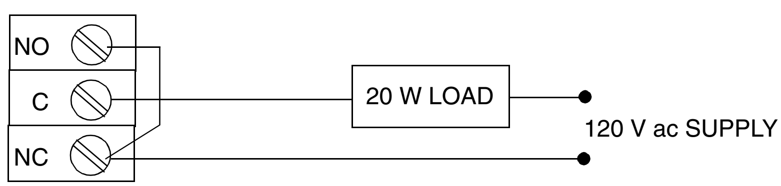

Figure 14. Alarm Contact Reconditioning Circuit

8. Warranty

For sales information or to place an order, contact your local Invensys Foxboro distributor or local Invensys Foxboro sales office.

For Warranty Information 1-800-746-6477

For Electrochemistry Analyzer Repair/Troubleshooting Information 508-549-2168

For Electrochemistry Technical Assistance and Application Support................. 508-549-4730

Or by FAX 508-549-4734

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