Instruction

MI 611-166
June 2004

873CC Series
Electrochemical Analyzers
for Contacting Conductivity Measurement

Style A

invensys®
FOXBORO®

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1. Introduction

General Description

The 873CC 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 873CC for automatic temperature compensation and may be displayed whenever the user wants.

It provides an isolated output signal proportional to the measurement for transmission to an external receiver. The plastic general purpose panel-mounted analyzer transmits one output signal, while the field-mounted (metal enclosure) analyzers can transmit two output signals.

Instrument Features

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

- Plastic or Metal Enclosure
- Dual Sensor Input
- Dual Alarms
- Dual Analog Outputs on Metal Enclosure
- 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, and IEC Degree of Protection IP-45.

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, corrosion-resistant, meeting the enclosure ratings 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

Two independent, nonpowered Form C contacts. Rated 5A 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 77.

No Battery Backup Required

Nonvolatile 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 versions are designed to meet the requirements for Class I, Division 2, Groups A, B, C and D hazardous locations. The 873 Analyzer is approved by Factory Mutual.

Front Panel Display

The instrument's display consists of a 4-digit bank of red LEDs with decimal point, and an illuminated legend area to the right of the LEDs (see Figure 1). 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 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 1.

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 Range, 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 door allows viewing of the display and is hinged for easy access to the front panel controls.

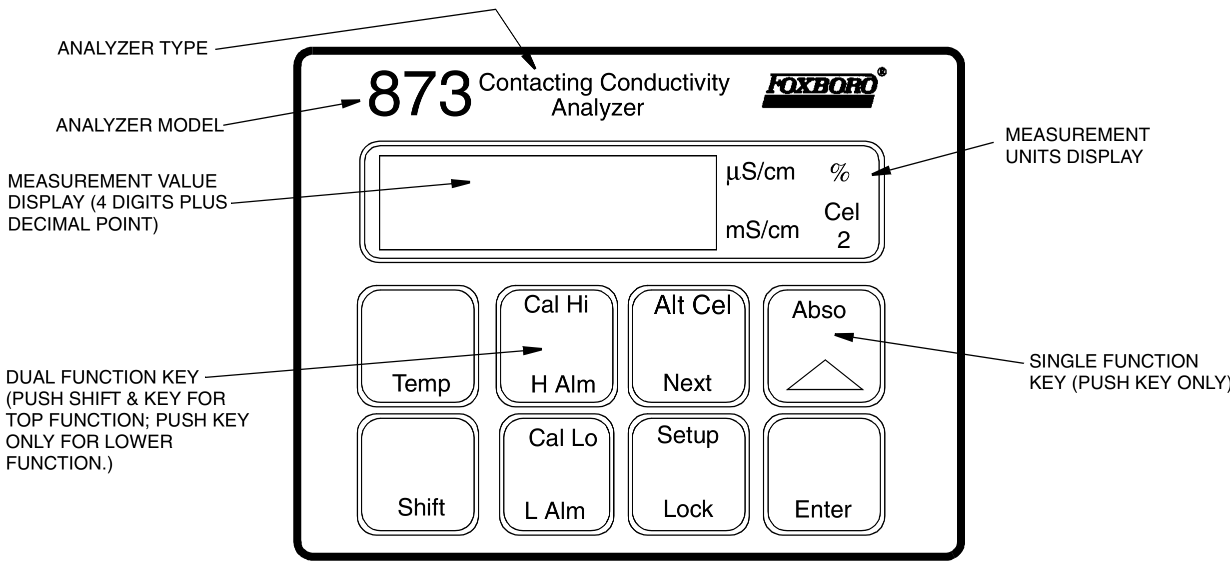

Figure 1. Front Panel Display and Keypad

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 2.

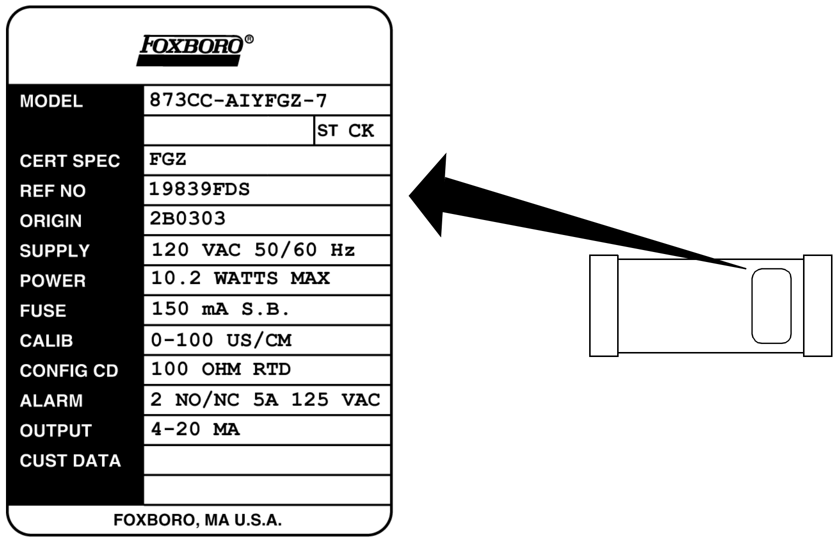

Figure 2. Data Label

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

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

1, 2, 5, 10, 20, 50, 100, 200, and 500 µS/cm;
0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 mS/cm.

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 K Ω thermistor

Temperature Compensation Range

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

Relative Humidity Limits

5 to 95%, noncondensing

Accuracy of Analyzer

±0.5% of upper range limit

Analyzer Identification

Refer to Figure 2.

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

Instrument Response

Two seconds maximum (when zero measurement damping is selected in Configuration Code). Temperature response is 15 seconds maximum.

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)

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 chemical feed, then delay for chemical 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 77.

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 873CC Electrochemical Analyzer, 220 V ac or 240 V ac system with 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 on page 17.

Product Safety Specifications

Testing Laboratory, Types of Protection and Area Classification	Condition of Certification	Electrical Certification 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**) certified for use in general purpose (ordinary) locations.	24 V, 100 V, and 120 V ac (Supply options -A, -E, -J only)	CGZ
CSA (**Canada**) suitable for use in Class 1, 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 safety descriptions noted in the table above. For detailed information or status of testing laboratory approvals and certifications, contact your Invensys Foxboro representative.

! CAUTION

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.

! CAUTION

Exposure to some chemicals may degrade the sealing properties of materials used in the following devices:

Relays K1 and K3: Poly Butylene Tera-ethalate and Epoxy Magnacraft 276XAXH-24

These materials are sensitive to acetone, MEK, and acids. Periodically inspect K1 and K3 for any degradation of properties and replace if degradation is found.

2. Installation

Mounting to a Panel - Plastic Enclosure, 873CC-_ _ P

The plastic enclosure is mounted to a panel as described below (see Figure 3).

1. Size panel opening in accordance with dimensions specified on Dimensional Print 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.

Mounting to a Panel - Metal Enclosure 873CC-_ _ 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 must be removed for this procedure.)

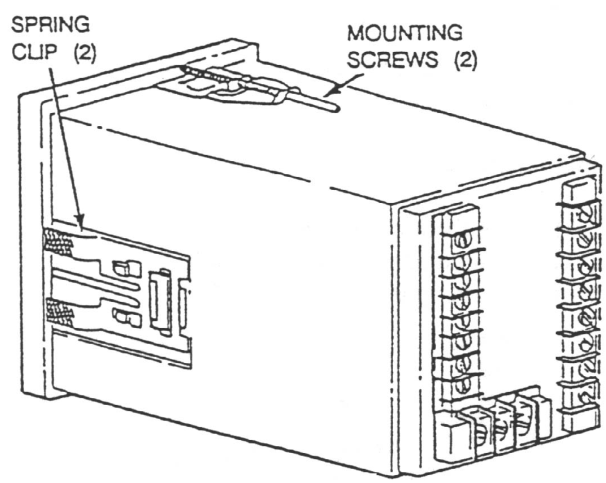

Figure 3. Mounting to Panel - Plastic Enclosure

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 4.
5. Tighten screws (CW) on clamp latches until enclosure is secured to panel.
6. Reassemble rear bezel to enclosure using four screws.

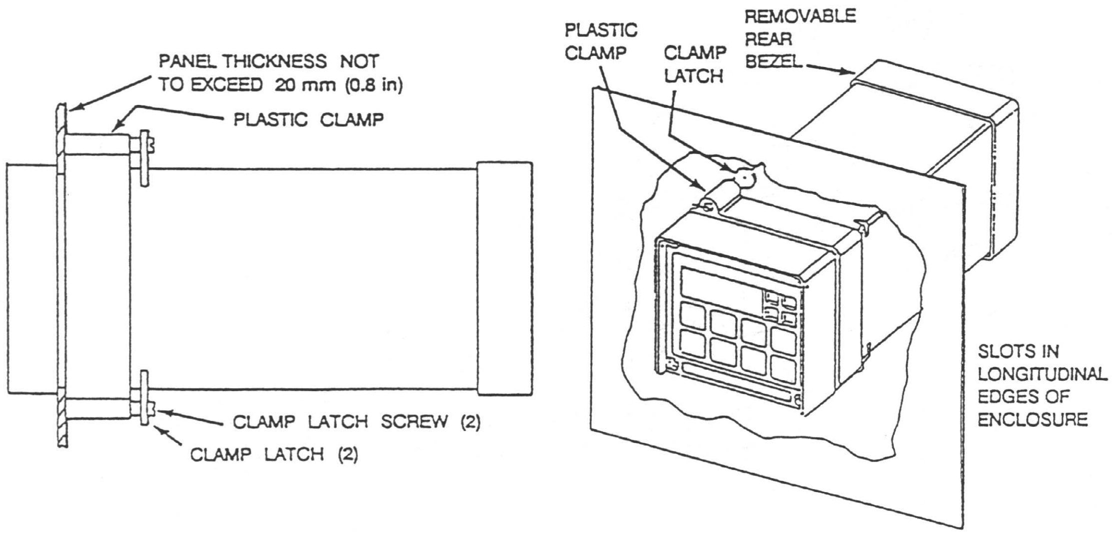

Figure 4. Mounting to Panel - Metal Enclosure

Mounting to Pipe (Metal Enclosure Only) 873CC-_ _ 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, 7, and 13.
3. Slide analyzer into support bracket and slide strap clamp (4) onto Analyzer. Using two sets of 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.

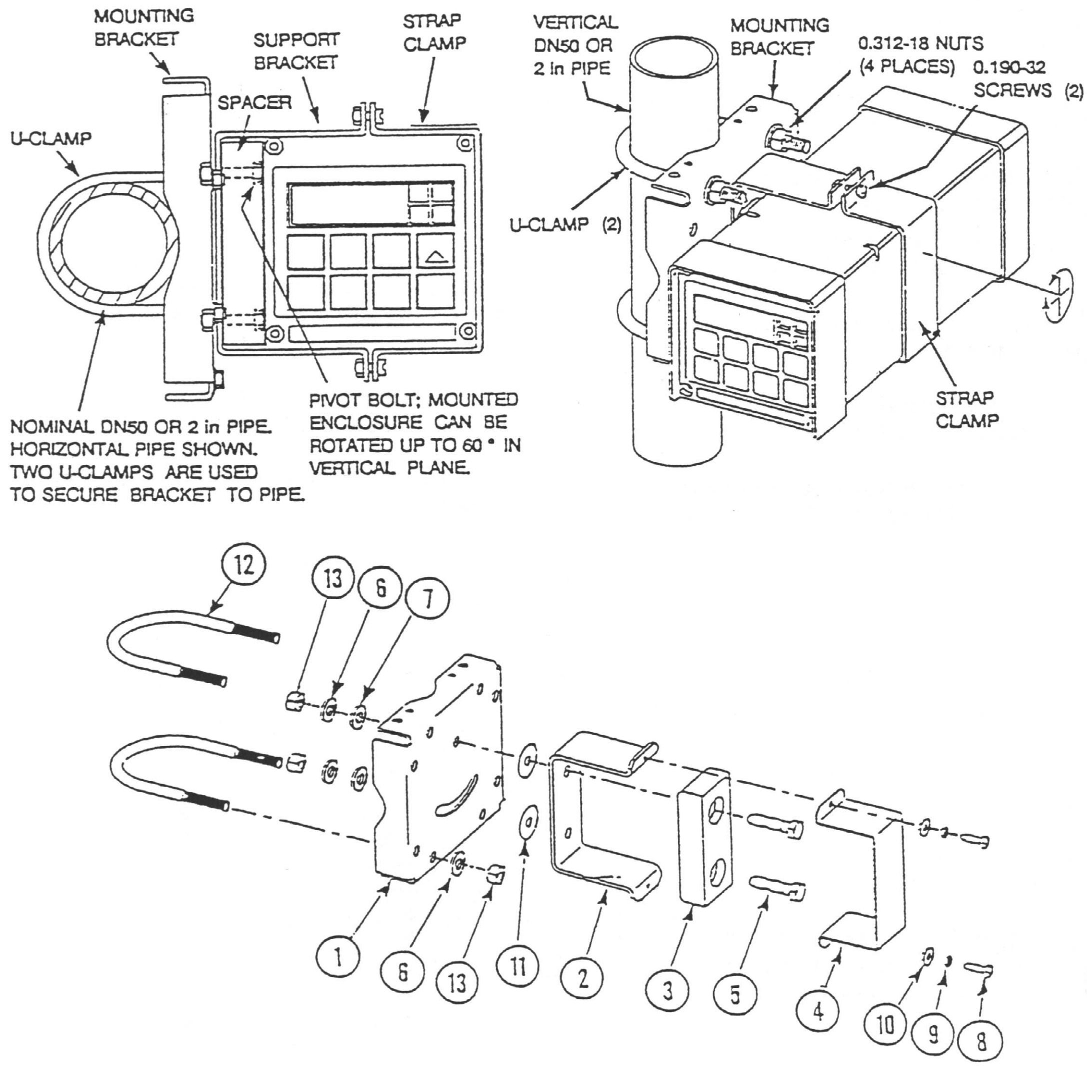

Figure 5. Metal Enclosure - Pipe Mounting

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

1. Locate mounting surface for Analyzer.
2. Referring to Figure 6, 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 sets of 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 sets of bolts, nuts, and washers to attach mounting bracket to surface.

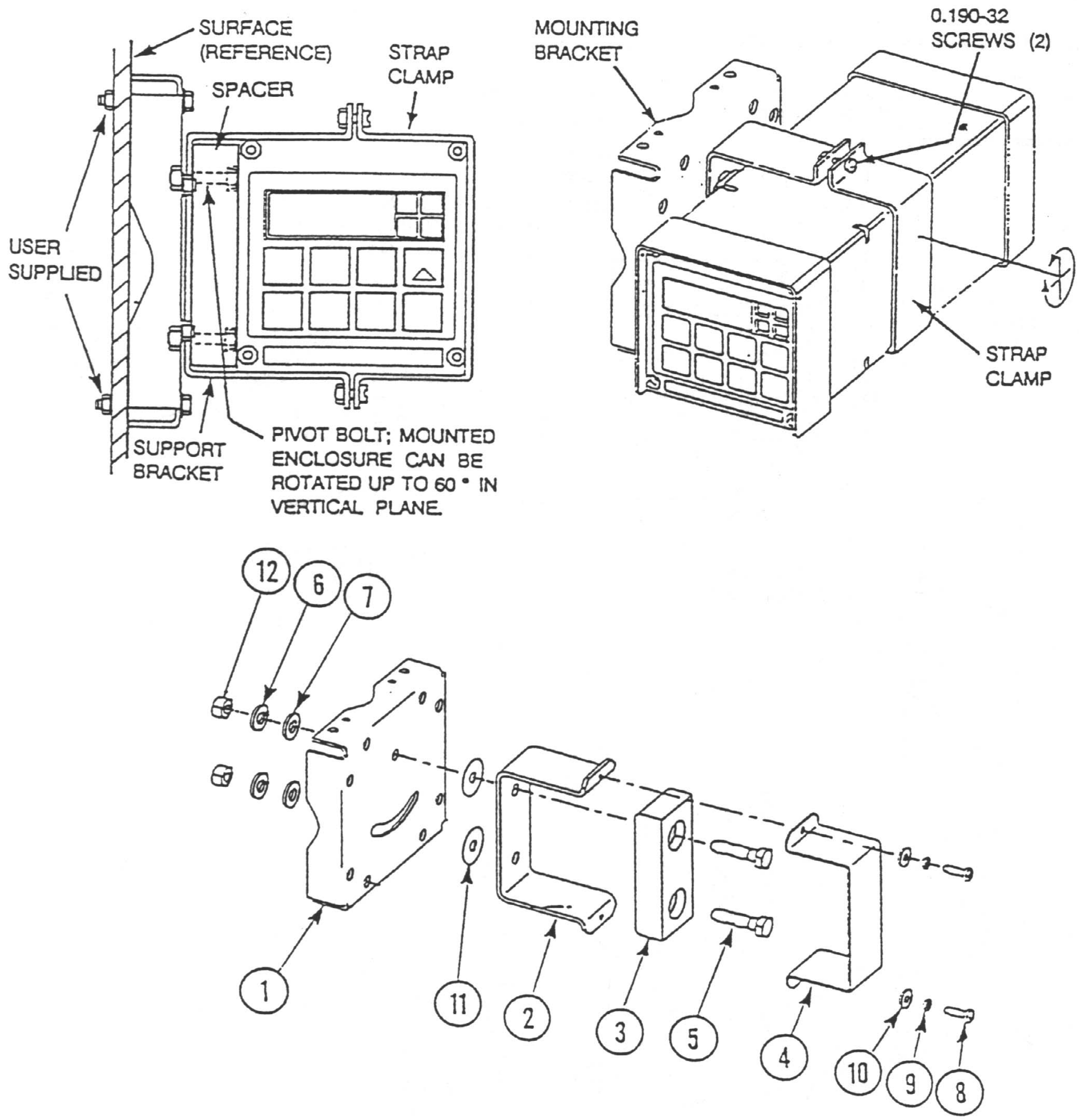

Figure 6. Metal Enclosure - Fixed Mount

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

1. Locate surface on which you wish to mount the Analyzer. Also refer to PL 611-016.
2. Referring to Figure 7, 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 sets of 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 sets of 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.

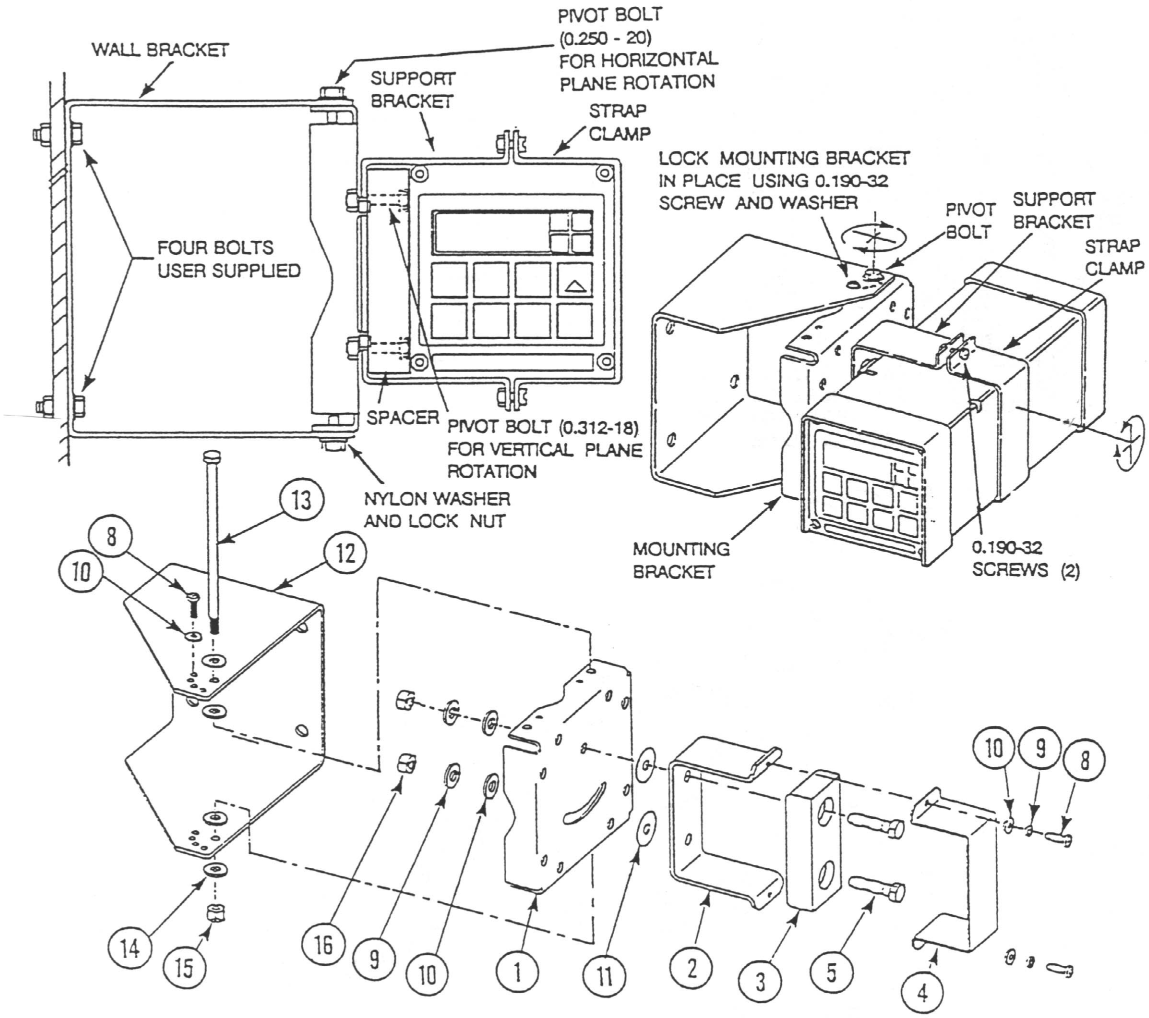

Figure 7. Metal Enclosure - Movable Mount

Wiring of Plastic Enclosure

Wiring installation must comply with any existing local regulations.

1. Remove optional rear cover assembly BS805QK, if present.
2. Connect Hi and Lo alarm wires to TB3 as shown in Figure 8. Fail-safe operation requires connections be made between NC and C and the alarms to be configured active. Refer to "General Information Alarms".
3. Connect wires from external circuit for analyzer measurement output to terminals TB3–1(+) and TB3–2(–). Refer to Figure 8.

— **NOTE**

Only 871CC type Sensors can be used with the 873CC Analyzer. Model 500, 910, 920, 921, and 923 Sensors cannot be used with the 873 Analyzer. The 871CC sensor types "A" through "F" use a 100 K Ω thermistor for automatic temperature compensation. The 871CC Sensors "K" through "M" use a 100 Ω RTD for automatic temperature compensation and are recommended for all measurements at elevated temperatures.

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4. Remove factory-installed jumper assembly from terminal block TB2 and discard.
5. Connect sensor wires to analyzer terminal block (TB2) in accordance with Figure 8. If a single sensor is used with this analyzer, it may be wired to either sensor input. See "User Notes" on page 79 for help with configuring the 873 Analyzer for single or dual sensor use.
6. Connect power wires to terminal block TB1 as shown in Figure 8.
7. Attach optional rear panel cover, if present.

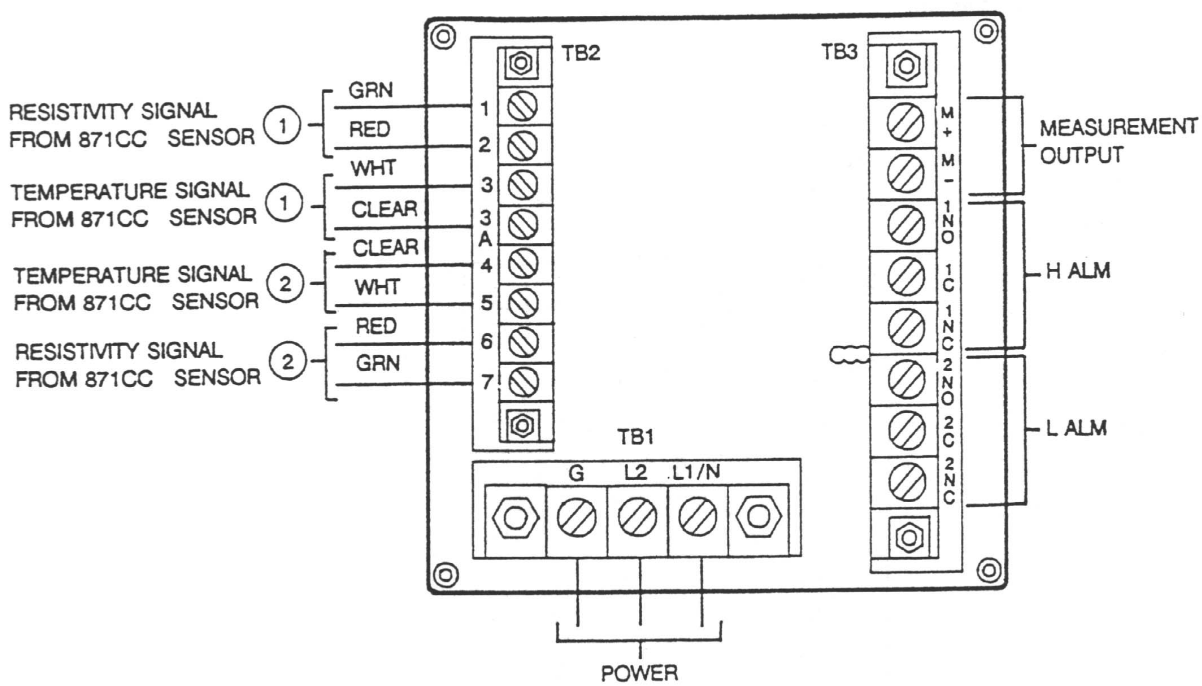


Figure 8. Rear Panel Wiring - Plastic Enclosure

Wiring of Metal Enclosure

— NOTE

1. Wiring installation must comply with any existing local regulations.
2. 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 1 identifies the appropriate parts. 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 Hi and Lo Alarm wires to TB3 as shown in Figure 9. Fail-safe operation requires connections to be made between contacts NC and C, and the alarms to be configured active. Refer also to “General Information Alarms”.
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 9.

— NOTE

Only 871CC type Sensors can be used with the 873CC Analyzer. Model 500, 910, 920, 921, and 923 Sensors cannot be used with the 873 Analyzer. Sensors “A” through “F” use a 100 KΩ thermistor for temperature compensation. Sensors “K” through “M” use a Pt 100 Ω RTD for temperature compensation and are recommended for all work at elevated temperature.

If a single sensor is used with this analyzer, it may be wired to either sensor input. See “User Notes” on page 79 for help with configuring the 873 for single or dual sensor use.

5. Connect power wires to terminal block 1 as indicated in Figure 9. The earth (ground) connection from the power cord should be connected to the stud located in the bottom of the case.

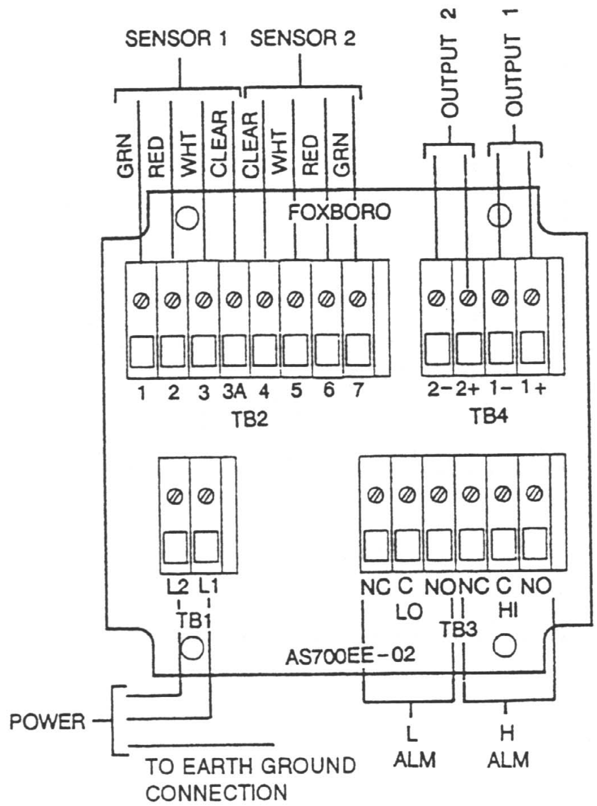


Figure 9. Rear Panel Wiring - Metal Enclosure

Table 1. 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

3. Operation

Overview

The 873 Analyzer functions in two modes, OPERATE and CONFIGURE.

In the OPERATE mode, the 873 Analyzer automatically displays its measurement, and outputs a proportional analog signal. Also, while in the OPERATE mode, you can read all the parameter settings and the solution temperature.

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

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

Display

The display, Figure 10, is presented in two parts, a measurement/settings display and a backlit engineering units display. There are seven possible automatic measurement displays as follows:

- The measurement of Cell 1, expressed in µS/cm.
- The measurement of Cell 2, expressed in µS/cm.
- The ratio between Cell 1 and Cell 2, expressed in %:

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

EXAMPLE: Cell 1 is measuring 50 µS/cm water. Cell 2 is measuring 45.0 µS/cm water. Ratio would read 90.0%.

- The measurement of Cell 1, expressed in mS/cm.
- The measurement of Cell 2, expressed in mS/cm.
- The % rejection between Cell 1 and Cell 2, expressed in %:

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

EXAMPLE: Cell 1 is measuring 50 µS/cm water. Cell 2 is measuring 45.0 µS/cm water. Percent rejection would read 10.0%.

- And with the special curve generation option, % can be illuminated, meaning concentration.

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

Keypad

The keypad, Figure 10, is made up of eight keys, five of which are dual function. The white lettered keys represent normal functions while the green lettered keys represent the alternate function. To operate the white lettered keys, just push them. To operate the green lettered keys, the **Shift** key must first be pushed and held. The function of all keys is presented in Figure 11.

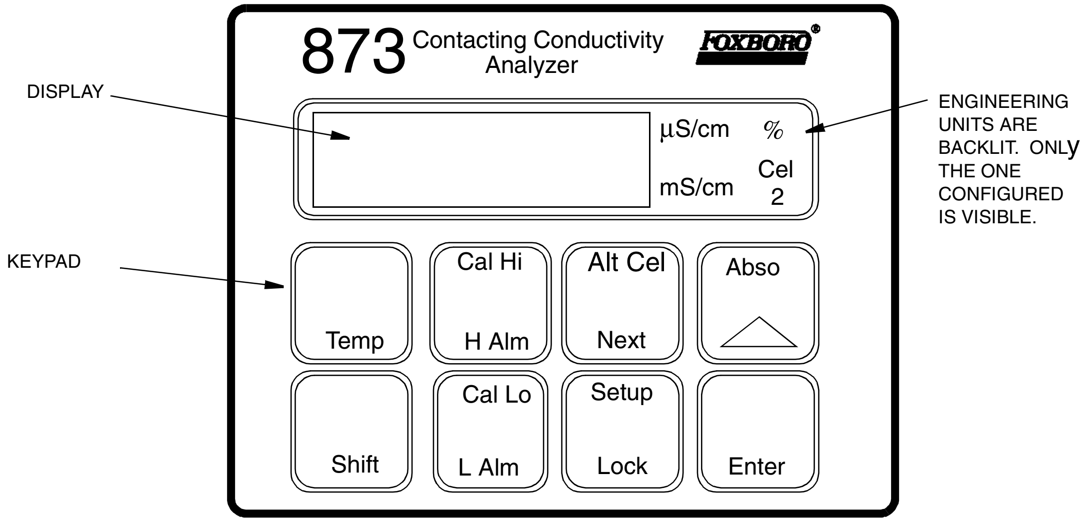
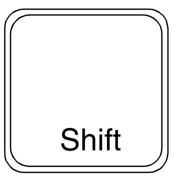
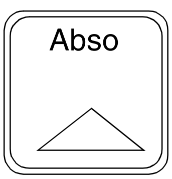


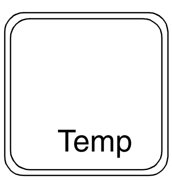
Figure 10. Display and Keypad



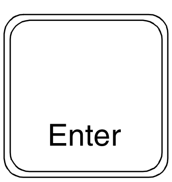
= **Shift:** Press and hold prior to pressing any dual-function key, to activate upper function on dual function key. It is ignored when pressed with single function keys or when pressed alone. However, holding the **Shift** key delays the 10-second time-out to allow longer viewing of a value or code.



= **Absolute:** Press key to display conductivity value of cell displayed without temperature correction. Pressing key in Ratio or % Rejection modes displays Cell 1's absolute conductivity.
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.



= **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:** 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 the 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 % Rejection is displayed 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 causes 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 / L Alm = **Calibration Low:** Used to set the desired lower calibration level during bench calibration.
Low Alarm: Used to display the set point value for the relay associated with this alarm.

Cal Hi / H Alm = **Calibration High:** Used to set the desired upper calibration level during bench calibration.
High Alarm: Used to display the set-point level for the relay associated with this alarm.

— NOTE
Pushing **Next** and Δ simultaneously allows you to step backward through the Setup program or digit place movement. You cannot reverse number count by this procedure.
Pushing **Shift** and **Enter** simultaneously circumvents the 10-second wait between Setup entries.

Figure 11. Key Functions

Operate Mode

As soon as the 873 Analyzer is powered, it is in the Operate mode. The instrument first conducts self-diagnostics, then automatically displays the measurement.

While in the Operate mode, you can 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 conductivity measurement to the process medium temperature or manually adjusted temperature.

The display is a rounded whole number with the temperature units (C or F) alternating with tenths of degrees. Once the unit is unlocked ("Unlocking Analyzer Using Security Code" on page 24), 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 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 push **Enter**. The process will then be compensated to the new displayed temperature. Automatic temperature compensation cannot be changed by this procedure. See "Calibrating the Analyzer to a Specific Sensor" on page 66. 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 can 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. The parameter symbols appear for 10 seconds also. 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, see "Configuration" (Section 4).

4. Configuration

Overview

This instrument is shipped with either factory settings (default values) or user-defined settings, as specified per Sales Order. Table 2 (Configuration Setup Entries) lists all the parameters that are more frequently changed and Table 10 (Basic Setup Entries) lists the parameters that are calibration oriented. Both tables list the displayed symbol, the section 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 two 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. The first level of security protects against unauthorized change of Temp, H Alm, L Alm, Cal Lo, Cal Hi, and all the "Configuration Setup Entries" (of which there are 17) (refer to "Configuration Setup Entries" section). The second level of security protects against the remaining 25 setup entries, called "Basic Setup Entries," 22 of which can be changed in the field (refer to "Basic Setup Entries" section).

Note that **any** of the parameters discussed above 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.

The **same** security code is used to unlock the unit in both levels of security. When the unit is unlocked at the first level (see "Unlocking Analyzer Using Security Code" section), the unit remains unlocked until a positive action is taken to lock the unit again (see “Locking Analyzer Using Security Code” section).

However, when the unit is unlocked using the bL entry at the second level of security (see “Unlocking Basic Setup Entries (bL)” section), it remains 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 reads 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 reads 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 17 parameters. These parameters are process oriented and access to them is passcode protected. Table 2 lists each parameter, with its applicable symbol, in the same sequence as seen on the display. Descriptions of each parameter are given in the following text.

Table 2. Configuration Setup Entries

Displayed Symbol	Page No.	Parameters and Values Accessed	Factory Default	User Settings
CELL		Configuration of Display, Analog Outputs	1113	
Hold		Holds and sets the Analog output value in Hold	0000	
Cd		Compensation and Damping – Damping Factor – Temperature Compensation	0001	
HAC		H Alarm Configuration – Measurement Selection – Low/High/Instrument plus Passive/Active State – % Hysteresis	1403	
HAFt		High Alarm Feed Time	00.00	

Table 2. Configuration Setup Entries (Continued)

Displayed Symbol	Page No.	Parameters and Values Accessed	Factory Default	User Settings
HAdL		High Alarm Delay Time	00.00	
LAC		L Alarm Configuration – Measurement Selection – Low/High/Instrument plus Passive/Active State – % Hysteresis	1203	
LAFt		Low Alarm Feed Time	00.00	
LAdL		Low Alarm Delay Time	00.00	
UL		User-Defined Upper Measurement Limit - Both Cells	per sales order	
LL		User-Defined Lower Measurement Limit - Both Cells	0.00	
UtL		User-Defined Upper Temperature Limit - Both Cells	100.00	
LtL		User-Defined Lower Temperature Limit - Both Cells	0.00	
HO1		100% Analog Output - Channel 1	per sales order	
LO1		0% Analog Output - Channel 1	0.00	
HO2		100% Analog Output - Channel 2	100°C	
LO2		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”).
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 Δ until the desired code or value is displayed.
6. Press **Enter**.
7. Lock analyzer (see “Locking Analyzer Using Security Code”).

— **NOTE**
To prevent time-out while in the middle of this procedure, press and hold the **Shift** key.

CELL Display and Output Configuration (CELL)

The CELL 4-digit code selects the measurement displayed, allows you to disable diagnostics on a channel not used, and configures the analog output assignment. See Table 3.

Digit 1 Configuration:

When Cell 1 is displayed (first digit a 1), no 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

$$\frac{\text{Cell 2}}{\text{Cell 1}} \times 100$$

Percent Rejection is displayed when the first digit of this code is 8. It is defined mathematically as

$$\left[1 - \frac{\text{Cell 2}}{\text{Cell 1}}\right] \times 100$$

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 8 is used as the first digit of this code, **Abso** refers to Cell 1's value. **Alt Cel** alternates between Cel 1 and Cel 2 with repeated pressings.

Digit 2 Configuration:

SINGLE CELL OPERATION: The second digit of this code **must** be 1, if one of the two sensor channels is left empty. In single sensor operation, all pertinent parameters in other setup configurations must also be configured to the cell channel chosen, even if you will not use them. These include output selection (see digits 3 and 4 of CELL code), and Alarm Selection (HAC and LAC). If the alarms and analog output(s) will not be used, these must be set outside of 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 79.

DUAL CELL OPERATION: The second digit of this code should be 0 when Ratio or Percent Rejection modes are used, or whenever the user configures either alarm or output of **both** sensors. See "User Notes" on page 79.

Digits 3 and 4 Configurations:

The general purpose plastic version has only one analog output. Configure Digit 3 (Output 1) to correspond to this output. With the metal field-mounted unit, two output signals are available. Most of the output choices in Table 3 are self-explanatory. The measurement signal can also be scaled logarithmically. Using this approach, the output signal may be expanded in a particular range of measurement. Possible combinations for the two outputs include:

- Conductivity Sensor 1 and Temperature Sensor 1
- Conductivity Sensor 1 and Conductivity Sensor 2
- % Rejection and Temperature Sensor 1
- % Rejection and Conductivity Sensor 1

For specific information on sensor setup, see "User Notes" on page 79.

Table 3. CELL Code - Display and Output Configuration

Digit 1	Digit 2	Digit 3	Digit 4
DISPLAY 1-Cell 1 2-Cell 2 7-Ratio 8-% Rejection	DIAGNOSTICS ENABLE 0-Interrogate both channels 1-Ignore non-configured channel	OUTPUT 1 1-Conductivity Cell 1 2-Conductivity Cell 2 3-Temp Cell 1 4-Temp Cell 2 5-Log (conductivity Cel1) 6-Log (conductivity Cel2) 7-Ratio 8-% Rejection	OUTPUT 2 1-Conductivity Cell 1 2-Conductivity Cell 2 3-Temp Cell 1 4-Temp Cell 2 5-Log (conductivity Cel1) 6-Log (conductivity Cel2) 7-Ratio 8-% Rejection

Holding the Analog Output (Hold)

The Hold 4-digit code is used to freeze the output(s) to a particular value. The selections are shown in Table 4. 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 frozen at a value corresponding to a % of the analog output scale. The percentage is set by the last three digits of the Hold code. While in one of the Hold modes, the analyzer continues to monitor and display the value the sensor observes. 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 (HAC, or LAC; 2nd digit in code a 1-6), the alarm status while in the Hold mode may be chosen by the first digit in the Hold code.

If, for instance, an alarm is configured as a Hold alarm (HAC or LAC; 2nd digit a 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 changed from 0 to 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) always equals 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:

$$\frac{(\text{Value displayed} - \text{LO1})}{\text{HO1} - \text{LO1}} \times 100$$

EXAMPLE 2: Hold at the value presently read on the display.

The presently displayed value for Cell 1 is 17 µS/cm. HO1 is set at 18.5 µS/cm, LO1 is set at 12 µS/cm. To set Hold at 17, the last 2 digits of Hold must be 77.

$$\frac{17 - 12}{18.5 - 12} \times 100 = \frac{5}{6.5} \times 100 = 77$$

The Hold Code should read 1077, 2077, or 3077, as applicable. See page 37 for a description of HO1 and LO1.

If two outputs are present, both will Hold at 77% (077) of their analog output ranges.

Table 4. 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, units of measurement, and type of temperature compensation desired. Damping time refers to an interval over which all measurement readings are averaged. Damping affects temperature displayed and analog outputs also.

NOTE
The Temperature Compensation Code 99 and custom curve generation software are only available on 873 models with the –05 designation in their Model Code.

If the 873CC unit has curve generation software, Digit 2 may be set to 1, and the units of measurement displayed as % (meaning % by weight or % by volume). The temperature compensation (Digits 3 and 4) must be set to 99 (Cd = X199), and the custom curve data must be installed. (See “Generating and Inputting Custom Curve Programs in the 873CC” on page 53.) For this measurement the full scale range (FSC) of the analyzer must be set high enough to accommodate the conductivity or the % range of interest. Refer to “The Full Scale Range (FSC)” on page 39. The custom curve data (if used) will be applied to either or both cells.

Table 5. Cd Code - Compensation and Damping

Digit 1	Digit 2	Digits 3 and 4
Damping	**Special % Concentration Range**	**Temperature Compensation**
0 = None 1 = 10 seconds 2 = 20 seconds 3 = 40 seconds	0 = % Legend disabled. Use for μS/cm, mS/cm, ratio and % rejection measurements. 1 = % Legend enabled. Requires programming of tCt and PCt parameters. Requires curve generation software.	00 =Absolute (no compensation) 01 =Dilute NaCl solution with water subtraction, referenced to 25°C. Applicable to all conductivity ranges, including ultrapure water ranges. 99 =Special. Requires programming of tCt parameter, and curve generation software.

General Information Alarms

Dual independent, Form C dry alarm contacts, rated at 3A noninductive (5A on general purpose panel-mounted instrument), 125 V ac/30 V dc are provided. The alarm status is alternately displayed with the measurement on the LED display. Alarms are set using a code for Low, High, Hold, or Instrument watchdog alarms, with active or passive relays, having a deadband or time delay. Wiring information for the alarms may be found in the Wiring sections of this instruction. See Example on next page.

— ⚠ 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 77.

— NOTE —

1. Alarms must 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 amount of damping set in the Cd code. The alarms remain “OFF” until this measurement has stabilized.

Check that the alarm configurations (Hi/Lo) are configured as desired. Refer to “High Alarm Configuration (HAC)” and “Low Alarm Configuration (LAC)” sections.

Setting Alarm Level(s)

— 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.

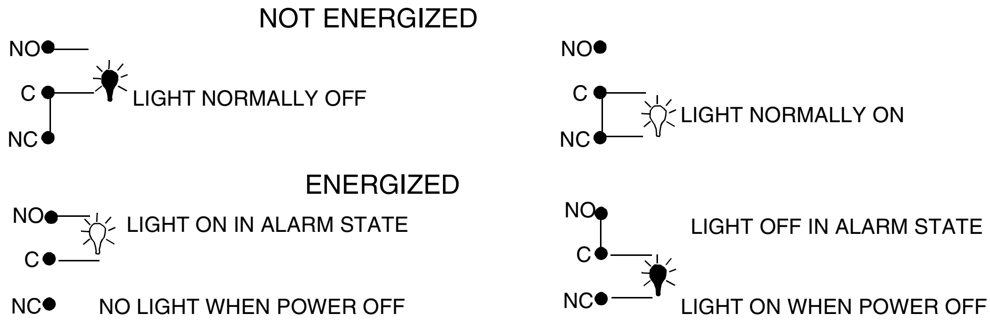
1. Unlock analyzer (see “Unlocking Analyzer Using Security Code”).
2. To set high alarm, press **H Alm**. Then use **Next** and ∆ to achieve the desired value on the display.
3. Press **Enter**.
4. To set low alarm, press **L Alm**. Then use **Next** and ∆ to achieve the desired value on the display.
5. Press **Enter**.
6. Lock analyzer (see “Locking Analyzer Using Security Code”).

— NOTE —

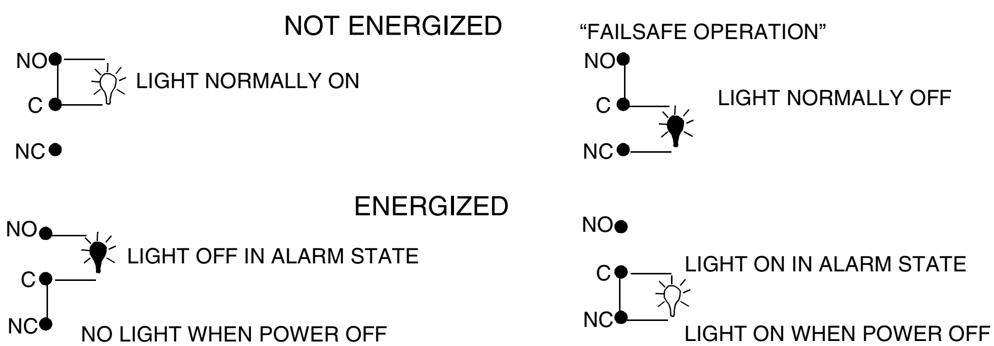
If use of the alarms is not desired, set the H Alm and L Alm values outside of normal measurement range.

EXAMPLE:

CONFIGURED PASSIVE



CONFIGURED ACTIVE



High Alarm Configuration (HAC)

The HAC 4-digit code configures the alarm designated as "H Alm". See Table 6. 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 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 trips on decreasing measurement.

A **high alarm** relay trips on increasing measurement.

Passive or active (fail-safe) configurations are also chosen by this digit choice. In the active (fail-safe) configuration, a loss of power to the analyzer results 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 fail-safe operation. Consult page 14 of this document for wiring information.

Alternative to a measurement alarm, the high alarm 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 high alarm cannot be used as a conventional measurement high alarm. However, one of the configurable diagnostic parameters is "measurement error," so when programmed properly, the high alarm can report either diagnostic or high measurement problems. Set digit 2 in this code as either 5 or 6, as applicable.

When the high alarm is configured as a diagnostic error communicator, it will report any system problem. It cannot 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, you can program several temperature and measurement error limits which, if exceeded, will cause an alarm condition. These programming options are explained in pages and .

Refer to “Error/Alarm Messages” in Section 6 for identifying error messages.

The High alarm can also be configured and used as a Hold alarm. When used as a Hold alarm, the high alarm cannot be used as a conventional measurement high alarm. When the high alarm is configured as a Hold alarm (HAC; 2nd digit a 7 or 8), the alarm triggers 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.

Finally, the alarm hysteresis (deadband) can 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 6. HAC Code - High Alarm Configuration

Digit 1	Digit 2	Digits 3 & 4
MEASUREMENT SELECTION	**CONFIGURATION**	**HYSTERESIS**
1 – Conductivity Cell 1 2 – Conductivity Cell 2 3 – Temp Cell 1 4 – Temp Cell 2 7 – % Ratio 8 – % Rejection	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 (mS/cm, µS/cm) 0.0 to 9.9% (% mode)

HAFt and HAdL

— NOTE
Only use when the alarms are configured as Measurement alarms.

High Alarm Feed Time (HAFt) works in conjunction with High Alarm Delay time (HAdL) to provide timed control over the High Alarm relay. Both parameters, if activated, take precedence over the alarm hysteresis set in HAC. HAFt and HAdL must be used together.

These parameters should be set to zero if the alarms are used as Instrument or Hold alarms.

The on/off relationship between HAFt and HAdL is shown in Figure 12.

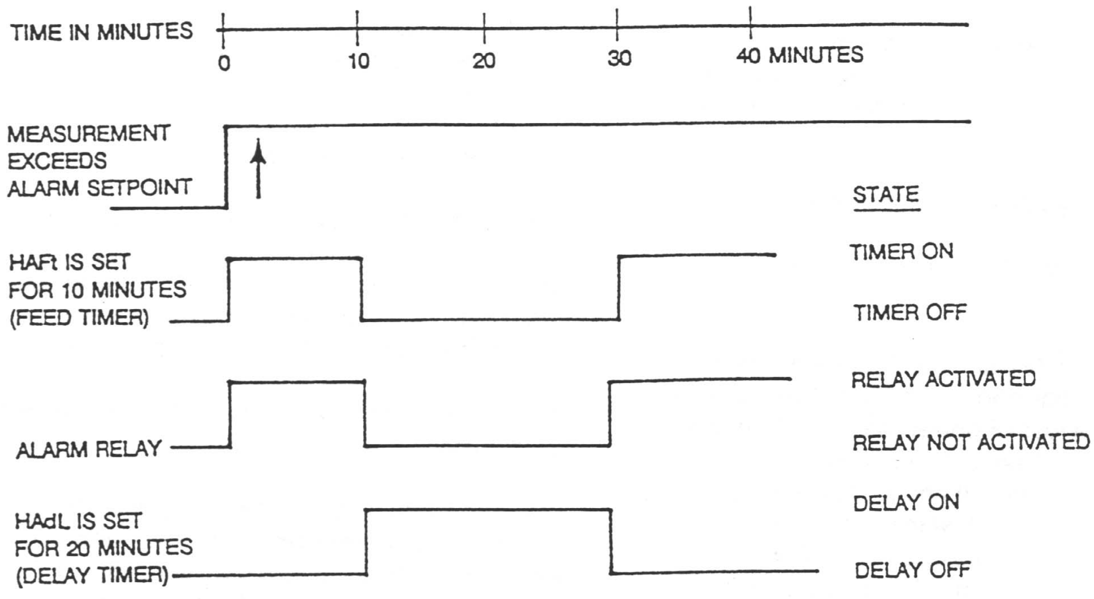


Figure 12. On/Off Relationship between HAFt and HAdL

When High Alarm Feed Time (HAFt) is activated, the high alarm stays on for the amount of time set in this function regardless of what the measurement value is in relation to set point. This means that the high alarm remains on even if the measurement goes out of alarm. Table 7 shows the code designation.

EXAMPLE: 0515 means 5 minutes 9 seconds.

High Alarm Delay time (HAdL) is activated by entering a time in the code parameter HAdL. Upon time-out of HAFt, the alarm will be deactivated for this time period. The alarm will NOT reactivate for the time period set in HAdL regardless of what the measurement value is in relation to set point. After time-out of HAdL, the 873 reverts to a normal run mode. If the instrument is still in a High Alarm state, the sequence of HAFt and HAdL repeats itself. Table 7 shows the code designation.

EXAMPLE: 2050 means 20 minutes 30 seconds.

Table 7. HAFt and HAdL Time Codes

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

Low Alarm Configuration (LAC)

The LAC 4-digit code configures the alarm designated as “L Alm”. 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 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 (fail-safe) configurations are also chosen by this digit choice. In the active (fail-safe) configuration, a loss of power to the Analyzer results 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 fail-safe operation. Consult page 14 of this document for wiring information.

Alternative to a measurement alarm, the low alarm 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 low alarm cannot be used as a conventional measurement low alarm. However, one of the configurable diagnostic parameters is "measurement error," so when programmed properly, the low alarm can report either diagnostic or low measurement problems. Set digit 2 in this code as either a 5 or 6, as applicable.

When the low alarm is configured as a diagnostic error communicator, it will report any system problem. It cannot 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, you can program several temperature and measurement error limits which, if exceeded, will cause an alarm condition. These programming options are explained in pages and .

Refer to "Error/Alarm Messages" in Section 6 for identifying error messages.

The low alarm may also be configured and used as a Hold alarm. When used as a Hold alarm, the low alarm cannot be used as a conventional measurement low alarm. When the low alarm is configured as a Hold alarm (LAC; 2nd digit a 7 or 8), the alarm triggers 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.

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. LAC Code - Low Alarm Configuration

Digit 1	Digit 2	Digits 3 & 4
MEASUREMENT SELECTION	CONFIGURATION	HYSTERESIS
1 – Conductivity Cell 1 2 – Conductivity Cell 2 3 – Temp Cell 1 4 – Temp Cell 2 7 – % Ratio 8 – % Rejection	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)

LAFt and LAdL

— **NOTE**

Only use when the alarms are configured as Measurement alarms.

Low Alarm Feed time (LAFt) works in conjunction with Low Alarm Delay time (LAdL) to provide timed control over the Low Alarm relay. Both parameters, if activated, takes precedence over the alarm hysteresis set in LAC. Both LAFt and LAdL must be used together.

LAFt and LAdL parameters should be set to zero if the alarms are used as Instrument or Hold alarms.

The on/off relationship between LAFt and LAdL is shown in Figure 13.

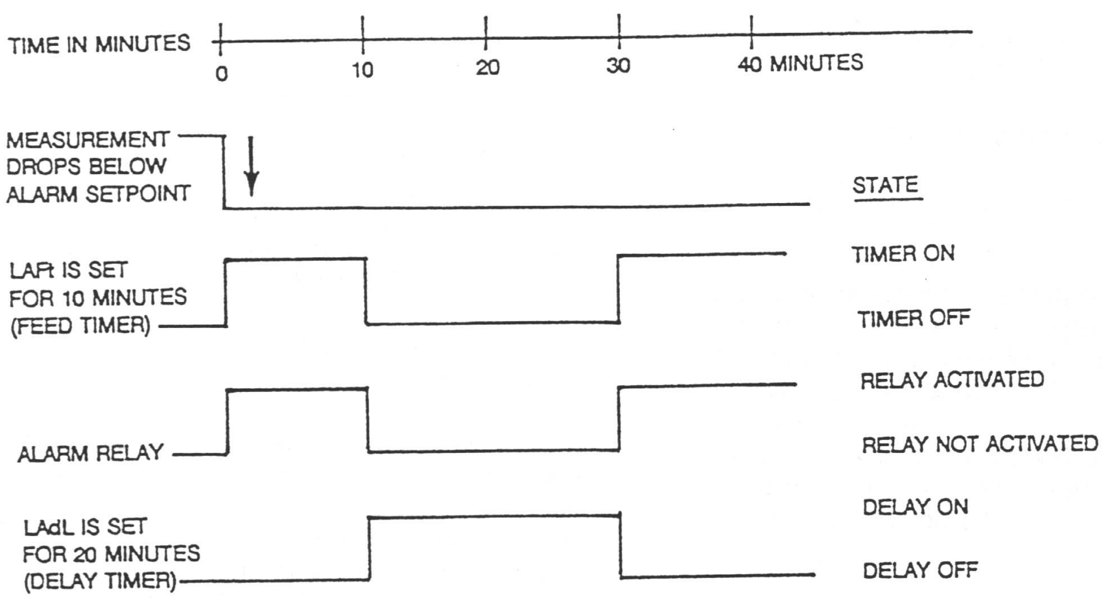


Figure 13. On/Off Relationship between LAFt and LAdL

When **Low Alarm Feed Time (LAFt)** is activated, the low alarm will stay on for the amount of time set in this function regardless of what the measurement value is in relation to set point. This means that the low alarm will remain on even if the instrument goes out of alarm. Table 9 shows the code designation.

EXAMPLE: 0515 means 5 minutes 9 seconds.

Low Alarm Delay Time (LAdL) is activated by entering a time in the code parameter LAdL. Upon time-out of LAFt, the alarm will be deactivated for this time period. The alarm will **not** reactivate for the time set in LAdL regardless of what the measurement value is in relation to set point. After time-out of LAdL, the 873 Analyzer reverts to normal RUN mode. If the instrument is still in a low alarm state, the sequence of LAFt and LAdL repeats itself. Table 9 shows the code designation.

EXAMPLE: 2050 means 20 minutes 30 seconds.

Table 9. LAFt and LAdL Time Codes

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

User-Defined Upper Measurement Limit (UL)

This enables you to define an upper measurement limit which, if exceeded, will give an error message on the display (see "Error Codes" on page 71), and, when used in conjunction with either alarm configured as instrument (watchdog) alarm (HAC or LAC digit 2 is 5 or 6), provides a relay contact. The value set by this code defines the measurement limit for both cells.

The primary use of UL is as a sensor diagnostic tool. Should the 871CC sensor develop a fault, such as leakage between the electrodes or a broken or intermittent lead wire, the measurement signal sent to the 873 analyzer will be ridiculously low or high. So by setting UL at a value which could never be achieved in a normal process situation, the activation of a UL alarm would indicate either a severe sensor failure or miscalibration. The upper limit on UL is 999.9 (µS/cm, mS/cm), or 99.99%.

— NOTE
Invensys Foxboro preconfigures the UL value equal to the specified full scale measurement per Sales Order.

User-Defined Lower Measurement Limit (LL)

This parameter is similar to the previously described UL parameter, except that it allows programming of a **lower** measurement limit. In any conductivity application, including ultrapure water measurement, a value of 0 is a good choice for LL, since ultrapure water could never actually reach a value as low as 0. The lower limit on LL is –0.99 (µS/cm, mS/cm, %). The value set by this parameter is related to **both** measurement cells.

User-Defined Upper Temperature Limit (UtL)

This parameter enables you to define an upper temperature measurement value which, if exceeded, gives an error message on the display (see "Error/Alarm Displays" section) and, when used in conjunction with the configurable alarms (HAC or LAC digit 2 is 5 or 6 (see "High Alarm Configuration (HAC)" and "Low Alarm Configuration (LAC)"), provides a relay contact.

The UtL function may be used in a few different ways. First, you may wish to alarm on high process temperature. For example, in a water supply line which is normally between 80 and 100°F, you may wish to set UtL to 120°F to indicate a problem with the water temperature control. Another use of UtL is as a sensor diagnostic tool. If the thermistor or RTD in the 871CC 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 871CC Sensor thermistor or RTD. The upper limit on UtL is 200°C or 392°F.

The value set for this parameter defines the limit for both sensors (if installed).

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. Invensys Foxboro preconfigures the LtL value to be 0°C. The value set for this parameter defines the limit for both sensors (if installed).

— NOTE

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

EXAMPLE 1:

To make the display read –.99 mS/cm, first display 0.99, then change the first digit to a negative sign.

EXAMPLE 2:

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

Scaling the Analog Outputs

Each 873 Analyzer has either one or two analog output signals as standard. Each output signal is linearly proportional to the measured variable (except when the output(s) is (are) configured as logarithmic). In the case of a conductivity output, the signal is linearly proportional to the displayed variable, either µS/cm, mS/cm, or percent (%).

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

EXAMPLE:

You may be measuring water in the range of 2 to 3 µS/cm, and may want to assign the minimum analog output level (e.g., 4 mA) to a value of 2 µS/cm water and the maximum analog output level (e.g., 20 mA) to a value of 3 µS/cm water.

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

EXAMPLE:

In the previous example, 20 mA may be assigned to the 2 µS/cm water and 4 mA assigned to the 3 µS/cm water. No special procedures need to be followed to accomplish a reverse output.

ANALOG OUTPUTS: 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, a loss of accuracy is possible. The analog output could develop steps instead of following the measurement in a continuum.

Output #1's 100% Analog Value (HO1)

This enables you to assign a measurement value to the maximum analog output (either 10 V or 20 mA dc). For example, you 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. This HO1 value ties to CELL Code Digit 3. See "CELL Display and Output Configuration (CELL)" section. Invensys Foxboro preconfigures the 100% value to be equal to the specified full scale measurement per sales order.

Output #1's 0% Analog Value (LO1)

This enables you 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 10 µS/cm. This LO1 value ties to CELL Code Digit 3. Invensys Foxboro preconfigures the 0% value to be equal to 0 (µS/cm or mS/cm, as applicable).

Output #2's 100% Analog Value (HO2)

— NOTE

Only use on field-mounted units; general purpose units use HO1 only.

HO2 configures the second output to 100% of the analog output. The parameter is similar to HO1. HO2 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 30°C. Once in HO2 mode, use **Next** and Δ to display 30°C. The correct units appear if CELL was configured properly. Press **Enter**.

Output #2's 0% Analog Value (LO2)

— NOTE

Only use on field-mounted units; general purpose units use LO1 only.

LO2 configures the second output to 0% of the analog output. This parameter is similar to LO1. LO2 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 100°C. Once in LO2 mode, use **Next** and Δ to display 100°C. The correct units appear if CELL was configured properly. Press **Enter**.

Basic Setup Entries

The Basic Setup entries consist of 22 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 10 lists each parameter, with its applicable symbol, in the same sequence as seen on the display. Procedures that use these parameters follow. These procedures follow and are: Unlocking Basic Setup Entries, Changing Ct, Selecting the Full Scale Range, Changing the Full Scale Range, Changing the Temperature Circuitry, Changing the Analog Output, and Changing the Security Code.

Table 10. Basic Setup Entry Selection

Display Symbol	Page No.	Parameter and Value Accessed	Factory Default	User Settings
bL		Basic Setup Lock Control	0800	
Ct		Cell Type (either 0.1 or 10.0 cm^{-1} cell factor)	per sales order	
FSC		Full Scale Value	per sales order	
CF 1		Cell Factor - Cell 1	per sales order	
tCF 1		Temperature Cell Factor - Cell 1	25.00	
tEC 1		Thermistor Temperature Electronics Calibration Cell 1	25.00	
tCL 1		RTD Low Temperature Electronics Calibration Cell 1	100	
tCC 1		RTD Mid Temperature Electronics Calibration Cell 1	150	
tCH 1		RTD High Temperature Electronics Calibration Cell 1	200	
LCC		Lock Code Change	0800	
CF 2		Cell Factor - Cell 2	per sales order	
tCF 2		Temperature Cell Factor - Cell 2	25.00	
tEC 2		Thermistor Temperature Electronics Calibration Cell 2	25.00	
tCL 2		RTD Low Temperature Electronics Calibration Cell 2	100	
tCC 2		RTD Mid Temperature Electronics Calibration Cell 2	150	
tCH 2		RTD High Temperature Electronics Calibration Cell 2	200	
tCt		Custom Temperature Compensation Curve	per sales order	
PCt		Custom Percent Concentration Curve	per sales order	
LCO1		Analog Out 1 Electronics Lower Calibration	00.00	
HCO1		Analog Out 1 Electronics Upper Calibration	100.0	
LCO2		Analog Out 2 Electronics Lower Calibration	00.00	
HCO2		Analog Out 2 Electronics Upper Calibration	100.00	

Display Symbols Sft, SOH, and SOL are not configurable.

Unlocking Basic Setup Entries (bL)

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

1. Unlock Analyzer at the first security level (see “Unlocking Analyzer Using Security Code” on page 24).
2. Press **Shift** and while holding, press **Setup**. Release finger from both keys.
3. Press **Next** seventeen times until bL is displayed.
4. Press **Enter**. LOC appears on the display.
5. Press **Next**.
6. Use **Next** and Δ until security code is displayed (0800 from factory).
7. Press **Enter**. ULOC appears on the display.
8. When display returns to bL, press **Next** one or more times until parameter to be changed appears on the display. Press **Enter**.
9. Use **Next** and Δ until the desired value is displayed. Press **Enter**.
10. When display defaults to the current measurement value, the analyzer is automatically locked at the second level (bL) of security.
11. Lock analyzer (see “Locking Analyzer Using Security Code” on page 24).

Changing Cell Type (Ct)

The 873CC Analyzer can be used with 871CC sensors with either 0.1 cm^{-1} or 10.0 cm^{-1} cell constants. When two sensors are connected to a single analyzer, both cell constants must be the same.

Determine whether the 871CC sensors have 0.1 cm^{-1} or 10.0 cm^{-1} cell constants by checking the attached labels:

871CC – □ 2 = 0.1 cm^{-1} cell constant = 1000 Ct.

871CC – □ 4 = 10.0 cm^{-1} cell constant = 10.00 Ct.

Procedure:

Unlock bL by following procedure in “Unlocking Basic Setup Entries (bL)”. 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 1000 and 10.00 with repeated pressing of Δ. When the correct value is displayed, press **Enter**.

The Full Scale Range (FSC)

Selecting the Full Scale Range (FSC)

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

Ct = 1000 Cell Constant = 0.1 cm^{-1}	Ct = 10.00 Cell Constant = 10.0 cm^{-1}
•1 µS/cm	•100 µS/cm
•2 µS/cm	•0.1 mS/cm
•5 µS/cm	•200 µS/cm
•10 µS/cm	•0.2 mS/cm
•20 µS/cm	•500 µS/cm
•50 µS/cm	•0.5 mS/cm
•100 µS/cm	•1 mS/cm
•200 µS/cm	•2 mS/cm
	•5 mS/cm
	•10 mS/cm
	•20 mS/cm

The Analyzer accuracy is .5% of the maximum upper measurement range value. Thus, for best accuracy, the FSC value should be set as low as possible while still allowing all measurement values to fall within its span.

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 µS/cm range, it can display up to 9.999 µS/cm at 25.0°C.

Invensys Foxboro preconfigures the FSC value per sales order.

For Dual Sensor, Ratio, and/or Percent Rejection applications, it will be necessary to assign a single full scale range value to both "legs" of the loop. In these instances, it is almost exclusively the lower range that requires the highest resolution. Thus it becomes very useful to identify what full scale range allows both ranges to be read with the greatest resolution.

Use Table 11 to choose the appropriate FSC range when using two sensors on the same instrument in different composition streams. First, choose a column with the measurement temperature indicated. Second, choose the maximum conductivity value that one or both of your sensors will be exposed to in that column. Third, proceed to the first two columns in the row you have chosen to determine what cell, Ct, and FSC are required for operation.

EXAMPLE:

Consider a reverse osmosis application at 25°C. Both the upstream and downstream water will be monitored, and the feed or upstream water may have a conductivity of up to ~300 microsiemens. The value of the finish, or downstream, water is critical and may reasonably be expected to have quite low conductivity, perhaps 20 microsiemens or less. Since both "legs" must be measured to employ percent rejection (with the same cell factor), and with 300 microsiemens normally relegated to the 10.0 Cell Factor Range, and 20 microsiemens to the 0.1 Cell Factor Range, the question becomes: What Full Scale Range allows you to read both ~300 microsiemens and ~20 microsiemens at 25°C using only one cell factor?

Using the matrix, it becomes clear that, when monitoring at 25°C with a cell factor of.1000, a full scale range value of 100 microsiemens (or 200 microsiemens) permits the desired resolution of both the upstream, as well as the critical downstream, leg to be displayed. That is, the use of the

100 microsiemen range will, as shown by the matrix, have an approximate upper limit of 360 microsiemens, which then will encompass the above example's upper range of 300 microsiemens. (If the temperature had been 55°C, then the 200 microsiemen range, with an upper limit of 448 microsiemens, would have been chosen.)

Table 11. Measurement Limits as a Function of Temperature, Cell Factor, and FSC

	Standard Full Scale Range FSC	**Process Temperature (°C)**					
		0 to 30°C	**30 to 60°C**	**60 to 90°C**	**90 to 120°C**	**120 to 150°C**	**150 to 200°C**
0.1 Cell Factor	0-1.000 µS	3.600 µS	2.240	1.590	1.260	1.040	1.000
	0-2.000 µS	7,200	4.480	3.180	2.520	2.080	2.000
	0-5.000 µS	9.990	9.990	7.930	6.300	5.220	5.000
	0-10.00 µS	36.00	22.40	15.90	12.60	10.40	10.00
	0-20.00 µS	72.00	44.80	31.80	25.20	20.80	20.00
	0-50.00 µS	99.99	99.99	79.33	63.09	52.22	50.00
0.1 or 10.0 Cell Factor	0-100.0 µS	360.0	224.0	159.0	126.0	104.0	100.0
	0-200.0 µS	720.0	448.0	318.0	252.0	208.0	200.0
10.0 Cell Factor	0-500.0 µS	999.9	999.9	793.3	630.9	520.2	500.0
	0-0.100 mS	.3600 mS	.2240	.1590	.1260	.1040	.1000
	0-0.200 mS	.7200	.4480	.3180	.2520	.2080	.2000
	0-0.500 mS	1.810	1.120	.7930	.6310	.5220	.5000
	0-1.000 mS	3.600	2.240	1.590	1.260	1.040	1.000
	0-2.000 mS	7.200	4.480	3.180	2.520	2.080	2.000
	0-5.000 mS	9.999	9.999	7.930	6.300	5.220	5.000
	0-10.00 mS	36.00	22.20	15.90	12.60	10.40	10.00
	0-20.00 mS	72.00	44.80	31.80	25.20	20.80	20.00

Changing the Full Scale Range

— NOTE

Ct must be entered correctly before the FSC is changed.

—⚠ CAUTION

When changing ranges, the drive voltage to the sensor inputs is changed. **Altering the FSC range via the keypad requires the unit to be bench calibrated before use.** Pressing **Enter** in FSC mode (even if range was not changed) requires the unit to be bench calibrated before use. If the range is set at a range you require, allow unit to time out. Do not press **Enter**.
After changing FSC, Configuration Setup Entries should be checked and altered, if necessary.

The procedure to change FSC is as follows:

1. Unlock analyzer (see “Unlocking Analyzer Using Security Code”).
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 seventeenth 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) is displayed.
6. Press **Enter**. The present full scale range is displayed.

⚠ CAUTION

If this is your desired FSC, allow unit to time out. **Do not press enter**. Entering any FSC causes Er4 to flash on the display, necessitating a bench calibration.

7. Press Δ until the desired range is displayed. See Table 11 for Standard FSC. Press **Enter**.
8. Lock analyzer (see “Locking Analyzer Using Security Code”).

NOTE

Calibration is required after full scale range is changed. Error code Er4 flashes until calibration is accomplished. Refer to “Electronic Bench Calibration” section.

Changing the Temperature Circuitry

Temperature Electronics Calibration for either thermistor (tEC1, tEC2) or RTD (tCL1, tCC1 and tCH1 or tCL2, tCC2, and tCH2) type sensors is performed at the factory. It is not necessary to perform these procedures in the field unless:

1. You have switched from RTD type sensors (871CC Series K through M) to thermistor type (871CC Series A through F) or vice versa.
2. You suspect a problem with the temperature calibration.
3. You wish to verify temperature electronics calibration.

If switching from an 871CC A through F style sensor (Thermistor) to an 871CC K through M style sensor (RTD) or vice versa, it is necessary to reposition the jumpers within the analyzer and perform a recalibration.

To Reposition Jumpers:

1. Remove power to the unit.
2. On the plastic general purpose version: remove optional rear cover. Remove the four screws holding back panel in place.

   On the 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 sensors 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 taps. 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 14 to identify jumper locations.
5. Use Table 12 to locate appropriate jumper positions.

Table 12. Jumper Positions for Temperature Transducer

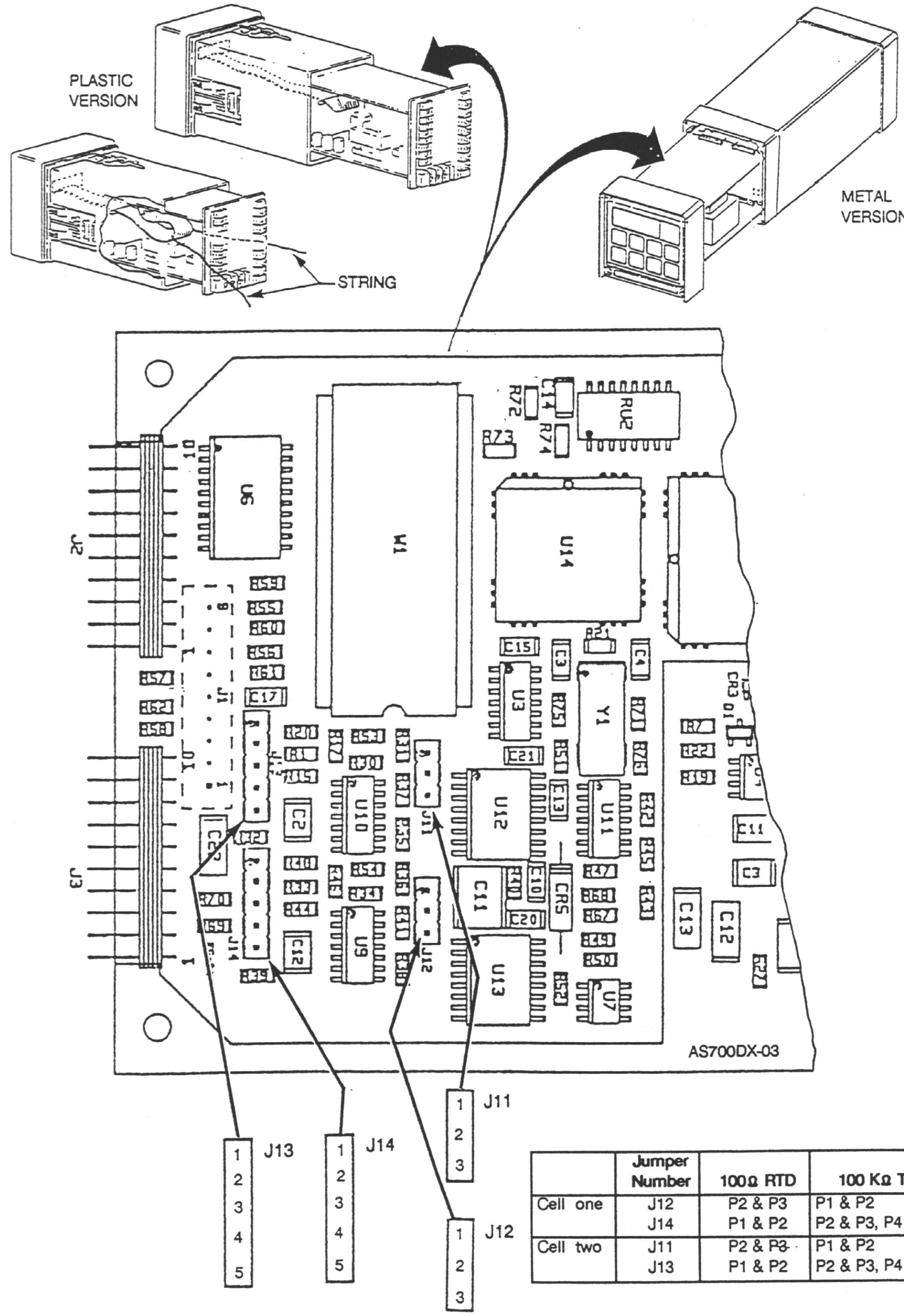
	Jumper Number	100 Ω RTD	100 KΩ Thermistor
Cell one	J12 J14	P2 & P3 P1 & P2	P1 & P2 P2 & P3, P4 & P5
Cell two	J11 J13	P2 & P3 P1 & P2	P1 & P2 P2 & P3, P4 & P5

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 Figure 14.

8. Replace cover. On metal enclosures, use Loctite (Part No. S0106ML) on the threads of the front bezel screws, and Lubriplate (Part No. X0114AT) on threads of the rear cover screws.
9. If you changed to Thermistor Temperature Compensation, see "Thermistor Temperature Electronic Calibration (tEC1, tEC2)" section to complete the calibration.
10. If you changed to RTD Temperature Compensation, see "RTD Temperature Calibration (tCL1, tCC1, tCH1, and tCL2, tCC2 tCH2)" section.
11. Make appropriate changes to the analyzer identification label.



	Jumper Number	100Ω RTD	100 KΩ Thermistor
Cell one	J12	P2 & P3	P1 & P2
	J14	P1 & P2	P2 & P3, P4 & P5
Cell two	J11	P2 & P3	P1 & P2
	J13	P1 & P2	P2 & P3, P4 & P5

Figure 14. Jumpers for Temperature Compensation

Thermistor Temperature Electronic Calibration (tEC1, tEC2)

— NOTE
Sensor Styles 871CC A-F use 100 KΩ thermistors.

Required: 2 100 KΩ precision resistors

1. Disconnect sensor lead connections 3, 3A, 4, and 5 from TB2.
2. Connect two precision 100 KΩ resistors between the sensor terminals:

   3 and 3A; **also** 4 and 5.

   See Figure 15.
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 Lock Setup) is displayed (bL will be the seventeenth 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** 5 times until tEC1 is displayed.
9. Press **Enter**. The value 25.00 is displayed.
10. Press **Enter**.
11. When display returns to tEC1, press **Next** seven times until tEC2 is displayed.
12. Press **Enter**. The value 25.00 is displayed.
13. Press **Enter**.
14. Disconnect 100 KΩ resistors from terminals 3 and 3A; **also** 4 and 5.
15. Reconnect sensor leads to 3, 3A, 4, and 5.
16. Lock Analyzer.

This completes the thermistor temperature electronics calibration.

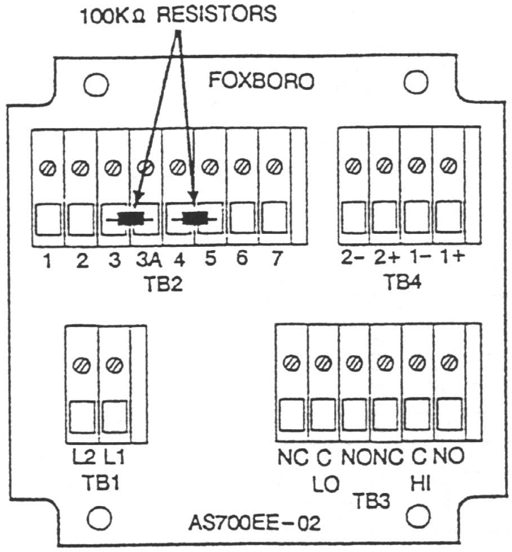


Figure 15. Thermistor Temperature Simulation (Metal Enclosure Shown)

RTD Temperature Calibration (tCL1, tCC1, tCH1, and tCL2, tCC2 tCH2)

— NOTE
871CC Sensors Type K-M use 100 Ω RTDs.

Required: two each, 100, 150, and 200 Ω precision resistors or precision resistance decade box with 0.1% accuracy. The decade box is recommended.

1. Disconnect sensor lead connections 3, 3A, 4, and 5 from TB2.
2. Connect 2 100 Ω precision resistors between terminals:

   3 and 3A; **also** 4 and 5.
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 Lock Setup) is displayed (bL will be the seventeenth message displayed).
6. Press **Enter**, then use **Next** and ∆ until the personal security code is displayed (0800 from factory).
7. Press **Enter**.
8. When display returns to bL, press **Next** six times until tCL1 is displayed. Press **Enter**. Then keep finger on **Shift**.
9. Display shows 100.0 ohms. Press **Shift** and hold for 20 seconds, then press **Enter**. Then keep finger on **Shift**.
10. Replace the 100 Ω resistor for cell 1 (leads 3 and 3A) with a 150 Ω precision resistor.

11. Release **Shift** key. When display returns to tCL1, press **Next** once to display tCC1. Press **Enter**.
12. Display shows 150.0 ohms. Press **Shift** and hold for 20 seconds, then press **Enter**. Then keep finger on **Shift**.
13. Replace the 150 Ω resistor for cell 1 with a 200 Ω precision resistor.
14. Release **Shift** key. When display returns to tCC1, press **Next** once to display tCH1. Press **Enter**.
15. Display shows 200 ohms. Press **Shift** and hold for 20 seconds, then press **Enter**.
16. When display returns to tCH1, press **Next** five times to display tCL2. Press **Enter**.
17. Display shows 100.0 ohms. Press **Shift** and hold for 20 seconds, then press **Enter**. Keep finger on **Shift**.
18. Replace the 100 Ω resistor for cell 2 with a 150 Ω precision resistor.
19. Release **Shift** key. When display returns to tCL2, press **Next** once to display tCC2. Press **Enter**.
20. Display shows 150.0 ohms. Press **Shift** and hold for 20 seconds, then press **Enter**. Then keep finger on **Shift**.
21. Replace the 150 Ω resistor for cell 2 with a 200 Ω precision resistor.
22. Release **Shift** key. When display returns to tCC2, press **Next** once to display tCH2. Press **Enter**.
23. Display shows 200.0 ohms. Press **Shift** and hold for 20 seconds, then press **Enter**.

This completes the RTD Temperature Calibration.

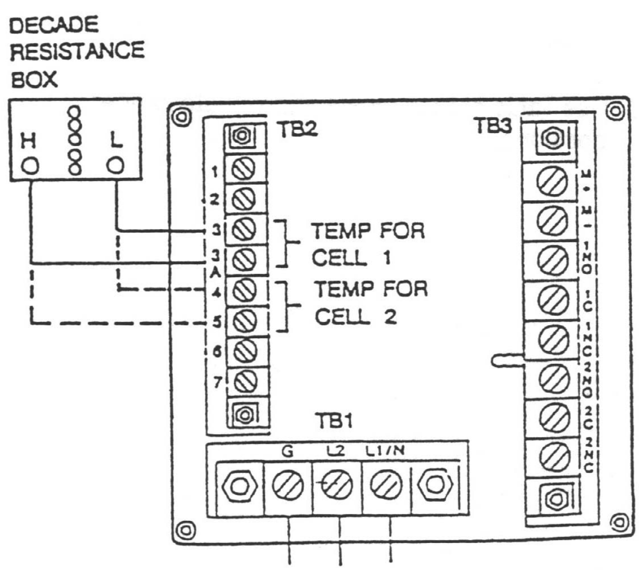


Figure 16. RTD Temperature Simulation (Plastic Enclosure Shown)

Changing the Analog Output

To change one or both of your analog outputs to a different output than the analyzer was ordered with, jumpers must be moved and a recalibration performed.

To Reposition Jumpers

1. Remove power to the unit.
2. On plastic enclosure: remove optional rear cover. Remove the four screws holding back panel in place.

   On the metal enclosure: 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 sensors 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 taps. 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 17 to identify jumper locations.
5. Use Table 13 to locate appropriate jumper positions.

Table 13. Jumper Positions for the Various Analog Outputs

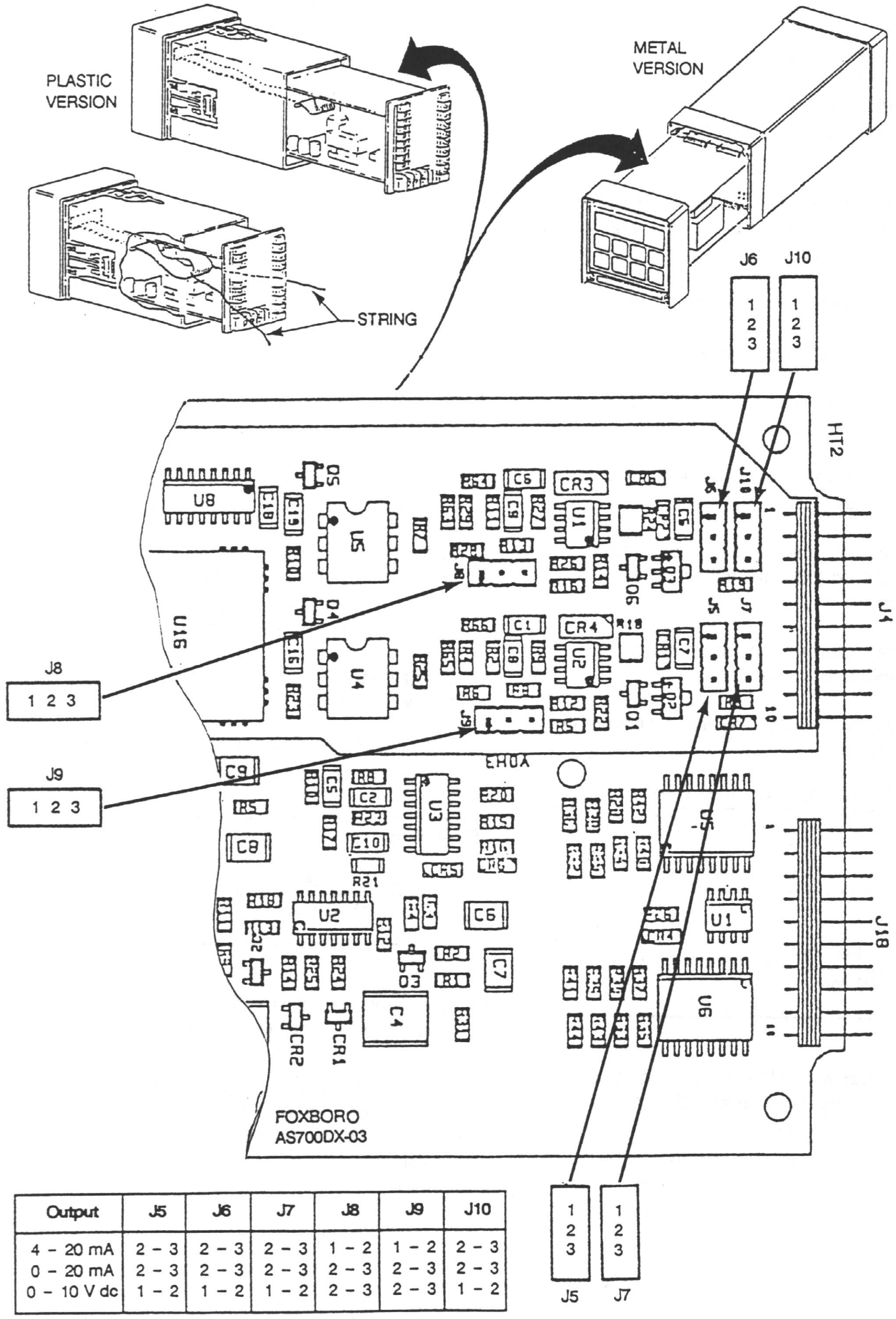
Output	J5	J6	J7	J8	J9	J10
4 - 20 mA	2 - 3	2 - 3	2 - 3	1 - 2	1 - 2	2 - 3
0 - 20 mA	2 - 3	2 - 3	2 - 3	2 - 3	2 - 3	2 - 3
0 - 10 V dc	1 - 2	1 - 2	1 - 2	2 - 3	2 - 3	1 - 2

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 Figure 17.

8. Replace cover. On metal enclosures, use Loctite (Part No. S0106ML) 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 is now necessary. Refer to next section.
10. Make appropriate changes to the analyzer identification label.



Output	J5	J6	J7	J8	J9	J10
4 – 20 mA	2 – 3	2 – 3	2 – 3	1 – 2	1 – 2	2 – 3
0 – 20 mA	2 – 3	2 – 3	2 – 3	2 – 3	2 – 3	2 – 3
0 – 10 V dc	1 – 2	1 – 2	1 – 2	2 – 3	2 – 3	1 – 2

Figure 17. Jumpers for Changing Analog Output

Analog Output Calibration (LCO1, HCO1, LCO2, HCO2)

This procedure is used to calibrate the Analog output. 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.

1. Connect an ampmeter/voltmeter to the analog output terminals. For LCO1 and HCO1, connect to Channel 1 output terminal. For LCO2 and HCO2, connect to Channel 2 output terminals. See Figure 18 and Wiring sections.
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**.
5. Use **Next** and ∆ until the personal security code is displayed (0800 from the factory). Press **Enter**.
6. When display returns to bL, press **Next** until LCO1 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:

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

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

— NOTE

Iteration of the above procedure may be required. Repeat Steps 7 and 8 until Observed Value is equal to the Desired Value.

9. When the display returns to LCO1, press **Next** once to display HCO1. Press **Enter**.
10. Calculate the high % required using the following formula:

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

EXAMPLE:

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

11. Use **Next** and ∆ 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.

— NOTE

Procedure is complete here for plastic version.

12. For metal version with second output, move ampmeter to second set of output terminals. Repeat Steps 3-5. Then press **Next** until LCO2 is displayed. Press **Enter**.
13. Calculate the low % input required by using the following formula:

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

EXAMPLE:

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

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

— NOTE
Iteration of the above procedure may be required. Repeat Steps 13 and 14 until Observed Value is equal to Desired Value.

15. When the display returns to LCO2, press **Next** once to display HCO2. Press **Enter**.

— 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 –1.1%, first display 01.1%, then change the first digit to a negative sign.

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.

This completes the Analog Output Calibration Procedure.

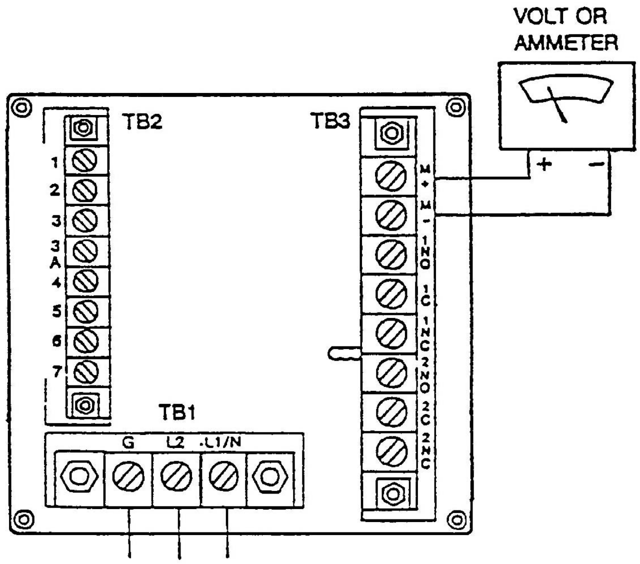


Figure 18. Output Terminals and Volt/Amp Meter (Plastic Version Shown)

Changing the Security Code (LCC)

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

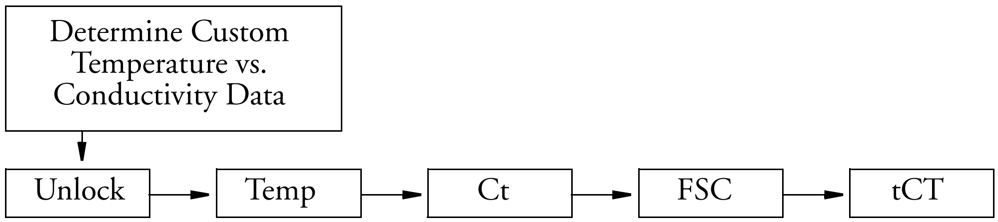
— NOTE
If existing security code is forgotten, a new security code **cannot** be entered using this procedure. In this case, contact Invensys Foxboro.

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 the procedure explained in "Unlocking Analyzer Using Security Code". 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 ∆ 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 (∆) keys until **new** desired security code is displayed.
10. Press **Enter**. The new code will be used on all future entries.
11. Lock the Analyzer using the procedures explained in "Locking Analyzer Using Security Code".

Generating and Inputting Custom Curve Programs in the 873CC

Flow Chart for Custom Temperature Compensation Curve (tCt)



Custom temperature compensation and process specific concentration data may be input into 873CC Analyzers ordered with the "Curve Generation Program" option, suffix -5. Check Model Code on data label (Figure 2) to verify if this option exists. This section will explain how to generate and input custom Curve Data into your 873CC analyzer. To use this data after it has been input requires setup parameter Cd ("Configuration Setup Entries") be set to XX99.

Custom Temperature Compensation Curve (tCt)

1. User-supplied, process-specific compensation data must be generated or extracted from literature in advance of entering it into the 873CC analyzer. This data must consist of temperature (in Fahrenheit or Celsius) vs. conductivity data for a particular concentration of the process (control point suggested). The temperatures should include and extend all temperatures in the target process temperature range and be input in ascending order. The data should be plotted graphically as well as tabularly to prepare it for entry in the 873CC.

   EXAMPLE:

   The control point of a process is 3.0%. The process typically runs at ambient temperatures which fall in the range of 15 to 35°C. A sufficient grab sample of the process is taken and protected from the atmosphere. Using the CC sensor and 873CC analyzer in the absolute mode (Cd = 0000) conductivity vs. temperature data is generated. The data results can be shown in Figure 19.

2. The user-supplied, process-specific compensation data must be reduced to 25 or less pairs.

   General guidelines for this follow:

   a. The data should be presented and input to the analyzer with increasing values of temperature. The temperature may be in Celsius or Fahrenheit. Fahrenheit temperatures are the preferred units to enter.

   b. A maximum or minimum temperature difference between successive temperatures is not required. The intervals do not need to be evenly spaced. Choose 2 or 3 points in a linear region, and more data points in a region when an exponential relationship (curved) is observed.

   c. The maximum number of data pairs that may be entered is 25.

EXAMPLE CONTINUED:

The number of pairs originally found have been reduced to 15. In linear regions pairs have been eliminated. Figure 20 illustrates that the same shape curve is still observed if the proper pairs are eliminated.

3. The process-specific reference temperature must be determined. This is the "optimum" temperature at which your process runs and is the temperature to which you wish to correct all your values. In the example, the reference temperature is 25°C.

4. Additional configuration parameters may require adjustments before their data can be input into the tCt parameter. An electronic Bench Calibration may be required (see Section 5) if Ct or FSC required change.

   a. Adjust the temperature to display the units of measurement in which you have collected your data (C or F). See "Changing Cell Type (Ct)" on page 39. Automatic compensation should be used; sequence the display to remove the decimal point after C or F. Press **Enter**.

   b. Adjust Ct to correspond to the sensor type you will be using. See "Changing Cell Type (Ct)".

   c. Adjust FSC (see "The Full Scale Range (FSC)"). FSC should be large enough to include all of the tablulated conductivity values that were determined in the temperature table, as well as those that will be found in the Concentration Table to be derived. See "Custom Percent Curve (PCt)".

5. Unlock the instrument at the second level (bL); then press **Next** several times until the code tCt appears. Press **Enter**.

— NOTE

If tCt does not appear on the display, the required software is not available in your analyzer.

---

   a. The first number to enter is the number of pairs of temperature/conductivity data that will be entered. Press **Enter**.

   b. The second number to enter is the reference temperature using the temperature unit convention set in Step 4. No temperature unit will be displayed. Press **Enter**.

   c. Use **Next** and Δ to display the first temperature in your table. Press **Enter**.

   d. Use **Next** and Δ to display the corresponding conductivity from your table. The legend should display the correct units of measurement. Press **Enter**.

   e. Repeat Steps (c) and (d) in sequence. To avoid a time-out during the entries, press and hold **Shift**. If a time-out occurs, the program must be restarted from Step 5.

The continuation of the example illustrates the procedure.

EXAMPLE CONTINUED:

A 10.0 cell constant sensor is to be used in the process - Ct = 10.00. The FSC is set to 500 µS/cm to allow the maximum value of 261.9 µS/cm to be included in the range. The following numbers are then entered into the tCt parameter.

Number of Pairs	15	Press **Enter**
Reference Temperature	25.0	Press **Enter**
First Temperature	11.4	Press **Enter**
First Conductivity	38.0 µS/cm	Press **Enter**
Second Temperature	12.4	Press **Enter**
Second Conductivity	38.2 µS/cm	Press **Enter**
Alternate and **Enter** remaining conductivity and temperature data	12.9	Press **Enter**
	38.3 µS/cm	Press **Enter**
	13.4	Press **Enter**
	38.5 µS/cm	Press **Enter**
	14.4	Press **Enter**
	39.3 µS/cm	Press **Enter**
	16.0	Press **Enter**
	42.4 µS/cm	Press **Enter**
	17.9	Press **Enter**
	50.1 µS/cm	Press **Enter**
	20.4	Press **Enter**
	60.6 µS/cm	Press **Enter**
	23.6	Press **Enter**
	77.9 µS/cm	Press **Enter**
	26.0	Press **Enter**
	92.5 µS/cm	Press **Enter**
	28.4	Press **Enter**
	107.9 µS/cm	Press **Enter**
	29.2	Press **Enter**
	113 µS/cm	Press **Enter**
	30.8	Press **Enter**
	135.6 µS/cm	Press **Enter**
	34.8	Press **Enter**
	194.3 µS/cm	Press **Enter**
	37.2	Press **Enter**
	261.9 µS/cm	Press **Enter**

6. This completes the custom temperature data entry. To use this information to get temperature corrected conductivity data, set Cd to correspond to X099.

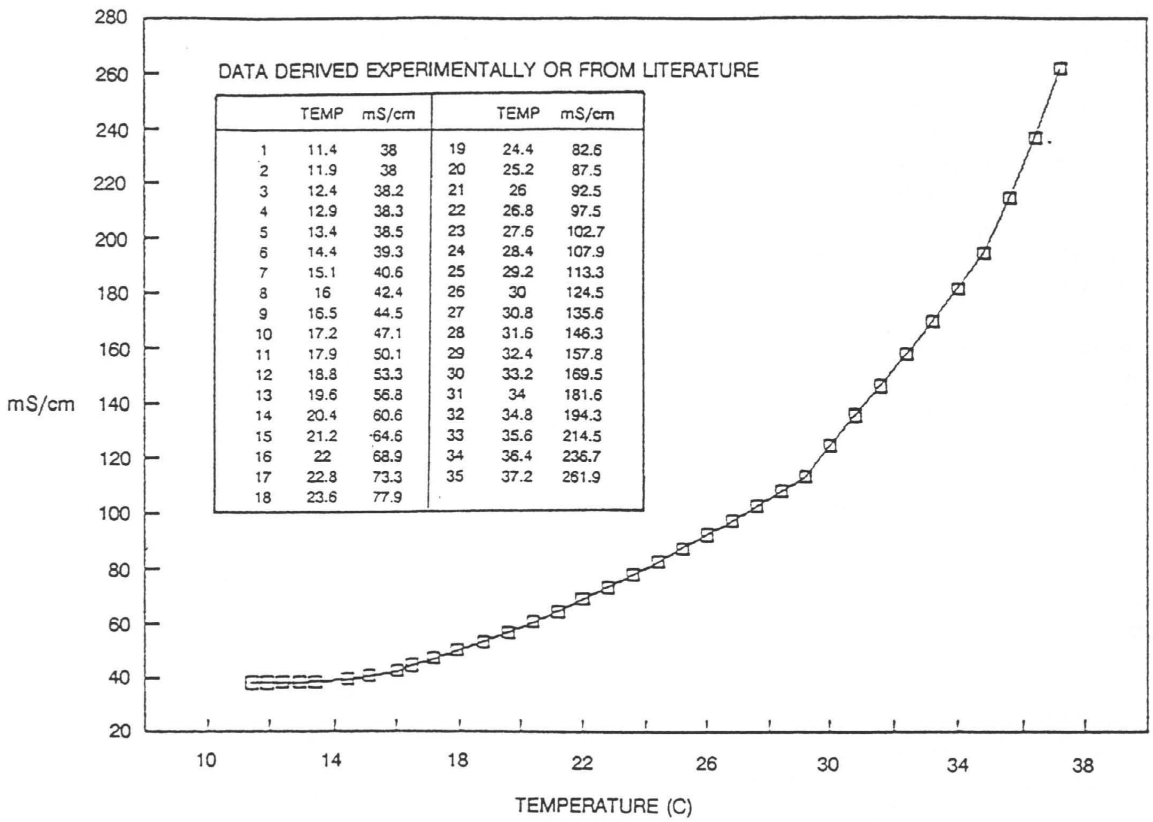


Figure 19. Initial Temperature vs. Conductivity Data

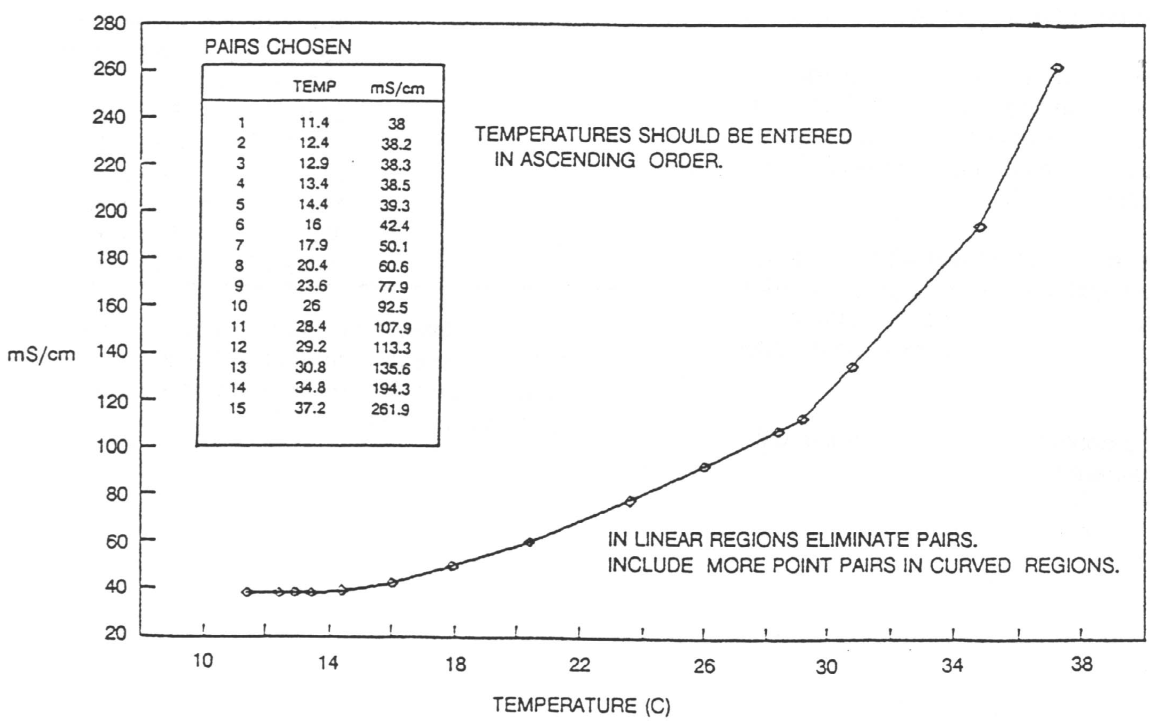
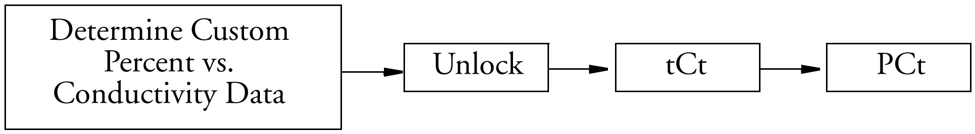


Figure 20. Temperature vs. Conductivity Data

Custom Percent Curve (PCt)

Flow Chart for Custom Percent Concentration



1. User-supplied process Percent Concentration vs. Conductivity data must be generated or extracted from literature in advance of entering it into the 873CC analyzer. This data must consist of Percent Concentration vs. conductivity data at the reference temperature specified in the "Custom Temperature Compensation Curve (tCt)" section. The concentrations should include and extend the entire range that the process may experience. Conductivity values must be input in ascending order and its slope cannot change directions. We suggest that the data be plotted graphically as well as tabularly to prepare it for entry in the 873CC.

   EXAMPLE:

   The control point of a process is 3.0%. The process has been known to vary between 0 and 6.0%. Dilutions of a concentrate are monitored at 25×C. Using the CC sensor and 873CC analyzer in the absolute mode (Cd = 0000), Conductivity vs. Percent Concentration data is generated. The data results can be shown in Figure 21.

2. The user-supplied, percent concentration data must be reduced to 25 or fewer pairs. General guidelines for this follow.

   a. The data should be presented and input to the analyzer with increasing values of Conductivity.

   b. The slope of Percent vs. Conductivity must not change signs; two different concentrations must not have the same conductivity.

   c. A maximum or minimum Percent difference between successive concentrations is not required. The intervals do not need to be evenly spaced. Choose 2 or 3 points in a linear region, and input more data points in a region when an exponential relationship (curved) is observed.

   d. The maximum number of data pairs that can be entered is 25.

   EXAMPLE CONTINUED:

   The number of data points originally found have been reduced. In linear regions, pairs have been eliminated. Figure 22 illustrates the same shape curve is still observed after the number of pairs have been reduced.

3. Custom Temperature Compensation tCt should be entered first. See "Custom Temperature Compensation Curve (tCt)" section. Unlock bL. Press **Next** until PCt appears on the display. Press **Enter**.

   a. The first number to enter is the number of pairs of concentration/conductivity data that will be entered. Press **Enter**.

   b. The second number to enter is the first conductivity value. Use **Next** and Δ to display the first conductivity value in your table. Press **Enter**.

c. Use **Next** and Δ to display the corresponding concentration from your table. Press **Enter**. The legend should display the correct units of measurement.

d. Repeat Steps (b) and (c) in sequence. To avoid a time-out during the entries, press and hold **Shift**. If a time-out occurs, the program must be restarted from Step 3(a).

Number of Pairs	0016	Press **Enter**
First Conductivity	000.0 µS/cm	Press **Enter**
First Percent	00.00	Press **Enter**
Second Conductivity	5.5 µS/cm	Press **Enter**
Second Percent	.20%	Press **Enter**
Alternate and **Enter** remaining conductivity and Percent data	27.5 µS/cm	Press **Enter**
	1.00%	Press **Enter**
	51.1 µS/cm	Press **Enter**
	1.80%	Press **Enter**
	74.7 µS/cm	Press **Enter**
	2.60%	Press **Enter**
	86.9 µS/cm	Press **Enter**
	3.00%	Press **Enter**
	99.7 µS/cm	Press **Enter**
	3.40%	Press **Enter**
	113.4 µS/cm	Press **Enter**
	3.80%	Press **Enter**
	128.2 µS/cm	Press **Enter**
	4.20%	Press **Enter**
	144.3 µS/cm	Press **Enter**
	4.60%	Press **Enter**
	161.9 µS/cm	Press **Enter**
	5.00%	Press **Enter**
	181.4 µS/cm	Press **Enter**
	5.40%	Press **Enter**
	204.4 µS/cm	Press **Enter**
	5.80%	Press **Enter**
	218.7 µS/cm	Press **Enter**
	6.00%	Press **Enter**
	236.2 µS/cm	Press **Enter**
	6.20%	Press **Enter**
	258.9 µS/cm	Press **Enter**
	6.40%	Press **Enter**

4. This completes the custom Percent Curve entry. To use this information to get temperature corrected Percent Concentration data, set Cd to correspond to X199. See "Compensation and Damping (Cd)" section.

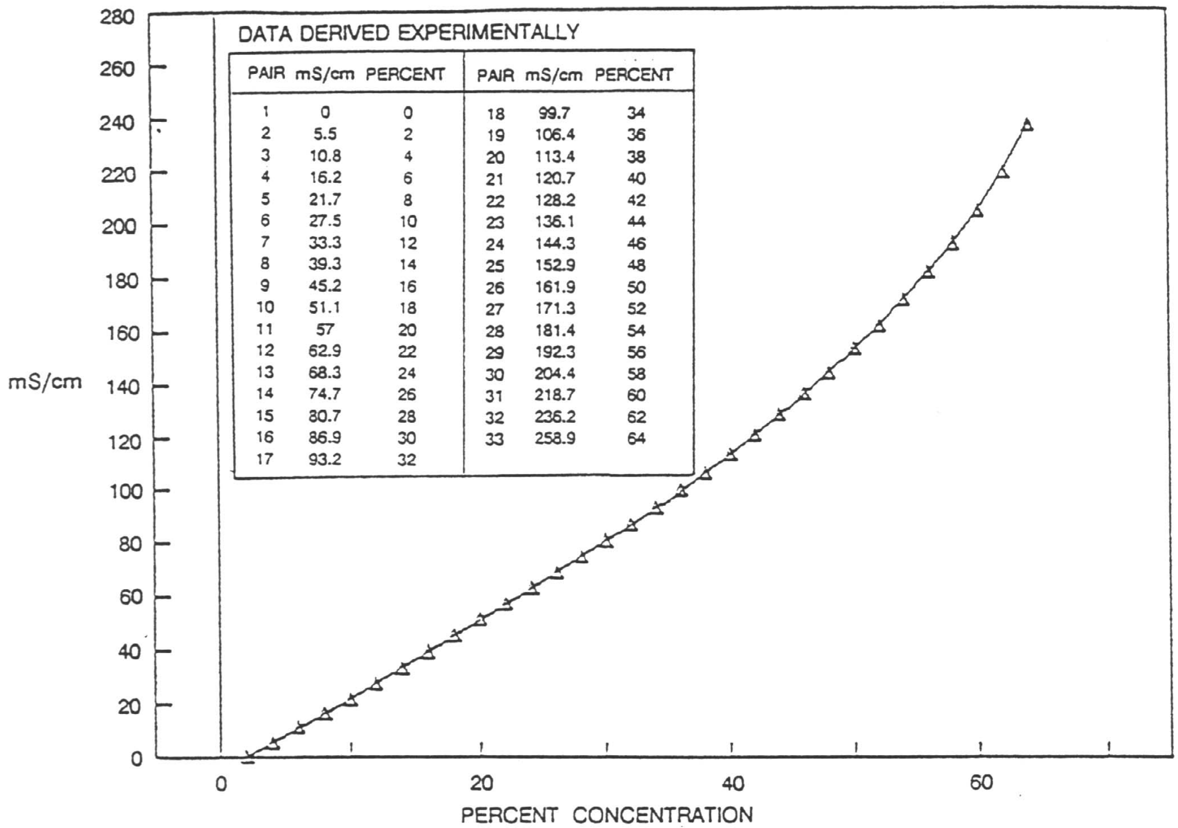


Figure 21. Initial Concentration vs. Conductivity Data

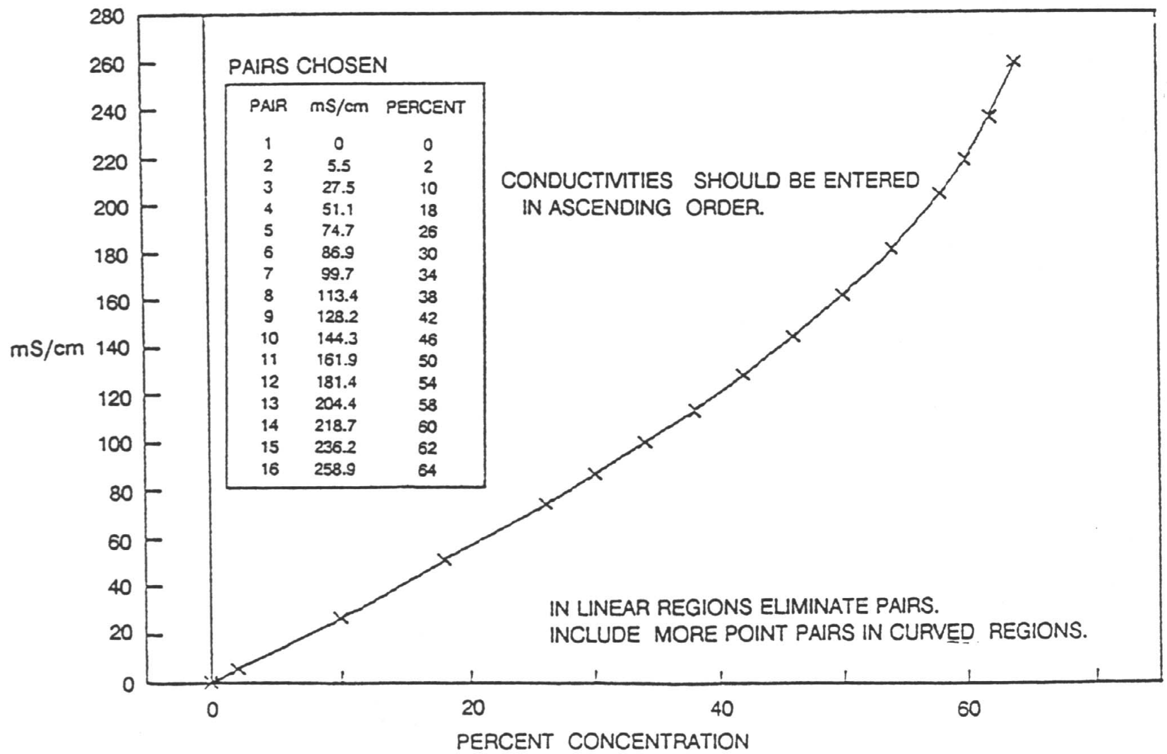


Figure 22. Concentration vs. Conductivity Data

5. Calibration

This section is divided into three parts.

- “Electronic Bench Calibration” contains the procedure for calibrating the 873CC Analyzer with precision resistors using theoretical sensor signal values. In many cases this calibration produces sufficient accuracy for the user's application.
- “Calibrating the Analyzer to a Specific Sensor” provides additional calibration procedures and standardization techniques. These additional procedures are recommended to obtain the best system accuracy. These procedures **must be used** when additional extension cables are used in installations.
- “Standardization Using a Known Solution” provides an additional wet calibration technique.

⚠ 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 turns and will not function properly with repeated use.

Electronic Bench Calibration

Ct → FSC → Cd 0000 → Open=0 Cal Lo → Ω Cal Hi

NOTE

Holding the **Shift** key between entries prevents the Analyzer from timing out and leaving the Setup entries.

This procedure is used to calibrate the 873 analyzers with precision resistors and theoretical sensor signal values.

NOTE

Invensys Foxboro calibrates and configures all 873 analyzers before leaving the factory. Calibration may be verified by installing resistors on the unit.

⚠ CAUTION

Do not press **Enter** if you are **checking** the calibration. It should not be necessary to implement the Electronic Bench Calibration unless the FSC has been changed or entered, or the Cal Hi and/or Cal Lo has been changed or entered.

Required:

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

Procedure:

Calibration of Cell 1 Channel:

1. Disconnect all sensor leads from terminal strip TB2.
2. Unlock analyzer (see “Unlocking Analyzer Using Security Code”).
3. Check and adjust the Cell code of the unit. Refer to “CELL Display and Output Configuration (CELL)” section. Set this code so the first digit is 1: “1XXX”.
4. Check and adjust the Cd code of the unit. Refer to “Compensation and Damping (Cd)” section. Set this code to read “0000”. The unit should have no damping and should utilize absolute temperature compensation.
5. Verify and reset the Ct code of the analyzer. Refer to “Changing Cell Type (Ct)” section.
6. Reset the Full Scale value of the analyzer. Refer to “Changing the Full Scale Range” on page 41. Even if the existing Full Scale value is the desired value, it is important to **reenter** the same value. When the FSC value is entered, Error Code “Er4” should begin to flash on the display.

— NOTE

If an Error Code of higher priority is present, it preempts the ER4 message. Holding the **Shift** key between entries prevents the analyzer from timing out and leaving the Setup entries.

---

7. For units utilizing 0.1 cm^{-1} cell factor sensors (CF1 = 1000), reset CF1 to 1000 (the theoretical cell factor).
8. Reset tCF1 to 25.00 (the theoretical temperature transducer value). See “Entering a tCF Value”.
9. **Checking the Temperature Circuit Calibration**
   a. Determine which type temperature compensation your analyzer has by checking the CONFIGURATION CD entry on the model identification label affixed to the analyzer (see Figure 2).

— NOTE

The 871CC Sensor types A through F use a 100 K Ω thermistor for automatic temperature compensation. The 871CC Sensors K through M use a 100 Ω RTD for automatic temperature compensation and are recommended for all measurements at elevated temperatures. Connect a 110 Ω or 100 K Ω resistor as applicable across terminals 3 and 3A on terminal strip TB2. Refer to Figure 23.

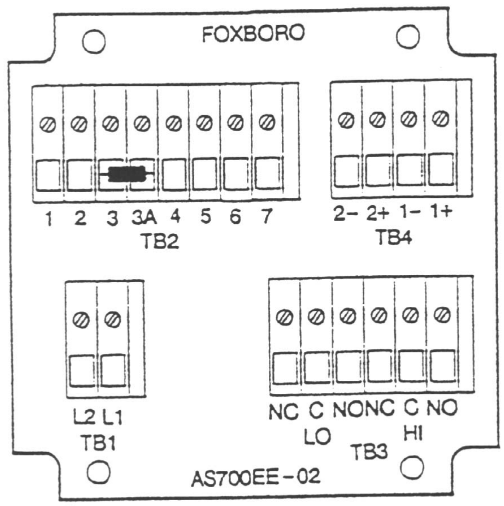


Figure 23. Temperature Simulation (Metal Version Shown)

b. Press **Temp**. The unit should be in the **Automatic Temperature** mode; no decimal should be visible after the "C" or "F" legend. If there is a decimal after the "C" or "F" legend, it should be removed. Press the increment key (Δ) once after pressing **Temp**; then press **Enter**. This removes the decimal.

c. Press **Temp**. The display should read **approximately** "25.C" or "77.F". If the display does not read these values, verify the correct resistor is being used, and ensure that it is installed correctly. If these measures do not improve the value, see "Changing the Temperature Circuitry" on page 42 for recalibrating procedures.

10. **Zero and Span Calibration**

a. With no input across terminals 1 and 2 on TB2 (infinite resistance), press **Shift** and while holding, press **Cal Lo**. Release fingers from both keys. Then use **Next** and Δ until the display reads 0 μS/cm or 0 mS/cm, as applicable. Press **Enter**.

b. Connect a decade resistance box to terminals 1 and 2 of TB2.

c. Calculate the Resistance Input required for Cal Hi Value using the following equation:

$$\text{Resistance Input in ohms} = \frac{(\text{Cell Factor})(1 \times 10^6)}{\text{Cal Hi Value in } \mu\text{S/cm}}$$

or

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

EXAMPLE:

For a conductivity display of 20 μS/cm and therefore a cell factor of 0.1 cm^{-1}, the resistance input in ohms is:

$$\text{Resistance Input} = \frac{(0.1)(1 \times 10^6)}{20} \times 5000\Omega$$

For other sample resistance inputs, refer to Table 14.

d. Set decade box to resistance input calculated. Wait at least 15 seconds.

e. Press **Shift** and while holding, press **Cal Hi**. Release fingers from both keys. Use **Next** and Δ until the display reads desired Cal Hi value. Press **Enter**.

Calibration of Cell 2 Channel

11. Check and adjust the CELL Code of the unit so Cell 2 is displayed. Refer to “CELL Display and Output Configuration (CELL)”. Set this code so the first digit is 2: “2XXX”.

12. For units utilizing 0.1 cm^{-1} cell factor sensors (Ct = 1000), reset CF2 to 1000 (the theoretical cell factor).

13. Reset tCF2 to 25.00 (the theoretical temperature transducer value).

Table 14. Various Resistance Inputs

For 0.1 cm^{-1} Cell			For 10.0 cm^{-1} Cell	
Cal Hi Value		Res. Input	Cal Hi Value	Res. Input
µS/cm	mS/cm	(Ω)	mS/cm	(Ω)
1	0.1	100 000	0.2	50 000
2	0.2	50 000	0.3	33 333
3	0.3	33 333	0.4	25 000
4	0.4	25 000	0.5	20 000
5	0.5	20 000	0.6	16 667
10	1	10 000	0.7	14 286
20	2	5 000	0.8	12 500
25	2.5	4 000	0.9	11 111
30	3	3 333	1	10 000
40	4	2 500	2	5 000
50	5	2 000	3	3 333
60	6	1 667	4	2 500
70	7	1 429	5	2 000
75	7.5	1 333	7.5	1 333
80	8	1 250	10	1 000
90	9	1 111	15	667
100	10	1 000	20	500

14. Checking the Temperature Circuit Calibration

a. Determine which type temperature compensation your analyzer is set up for by checking the CONFIGURATION CD entry on the model identification label affixed to the analyzer. See Figure 2.

— NOTE

871CC Sensor types "A" through "F" use a 100 K Ω thermistor for automatic temperature compensation. The 871CC Sensors "K" through "M" use a 100 Ω RTD for automatic temperature compensation and are recommended for all measurements at elevated temperature.

Connect a 100 Ω or 100 K Ω resistor, as applicable, across terminals 4 and 5 on terminal strip TB2. Refer to Figure 24.

b. Press **Temp**. The unit should be in the **Automatic Temperature** mode: No decimal should be visible after the "C" or "F" legend. If there is a decimal after the "C" or "F" legend, it should be removed. Press Δ once after pressing **Temp**; then press **Enter**. This removes the decimal.

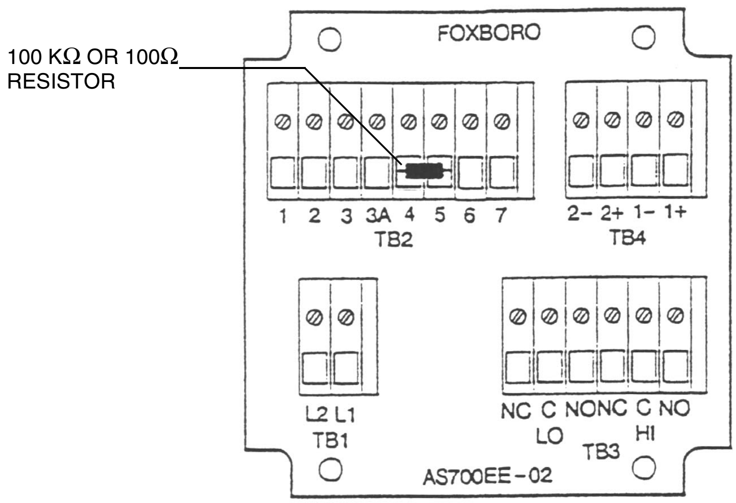


Figure 24. Temperature Calibration

c. 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 installed correctly. If these measures do not improve the value, see "Changing the Temperature Circuitry" for recalibrating procedures.

15. Zero and Span Calibration

a. With no input across terminals 6 and 7 on TB2 (infinite resistance), press **Shift** and while holding, press **Cal Lo**. Release fingers from both keys. Then use **Next** and Δ until the display reads 0 (µS/cm or mS/cm, as applicable). Press **Enter**.

b. Connect a decade resistance box to terminals 6 and 7 of TB2.

c. Calculate the Resistance Input required for Calibrate High Value using the following equation:

$$\text{Resistance Input in Ohms} = \frac{(\text{Cell Factor})(1 \times 10^6)}{\text{Cal Hi Value in } \mu\text{S/cm}}$$

or

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

EXAMPLE:

For a conductivity display of 20 µS/cm and therefore a cell factor of 0.1 cm^{-1}, the resistance input in ohms is:

$$\text{Resistance Input} = \frac{(0.1)(1 \times 10^6)}{20} \times 5000\Omega$$

For other sample resistance inputs, refer to Table 14.

- **d.** Set decade box to resistance input calculated. Wait at least 15 seconds.
- **e.** Press **Shift** and while holding, press **Cal Hi**. Release fingers from both keys. Use **Next** and Δ until the display reads desired Cal Hi value. Press **Enter**. At this point, error message “Er4” should disappear.

16. Disconnect decade box and resistor from terminal strip TB2.
17. Reconnect all sensor leads to terminal strip TB2.
18. Check and adjust the CELL and Cd codes of the unit to the desired values.
19. Lock analyzer.

This completes the Electronics Bench Calibration. It is suggested that you also enter specific sensor factors into the analyzer before using. See “Calibrating the Analyzer to a Specific Sensor”.

Calibrating the Analyzer to a Specific Sensor

Temperature Cell Factor (tCF1 and tCF2) and Cell Factor (CF1 and CF2) Adjustments

Invensys Foxboro conductivity sensors are manufactured under strict guidelines for quality and uniformity. Even with the stringent specifications of our assembly procedures, small offsets from theoretical values are possible. Under many circumstances the theoretical bench calibration and a sensor can still provide sufficient information to you. In these cases, the sensor should be connected to the analyzer and used without further calibration. For the best possible system accuracy of an 873CC and 871CC sensor, additional calibrations are required to standardize these small offsets.

An accurate temperature signal is required for proper temperature compensation, especially when measuring over a large temperature gradient. The temperature cell factors (tCF1 and tCF2) are used to offset a small deviation from ideality for the two sensors. This procedure must be used when extension cables are used.

— **NOTE**
The 871CC Sensor type A through F use a 100 K Ω thermistor for automatic temperature compensation. The 871CC Sensors K through M use a 100 Ω RTD for automatic temperature compensation and are recommended for all measurements at elevated temperature.

Additionally, individual sensors with 0.1 cm^{-1} cell factors may differ slightly from.1000 cm^{-1} (their nominal constant). The cell factor adjustments (CF1 and CF2) are used to offset these small deviations from ideality for the two sensors.

871CC Sensors with 0.1 cm^{-1} nominal cell constants are stamped with a 4-digit number (e.g., .1001) which is the cell factor (CF) of that particular cell when tested in our factory. These cells are also stamped with a temperature value (tCF) (e.g., 24.97°C) which is the temperature where that particular transducer read its theoretical resistance value. See Figure 25. When the sensor is connected directly to the Analyzer, these factors may be input directly into the 873CC to correct for these offsets. Alternately, the procedures that follow may be used to **determine** these offset values, and must be used when additional cable lengths are used with the sensors.

Determining tCF

1. Place 871CC sensor and an accurate Centigrade thermometer (with .10°C resolution) into a container of water. Allow the system to reach thermal equilibrium.
2. Press **Temp**. Put the analyzer into Automatic Temperature Compensation; that is, no decimal after the C. If there is a decimal after the C, it should be removed. Press ∆ once after pressing **Temp**; then press **Enter**.

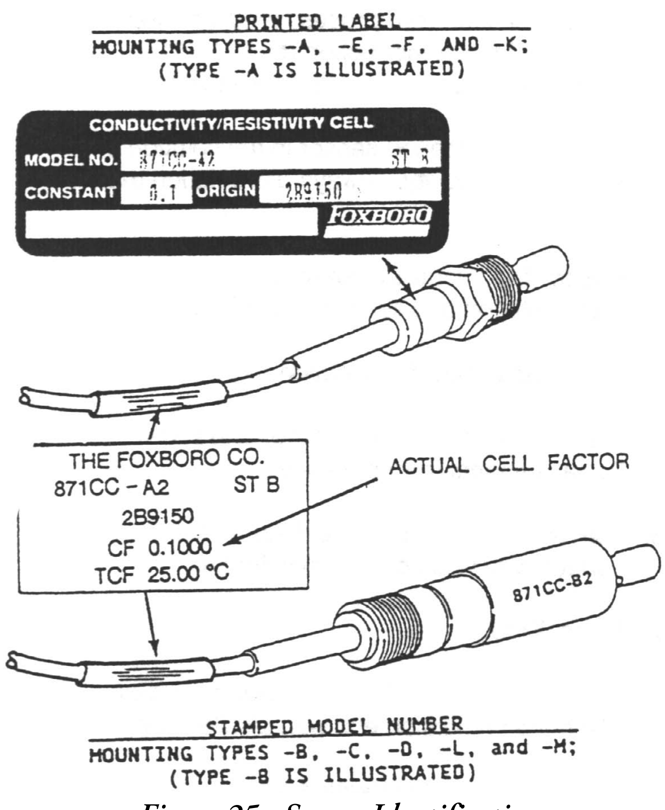


Figure 25. Sensor Identification

3. Read the temperature displayed on the 873 Analyzer to the hundredths place. When **Temp** is pressed, the current temperature value with tenths place alternates with the C legend. The value read by the 873 Analyzer 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 is not visible (e.g., 25.20 is 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 Analyzer says (2)5.20 C; the 873 Analyzer is reading higher by .50°C.
5. Subtract this value from 25.00 (e.g., 25.00 – .50 = 24.50). This is your new tCF value.

— NOTE

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

Entering a tCF Value

— NOTE

1. Before this procedure is performed, it should be verified that the 873CC Analyzer has been electronically bench calibrated. The electronic bench calibration procedure is performed at the factory on all new analyzers.
2. The procedure given in the "Bench Calibration" section must precede, not follow, the procedure below.

1. Unlock analyzer (see "Unlocking Analyzer Using Security Code").
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 cell you wish to "fine tune") is displayed.
7. Press **Enter** and then use **Next** and Δ until desired value (matching the data on the cell) is displayed.
8. Press **Enter**.
9. Recheck any differences that exist between a thermometer and temperature displayed on the 873 Analyzer.
10. Lock Analyzer using procedure in "Locking Analyzer Using Security Code".

Entering a CF Value

NOTE

1. This procedure should be implemented after the 873CC Analyzer has been electronically bench calibrated. The theoretical value of .1000 cm^{-1} is input to the analyzer at the factory on all new analyzers.
2. The procedure given in the “Electronic Bench Calibration” section must precede, not follow, the procedure below.

1. Unlock analyzer (see “Unlocking Analyzer Using Security Code”).
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 CF1 or CF2 (depending on the cell you wish to “fine tune”) is displayed.
7. Press **Enter**, then use **Next** and Δ until desired value (matching the data on the cell) is displayed. Press **Enter**.
8. Lock analyzer (see “Locking Analyzer Using Security Code”).

Standardization Using a Known Solution

The analyzer may be standardized using a solution of known conductivity after the analyzer has been bench calibrated, and specific sensor factors have been input. See Section 5. The following procedure is used when calibrating with one known solution.

1. Remove sensor from process medium. Refer to sensor Master Instruction (MI 611-151). Wash the immersion end in distilled water.
2. Immerse the cleaned sensor in the solution of known conductivity. Always use solution that is midscale.
3. Wait for five minutes to allow the temperature of the solution and sensor to stabilize.
4. Unlock analyzer. See “Unlocking Analyzer Using Security Code”.
5. Press **Shift** and while holding, press **Cal Lo**. Release fingers from both keys.
6. Use **Next** and Δ until the display reads conductivity value of known solution.
7. Press **Enter**.
8. Remove the sensor from the known solution. Wash the immersion end with distilled water.
9. Lock analyzer. See “Locking Analyzer Using Security Code”.
10. Reinstall sensor in process solution.

6. Diagnostics

Troubleshooting

Table 15. Troubleshooting Symptoms

Symptom	Approach
Noisy Signal	May be flow related 1. Check Analyzer noise by simulating sensor signal with a resistor. 2. Increase damping. 3. Reorient sensor.
Conductivity Decreases	Gas bubble may be trapped.
Temperature Reads Incorrectly	1. Check to see if correct tCF is being used. Extension cables and junction box use requires a new tCF be determined. 2. Verify 873 is set up for proper temperature transducer. See "Electronic Bench Calibration" on page 61, Items 9 and 14.
Accuracy	Accuracy of the sensor may be affected by deposits from the process liquid. Consult sensor MI for cleaning recommendations.

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 16.

Table 16. 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 security code using procedure. 2. Power down unit. 3. On plastic unit, verify that metal shorting strip used in shipping has been removed.

Table 16. Error/Alarm Messages (Continued)

Alternate Display	Condition	Priority	Action Required to Clear Error Message
Er 2	User-defined temperature range error or temperature measurement error Analyzer set up for wrong temperature transducer.	3	1. Change user-defined temperature limits, UtL or LtL. 2. Replace sensor. 3. Place temperature in manual mode (e.g., 25.C.). 4. See "Changing the Temperature Circuitry" on page 42.
Er 3	User-defined measurement range error	4	1. Change user-defined measurement limits, UL or LL. 2. Replace sensor.
Er 4	Measurement calibration incorrect	2	Recalibrate analyzer using Bench Calibration procedure.
A Hi	Measurement in Hi alarm	6	
A HH	Measurement in HiHi alarm	5	
A LO	Measurement in Lo alarm	8	
A LL	Measurement in LoLo alarm	7	
****	Measurement over or under range of analog output limits	9	
Err	Incorrect code or parameter attempted	2	Check code and reenter.

— NOTE

If two or more errors exist simultaneously, the analyzer flashes only the error with the 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 SHEETS

Configuration Setup Entries

Symbol	Parameters and Values Accessed	User Settings
CELL	Configuration of Display, Analog Outputs	
Hold	Holds and sets the Analog output value in Hold	
Cd	Compensation and Damping –Damping Factor –Temperature Compensation	
HAC	H Alarm Configuration –Measurement Selection –Low/High/Instrument plus Passive/Active State –% Hysteresis	
HAFt	High Alarm Feed Time	
HAdL	High Alarm Delay Time	
LAC	L Alarm Configuration –Measurement Selection –Low/High/Instrument plus Passive/Active State –% Hysteresis	
LAFt	Low Alarm Feed Time	
LAdL	Low Alarm 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	

CELL Code - Display and Output Configuration

Digit 1	Digit 2	Digit 3	Digit 4
DISPLAY 1-Cell 1 2-Cell 2 7-Ratio 8-% Rejection	DIAGNOSTICS ENABLE 0-Interrogate both channels 1-Ignore non-configured channel	OUTPUT 1 1-Conductivity Cell 1 2-Conductivity Cell 2 3-Temp Cell 1 4-Temp Cell 2 5-Log (conductivity Cel1) 6-Log (conductivity Cel2) 7-Ratio 8-% Rejection	OUTPUT 2 1-Conductivity Cell 1 2-Conductivity Cell 2 3-Temp Cell 1 4-Temp Cell 2 5-Log (conductivity Cel1) 6-Log (conductivity Cel2) 7-Ratio 8-% Rejection

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 0 = None 1 = 10 seconds 2 = 20 seconds 3 = 40 seconds	0 = % Legend disabled. 1 = % Legend enabled.	00 = Absolute (no compensation) 01 = Dilute NaCl solution with water subtraction 99 = Special.

Basic Setup Entry Selection

Display Symbol	Parameter and Value Accessed	User Settings
bL	Basic Setup Lock Control	
Ct	Cell Type (either 0.1 or 10.0 cm^{-1} cell factor)	
FSC	Full Scale Value	
CF 1	Cell Factor - Cell 1	
tCF 1	Temperature Cell Factor - Cell 1	
tEC 1	Thermistor Temperature Electronics Calibration Cell 1	
tCL 1	RTD Low Temperature Electronics Calibration Cell 1	
tCC 1	RTD Mid Temperature Electronics Calibration Cell 1	
tCH 1	RTD High Temperature Electronics Calibration Cell 1	
LCC	Lock Code Change	
CF 2	Cell Factor - Cell 2	
tCF 2	Temperature Cell Factor - Cell 2	
tEC 2	Thermistor Temperature Electronics Calibration Cell 2	
tCL 2	RTD Low Temperature Electronics Calibration Cell 2	
tCC 2	RTD Mid Temperature Electronics Calibration Cell 2	
tCH 2	RTD High Temperature Electronics Calibration Cell 2	
tCt	Custom Temperature Compensation Curve	
PCt	Custom Percent Concentration Curve	
LCO1	Analog Out 1 Electronics Lower Calibration	
HCO1	Analog Out 1 Electronics Upper Calibration	
LCO2	Analog Out 2 Electronics Lower Calibration	
HCO2	Analog Out 2 Electronics Upper Calibration	
Sft	Software Version Number	
SOH	Sales Order High	
SOL	Sales Order Low	

HAC and LAC Codes - Alarm Configuration

Digit 1	Digit 2	Digits 3 & 4
Measurement Selection	**Configuration**	**Hysteresis**
1 – Conductivity Cell 1 2 – Conductivity Cell 2 3 – Temp Cell 1 4 – Temp Cell 2 7 – % Ratio 8 – % Rejection	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 (mS/cm, µS/cm) 0.0 to 9.9% (% mode)

HAFt, HAdL, LAFt and LAdL Time Codes

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

UL = The Upper Limit is 999.9 uS/cm, mS/cm, or 99.99%.
LL = The Lower Limit is -.99 uS/cm, mS/cm,%.
UtL = The Upper Limit is 200°C (392°F).
LtL = The Lower Limit is -20°C (-5°F).
HO1 = May be set to any value between -0.99 and 99.99.
LO1 = May be set to any value between -0.99 and 99.99.
HO2 = May be set to any value between -0.99 and 99.99.
LO2 = May be set to any value between -0.99 and 99.99.

Troubleshooting Symptoms

Symptom	Approach
Noisy Signal	May be flow related 1. Check Analyzer noise by simulating sensor signal with a resistor. 2. Increase damping. 3. Reorient sensor.
Conductivity Decreases	Gas bubble may be trapped.
Temperature Reads Incorrectly	1. Check to see if correct tCF is being used. Extension cables and junction box use will require a new tCF to be determined. 2. Verify 873 is set up for proper temperature transducer. See “Electronic Bench Calibration” on page 61, Items 9 and 14.
Accuracy	Accuracy of the sensor may be affected by deposits from the process liquid. Consult sensor MI for cleaning recommendations.

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 security code using procedure. 2. Power down unit. 3. On plastic unit, verify that metal shorting strip used in shipping has been removed.
Er 2	User-defined temperature range error or temperature measurement error Analyzer set up for wrong temperature transducer.	3	1. Change user-defined temperature limits, UtL or LtL. 2. Replace sensor. 3. Place temperature in manual mode (e.g., 25.C.). 4. See “Changing the Temperature Circuitry” on page 42.
Er 3	User-defined measurement range error	4	1. Change user-defined measurement limits, UL or LL. 2. Replace sensor.
Er 4	Measurement calibration incorrect	2	Recalibrate analyzer using Bench Calibration procedure.
A Hi	Measurement in Hi alarm	6	
A HH	Measurement in HiHi alarm	5	
A LO	Measurement in Lo alarm	8	
A LL	Measurement in LoLo alarm	7	
****	Measurement over or under range of analog output limits	9	
Err	Incorrect code or parameter attempted	2	Check code and re-enter.

— 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.

For Warranty Information 1-866-746-6477
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

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 26 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.

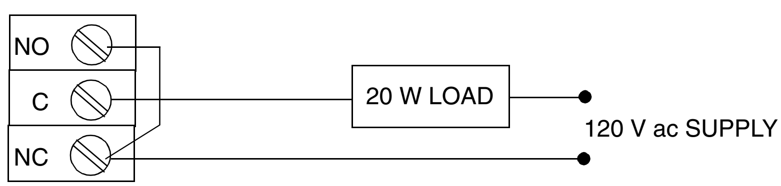


Figure 26. Alarm Contact Reconditioning Circuit

8. User Notes

Single Sensor Use

This section allows fault-free setup of the 873CC 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 up the sensor, follow the steps below to determine the pertinent configuration code assignments. Error codes will occur if the unit is configured improperly.

USE THIS COLUMN FOR CELL 1 CONFIGURATION

1. Wire Sensor to TB2
   Cell 1 terminals 1, 2, 3, 3A
2. Choose Cell Code

Digit			
1	**2**	**3**	**4**
1	1	1 or 3 or 5	1 or 3 or 5

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

If Yes, set to desired values. See Section:	If No, set to values below.
HO1 page 37	HO1 = 99.99
LO1 page 37	LO1 = - .99

4. Will you be using Alarms?

LAC

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

HAC

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 LAC = 1100
set HAC = 1300
set L ALM = - .99
set H ALM = 99.99

OR USE THIS COLUMN FOR CELL 2 CONFIGURATION

Cell 2 terminals 4, 5, 6, 7

Digit			
1	**2**	**3**	**4**
2	1	2 or 4 or 6	2 or 4 or 6

If Yes, set to desired values. See Section:	If No, set to values below.
HO2 page 37	HO2 = 99.99
LO2 page 37	LO2 = -.99

LAC

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

HAC

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 LAC = 2100
set HAC = 2300
set L ALM = - .99
set H ALM =99.99

Dual Sensor Use

Ratio:

For Ratio measurements, the sensor designated Cell 1 must be located physically on the untreated water source. Cell 2 is placed after the "clean up" operation.

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 HO1, LO1 and HO2, LO2 to the proper values. If an output will not be used (or plastic version), set to:

HO1 and HO2 = 99.99; LO1 and LO2 = -.99.

Percent Rejection:

For Percent Rejection measurements, the sensor designated Cell 1 must be located physically on the untreated water source. Cell 2 is placed after the "clean up" operation.

Cell Code

Digit			
1	2	3	4
8	0	X	X

Where XX means any values.

Set digits 3 and 4 as desired. If the Analog outputs will be used, set HO1, LO1 and HO2, LO2 to the proper values. If an output will not be used (or plastic version), set to:

HO1 and HO2 = 99.99; LO1 and LO2 = -.99.

Redundant Sensor Operation

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. The cell code should be set.

Cell Code

Digit			
1	2	3	4
1	0	X	X

Where XX means any values.

Set the analog outputs as desired (digits 3 and 4 of cell code) to functions of cell 1's operation. HO1 and LO1, HO2 and LO2 should be set appropriately.

Configure the alarms, HAC and LAC to Ratio measurement.

LAC

Digit			
1	2	3	4
7	X	X	X

HAC

Digit			
1	2	3	4
7	X	X	X

Determine acceptable variances between the two sensors at the control before alarming. Calculate the ratio relationship:

$$\frac{\text{Cell 2}}{\text{Cell 1}} \times 100$$

Set L ALM and H ALM and wire alarm terminals to appropriate alarm device.

Backup Sensor Operation

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 configure Cell 2 as the primary cell using the right column information.

1. Wire Sensor to TB2

Cell 1 terminals 1, 2, 3, 3A **AND** Cell 2 terminals 4, 5, 6, 7

USE THIS COLUMN FOR CELL 1 CONFIGURATION

2. Choose Cell Code

Digit			
1	2	3	4
1	1	1 or 3 or 5	1 or 3 or 5

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

If Yes, set to desired values. See Section:	If No, set to values below.
HO1 page 37	HO1 = 99.99
LO1 page 37	LO1 = - .99

4. Will you be using Alarms?

LAC

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

HAC

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 LAC = 1100
set HAC = 1300
set L ALM = - .99
set H ALM = 99.99

OR USE THIS COLUMN FOR CELL 2 CONFIGURATION

Digit			
1	2	3	4
2	1	2 or 4 or 6	2 or 4 or 6

If Yes, set to desired values. See Section:	If No, set to values below.
HO2 page 37	HO2 = 99.99
LO2 page 37	LO2 = -.99

LAC

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

HAC

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 LAC = 2100
set HAC = 2300
set L ALM = - .99
set H ALM =99.99

Thank you for buying an American made Invensys Foxboro 873CC electrochemical analyzer. We also supply pH/ORP, resistivity, and electrodeless conductivity analyzers and equipment. Contact us for your analysis needs.

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

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Foxboro, MA 02035-2099
United States of America
http://www.foxboro.com
Inside U.S.: 1-866-746-6477
Outside U.S.: 1-508-549-2424
or contact your local Foxboro
Representative.
Facsimile: (508) 549-4492

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