873EC Series
Electrochemical Analyzers
for Electrodeless Conductivity Measurement

Style D

FOXBORO

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Read This First

Upon receiving your 873 Analyzer —

CHECK:

1. Data Label (see Figure 2 on page 4) to verify such things as:

   a. Analyzer Type

   b. Model code options, if applicable

   c. Power supply

   d. Sensor type

If any are incorrect, please contact your supplier.

2. Calibration Range. If ordered through Invensys Process Systems (IPS), the analyzer has been preprogrammed to your specifications at the factory. The full scale range is noted on the data label next to CALIB and possibly next to CUST DATA if given. This should match your application requirements.

   If the DATA LABEL CALIBRATION information does not match your application requirements, or if the sensor type is incorrect, you may need to bench calibrate the analyzer. To do so, see Section 5 - Calibration.

   If the DATA LABEL information is correct, proceed to "Quick Starting the 873EC Analyzer"

Quick Starting the 873EC Analyzer

Since you have determined the full scale range and the sensor type is correct for your application, a bench calibration is not required.

Your analog outputs were scaled to your full scale range during factory calibration. Therefore, you need only do the following:

1. Hook up the sensor to the analyzer.

2. Hook up power to the analyzer.

For maximum measurement precision, you may opt to do the following:

1. Perform tCF Temperature Cell Factor Adjustment.

2. Perform a zero calibration in air.

In addition, you may choose to:

1. Set alarms.

2. Change Temperature Legend.

For technical assistance with the calibration or operation of the 873 Analyzer, call the Technical Assistance Center at 1-508-549-2168.

For application assistance or questions concerning our other measurement offerings, such as Dual pH/ORP, fluoride, dissolved oxygen, resistivity, or contacting conductivity, call the IPS Global Client Support Center at 1-866-746-6477.

Also, refer to Sensor Notes, which follow.

Sensor Notes

For proper installation and to provide maximum sensor accuracy, the electrodeless sensors require the minimum I.D. spacing specified below in order to avoid sidewall effects:

Small Bore Sensors (SP, HP, TF, NL, PN, PX, PP, or PT):   3 inch minimum I.D. mounting

Large Bore Sensors (LB, RE, UT, BW, or EV):   6 inch minimum I.D. mounting

The use of Foxboro Flowthru 871FT Sensors eliminates this requirement.

Various sensor accessories are available to satisfy differing mounting requirements.

In addition —

For applications involving low conductivity ranges (such as 0 to 500 µS/cm), the appropriate large bore sensor should be employed.

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

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

For a White Paper detailing this procedure and the effects, please contact the IPS Global Client Support center at 1-866-746-6477.

1. Introduction

General Description

The 873EC Analyzer measures 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 873EC 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 panel-mounted analyzer transmits one output signal only, while the metal enclosure analyzers can transmit two output signals.

Instrument Features

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

♦ Plastic or Metal NEMA 4X Enclosure

♦ Dual Alarms

♦ Dual Isolated Analog Outputs on Metal Enclosure

♦ EEPROM Memory

♦ Instrument Security Code

♦ Hazardous Area Classification (Metal Units)

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

Dual Alarms

The two independent, nonpowered Form C contacts are rated at 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 87.

No Battery Backup Required

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

Instrument Security Code

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

Hazardous Area Classification

The field-mounted, epoxy-painted, aluminum enclosures are designed to meet the requirements for Class I, Division 2, Groups A, B, C and D hazardous locations. The 873 is approved by Factory Mutual (FM) and the Canadian Standards Association (CSA).

Front Panel Display

The instrument's display consists of a four-digit bank of red LEDs with decimal point, and an illuminated legend area to the right of the LEDs (see Figure 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 between 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; 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 mounted applications. The transparent door allows viewing of the display and is hinged for easy access to the front panel controls.
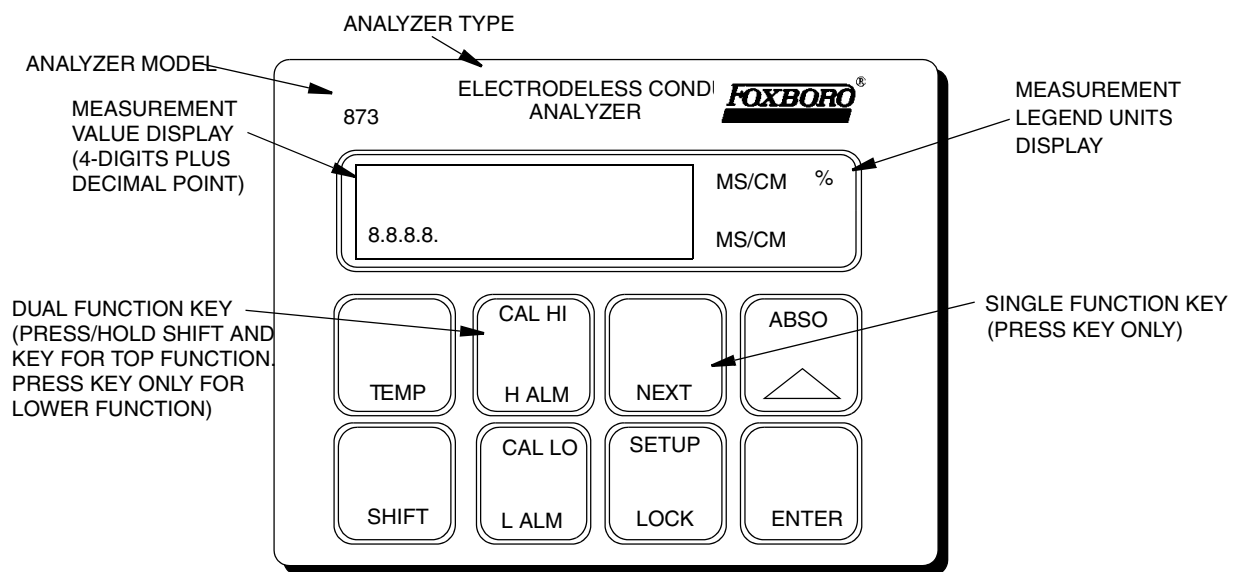
Figure 1. Front Panel Display and Keypad

Analyzer Identification

A data label is located on the side surface of the enclosure. This data label provides Model No. and other information pertinent to the particular analyzer purchased. Refer to Figure 2.
.

MODEL	873EC-AIYFGZ-7	
		ST DM
CERT SPEC	FGZ	
REF NO	19839F05	
ORIGIN	2B0303	
SUPPLY	120 VAC 50/60 Hz	
POWER	10.2 WATTS MAX	
FUSE	150 mA S.B.	
CALIB	0-50 MS/CM	
CONFIG CD	100K THERMISTOR	
ALARM	2 NO/NC 5A 125 VAC	
OUTPUT	4-20 MA	
CUST DATA		

FOXBORO, MA U.S.A.
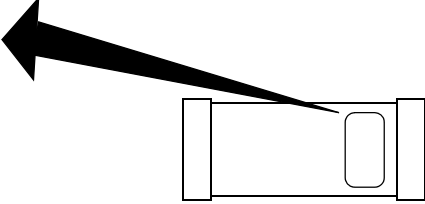
Figure 2. Data Label Location

Standard Specifications

Supply Voltages

–A	120 V ac
–B	220 V ac
–C	240 V ac
–E	24 V ac
–J	100 V ac

Supply Frequency

50 or 60, ±3 Hz

Output Signal

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

Ambient Temperature Limits

–25 to +55°C (–13 to +131°F)

Measurement Ranges

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

HCl, 0-15%
NaCl, 0-25%
H_3PO_4, 0-35%
HNO_3, 0-10%
H_2SO_4, 0-25%
H_2SO_4, 99.5-93% at 50 °C (122°F)
Oleum, 42-18% at 65 °C (149°F)
NaOH, 0-15% at 25 °C (77°F)
NaOH, 0-20% at 100 °C (212°F)

Temperature Measurement Range

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

Temperature Compensation Range

See Table 7.

Relative Humidity Limits

5 to 95%, noncondensing

Accuracy of Analyzer

±0.5% of upper range limit

Analyzer Identification

Refer to Figure 2.

Dimensions

Plastic:92(H) x 92(W) x 183(L) mm [3.6 (H) x 3.6 (W) x 7.2 (L) inches]
Metal: 92(H) x 92(W) x 259(L) mm [3.6 (H) x 3.6 (W) x 10.2 (L) inches]

Enclosure/Mounting Options

−P   Plastic /Panel Mount
−W   Metal/Panel Mount
−X   Metal/Surface Mount
−Y   Metal/Pipe Mount
−Z   Metal/Movable Surface Mount

Approximate Mass

Plastic Enclosure:0.68 kg (1.5 lb)

Metal Enclosure (with Brackets):

Panel Mounting 1.54 kg (3.4 lb)
Pipe Mounting 2.31 kg (5.1 lb)
Fixed Surface Mounting 2.22 kg (4.9 lb)
Movable Surface Mounting 3.13 kg (6.9 lb)

Instrument Response

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

Measurement Damping

Choice of 0, 10, 20, or 40 seconds, configurable from keypad. Damping affects displayed parameters and analog outputs.

Alarms

♦ Two alarms configurable via keypad

♦ Individual setpoints 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 at 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 87.

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)

Metal Case Analyzers

The metal case 220 V ac or 240 V ac analyzers comply with the requirements of the European EMC Directive 89/336/EEC when the sensor cable and power cable are enclosed in rigid metal conduit. See Table 2.

Plastic Case Analyzers

The plastic case analyzers are intended for mounting in metal consoles or cabinets. The plastic case analyzers comply with the European EMC Directive 89/336/EEC when mounted in a metal enclosure and the I/O cables extending outside the enclosure are enclosed in rigid metal conduit. See Table 2.

Product Safety Specifications

Table 1. Product Safety Specifications

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

⚠ **CAUTION**

1. When replacing covers on the 873 metal case, use Loctite (Part No. S0106ML) on the threads for the front cover and Lubriplate (Part No. X0114AT) on the threads for the rear cover. Do not mix.

2. Exposure to some chemicals may degrade the sealing properties of Polybutylene Teraethalate and Epoxy used in some components. These materials are sensitive to acetone, MEK, and acids. Periodically inspect relays K1 and K3 for any degradation of properties and replace if degradation is found.

2. Installation

Mounting to a Panel — Plastic Enclosure 873EC-_ _ 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 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 873EC-_ _ W

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

1. Make cutout in panel in accordance with DP 611-162.
2. Insert analyzer through panel cutout and temporarily hold in place. (Rear bezel will have to be removed for this procedure.)
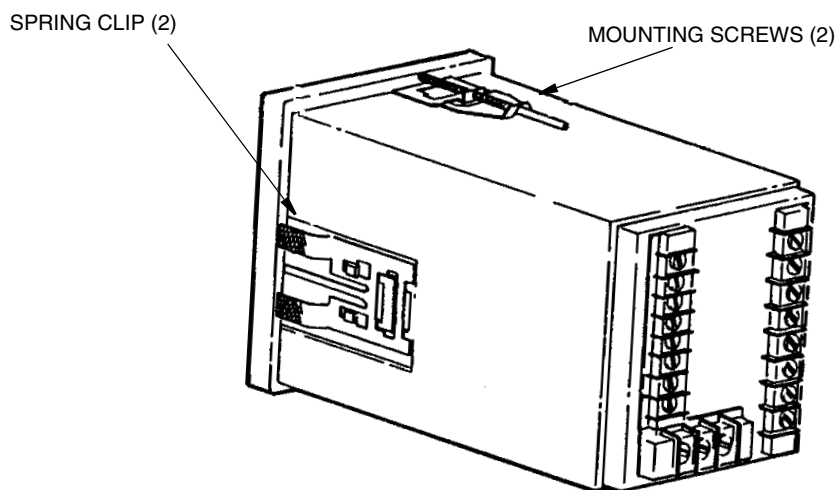
Figure 3. Mounting to Panel - Plastic Enclosure

3. 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.
4. Tighten screws (CW) on clamp latches until enclosure is secured to panel.
5. Reassemble rear bezel to enclosure using four screws.

9
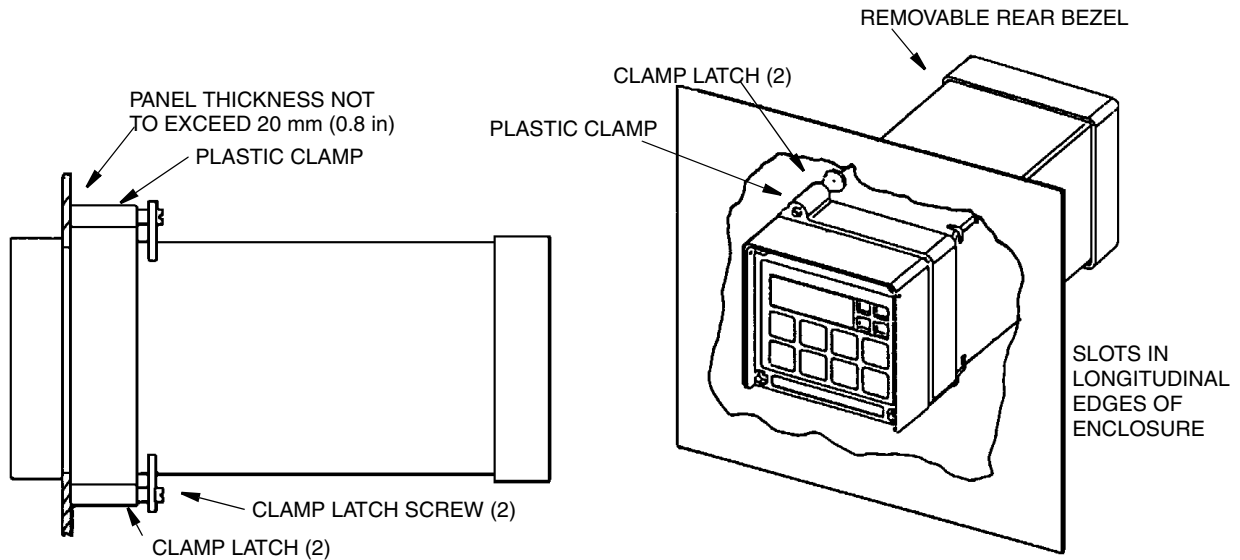
Figure 4. Mounting to Panel - Metal Enclosure

Mounting To Pipe (Metal Enclosure Only) 873EC-_ _ Y

1. Locate surface on which you wish to mount the analyzer.

2. Assemble universal mounting as follows, referring to Figure 5:

   a. Place hex bolts (5) through spacer (3) into support bracket (2).

   b. Slide nylon washers (11) over bolts (5).

   c. Slide bolts through pipe mounting bracket (1) and fasten assembly tightly with hardware designated 7, 6, and 13.

   d. Attach pipe mounting bracket (1) to pipe using U-bolts (12) using hardware designated 6, 7, and 13.

3. Slide analyzer into support bracket and slide strap clamp (4) onto analyzer. Using two screws, nuts, and washers, attach strap clamp to support bracket to secure analyzer.

4. Lift entire assembly of Step 3, and using two U-clamps, nuts, and washers, secure mounting bracket to pipe

MOUNTING
BRACKET

SUPPORT
BRACKET

STRAP
CLAMP

MOUNTING
BRACKET

0.312-18 NUTS (4)

0.190-32 SCREWS (2)

SPACER

VERTICAL
DN50 OR
2-IN. PIPE

U-CLAMP

U-CLAMP

STRAP
CLAMP

NOMINAL DN50 OR 2-IN.
PIPE. HORIZONTAL PIPE
SHOWN. TWO U-CLAMPS
ARE USED TO SECURE
BRACKET TO PIPE.

PIVOT BOLT; MOUNTED
ENCLOSURE CAN BE
ROTATED UP TO 60°
IN VERTICAL PLANE.

REFER TO PARTS LIST
PL 611-016
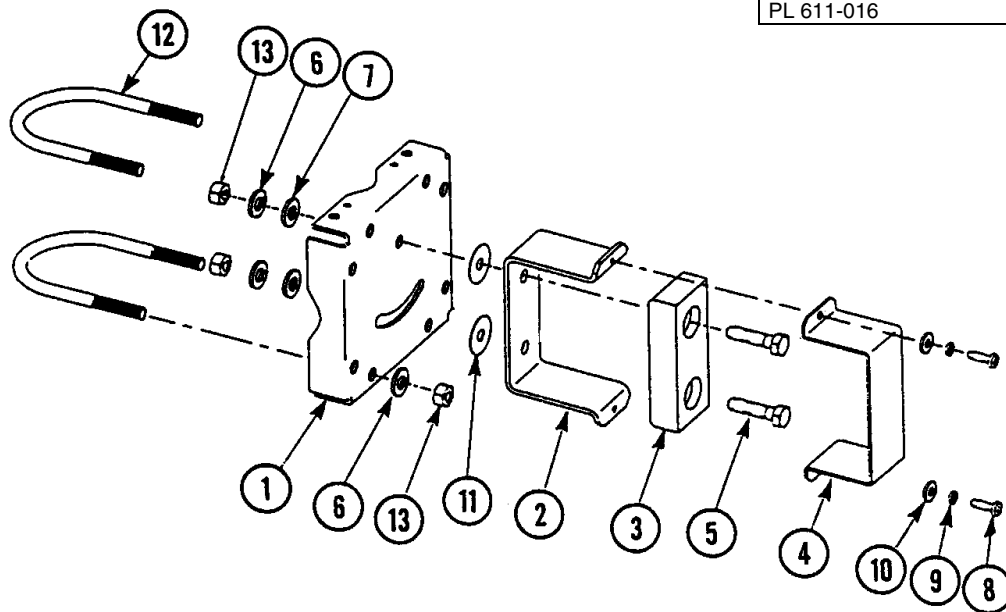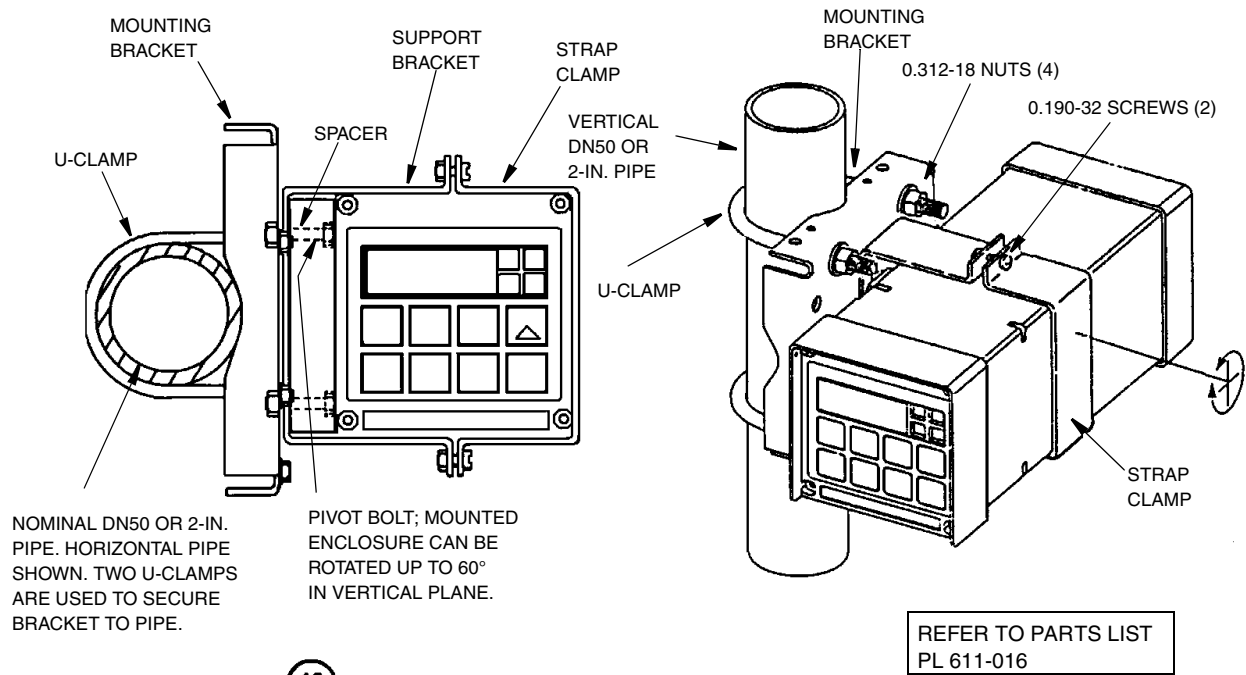
Figure 5. Metal Enclosure - Pipe Mounting

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

1. Locate surface on which you wish to mount the 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 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 user-supplied bolts, nuts, and washers to attach mounting bracket to surface.
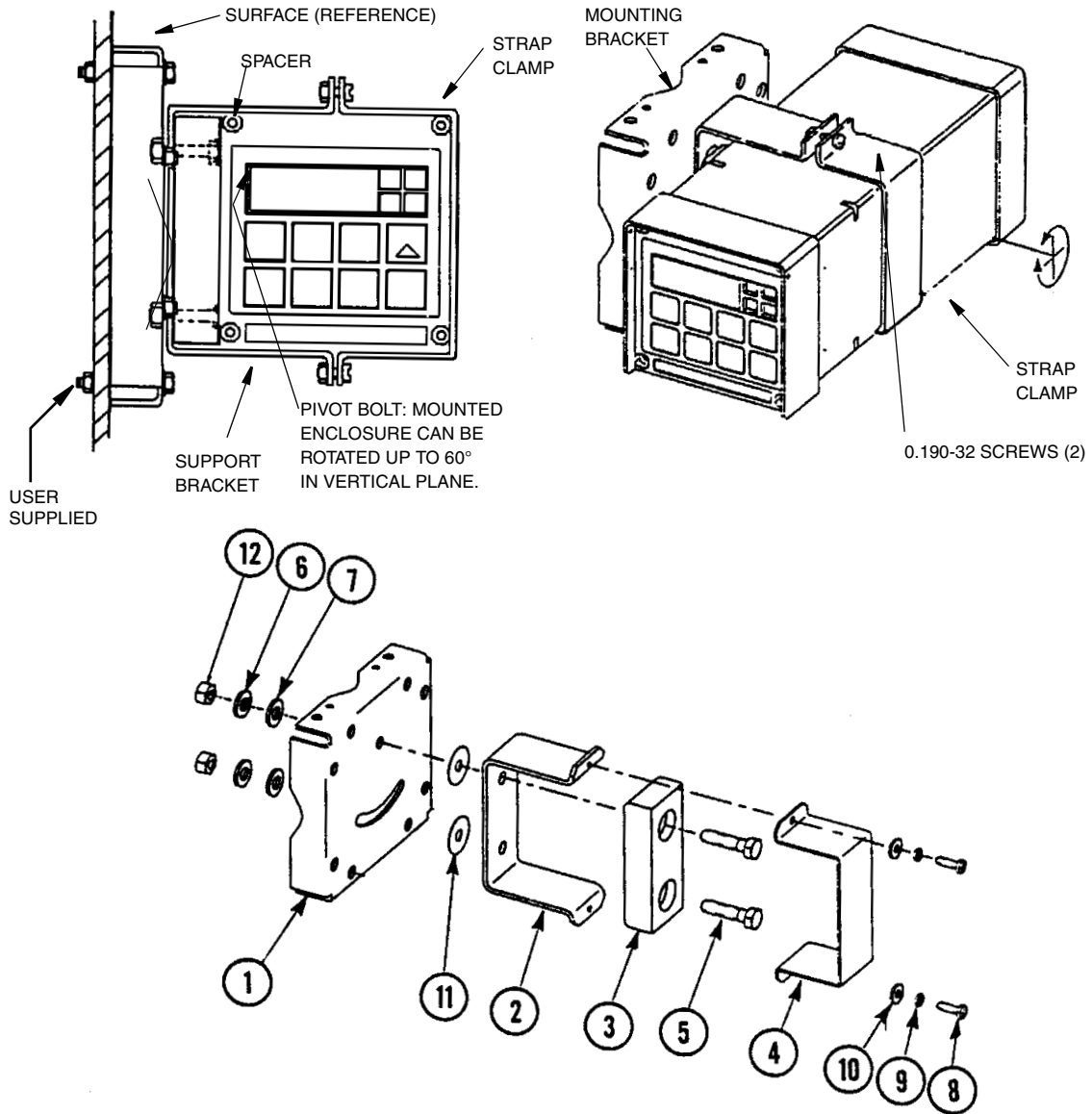
Figure 6. Metal Enclosure - Fixed Mount

Mounting to Surface, Movable Mount (Metal Enclosure Only) 873EC-_ _ 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 user-supplied bolts, washers, and nuts.

4. Assemble universal mounting as follows:

   a. Place hex bolts (5) through spacer (3) into support bracket (2).

   b. Slide nylon washers (11) over bolts (5).

   c. Slide bolts through universal mounting bracket (1) and fasten assembly finger tight with hardware designated 9, 10, and 16.

5. Slide analyzer into support bracket and slide strap clamp (4) onto analyzer. Using two screws, nuts, and washers, attach strap clamp to support bracket to secure analyzer.

6. Lift entire assembly of Step 5, align mounting bracket and wall bracket pivot bolt holes, and then insert pivot bolt (13) through wall and mounting bracket into nylon washer and locking nut (14,15).

7. Rotate bracket and analyzer assembly in horizontal plane to desired position and lock in place using screw and washer.

WALL BRACKET

PIVOT BOLT
(0.250 2 20) FOR
HORIZONTAL
PLANE ROTATION

SUPPORT
BRACKET

STRAP CLAMP

LOCK MOUNTING BRACKET IN PLACE
USING 0.190-32 SCREW AND WASHER

PIVOT BOLT

SUPPORT
BRACKET

STRAP
CLAMP

4 BOLTS
SUPPLIED
BY USER

PIVOT BOLT
(0.312-18) FOR
VERTICAL PLANE
ROTATION

NYLON WASHER
AND LOCK NUT

MOUNTING
BRACKET

0.190-32 SCREWS (2)

REFER TO PARTS LIST
PL 611-016
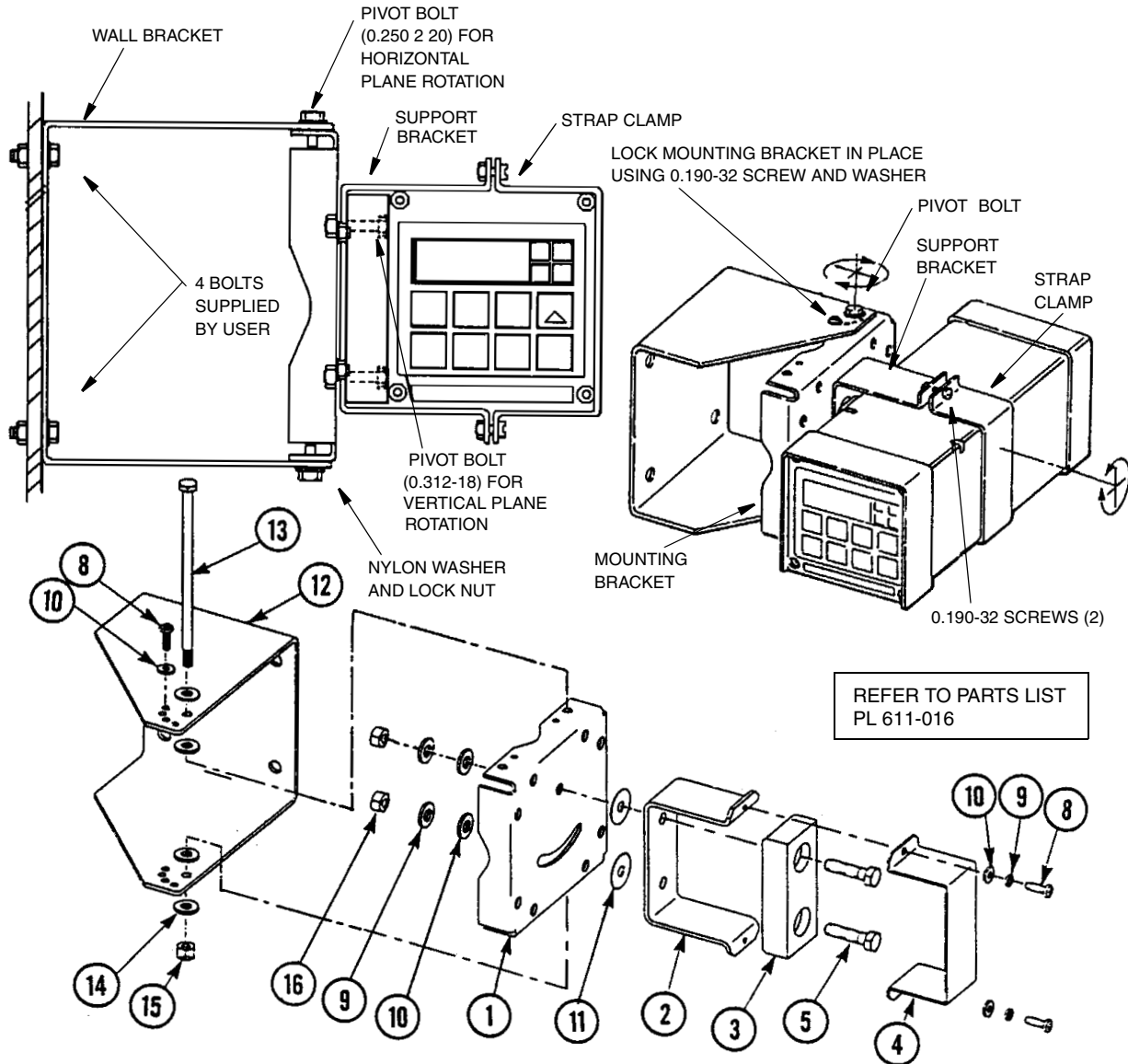
Figure 7. Metal Enclosure - Movable Mount

Wiring of Plastic Enclosure

> ⚠️ **CAUTION**
> Use proper ESD precautions when opening this instrument for any servicing.

Wiring installation must comply with any 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.

3. Connect wires from external circuit for analyzer measurement output to terminals TB3–1(+) and TB3–2(–). Refer to Figure 8.

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

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.

6. Remove the safety cover from TB1. Connect power wires to terminal block TB1 as shown in Figure 8. Replace the safety cover on TB1.

7. Attach optional rear panel cover, if present.
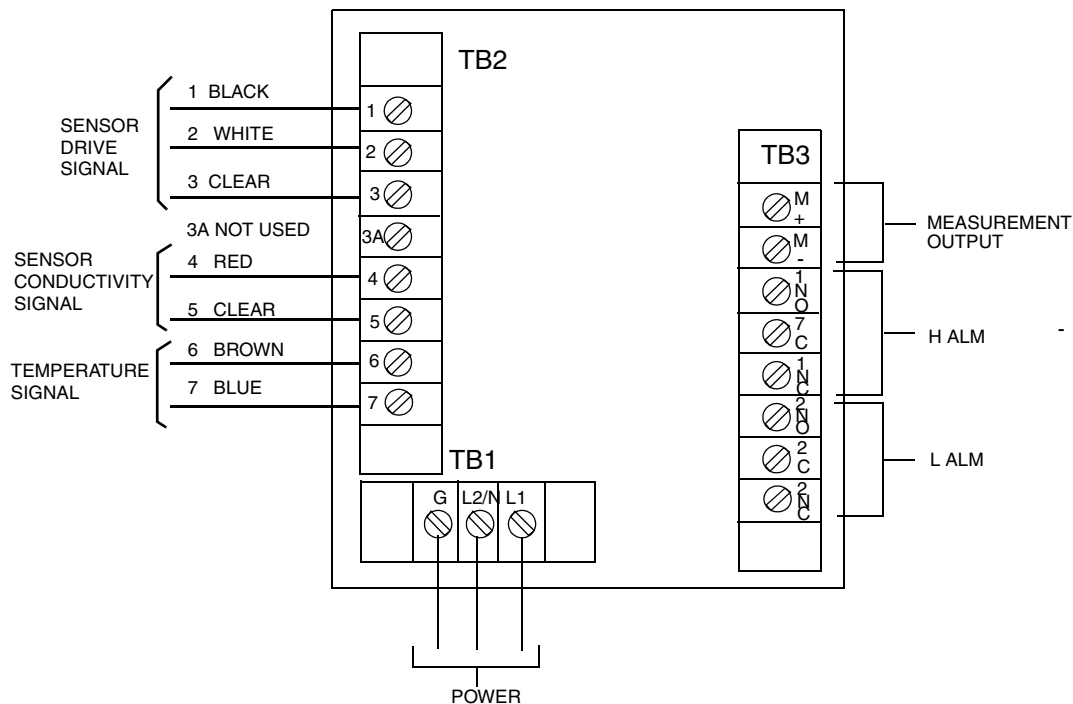
Figure 8. Rear Panel Wiring - Plastic Enclosure

Wiring of Metal Enclosure

> ⚠ **CAUTION**
> Use proper ESD precautions when opening this instrument for any servicing.

Use proper ESD precautions when opening this instrument for any servicing.

Wiring installation must comply with any local regulations.

> — **NOTE**
> To maintain a rating (NEMA 4X, CSA Enclosure 4X, or IEC Degree of Protection IP-65), wiring methods and fittings appropriate to the ratings must be used. Table 2 identifies 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. Failsafe operation requires connections to be made between contacts NC and C, and the alarms to be configured active. Refer also to "General Information Alarms" on page 31.

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 871EC and 871FT type sensors can be used with the 873EC analyzer. Model 1210 sensors cannot be used with the 873 Analyzer. Remove spade lugs from 871EC sensor wires, and tin the leads. Be careful that sleeves with numbers do not fall off. Recommended exposed wire length is 5/8 inch to 3/4 inch.

5. Connect power wires to terminal block TB1 as indicated in Figure 9. The earth (ground) connection from the power cord should be connected to the ground stud located in the bottom of the case.
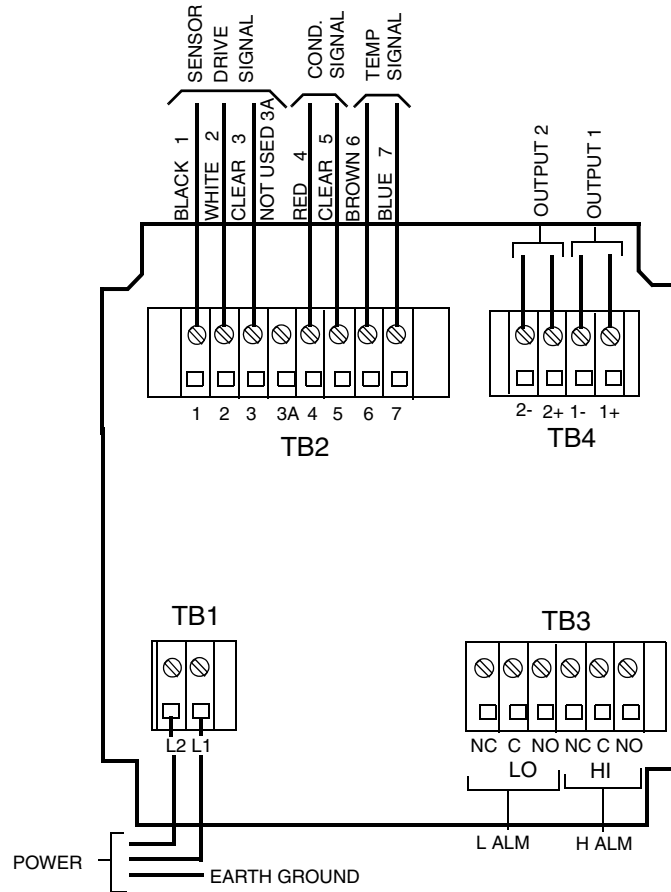
Figure 9. Rear Panel Wiring - Metal Enclosure

Table 2. Metal Enclosure Rear Panel Wiring for Sensor
Recommended Conduit and Fitting (Due to Internal Size Restraints)

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

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

3. Operation

Overview

The 873 functions in two modes, OPERATE and CONFIGURE.

In the OPERATE Mode, the 873 automatically displays its measurement and outputs a proportional analog signal. Also, while in the OPERATE Mode, a user may read all parameter settings and the solution temperature.

In the CONFIGURE Mode, the user may 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 three possible automatic measurement displays as follows:

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

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

Keypad

The keypad, Figure 10, is made up of eight keys, four of which are dual function. The white lettered keys represent normal functions and 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 functions of all keys are presented in Table 3.
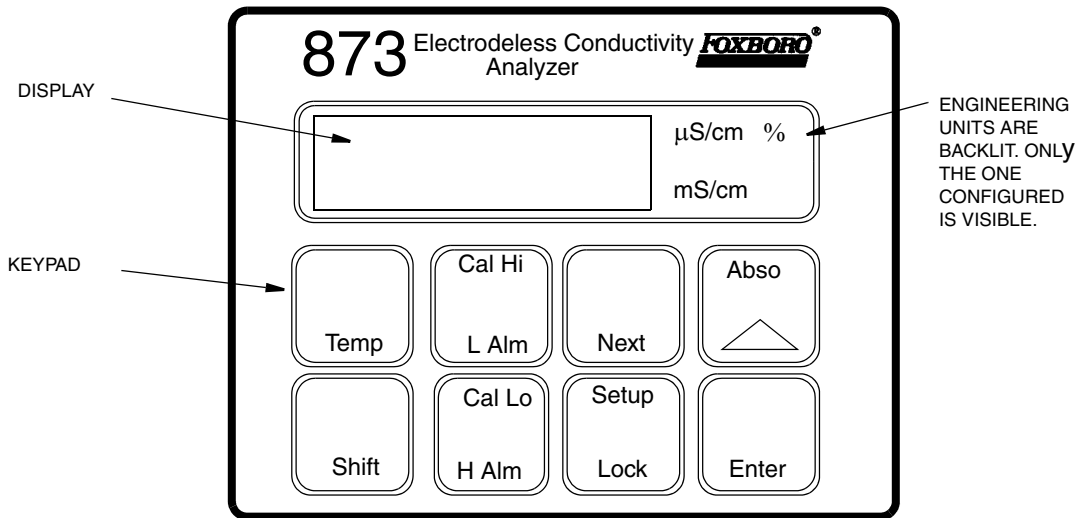
Figure 10. Display and Keypad

Table 3. Keypad Functions
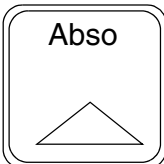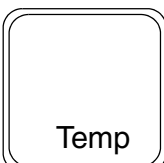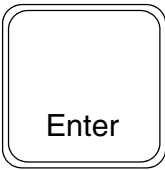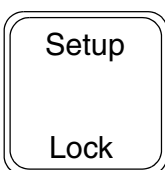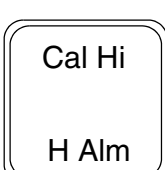
Key	Function
Shift	**Shift**: To activate upper function of dual function key, press and hold SHIFT prior to pressing any dual function key. It is ignored when pressed with single function keys or when pressed alone. However, holding the SHIFT key will delay the 10-second time-out to allow longer viewing of a value or code.
Abso	**Absolute**: Press key to display conductivity value without temperature correction. **Increment**: Press to increase the flickering number appearing on display. Each press causes the value to increase by one. When 9 or the highest number in the configuration sequence is reached, the sequence will repeat.
Temp	**Temp**: Causes the process medium temperature or manually set value to appear on the display. A rounded value with legend (C or F) shown will alternate with a tenths place digit. Manual temperature compensation (period shown after legend) may be altered in this mode by entering a new value. The value may not be changed in the Automatic mode.

Table 3. Keypad Functions (Continued)

Key	Function
Enter	**Enter**: Used to display the value or code of a setup entry. It is also used to select a parameter or code by entering the value or code into the memory.
Next	**Next**: Used to select one of the four display digits similar to a cursor except causes digit to flicker. Also used to select the next entry choice of the setup function.
Setup / Lock	**Setup**: Used to select and access the 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 setpoint 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 setpoint level for the relay associated with this alarm.

─── **NOTE** ───
Pushing NEXT and Δ simultaneously allows the user to step backward through the Setup program or digit place movement. One cannot reverse number count by this procedure. Pushing SHIFT and ENTER simultaneously circumvents the 10-second wait between Setup entries.

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

TEMP Key

To view the process temperature push TEMP. 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 873 is unlocked (see "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, and also allows 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 again 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 "Temperature Cell Factor (TCF1) Adjustments" on page 74.) To return to automatic compensation, sequence the display to remove the decimal point after C or F.

View Setup Entries

Setup Entries may be viewed at any time.

To view any of the Setup Entries, follow the procedures given in the Configuration Setup Entries or Basic Setup Entries section but do not "Unlock" the instrument.

When viewing the Setup Entries, you may page through the parameters as rapidly as you wish (SHIFT + Setup, NEXT one or more times). However, once ENTER is pushed (ENTER must be pushed to read a parameter value), you must wait 10 seconds (value is displayed for 10 seconds) for the parameter symbol to reappear. 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, see the Configuration section.

4. Configuration

See "Quick Starting the 873EC Analyzer" on page ix.

Overview

This instrument is shipped with either factory settings (default values) or user defined settings, as specified when ordered. Table 4, "Configuration Setup Entries," on page 25 lists all the parameters that are more frequently changed and Table 12, "Basic Entry Selection," on page 43, lists the parameters that are calibration oriented. Both tables list the displayed symbol, the page containing information 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 user 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. The numeric limits for the display are -0.99 and +9999.

Successful configuration requires four simple steps:

1. Write down all your parameters in the spaces provided on the configuration tables.

2. Unlock the instrument.

3. Enter the 4-digit codes.

4. Lock the instrument.

> ─ **NOTE** ──────────────────────────────
> Before entering these 4-digit codes, verify Ct and FSC are set appropriately.
> Configuration values will change if Ct or FSC are changed after entering
> configuration parameters. See User Notes for Changing Applications.

Configure Mode

The Configure Mode is protected through two levels of security, one level for "Configuration Setup Entries" and the second for "Basic Setup Entries". Any configuration change starts with Unlocking the instrument. Unlocking is accomplished by inputting a security code via 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" on page 24). The second level of security protects against the remaining setup entries, called "Basic Setup Entries," of which there are 18 in all, 15 that can be changed in the field (refer to "Basic Setup Entries" on page 43).

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 will remain 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)" on page 44), 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 will read Loc.

2. Press NEXT and then use the NEXT and increment (Δ) keys until security code is displayed (0800 from factory).

3. Press ENTER. Analyzer will read uLoc, indicating unlocked state.

Locking Analyzer Using Security Code

1. Press Lock. Display will read uLoc.

2. Press NEXT and then use the NEXT and increment (Δ) keys until security code is displayed (0800 from factory).

3. Press ENTER. Analyzer will read Loc, indicating locked state.

Configuration Setup Entries

The configuration setup entries consist of 17 parameters. These parameters are process oriented and access to them is passcode protected. Table 4 lists each parameter, with its applicable symbol, in the same sequence as seen on the display. Descriptions of each parameter are given in Table 4.

Table 4. Configuration Setup Entries

Displayed Symbol	Reference	Parameters and Values Accessed	Factory Default	User Settings
CELL	page 26	Configuration of Analog Outputs	1013	
HOLD	page 26	Holds and sets the Analog Output Value in HOLD	0000	

Cd	page 28	Compensation and Damping
		    Damping Factor
		    Chemical Temperature Compensation
			0001	

HAC	page 32	H Alarm Configuration
		    Measurement Selection
		    Low/High/Instrument plus Passive/Active State
		    % Hysteresis
			1403	

HAtt	page 34	High Alarm Trigger Time	00.00	
HAFt	page 34	High Alarm Feed Time	00.00	
HAdL	page 34	High Alarm Delay Time	00.00	

LAC	page 36	L Alarm Configuration
		    Measurement Selection
		    Low/High/Instrument plus Passive/Active State
		    % Hysteresis
			1203	

LAtt	page 38	Low Alarm Trigger Time	00.00	
LAFt	page 38	Low Alarm Feed Time	00.00	
LAdL	page 38	Low Alarm Delay Time	00.00	
UL	page 40	User-defined Upper Measurement Limit	Full Scale Value	
LL	page 40	User-defined Lower Measurement Limit	0.00	
UtL	page 41	User-defined Upper Temperature Limit	100°C	
LtL	page 41	User-defined Lower Temperature Limit	0°C	
HO1	page 42	100% Analog Output - Channel 1	Full Scale Value	
LO1	page 42	0% Analog Output - Channel 1	00.00	
HO2	page 42	100% Analog Output - Channel 2	100°C	
LO2	page 43	0% Analog Output - Channel 2	0°C	

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

1. Unlock analyzer (see "Unlocking Analyzer Using Security Code" on page 24).

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" on page 24).

CELL Output Configuration (CELL)

This 4-digit code allows the user to configure the analog output(s). The 4-digit CELL code is shown in Table 5.

The plastic enclosure has only one isolated analog output. Configure Digit 3 (Output 1) to correspond to this output. With the metal field-mounted unit, two isolated output signals are available. Most of the output choices in Table 5 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. (See "Scaling the Analog Output Logarithmically" on page 27.) Possible combinations of the dual output feature include:

♦ Conductivity and Temperature

♦ Conductivity and Log of Conductivity

♦ Conductivity and Conductivity (2 distinct output spans are feasible (see "Output #1's 100% Analog Value (HO1)" on page 42 through "Output #1's 0% Analog Value (LO1)" on page 42).

Table 5. CELL Code - Output Configuration

Digit 1	Digit 2	Digit 3	Digit 4
		Output 1	Output 2
1= Only Choice	0 = Only Choice	1 = Conductivity 3 = Temperature 5 = Log of Conductivity	1 = Conductivity 3 = Temperature 5 = Log of Conductivity

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 6. When the first digit of this code is 1, 2, or 3, the display flashes between the word HOLD and the current measurement value. The outputs are 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 will continue 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 will allow a control room or alarm device (light, bell, etc.) to know the analyzer is in a HOLD mode, not a "RUN" mode. The ALARM will be activated when HOLD is implemented when the first digit in the HOLD code is 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) will always equal 12 mA, and 0% will equal 4 mA.

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

$$\frac{\text{Value Displayed} - (\text{LO})1}{\text{HO}1 - \text{LO}1} \times 100$$

Example 2: HOLD at the value presently read on the display.

The presently displayed value is 17 mS/cm. HO1 is set at 18.5 mS/cm, LO1 is set at 12 mS/cm. To set HOLD at 17, the last two 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 either 1077, 2077, or 3077, as applicable. See "Output #1's 100% Analog Value (HO1)" on page 42 and "Output #1's 0% Analog Value (LO1)" on page 42.

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

Table 6. HOLD Code - HOLD Analog Output Values

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

Scaling the Analog Output Logarithmically

The output signal may be expanded in a particular range of measurement.

Example:

For a Clean In Place (CIP) application, the caustic concentration (corrected to 25°C; Cd=0010) may have a conductivity of 0-300 mS/cm, while the product may have a conductivity of 0-5 ms/cm. By using a single linear output, only a fraction of a mA would be dedicated to the lower conductivity range, while 20 mA would be used to monitor the caustic. However, by utilizing the Log output, for example, over 6 mA may be dedicated to the 0-5 mS/cm Product range, and the entire 20 mA used for the caustic concentration, thus providing sufficient resolution of both concentrations on chart tracings.

To configure a unit as a 'Log' analog output, change the third and fourth digits in the Cell Code, as shown in Table 5.

The equation for computing the values follows. Use a log function calculator, and/or contact IPS to request the White Paper that discusses this capability in detail.

$$\left[\frac{(\text{Log Value Displayed} - \text{LogL01})}{(\text{LogH01} - \text{LogL01})} \times 16\text{mA}\right] + 4$$

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 will affect temperature displayed and analog outputs also.

If the units of measurement are chosen to be conductance units (either µS/cm or mS/cm) (Digit 2 = 0), a choice of temperature compensation (digits 3 and 4) provides for a conductance reading referenced to a particular temperature for a particular solution composition.

If the units of measurement are chosen to be percent (%)(Digit 2 = 1), both the chemical concentration range and temperature compensation selections are fixed by the selection from Digits 3 and 4. For % concentration measurements, you need to ensure that the full scale range (FSC) of the analyzer is set high enough to accommodate the conductivity equivalences of the % range of interest. Refer to "Selecting a Full Scale Range" on page 45.

Several different temperature compensation selections are available. If the analyzer is being used in the conductance mode (either µS/cm or mS/cm), the temperature compensation chosen should be that which most closely matches the user's process. Table 7 displays Cd options.

Examples:

   Application 1 - Measurement of a Caustic Cleaning Solution in the range of 0 to 30 mS/cm. Refer to Table 7. The choice of Compensation Code Digits 3 and 4 = 10 would be appropriate.

   Application 2 - Measurement of River Water in the range of 0 to 2 mS/cm. Refer to Table 7. The choice of Compensation Code Digits 3 and 4 = 02 would be appropriate.

   Application 3 - Measurement of White Liquor Strength in the range of 400 to 1000 mS/cm at 210 °F in a Pulp Mill (causticizer application). Refer to Table 7. The choice of Compensation Code Digits 3 and 4 = 11 would be appropriate.

If in doubt as to the correct choice of temperature compensation, contact IPS. Also see the Sample Curves following Table 7.

If the analyzer is being used in the percent (%) mode, the choice of Cd Code Digit 2 = 1 allows the user to select one of several preprogrammed chemical concentration ranges as selected by Digits 3 and 4. See Table 7. When the analyzer displays percent (%), it uses the preprogrammed chemical concentration range in conjunction with the corresponding temperature compensation for that particular process composition.

Examples:

   Application 1 - Measurement of 0 to 3% Caustic (NaOH) used as a CIP (Clean-in-Place) solution in a brewery. Refer to Table 7. The choice of Cd Code Digits 3 and 4 = 10 would be appropriate. Cd Code Digit 2 should be set as "1".

Application 2 - Measurement of 0 to 10% H$_2$SO4 in a Deionization Bed Regeneration application. Refer to Table 7. The choice of Cd Code Digits 3 and 4 = 05 would be appropriate. Cd Code Digit 2 should be set as "1".

Application 3 - Measurement and control of 98% Sulfuric Acid (H$_2$SO$_4$) in a refinery. Refer to Table 7. The choice of Cd Code Digits 3 and 4 = 06 would be appropriate. Cd Code Digit 2 should be set as "1".

— **NOTE** ——————————————————————————————————————
When switching from conductivity units to percent concentration units, configuration and alarms must be set after % concentration has been set.

Table 7. Cd Code - Compensation and Damping

Digit 1	Digit 2	Digits 3 and 4			
Damping	Units of Measurement	Temperature Compensation to Match Process Composition (a)	Process Temp Range (a)	Reference Temp	Programmed Percent (%) Concentration Range
0 = none 1 = 10 sec. 2 = 20 sec. 3 = 40 sec.	0 = % Legend disabled. Use for μS/cm and mS/cm measurements 1 = % Legend enabled	99 = Special. Use in conjunction with curve generation program.	Special	Special	Special
		00 = No temperature compensation. Absolute electrodeless conductivity.	Not Applicable	Not Applicable	Special
		01 = Dilute NaCl solution with water subtraction. for dilute solutions and pure water.	32 to 392°F	25° C (77° F)	Not Applicable
		02 = Sodium Chloride (NaCl). From dilute solutions up through 25%	32 to 392°F	25°C (77°F)	0 to 25%
		03 = Hydrochloric Acid (HCl). From dilute solutions up through 15%.	14 to 252°F	25°C (77°F)	0 to 15%
		04 = Nitric Acid (HNO$_3$). From dilute solutions up through 10%.	19 to 249°F	25°C (77°F)	0 to 10%
		05 = Sulfuric Acid (H$_2$SO$_4$). From dilute solutions up through 25%.	32 to 216°F	25°C (77°F)	0 to 25%
		06 = Sulfuric Acid (H$_2$SO$_4$). From 93% to 99.5%.	122 to 249°F	50°C (122°F)	99.5 to 93%
		07 = Green Liquor in Pulp and Paper Dissolving Tank.	94 to 204°F	85°C (185°F)	Not Applicable
		08 = Phosphoric Acid (H$_3$PO$_4$). From dilute solutions up through 35%.	40 to 200°F	25°C (77°F)	0 to 35%
		09 = Oleum (Concentrated Sulfuric Acid). From 18% to 42%.	89 to 249°F	65°C (149°F)	42 to 18%
		10 = Sodium Hydroxide (NaOH). From dilute solutions up through 15%.	31 to 250°F	25°C (77°F)	0 to 15%
		11 = Sodium Hydroxide (NaOH). From dilute solutions up through 20%.	147 to 252°F	100°C (212°F)	0 to 20%
		12 = Black Liquor in Pulp and Paper Digesters. Nominal 2.7 lb Na$_2$O per ft^3.	115 to 411°F	160°C (320°F)	Not Applicable

(a)Actual application ratings may be impacted by specific sensor materials and temperature limits.

Sulfuric Acid: Conductivity vs. Temperature

CD = XX06

AT 100 C

mS/cm — 495 to 75, TEMP. -10C to 120C

Sulfuric Acid: Conductivity vs. % Concentration

CD = X106

AT 50 C

mS/cm — 234 to 65.3, PERCENT CONCENTRATION 92.5 to 99.5

Sodium Hydroxide: Conductivity vs. Percent (0 - 15%)

CD = X110

AT 25 C

mS/cm — 420 to 0, PERCENT CONCENTRATION

Sodium Hydroxide: Conductivity vs. Percent (0 - 20%)

CD = X111

AT 100 C

mS/cm — 1300 to 0, PERCENT CONCENTRATION 0 to 20

Green Liquor: Temperature vs. Conductivity

CD = X007

S.G. 1.21

mS/cm — 580 to 225, TEMP. 25C to 95C

1. WHEN THESE STANDARD TEMPERATURE COMPENSATION PROGRAMS ARE INPUT INTO THE 873 EC SOFTWARE VIA THE SETUP PARAMETER CD, THE CONCENTRATION DISPLAYED (AND OUTPUT) WILL BE TEMPERATURE CORRECTED TO THE REFERENCE TEMPERATURE.

2. CONCENTRATION PROGRAMS THAT CONVERT THE ANALYZER TO READ IN UNITS OF PERCENT ARE INPUT WHEN DIGIT 2 OF THE CD CODE IS A 1 AND THE 3RD AND 4TH DIGITS ARE CHOSEN TO MATCH THE PROCESS COMPOSITION.

3. CUSTOM CURVE GENERATION IS AVAILABLE ON YOUR ANALYZER IF XX99 CAN BE ENTERED INTO THE CD CODE.

Figure 11. Sample 873EC Temperature and Concentration Curves
Available via Cd Parameter

General Information Alarms

Dual independent, Form C dry alarm contacts, rated at 5A noninductive, 125 V ac/30 V dc, are provided. Inductive loads can be driven with external surge-absorbing devices installed across contact terminations. 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 of Plastic Enclosure" on page 16 or "Wiring of Metal Enclosure" on page 17 of this instruction. See example on page 32.

> ⚠ **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 87.

> **NOTE**
>
> Alarms will have to be reset if any changes are made to FSC.
> 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 will remain "OFF" until the measurement is stabilized.

Check that the alarms (Hi/Lo) are configured as desired. Refer to "High Alarm Configuration (HAC)" on page 32 and "Low Alarm Configuration (LAC)" on page 36.

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" on page 24).

2. To set high alarm, press H Alm. Then use NEXT and Δ to achieve the desired value on the display.

3. Press ENTER.

4. To set low alarm, press L Alm. Then use NEXT and Δ to achieve the desired value and then Press ENTER.

5. Lock analyzer (see "Locking Analyzer Using Security Code" on page 24).

> **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 – ENERGIZED IN ALARM CONDITION ONLY
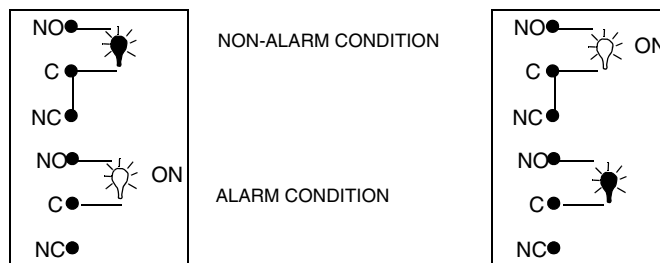
CONFIGURED ACTIVE – NOT ENERGIZED IN ALARM STATE
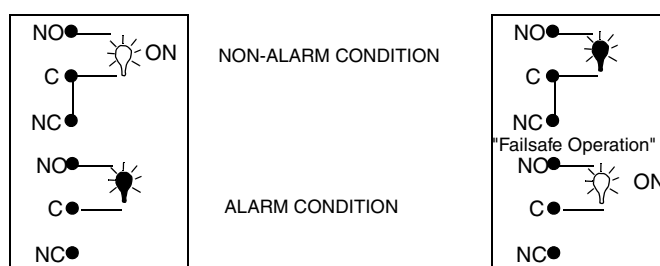
High Alarm Configuration (HAC)

The HAC 4-digit code configures the alarm designated as "H Alm" in Figures 8 and 9. See Table 8. There are three configurable parameters associated with each alarm. The first digit of this code allows the alarm to be configured to correspond to one of two alarm measurement selections. The second digit of this code configures the alarm as a Measurement alarm, Instrument alarm, or HOLD alarm.

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

A low alarm relay will trip on decreasing measurement.

A high alarm relay will trip on increasing measurement.

Passive or active (failsafe) configurations are also chosen by this digit choice. In the active (failsafe) configuration, a loss of power to the analyzer will result in a change from active to passive relay state, providing contact closure and an indication of a power problem. Correct wiring of the contacts is necessary for true failsafe operation. Consult "Wiring of Plastic Enclosure" on page 16 and "Wiring of Metal Enclosure" on page 17 of this document.

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 that will cause an alarm include:

♦ A/D converter error

♦ EEPROM checksum error

♦ RAM error

♦ ROM error

♦ Processor task time error (watchdog timer)

In addition to these diagnostics, the user may program several temperature and measurement error limits which, if exceeded, will cause an alarm condition. These programming options are explained in "User-Defined Upper Measurement Limit (UL)" on page 40 through "User-Defined Lower Temperature Limit (LtL)" on page 41.

Refer to the "Error Codes" on page 80, for identifying error messages.

The High alarm may 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 will trigger when the HOLD is activated. This feature will allow a control room or alarm device (light, bell, etc.) to know the analyzer is in a HOLD mode, not a "RUN" mode. The ALARM will be activated when HOLD is implemented when the first digit in the HOLD code is 1, 2, or 3.

Finally, the alarm hysteresis (deadband) may be varied from 0 to 99% of the full scale measurement value in increments of 1%. If the 873 Analyzer is configured in units of percent concentration, the hysteresis may be varied from 0.0 to 9.9%. Consult IPS for assistance.

─ **NOTE** ─
Decimal not indicated.

Table 8. HAC Code - High Alarm Configuration

Digit 1	Digit 2	Digits 3 & 4
Measurement Selection	Configuration	Hysteresis
1 - Conductivity 3 - Temperature	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 (when configured to display in units of µS/cm or mS/cm). 0.0 to 9.9% concentration (when configured to display in units of % concentration).

Alarm Timers (HAtt, HAFt, and HAdL)

There are three timers associated with the H Alarm:

1. *HAtt (H Alarm Trigger Time)*
   Programmable timer to prevent alarm from triggering unless the measurement
   remains in the alarm state for a user-defined period of time.

2. *HAFt (H Alarm Feed Time)*
   Programmable timer to keep alarm ON for a user-defined period of time once it has
   been tripped.

3. *HAdL (H Alarm Delay Time)*
   Programmable timer to keep the alarm OFF for a user-defined period of time once
   the HAFt time has expired.

Each of these timers will be explained fully in the following paragraphs and their relationships
illustrated in Figure 12 and the flow diagram in Figure 13.

H Alarm Trigger Timer (HAtt) may be used with or without the other alarm timers (HAFt and
HAdL). HAtt is used when H Alarm is configured as a *measurement* alarm only. The purpose of
this timer is to prevent the alarm from activating due to transient conditions such as air bubbles
or other spikes. After the timer has counted down, that alarm will activate *only* if the measurement
has remained in an alarm state during the *entire* trigger time. HAtt resets any time the
measurement passes through the alarm setpoint. Table 9 shows the code designation.

H Alarm Feed Time (HAFt) is activated by entering a time in the code parameter HAFt. When the
H Alarm is triggered, the alarm will remain ON for this time period regardless of what the
measurement value is with respect to the alarm setpoint (i.e., H Alarm will remain ON even if the
measurement returns to normal). Table 9 shows the code designation.

H Alarm Delay Time (HAdL) is activated by entering a time in the code parameter HAdL. Upon
timeout of HAFt, the alarm will stay OFF for this time period regardless of what the
measurement value is with respect to the alarm setpoint (i.e., H Alm will remain OFF even if the
measurement goes back into alarm). Table 9 shows the code designation.

Table 9. HAtt, HAFt, and HAdL Time Codes

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

Examples:

05.15 means 5 minutes, 9 seconds
20.50 means 20 minutes, 30 seconds

After timeout of HAdL, the 873 reverts to normal run mode. If the measurement has remained in
an alarm state for the entire period (HAFt + HAdL), the sequence of HAFt and HAdL repeats
itself. If, however, the measurement has gone out of alarm at any time during the cycle, it must
remain in alarm for the trigger time before reactivating the cycle.
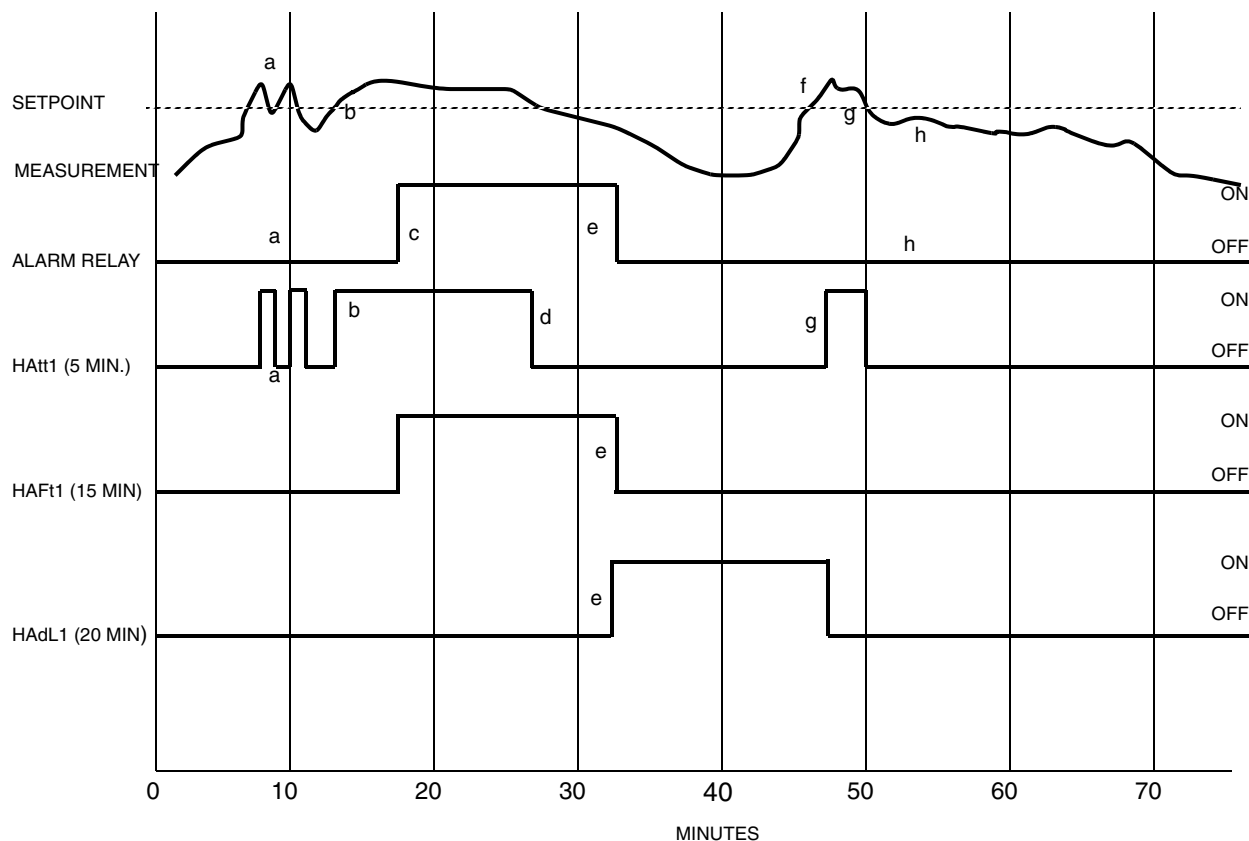
Figure 12. ON/OFF Relationship between HAtt, HAFt, and HAdL

The following explanatory notes coupled with the illustration above should serve to demonstrate the function of the three 873 Analyzer timers.

a. Measurement exceeds setpoint but does not remain above setpoint for the time period set in HAtt (5 minutes). Alarm relay remains inactive. Note that HAtt resets when the measurement falls below setpoint.

b. Measurement exceeds setpoint once again, activating HAtt, and remains continuously above setpoint for the time period set in HAtt (5 minutes).

c. After measurement has remained above setpoint for the entire trigger time (5 minutes), the alarm relay is activated.

d. HAtt is reset when measurement falls below setpoint once again. Note that the alarm relay remains activated despite the fact that the measurement has fallen below the setpoint. The alarm relay will remain activated for the time period set in HAFt (15 minutes).

e. After the alarm relay has been activated for the feed time (15 minutes), HAFt times out and the alarm relay is deactivated. The alarm relay will remain deactivated for the time period set in HAdL (20 minutes).

f. Measurement exceeds setpoint, but the alarm relay remains deactivated because the delay time (20 minutes) has not expired.

g. After the delay time has expired, the measurement is still in alarm, so HAtt is activated.

h. The measurement drops below setpoint before the trigger time (5 minutes) expires, so the alarm relay does not activate and HAtt is reset.

The following flow diagram should also serve to illustrate the logic of the three alarm timers:
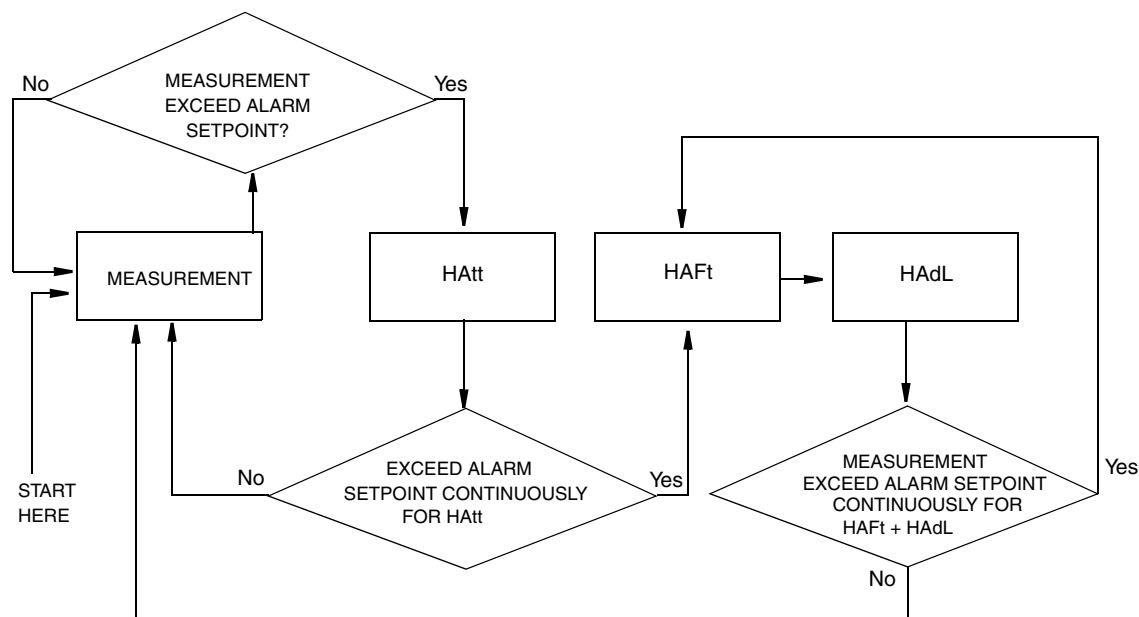
Figure 13. Flow Diagram for Alarm Timer Logic

Low Alarm Configuration (LAC)

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

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

A low alarm relay will trip on decreasing measurement.

A high alarm relay will trip on increasing measurement.

Passive or active (failsafe) configurations are also chosen by this digit choice. In the active (failsafe) configuration, a loss of power to the analyzer will result in a change from active to passive relay state, providing contact closure and an indication of a power problem. Correct wiring of the contacts is necessary for true failsafe operation. Consult "Wiring of Plastic Enclosure" on page 16 and "Wiring of Metal Enclosure" on page 17 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 that 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 that will cause an alarm include:

♦ A/D converter error

♦ EEPROM checksum error

♦ RAM error

♦ ROM error

♦ Processor task time error (watchdog timer)

In addition to these diagnostics, the user may program several temperature and measurement error limits which, if exceeded, will cause an alarm condition. These programming options are explained in "User-Defined Upper Measurement Limit (UL)" on page 40 through "User-Defined Lower Temperature Limit (LtL)" on page 41.

Refer to the "Error Codes" on page 80, 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 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 is activated when HOLD is implemented if 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 873 Analyzer is configured in units of percent concentration, the hysteresis may be varied from 0.0 to 9.9%. Consult IPS for assistance.

─ **NOTE** ─────────────────────────────
Decimal not shown.

Table 10. LAC Code - Low Alarm Configuration

Digit 1	Digit 2	Digits 3 & 4
Measurement Selection	**Configuration**	**Hysteresis**
1 - Conductivity 3 - Temperature	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 (when configured to display in units of µS/cm or mS/cm). 0.0 to 9.9% concentration (when configured to display in units of % concentration).

Alarm Timers (LAtt, LAFt, and LAdL)

There are three timers associated with the L Alarm:

1. *LAtt (L Alarm Trigger Time)*
   Programmable timer to prevent alarm from triggering unless the measurement
   remains in the alarm state for a user-defined period of time.

2. *LAFt (L Alarm Feed Time)*
   Programmable timer to keep alarm ON for a user-defined period of time once it has
   been tripped.

3. *LAdL (L Alarm Delay Time)*
   Programmable timer to keep the alarm OFF for a user-defined period of time once
   the LAFt time has expired.

Each of these timers will be explained fully in the following paragraphs and their relationships
illustrated in Figure 14 and the flow diagram in Figure 15.

L Alarm Trigger Timer (LAtt) may be used with or without the other alarm timers (LAFt and
LAdL). LAtt is used when L Alarm is configured as a *measurement* alarm only. The purpose of this
timer is to prevent the alarm from activating due to transient conditions such as air bubbles or
other spikes. After the timer has counted down, that alarm will activate *only* if the measurement
has remained in an alarm state during the *entire* trigger time. LAtt resets any time the
measurement passes through the alarm setpoint. Table 11 shows the code designation.

L Alarm Feed Time (LAFt) is activated by entering a time in the code parameter LAFt. When the
L Alarm is triggered, the alarm will remain ON for this time period regardless of what the
measurement value is with respect to the alarm setpoint (i.e., L Alarm will remain ON even if the
measurement returns to normal). Table 11 shows the code designation.

L Alarm Delay Time (LAdL) is activated by entering a time in the code parameter LAdL. Upon
timeout of LAFt, the alarm will stay OFF for this time period regardless of what the measurement
value is with respect to the alarm setpoint (i.e., L Alarm will remain OFF even if the measurement
goes back into alarm). Table 11 shows the code designation.

Table 11. LAtt, LAFt, and LAdL Time Codes

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

Examples:

05.15 means 5 minutes, 9 seconds
20.50 means 20 minutes, 30 seconds

After timeout of LAdL, the 873 reverts to normal run mode. If the measurement has remained in
an alarm state for the entire period (LAFt + LAdL), the sequence of LAFt and LAdL repeats itself.
If, however, the measurement has gone out of alarm at any time during the cycle, it must remain
in alarm for the trigger time before reactivating the cycle.
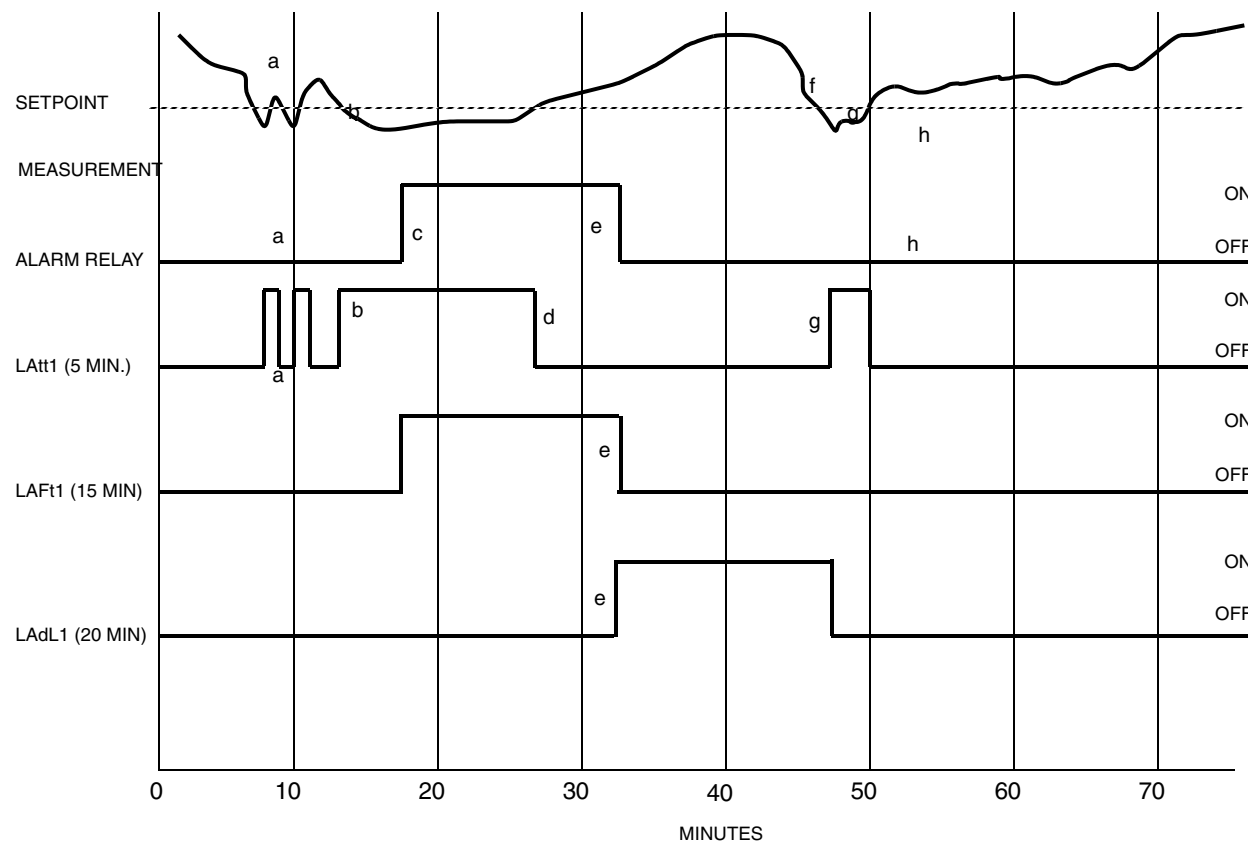
Figure 14. ON/OFF Relationship between LAtt, LAFt, and LAdL

The following explanatory notes coupled with the illustration above should serve to demonstrate the function of the three 873 Analyzer timers.

    a. Measurement drops below setpoint but does not remain below setpoint for the time period set in LAtt (5 minutes). Alarm relay remains inactive. Note that LAtt resets when the measurement rises above setpoint.

    b. Measurement drops below setpoint once again, activating LAtt, and remains continuously below setpoint for the time period set in LAtt (5 minutes).

    c. After measurement has remained below setpoint for the entire trigger time (5 minutes), the alarm relay is activated.

    d. LAtt is reset when measurement rises above setpoint once again. Note that the alarm relay remains activated despite the fact that the measurement has risen above the setpoint. The alarm relay will remain activated for the time period set in LAFt (15 minutes).

    e. After the alarm relay has been activated for the feed time (15 minutes), LAFt times out and the alarm relay is deactivated. The alarm relay will remain deactivated for the time period set in LAdL (20 minutes).

    f. Measurement drops below setpoint, but the alarm relay remains deactivated because the delay time (20 minutes) has not expired.

g. After the delay time has expired, the measurement is still in alarm, so LAtt is activated.

h. The measurement rises above setpoint before the trigger time (5 minutes) expires, so the alarm relay does not activate and LAtt is reset.

The following flow diagram should also serve to illustrate the logic of the three alarm timers:
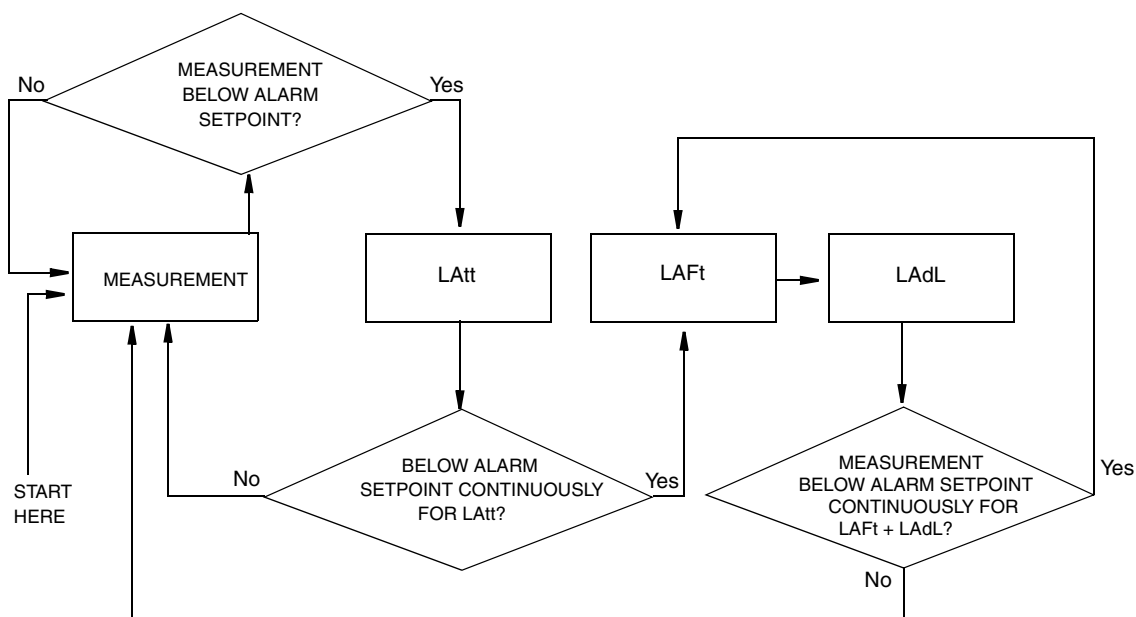
Figure 15. Flow Diagram for Alarm Timer Logic

User-Defined Upper Measurement Limit (UL)

This enables the user to define an upper measurement limit which, if exceeded, will give an error message on the display (see "Error Codes" on page 80), and, when used in conjunction with either alarm configured as instrument (watchdog) alarms (HAC or LAC digit 2 is 5 or 6), provides a relay contact.

The primary use of UL is as a sensor diagnostic tool. Should the 871EC sensor develop a fault, such as leakage between the toroids 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 that could never be achieved in a normal process situation, activation of a UL alarm indicates either a severe sensor failure or a miscalibration.

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 pure water measurements, a value of 0 (µS/cm or mS/cm, as applicable) is a good choice for LL, since water could never actually reach a conductivity value as low as 0.

User-Defined Upper Temperature Limit (UtL)

This parameter enables the user to define an upper temperature measurement value which, if exceeded, will give 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)" on page 32 and "Low Alarm Configuration (LAC)" on page 36), provides a relay contact.

The UtL function may be used in a few different ways. First, the user may wish to alarm on high process temperature.

Example:

A water supply line is normally between 80 and 100°F. The user may wish to set UtL to 120°F to indicate a problem with the water temperature control.

Example:

Another use of UtL is as a sensor diagnostic tool. If the thermistor or RTD in the 871EC 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 871EC sensor thermistor or RTD. The upper limit on UtL is 200°C or 392°F.

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. IPS preconfigures the LtL value to be 0°C.

> ─ **NOTE** ─────────────────────────
> To make a minus sign appear on the display requires that a digit other than zero be present on the display.

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 (refer to "Holding the Analog Output (HOLD)" on page 26). 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:

The user may be measuring sodium hydroxide in the range of 2 to 3%, and may want to assign the minimum analog output level (e.g., 4 mA) to a value of 2% NaOH and the maximum analog output level (e.g., 20 mA) to a value of 3% NaOH.

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

Example:

In the measurement of 99.5 to 93% sulfuric acid (H_2SO_4), the user may wish to assign the minimum analog output (e.g., 4 mA) to the higher H_2SO_4 concentration in order to match the output scaling to existing recorder charts. 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 the user to assign a measurement value to the maximum analog output (either 10 V or 20 mA dc). For example, a user may wish to retransmit 4 to 20 mA dc over a conductivity range of only 10 to 15 mS/cm. This parameter would allow the assignment of the 20 mA dc output to a value of 15 mS/cm. This H01 value ties to CELL Code digit 3. See "CELL Output Configuration (CELL)" on page 26. IPS 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 the user to assign a measurement value to the minimum analog output (either 0 V, 0 mA, or 4 mA dc). In the example given above, the user would assign the minimum analog output of 4 mA dc to a value of 10 mS/cm. This L01 value ties to CELL Code Digit 3. See "CELL Output Configuration (CELL)" on page 26. IPS preconfigures the 0% value to be equal to 0 (µS/cm or mS/cm, as applicable).

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

─ **NOTE** ───
Only use on metal units; for plastic units, use H01 only.
───

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

Example:

Output 2 is configured to correspond to temperature (CELL Code 1013). You wish to have 20 mA correspond to 30°C. Once in H02 mode, use NEXT and Δ to display 30°C. The correct units will appear if CELL was configured properly. Press ENTER.

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

> ─ **NOTE** ──────────────────────────────────
> Only use on metal units; for plastic units, use L01 only.

L02 configures the second output to 0% of the analog output. This parameter is similar to L01. L02 value ties to cell code digit 4.

Basic Setup Entries

The Basic Setup entries consist of 18 parameters. These parameters are calibration oriented and access to them has two levels of passcode protection. Changes to most of these parameters require the analyzer to be recalibrated. DO NOT make any changes before reading the following text for each parameter.

Table 12 lists each parameter, with its applicable symbol, in the same sequence as seen on the display. Procedures that use these parameters are: Unlocking Basic Setup Entries, Changing Cell Type, Selecting a Full Scale Range, Changing the Full Scale Range, Changing the Temperature Circuitry, Changing the Analog Output, and Changing the Security Code.

Table 12. Basic Entry Selection

Display Symbol	Page	Parameter and Value Accessed	Factory Default	User Settings
bL	page 44	Basic Setup Lock Control	0800	
Ct	page 44	Cell Type	per sales order	
FSC	page 45	Full Scale Value	per sales order	
tCF1	page 74	Temperature Cell Factor	25.00	
tEC1	page 52	Thermistor Temperature Electronics Calibration	25.00	
tCL1	page 53	RTD Low Temperature Electronics Calibration	100.0	
tCC1	page 53	RTD Mid Temperature Electronics Calibration	150.00	
tCH1	page 53	RTD High Temperature Electronics Calibration	200.0	
LCC	page 59	Lock Code Change	0800	
tCt	page 60	Custom Temperature Compensation Curve	option per sales order	
PCt	page 64	Custom Percent Concentration Curve	option per sales order	
LCO1	page 56	Analog Out 1 Electronics Lower Calibration	00.00	
HCO1	page 56	Analog Out 1 Electronics Upper Calibration	100.0	
LCO2	page 56	Analog Out 2 Electronics Lower Calibration	00.00	
HCO2	page 56	Analog Out 2 Electronics Upper Calibration	100.00	
SFt		Software Version Number	cannot be changed	
SOH		Sales Order High	cannot be changed	
SOL		Sales Order Low	cannot be changed	

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.

9. Press ENTER.

10. Use NEXT and Δ until the desired value is displayed.

11. Press ENTER.

12. When display defaults to the current measurement value, the analyzer is automatically locked at the second level (bL) of security.

13. Lock analyzer (see "Locking Analyzer Using Security Code" on page 24).

Changing the Cell Type (Ct)

The parameter Ct is used to configure the analyzer to the type of 871EC sensor being used. Use this procedure to configure a new installation properly or to reconfigure the analyzer when sensor type is changed. See Table 13.

For calibration when using an 871FT Flowthrough sensor, refer to MI 611-202.

Table 13. Sensor Type

Ct Code Digit	871EC Sensor type
1	UT/LB
2	RE/BW/EV
3	AB
4	SP/HP/PP/PT
5	TF
6	NL
7	PN/PX

─ **NOTE** ──────────────────────────────────
After changing Ct, the Full Scale Range (FSC) procedure and Calibration procedure will have to be performed. Refer to "Selecting a Full Scale Range" on page 45.

1. Unlock analyzer at the first security level.

2. Press SHIFT and while holding, press Setup. Release fingers from both keys.

3. Press NEXT several times until the code bL is displayed.

4. Press ENTER. The code LOC appears on the display.

5. Press NEXT.

6. Then use NEXT and Δ until security code is displayed (0800 from factory).

7. Press ENTER. The code ULOC appears on the display.

8. When display returns to bL, press NEXT once. The code Ct will appear.

9. Press ENTER.

10. Then press Δ until the desired digit appears in the display.

11. Press ENTER.

12. Lock analyzer.

Selecting a Full Scale Range

For Measurements in Conductance Units (μS/cm or mS/cm)

♦ Determine the highest conductivity reading expected.

♦ Determine the type of sensor being used.

♦ Refer to Table 15 and choose an appropriate full scale range.

> ─ **NOTE** ────────────────────────────────────
> Millisiemens (mS/cm) are the same as millimohs/cm.

Example:

Application - Measurement of Cooling Tower Water in the Range of 0 to 2.5 mS/cm with a Sensor Type "SP" (871EC-SPO).

From Table 15, the choice of full scale range 0 to 5 mS/cm would be appropriate.

For Measurements in Concentration Units (%)

Table 14 lists the standard concentration calibration curves that are preprogrammed into the memory of each 873 Analyzer.

Table 14. Preprogrammed Concentration Curves

Calibration Curve	Reference Temperature
Hydrochloric (HCl); 0 to 15%	25°C
Nitric Acid (HNO$_3$); 0 to 10%	25°C
Sulfuric Acid (H$_2$SO$_4$); 0 to 25%	25°C
Sulfuric Acid (H$_2$SO$_4$); 99.5 to 93%	50°C
Oleum; 42 to 18%	65°C
Sodium Hydroxide (NaOH); 0-15%	25°C
Sodium Hydroxide (NaOH); 0 to 20%	100°C
Phosphoric Acid (H$_3$PO$_4$); 0 to 35%	35°C
Sodium Chloride (NaCl); 0 to 25%	25°C

Any % concentration measurement which falls inside the bounds of the calibration curves shown above can be accomplished with a standard 873 unit, configured appropriately. See example.

Example:

Examples of feasible standard applications include:

 ♦ Sodium Hydroxide, 0 to 1%

 ♦ Hydrochloric Acid, 0.5 to 2.0%

 ♦ Sulfuric Acid, 99 to 98%

Applications for % concentration measurements which fall outside the bounds of the standard calibration curves are usually achievable through the use of the optional curve generation feature. (Analyzer must have optional suffix "-5" in Model Code.) See Example.

For details concerning the use of the curve generation program for nonstandard % concentration measurements, refer to "Generating and Inputting Custom Curve Programs" on page 60.

Example:

Examples of feasible nonstandard applications include:

 ♦ Ammonium Hydroxide, 0 to 6%

 ♦ Acetic Acid, 0 to 5%

 ♦ Oleum, 0 to 10%

Table 15. Full Scale (FSC) Range Settings

Conductivity Ranges	871EC Sensor Type													
	SP	HP	NL	TF	PN	PX	RE	BW	LB	UT	EV	AB	PP	PT
	Ct=4	Ct=4	Ct=6	Ct=5	Ct=7	Ct=7	Ct=2	Ct=2	Ct=1	Ct=1	Ct=2	Ct=3	Ct=4	Ct=4
0 to 50µS/cm									X	X				
0 to 100µ S/cm									X	X				
0 to 200 µ S/cm							X	X	X	X	X	X		
0 to 500µ S/cm							X	X	X	X	X	X		
0 to 1 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 2 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 5 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 10 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 20 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 50 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 100 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 200 mS/cm	X	X	X	X	X	X	X	X	X	X	X	X	X	X
0 to 500 mS/cm	X	X	X	X	X	X	X	X			X	X	X	X
0 to 1000 mS/cm	X	X	X	X	X	X	X	X			X	X	X	X
0 to 2000 mS/cm	X	X	X	X	X	X							X	X

X = Available

For Full Scale Range settings of 871FT Flowthrough sensors, refer to MI 611-202.

For % concentration measurements using the standard preprogrammed calibration curves, it is not necessary to choose a full scale range to accommodate the highest conductance value in the full standard range. It is only necessary to choose a full scale range high enough to accommodate the highest conductance value in the specific application.

Determine the highest equivalent conductance at reference temperature for the % concentration readings expected. Refer to Table 16 for a listing of many common electrolytes. Determine the type of sensor being used. Refer to Table 15 and choose an appropriate full scale range.

Examples:

Application 1 - Measurement of Caustic (NaOH) in the Range of 0 to 3% with a Sensor Type "SP" (871EC-SPO).

1. Refer to Table 16. The conductance of 3% NaOH is 145 mS/cm at 25° C reference temperature.

2. From Table 15, the choice of full scale range 200 mS/cm would be appropriate.

Application 2 - Measurement of Sulfuric Acid (H_2SO_4) in the Range of 99.5 to 93% with a Sensor Type "TF" (871EC-TF2-V) at 50° C.

1. Refer to Table 16. At reference temperature of 50°C, the conductivity of 93% H2SO4 is 232.3 mS/cm; that of 99.5%, H2SO4 is 65.3 mS/cm. Thus, even though the highest % reading expected is 99.5%, the analyzer must be ranged for conductance readings as high as 232.3 mS/cm.

2. From Table 15, the choice of 500 mS/cm would be appropriate.

For convenience, Table 16 is provided for conversion from % concentration to mS/cm when analyzer is to be used in % concentration mode.

Table 16. Percent Concentration and Equivalent mS/cm Conductivity

Percent Concentration	Conductivity mS/cm	Ref. Temp. °C
0 to 3% NaCl	0 to 50	25
0 to 5% NaCl	0 to 79	25
0 to 10% NaCl	0 to 140	25
0 to 15% NaCl	0 to 140	25
0 to 25% NaCl (d)	0 to 246.5	25
0 to 3% NaOH	0 to 145	25
0 to 5% NaOH	0 to 223	25
0 to 10% NaOH	0 to 355	25
0 to 15% NaOH (d)	0 to 410	25
0 to 20% NaOH (a,d)	0 to 1260	100
0 to 3% HCl	0 to 285	25
0 to 5% HCl	0 to 432	25
0 to 10% HCl	0 to 697	25
0 to 15% HCl (d)	0 to 819	25
0 to 3% H_2SO_4	0 to 136	25
0 to 5% H_2SO_4	0 to 219	25
0 to 10% H_2SO_4	0 to 425	25
0 to 15% H_2SO_4	0 to 592	25
0 to 20% H_2SO_4	0 to 716	25
0 to 25% H_2SO_4 (d)	0 to 790	25
99.5 to 93% H_2SO_4 (b,d)	65.3 to 232.3	50
0 to 10% Oleum	0 to 35	65
42 to 18% Oleum (c,d)	15.0 to 78.6	65
0 to 10% HNO_3	0 to 500	25
0 to 3% H_3PO_4	0 to 23	25
0 to 5% H_3PO_4	0 to 35	25
0 to 10% H_3PO_4	0 to 61	25
0 to 20% H_3PO_4	0 to 123	25
0 to 30% H_3PO_4	0 to 182	25
0 to 40% H_3PO_4	0 to 223	25

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

b. Suppressed-zero conductivity = 65.3 mS/cm Reference Temperature = 50°C (122°F) Thermistor Value = 33 591Ω

c. Suppressed-zero conductivity = 15 mS/cm Reference Temperature = 65°C (149°F) Thermistor Value = 18 668 Ω

d. Standard Ranges. Refer also to Table 7, Compensation Code

Changing the Full Scale Range (FSC)

This parameter allows the user to select one of several possible ranges. The analyzer accuracy is .5% of the FSC chosen. 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.

> ⚠ **CAUTION**
>
> When changing ranges, the drive voltage to the sensor inputs is changed. Altering the FSC range via the keypad will require the unit to be bench calibrated before use. Pressing ENTER in FSC mode (even if range was not changed) will require 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 analyzer is capable of displaying values greater than that set by the FSC ranges. For example, when the FSC is on the 0 to 5.000 mS/cm range, it can display up to 9.999 mS/cm.

IPS preconfigures the FSC value per sales order.

The procedure to change FSC is as follows:

1. Unlock analyzer (see "Unlocking Analyzer Using Security Code" on page 24).

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).

5. Press ENTER.

6. When display returns to bL, press NEXT twice. The code FSC (Full Scale Range Change) will be displayed.

7. Press ENTER. The present full scale range will be displayed.

> ⚠ **CAUTION**
>
> If you are verifying FSC and this is your desired range, allow unit to time out. DO NOT PRESS ENTER. Entering any FSC causes Er4 to flash on the display, necessitating a calibration. If Ct was altered, this value must be entered.

8. Press Δ until the desired range is displayed.

9. Press ENTER.

10. Lock analyzer (see "Locking Analyzer Using Security Code" on page 24).

> **NOTE**
>
> Calibration is required after full scale range is changed. Error code ER4 flashes until calibration is accomplished. Refer to "Calibration" on page 67.

Changing the Temperature Circuitry

Temperature Electronics Calibration for either thermistor (tEC1) or RTD (tCL1, tCC1 and tCH1) type sensors is performed at the factory. BW, HP, PP, and UT sensors contain 100 Ω RTDs. RE, LB, NL, EV, AB, PN, PX, PT, TF, and SP sensors contain a 100 kΩ thermistor. It is not necessary to perform these procedures in the field unless:

1. You have switched from RTD type sensors to thermistor type or vice versa.

2. You suspect a problem with the temperature calibration.

3. You wish to verify temperature electronics calibration.

If switching from a thermistor to an RTD type sensor or vice versa, it is necessary to relocate jumpers within the analyzer and to recalibrate the unit.

To Reposition Jumpers:

⚠️ **CAUTION**
Use proper ESD precautions when opening this instrument for any servicing.

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.

— **NOTE**
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 AS700DY-0A. The plastic enclosure slides out from the rear of its housing. The metal enclosure slides out from the front of its housing.

4. Refer to Figure 16 to identify jumper locations.

5. Use Table 17 to locate appropriate jumper positions.

Table 17. Jumper Positions for Temperature Transducer

Jumper No.	100 Ω RTD	100 kΩ Thermistor
J12	P2 & P3	P1 & P2
J14*	P1 & P2	P2 & P3, P4 & P5

*Spare jumper may be stored by placing it over one pin only.

6. Move each jumper to its appropriate position.

7. Replace board assembly inside unit.

⚠ **CAUTION**

On the plastic enclosure, 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 16.

8. Replace cover. Use Loctite (Part No. S0106ML) on the threads of the front screws and Lubriplate (Part No. X0111AT) on the threads of the rear screws of all metal enclosures.

9. If you changed to Thermistor Temperature Compensation, see "Thermistor Temperature Electronic Calibration (tEC1)" on page 52 to complete the calibration.

10. If you changed to RTD Temperature Compensation, see "RTD Temperature Calibration (tCL1, tCC1, tCH1)" on page 53.

11. Make appropriate changes to the analyzer identification label.
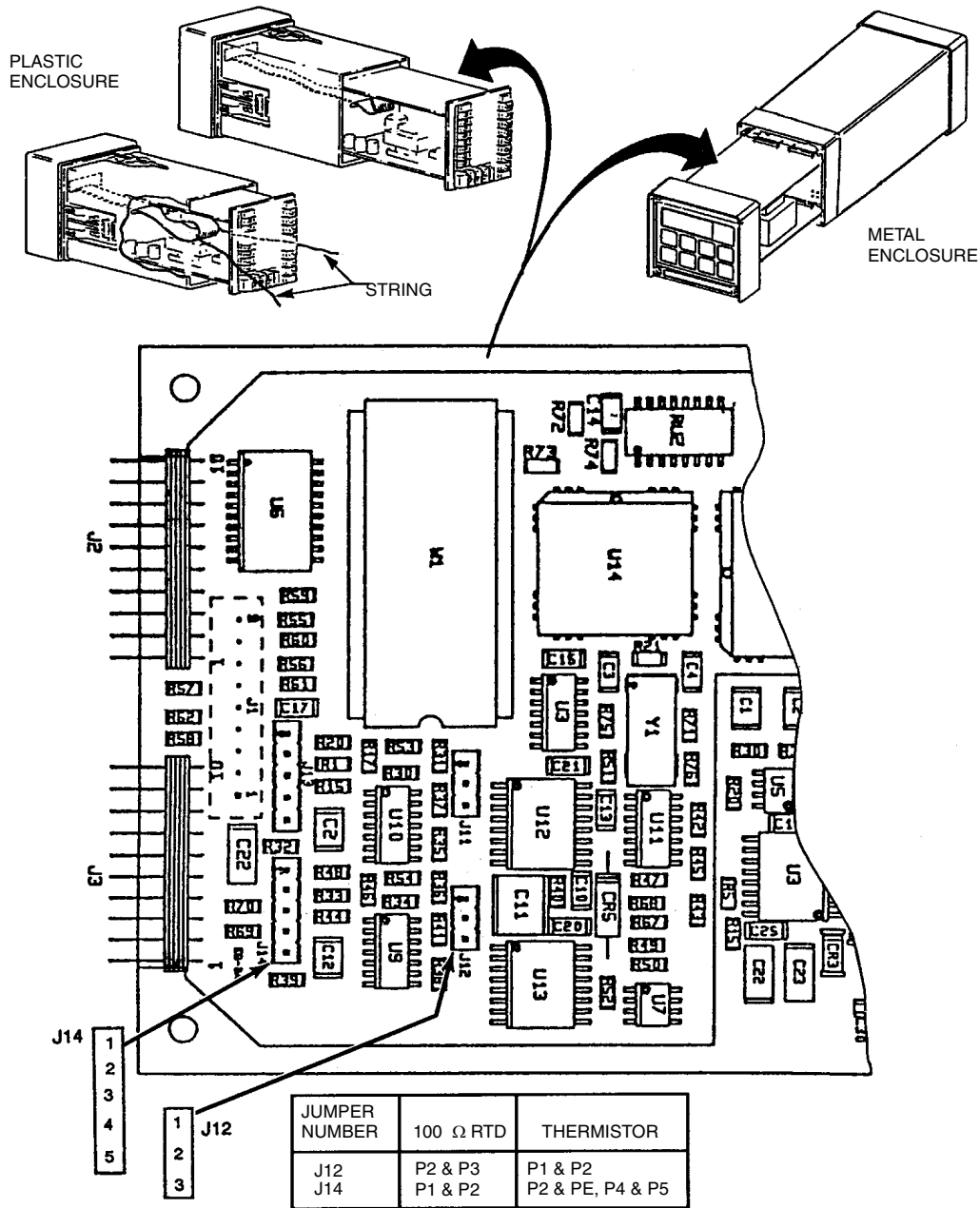
Figure 16. Jumpers for Temperature Compensation

Thermistor Temperature Electronic Calibration (tEC1)

NOTE

The following sensors use a 100 kΩ thermistor for temperature measurement: SP, NL, TF, PN, PT, PX, RE, LB, EV, and AB.

Required: One 100 kΩ precision resistor

1. Disconnect sensor lead connections 6 and 7 from TB2.

2. Connect the precision 100 kΩ resistor between the sensor terminals 6 and 7. See Figure 17.

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 4 times until tEC1 is displayed.

9. Press ENTER. The value 25.00 will be displayed.

10. Press ENTER.

11. Lock analyzer.

This completes the thermistor temperature electronics calibration.
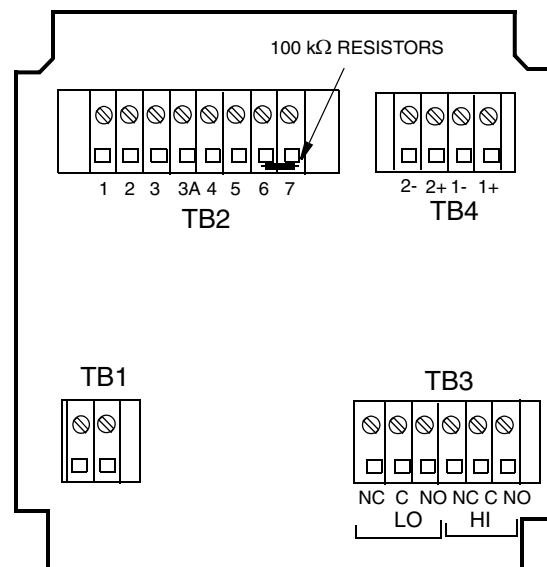
Figure 17. Thermistor Temperature Simulation (Metal Enclosure Shown)

RTD Temperature Calibration (tCL1, tCC1, tCH1)

— **NOTE** —————————————————————————————
The following sensors use a 100 Ω platinum RTD for temperature measurement: HP, BW, UT.
———

Required: one each, 100, 150, and 200 Ω precision resistors or precision resistance decade box with 0.01% accuracy. The decade box is recommended.

1. Disconnect sensor lead connections 6 and 7 from TB2.

2. Connect the 100 Ω precision resistor between terminals 6 and 7. See Figure 18.

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 five times until tCL1 is displayed. Press ENTER. Then keep finger on SHIFT.

9. Display will show 100.0 (ohms). Press SHIFT and hold for 20 seconds, then press ENTER. Then keep finger on SHIFT.

10. Replace the 100 Ω resistor (leads 6 and 7) 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 will show 150.0 (ohms). Press SHIFT and hold for 20 seconds, then press ENTER. Then keep finger on SHIFT.

13. Replace the 150 Ω resistor 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 will show 200 (ohms). Press SHIFT and hold for 20 seconds, then press ENTER.

16. Lock analyzer.

This completes the RTD Temperature Calibration.
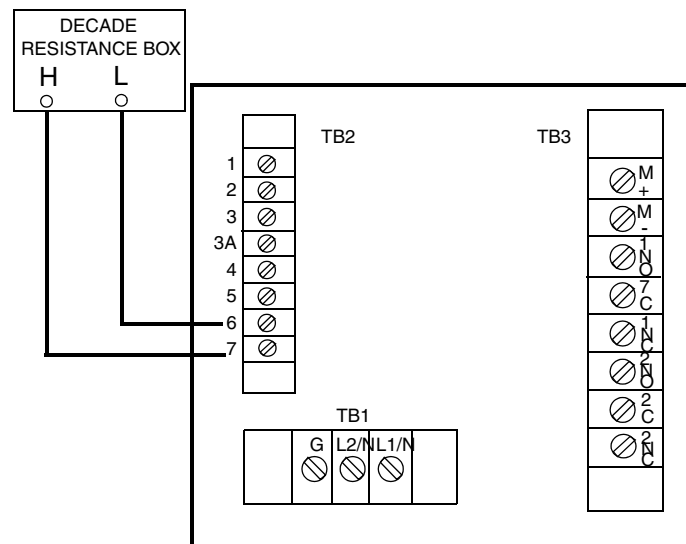
Figure 18. RTD Temperature Simulation (Plastic Enclosure Shown)

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

> ⚠ **CAUTION**
>
> Use proper ESD precautions when opening this instrument for any servicing.

1. Remove power to the unit.

2. On the 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. The plastic enclosure slides out from the rear of its housing. The metal enclosure slides out from the front of its housing.

4. Refer to Figure 19 to identify jumper locations.

5. Use Table 18 to locate appropriate jumper positions.

Table 18. Jumper Positions for the Various Analog Outputs

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

6. Move each jumper to its appropriate position.

7. Replace board assembly inside unit.

> ⚠ **CAUTION**
>
> On the plastic enclosure, 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 19.

8. Replace cover. Use Loctite (Part No. S0106ML) on the threads of the front screws and Lubriplate (Part No. X0111AT) on the threads of the rear screws of all metal enclosures.

9. An analog output calibration will now be necessary. Refer to "Analog Output Calibration (LC01, HC01, LC02, HC02)" on page 56.

10. Make appropriate changes to the analyzer identification label.

Output	J5	J6	J7	J10
4 - 20 mA	2 - 3	2 - 3	2 - 3	2 - 3
0 - 20 mA	2 - 3	2 - 3	2 - 3	2 - 3
0 - 10 V dc	1 - 2	1 - 2	1 - 2	1 - 2
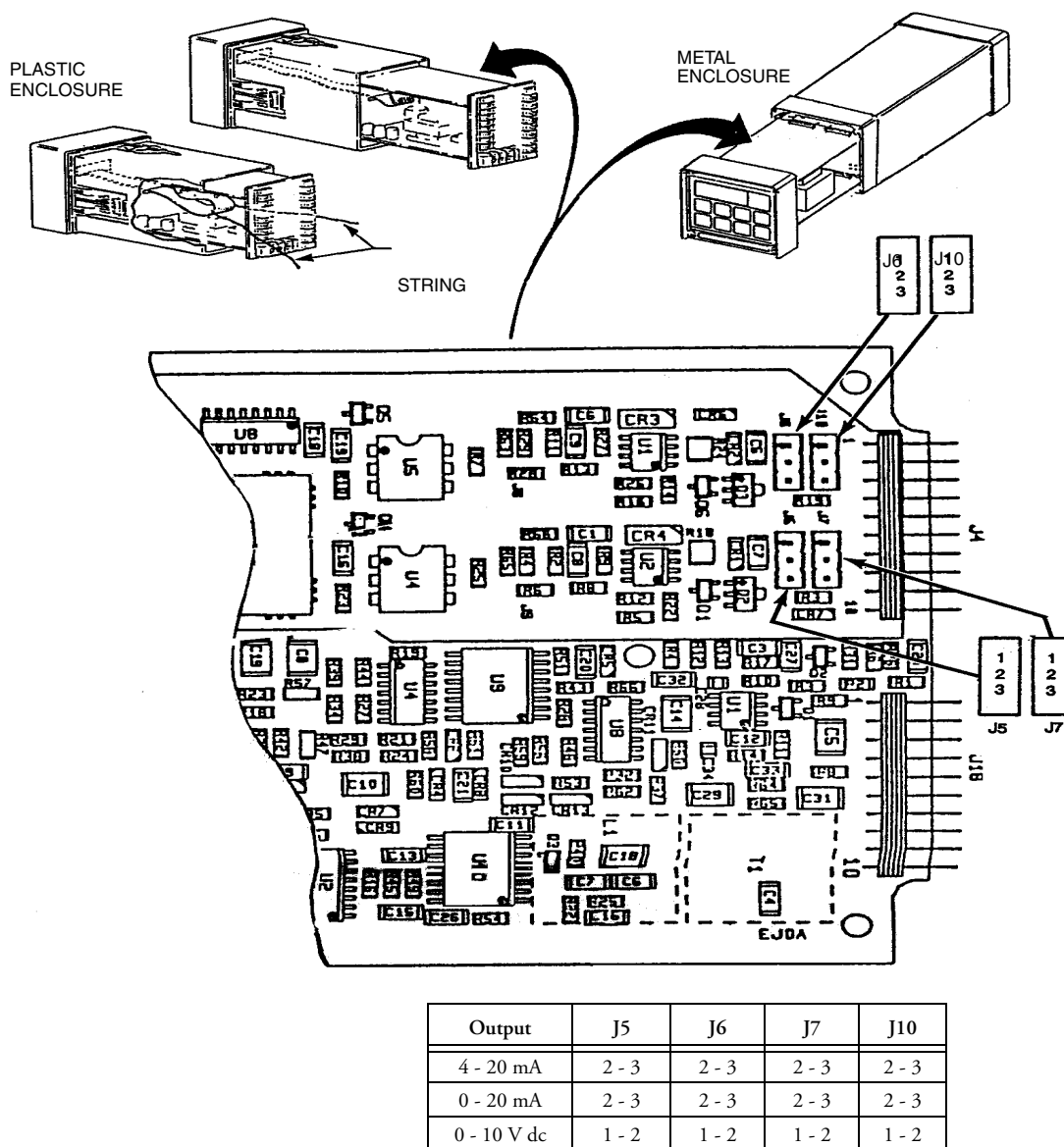
Figure 19. Jumpers for Changing Analog Output

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

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 ammeter/voltmeter to the analog output terminals. For LC01 and HC01, connect to Channel 1 output terminals. For LC02 and HC02, connect to Channel 2 output terminals. See Figure 20 and Figure 8 on page 16 or Figure 9 on page 18.

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 Δ until the personal security code is displayed (0800 from the factory). Press ENTER.

6. When display returns to bL, press NEXT until LC01 is displayed. Press ENTER.

7. Calculate the low % input required by using the following formula:

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

Example:

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

8. Use NEXT and Δ 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 LC01, press NEXT once to display HC01. 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.

10. Calculate the high % required using the following formula:

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

Example:

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

11. Use NEXT and Δ until the calculated value from Step 10 is displayed. If necessary, repeat Steps 10 and 11 until Observed Value is equal to the Desired Value. Press ENTER.

> ─ **NOTE** ──────────────────────────────
> Procedure complete here for plastic enclosure.

12. For metal enclosure with second output, move ammeter to second output terminals. Repeat Steps 3-5, then press NEXT until LC02 is displayed. Press ENTER.

13. Calculate the low % input required by using the following formula:

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

Example:

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

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 LC02, press NEXT once to display HC02. 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:

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

Example:

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

17. Use NEXT and Δ until the calculated value from Step 16 is displayed. Press ENTER.

> ─ **NOTE** ──────────────────────────────
> Repeat Steps 16 and 17 until Observed Value is equal to the Desired Value.

18. Lock analyzer using procedure in "Locking Analyzer Using Security Code" on page 24.

This completes the Analog Output Calibration Procedure.
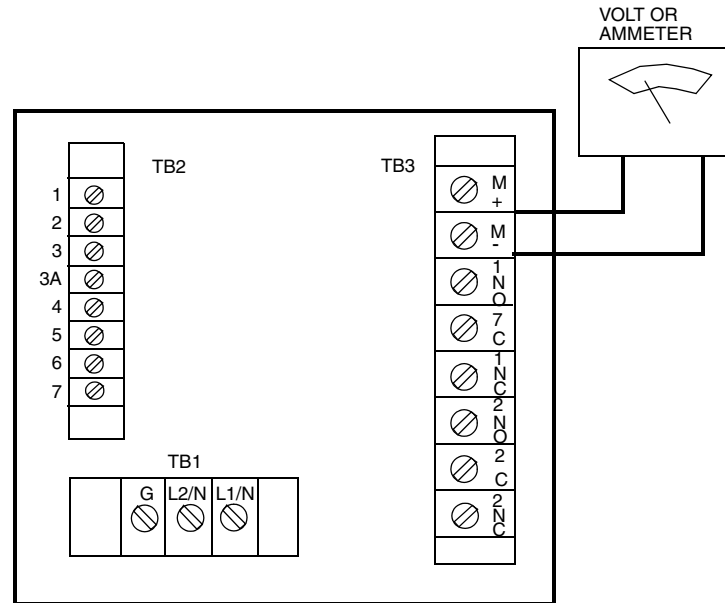
Figure 20. Output Terminals and Volt/Amp Meter (Plastic Enclosure Shown)

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 IPS.

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 onpage 24. Display will read uLoc.

4. Press SHIFT and while holding, press Setup. Release fingers from both keys.

5. Press NEXT several times until the code bL (Basic Setup Lock) is displayed. Press ENTER.

6. Then use NEXT and Δ until existing security code is displayed (0800 from factory).

7. Press ENTER.

8. When display returns to bL, press NEXT several times until the code LCC (Lock Code Change) is displayed.

9. Press ENTER, then use the NEXT and increment (Δ) keys until new desired security code is displayed.

10. Press ENTER. The new code will have to be used on all future entries.

11. Lock the analyzer using the procedures explained on page 24.

Generating and Inputting Custom Curve Programs

Custom temperature compensation and process specific concentration data may be input into 873EC Analyzers ordered with the "Curve Generation Program" option, suffix -5. Check Model Code on data label (Figure 2) to verify if this option is installed. This section will explain how to generate and input custom Curve Data into your 873EC analyzer. To use this data after it has been input requires setup parameter Cd ("Compensation and Damping (Cd)" on page 28) to be set to XX99.

The '-5' Custom Curve capability may be added in the field. Contact IPS with the complete analyzer Model No. and Date Code.

Custom Temperature Compensation Curve (tCt)

```
┌─────────────────────┐
│  DETERMINE CUSTOM   │
│   TEMPERATURE VS.   │
│  CONDUCTIVITY DATA  │
└─────────────────────┘
          │
          ▼
┌────────┐   ┌────────┐   ┌────────┐   ┌────────┐   ┌────────┐
│ Unlock │ → │  Temp  │ → │   Ct   │ → │  FSC   │ → │  tCt   │
└────────┘   └────────┘   └────────┘   └────────┘   └────────┘
```
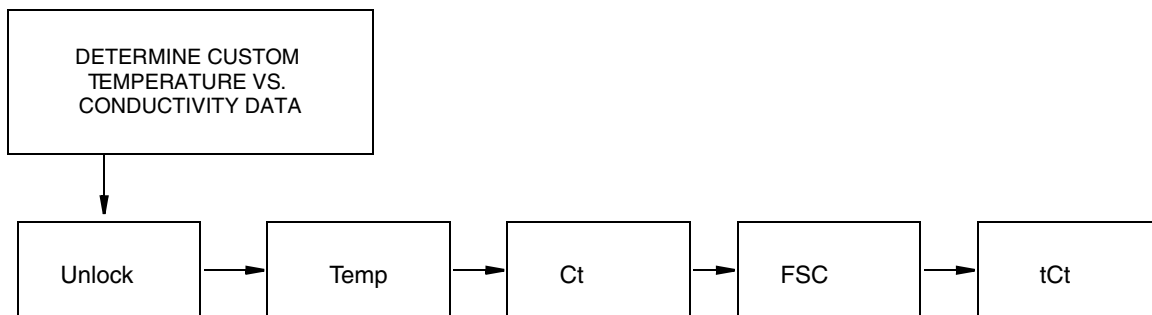
Figure 21. Flow Chart for Custom Temperature Compensation Curve (tCt)

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

Example:

The control point of a process is 30%. 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 EC sensor and 873EC analyzer in the absolute mode (Cd = 0000), conductivity versus temperature data is generated. Typical data results are shown in Figure 22.

1. The user-supplied, process specific compensation data must be reduced to 25 or fewer pairs. General guidelines for this are:

   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 have to be evenly spaced. We

suggest 2 or 3 points be chosen in a linear region, and more data points be input in a region when an exponential relationship (curved) is observed.

c. The maximum number of data pairs that may be entered is 25. See Figures 22 and 23 on page 63.

The number of pairs originally found have been reduced to 15. In linear regions pairs have been eliminated. Figure 23 illustrates that the same shape curve will still be observed if the unneeded or redundant pairs are eliminated.

2. The Process specific reference temperature must be determined. This is the "optimum" temperature your process runs at and is the temperature you wish to have all your values corrected to. In our example, the reference temperature is 25°C.

3. Additional Configuration Parameters may require adjustments before these data may be input into the tCt parameter.

a. Adjust the temperature to display the units of measurement you have collected your data in (C or F). See "TEMP Key" on page 22. 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 the Cell Type (Ct)" on page 44

c. Adjust FSC. FSC should be large enough to include all of the tabulated conductivity values that were determined in the temperature table as well as those that will be found in Concentration Table 16. See "Changing the Full Scale Range (FSC)" on page 49, for the procedure. Press ENTER.

── **NOTE** ──

An electronic Bench Calibration may be required (see Section 5, "Calibration" on page 67) if Ct or FSC required change.

───

4. Access Setup Code tCt.

── **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 3a. 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 4(a).
The continuation of our example will illustrate the procedure.

Example Continued:

An SP sensor is to be used in the process -Ct = 4. The FSC is set to 500 mS/cm to allow the maximum value of 261.9 mS/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 mS/cm	Press ENTER
Second Temperature	12.4	Press ENTER
Second Conductivity	38.2 mS/cm	Press ENTER
Alternate and enter remaining conductivity and temperature data	12.9	Press ENTER
	38.3 mS/cm	Press ENTER
	13.4	Press ENTER
	38.5 mS/cm	Press ENTER
	14.4	Press ENTER
	39.3 mS/cm	Press ENTER
	16.0	Press ENTER
	42.4 mS/cm	Press ENTER
	17.9	Press ENTER
	50.1 mS/cm	Press ENTER
	20.4	Press ENTER
	60.6 mS/cm	Press ENTER
	23.6	Press ENTER
	77.9 mS/cm	Press ENTER
	26.0	Press ENTER
	92.5 mS/cm	Press ENTER
	28.4	Press ENTER
	107.9 mS/cm	Press ENTER
	29.2	Press ENTER
	113.3 mS/cm	Press ENTER
	30.8	Press ENTER
	135.6 mS/cm	Press ENTER
	34.8 Press ENTER	
	194.3 mS/cm	Press ENTER
	37.2	Press ENTER
	261.9 mS/cm	Press ENTER

5. This completes the custom Temperature data entry. To use this information, resulting in temperature corrected conductivity data, set Cd to correspond to X099.
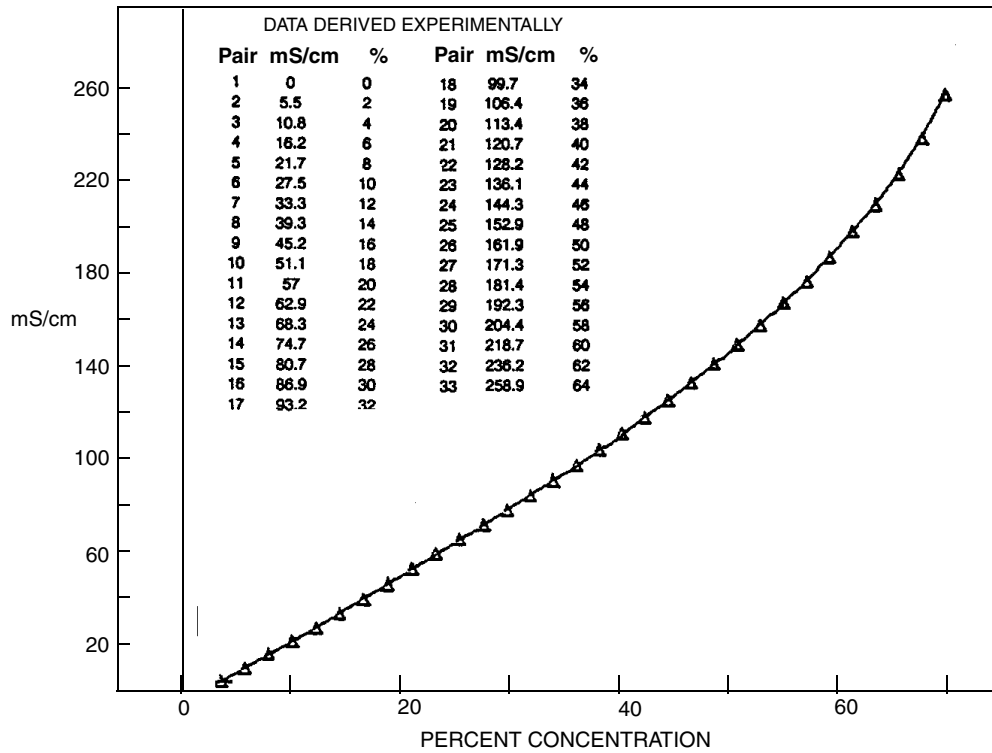
Figure 22. Initial Temperature vs. Conductivity Data
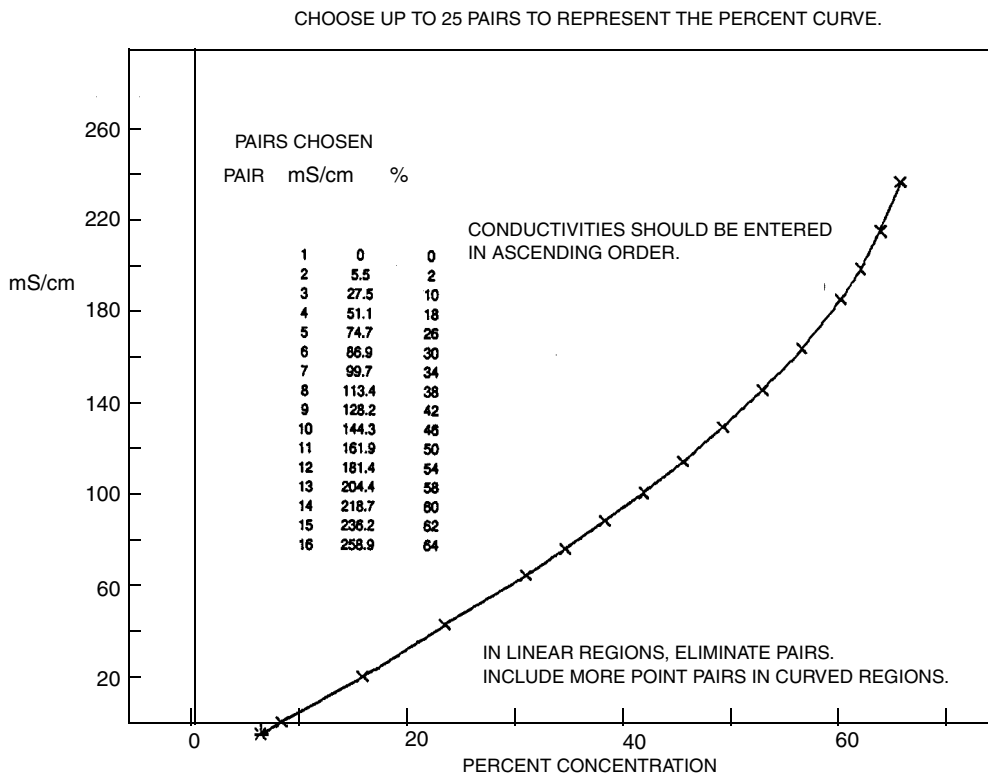
Figure 23. Temperature vs. Conductivity Data

Custom Percent Curve (PCt)
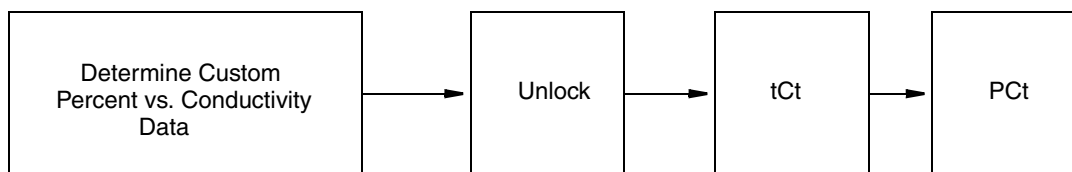
Figure 24. Flow Chart for Custom Percent Concentration

User-supplied process Percent Concentration versus Conductivity data must be generated or extracted from literature in advance of entering it into the 873EC analyzer. This data must consist of Percent Concentration versus conductivity data at the reference temperature specified in "Custom Temperature Compensation Curve (tCt)" on page 60. The Concentrations should include and extend beyond the entire range that the process may experience. Conductivity values must be input in ascending order and the slope cannot change directions (i.e., you will not be successful if attempting to measure on both the front side (upslope) and backside (downslope) of a curve). We suggest that the data be plotted graphically as well as tabularly to prepare it for entry in the 873EC.

Example:

The control point of a process is 30%. The process has been known to vary between 0 and 60%. Dilutions of a concentrate are monitored at 25°C. Using the EC sensor and 873EC analyzer in the absolute mode (Cd = 0000), Conductivity versus Percent Concentration data is generated. Typical data results are shown in Figure 25.

1. The User-supplied, percent concentration data must be reduced to 25 or fewer pairs. General guidelines for this are.

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

    b. The slope of Percent versus 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 have to be evenly spaced. We suggest 2 or 3 points be chosen in a linear region, and more data points be input in a region when an exponential relationship (curved) is observed.

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

        The number of pairs originally found have been reduced. In linear regions, pairs have been eliminated. Figure 26 illustrates the same shape curve is still observed after the number of pairs have been reduced.

2. Custom Temperature Compensation tCt should be entered first. See "Custom Temperature Compensation Curve (tCt)" on page 60. Unlock bL (see page 44). 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 be displayed.

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 2(a).

Number of pairs	0016	Press ENTER
First Conductivity	000.0 mS/cm	Press ENTER
First Percent	0.00%	Press ENTER
Second Conductivity	5.5 mS/cm	Press ENTER
Second Percent	2.00%	Press ENTER
Alternate and enter remaining conductivity and Percent data	27.5 mS/cm	Press ENTER
	10.00%	Press ENTER
	51.1 mS/cm	Press ENTER
	18.00%	Press ENTER
	74.7mS/cm	Press ENTER
	26.00%	Press ENTER
	86.9 mS/cm	Press ENTER
	30.00%	Press ENTER
	99.7 mS/cm	Press ENTER
	34.00%	Press ENTER
	113.4 mS/cm	Press ENTER
	38.00%	Press ENTER
	128.2 mS/cm	Press ENTER
	42.00%	Press ENTER
	144.3 mS/cm	Press ENTER
	46.00%	Press ENTER
	161.9 mS/cm	Press ENTER
	50.00%	Press ENTER
	181.4 mS/cm	Press ENTER
	54.00%	Press ENTER
	204.4 mS/cm	Press ENTER
	58.00%	Press ENTER
	218.7 mS/cm	Press ENTER
	60.00%	Press ENTER
	236.2 mS/cm	Press ENTER
	62.00%	Press ENTER
	258.9 mS/cm	Press ENTER
	64.00%	Press ENTER

3. This completes the custom Percent Curve entry. To use this information, resulting in temperature corrected Percent Concentration data, set Cd to correspond to X199. See "Compensation and Damping (Cd)" on page 28.

CHOOSE UP TO 25 PAIRS TO REPRESENT THE PERCENT CURVE.

CONDUCTIVITIES SHOULD BE ENTERED
IN ASCENDING ORDER.

PAIRS CHOSEN

PAIR	mS/cm	%	PAIR	mS/cm	%
1	0	0	18	99.7	34
2	5.5	2	19	106.4	36
3	10.8	4	20	113.4	38
4	16.2	6	21	120.7	40
5	21.7	8	22	128.2	42
6	27.5	10	23	136.1	44
7	33.3	12	24	144.3	46
8	39.3	14	25	152.9	48
9	45.2	16	26	161.9	50
10	51.1	18	27	171.3	52
11	57	20	28	181.4	54
12	62.9	22	29	192.3	56
13	68.3	24	30	204.4	58
14	74.7	26	31	218.7	60
15	80.7	28	32	236.2	62
16	85.9	30	33	258.9	64
17	93.2	32			

Figure 25. Initial Concentration vs. Conductivity Data

CHOOSE UP TO 25 PAIRS TO REPRESENT THE PERCENT CURVE.

CONDUCTIVITIES SHOULD BE ENTERED
IN ASCENDING ORDER.

PAIRS CHOSEN

Pair	mS/cm	%
1	0	0
2	5.5	2
3	27.5	10
4	51.1	18
5	74.7	26
6	85.9	30
7	99.7	34
8	113.4	38
9	128.2	42
10	144.3	46
11	161.9	50
12	181.4	54
13	204.4	58
14	218.7	60
15	236.2	62
16	258.9	64

IN LINEAR REGIONS, ELIMINATE PAIRS.
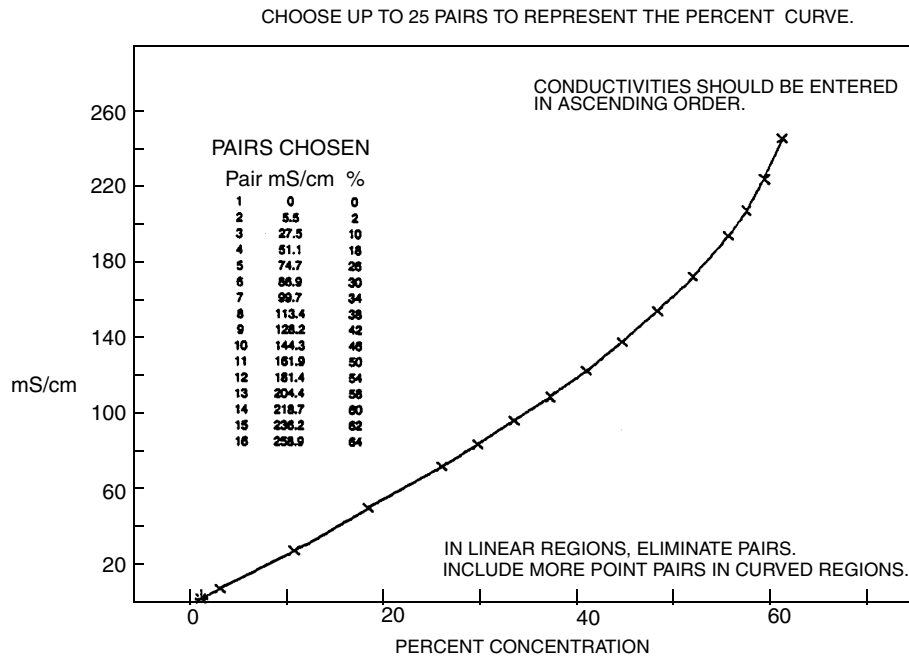INCLUDE MORE POINT PAIRS IN CURVED REGIONS.

Figure 26. Concentration vs. Conductivity Data

5. Calibration

The Calibration section is divided into two parts.

"Electronic Bench Calibration" contains the procedure for calibrating the 873EC Analyzer with precision resistors using theoretical sensor signal values. In many cases this calibration produces sufficient accuracy for the user's application.

"Standardization Using a Known Solution" provides additional calibration accuracy and standardization techniques.

─ **NOTE** ──────────────────────
The temperature cell factor (see "Temperature Cell Factor (TCF1) Adjustments" on page 74) procedure tCF must be used any time long or additional cable lengths are installed.
─────────────────────────────

─ ⚠ **CAUTION** ──────────────
On metal enclosures, do **not** remove four front panel screws and remove electronics package for calibration. The self-tapping screws have a limited number of taps and will not function properly with repeated use.
─────────────────────────────

Electronic Bench Calibration

```
┌──────────┐    ┌──────────┐    ┌──────────┐    ┌──────────┐    ┌──────────┐
│          │    │          │    │   Cd     │    │ Open = 0 │    │    Ω     │
│    Ct    │───▶│   FSC    │───▶│  0000    │───▶│  Cal Lo  │───▶│  Cal Hi  │
│          │    │          │    │          │    │          │    │          │
└──────────┘    └──────────┘    └──────────┘    └──────────┘    └──────────┘
```
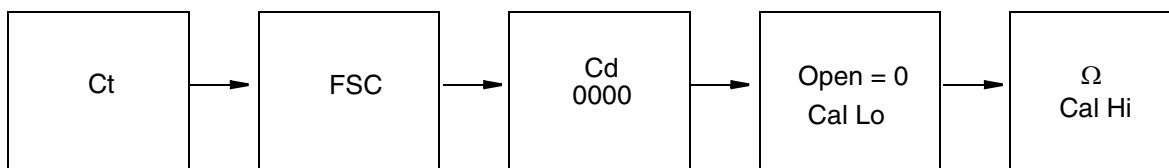
─ **NOTE** ──────────────────────
Holding the SHIFT key between entries will prevent the analyzer from timing out and leaving the Setup entries.
─────────────────────────────

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

─ **NOTE** ──────────────────────
IPS calibrates and configures all 873 Analyzers before leaving the factory. Calibration may be verified by using this decade box procedure.
─────────────────────────────

─ ⚠ **CAUTION** ──────────────
Do **not** press ENTER if you are checking the calibration. It should not be necessary to implement the Electronic Bench Calibration unless Ct or the FSC has been changed or entered, or the Cal Hi and/or Cal Lo has been changed or entered. Allow the unit to "time out."
─────────────────────────────

Required:

Decade resistance box, a 110 Ω (±0.01%) or 100 kΩ (±0.1%) resistor for temperature simulation, and a small screwdriver.

Procedure:

1. Access sensor terminal block TB2. Remove four screws from back cover to access connections on metal enclosure only.

2. Remove power from analyzer. Connect sensor leads 1-5 to terminal strip TB2. NOTE: 3A is not used. If sensor is being calibrated in the field, remove sensor from process medium. Clean and dry off. Disconnect leads 6 and 7.

3. Verifying 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** ───

    Sensor types LB, NL, RE, EV, AB, PN, PX, PT, TF, and SP use a 100 kΩ thermistor for automatic temperature compensation. Sensors UT, BW, PP, and HP and the 871FT Flowthrough sensors use a 100 Ω RTD for automatic temperature compensation and are recommended for all measurements at elevated temperature (for example, >250°F).

    ──

    b. Connect the appropriate resistor across terminals 6 and 7 on terminal strip TB2 (100 kΩ for Thermistor, 110 Ω for RTD sensors).

    c. Apply power to analyzer.

    d. Unlock analyzer.

    e. 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.

    f. Reset tCF1 to 25.00 (the theoretical temperature transducer value).

    g. Press Temp. The display should read approximately "25.C" or "77.F". If the display does not read either of these values, reset the temperature electronics. See "Changing the Temperature Circuitry" on page 50.

4. Enter the Setup parameter Ct for the cell type required for your sensor. Refer to Table 13 on page 44; or for 871FT Flowthrough sensors, refer to MI 611-202.

5. Reset the Full Scale value of the analyzer. Refer to "Selecting a Full Scale Range" on page 45. 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

1. If an Error code of higher priority is present, it will preempt the ER4 message.

2. Holding the SHIFT key between entries will prevent the analyzer from timing out and leaving the Setup entries.

---

6. Check and adjust the Cd code of the unit. Refer to "Compensation and Damping (Cd)" on page 28. Set this code to read "0000". The unit should have no damping and should utilize absolute temperature compensation.

7. Zero and Span Calibration

   a. Suspend the clean dry sensor in the air (see Figure 27). An open loop (Infinite Resistance) is used to calibrate at 0 µS/cm or 0 mS/cm.

   b. Wait at least 15 seconds for the electronics to stabilize.

   c. Press SHIFT and while holding, press Cal Lo. Release fingers from both keys. Use NEXT and Δ until the display reads 0.00. Press ENTER.

   d. Route resistance loop from a decade box through sensor as shown in Figure 27.
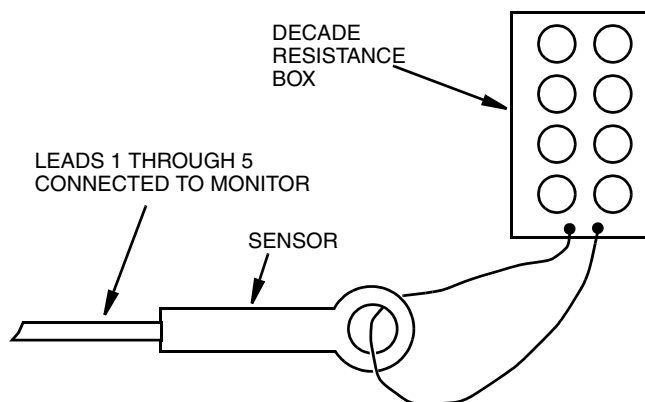
Figure 27. Sensor/Decade Box Configuration for Calibration

   e. Calculate the Resistance Input required for Calibrate High value. The Cal Hi value should fall within the range of the FSC that has been chosen and closest to the process control point for the most accuracy. The cell factors are required for this calculation (Table 19).

Table 19. Sensor vs. Cell Factor

Sensor Type	Cell Factor
AB	0.588
EV	0.45
NL	2.35
PN, PX	2.45
TF	2.31
SP, HP	2.15
RE, LB, UT, BW	0.873
PP, PT	2.185

For 871FT Flowthrough sensors, refer to MI 611-202.

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

Example:

For a conductivity display of 20.00 mS/cm with an AB sensor,

$$\text{Resistance Input} = \frac{(0.588)(1000)}{20.00} = 29.4\Omega$$

Other sample resistance inputs:

For a display of 20 mS/cm, with an SP sensor:

Resistance Input = 107.5 Ω

For a display of 200 µS/cm with an LB sensor:

Resistance Input = 4.365 kΩ

─ **NOTE**

The resistance values calculated in the preceding formulas assume a single loop (or turn) through the sensor as shown in Figure 27. When extremely small resistances are required and are not available using equipment at hand, the user may loop the decade box wire several times through sensor and then multiply R_L by square of the number of loops used.

$$R_L = n^2 \times R_C$$

where

R_C	=	Resistance required from calculation
n	=	Number of loops through sensor donut
R_L	=	Resistance to use in the loop

Example:

If R_L is calculated as being 0.45 Ω, user may choose to put 10 loops through sensor and use a 45 Ω resistance. The square of 10 is 100.

$n^2 \times R_C$	= R_L
$10^2 \times .45$	= R_L
100×0.45	= 45
R_L	= 45 Ω

    f. Set the decade box to the resistance value calculated in the previous step.

    g. Wait at least 15 seconds for the electronics to stabilize.

    h. 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.

8. Remove power from analyzer.

9. Remove resistor from terminals 6 and 7 of TB2, and reconnect sensor wires. Apply power.

10. Change Cd code for appropriate compensation and damping (see page 28).

11. Verify temperature is reading appropriately in Automatic mode. (No decimal should be visible after the temp unit.) See "Temperature Cell Factor (TCF1) Adjustments" on page 74 for procedure to offset temperature errors.

12. Lock analyzer.

This completes the electronic Bench Calibration procedure.

Standardization Using a Known Solution

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

♦ after a bench/dry calibration as a final check before operation

♦ to offset wall effects

♦ once per month for a new installation; more or less frequently for an old installation, as dictated by historical need

♦ whenever the measurement value is in doubt

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

> ─ **NOTE** ─────────────────────────────────
> Before performing standardization procedures with a solution, verify that the temperature signal from the sensor is correct. "Temperature Cell Factor (TCF1) Adjustments" on page 74 contains a procedure to offset temperature errors.

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

In-Line Type Standardization

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

Advantages of In-Line Type Standardization

♦ Fast

♦ Compensates for installation related measurement effects, such as pipe wall effects

Disadvantages of In-Line Type Standardization

♦ Relies on accuracy of second analyzer

♦ Sample may change temperature, keep reacting, absorb CO_2, etc.

♦ One point check only

Off-Line Type Standardization

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

Advantages of Off-Line Type Standardization

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

Disadvantages of Off-Line Type Standardization

- ♦ Takes more time
- ♦ Requires the sensor to be removed from the process
- ♦ Does not compensate for installation related measurement effects
- ♦ Standard conductivity solutions may degrade or become contaminated

In-Line Standardization Procedure

1. Unlock analyzer using Security Code.

2. Analyzer must have zero damping. Refer to Table 7 on page 29 and change the Cd Code, if necessary, so that Digit 1 = 0. Refer to "Compensation and Damping (Cd)" on page 28.

   — **NOTE** —————————————————————
   If using temperature compensation to match process composition (last two digits of Cd), the alternate analysis should be done at reference temperature (see Table 7).
   ———————————————————————————————

3. If correcting for a shift in system zero (such as might be present if a sensor becomes magnetized), press SHIFT and while holding, press Cal Lo. Release both keys.
   OR,
   If correcting for a shift in system span (such as might be present if a sensor is too close to a pipe or vessel wall), press SHIFT and while holding, press Cal Hi. Release both keys.

   — **NOTE** —————————————————————
   1. When correcting for pipe wall effects, this procedure gives high accuracy at one point only. As the measurement moves away from this point, it becomes less accurate.

   2. This procedure assumes that prior to installing the sensor in process piping, a complete bench calibration was either checked or performed, and that system "zero" was ascertained during the course of the bench calibration procedure.
   ———————————————————————————————

4. Use NEXT and Δ until the display reads conductivity value of known solution at the reference temperature.

5. Press ENTER.

6. Lock analyzer using Security Code.

Off-Line Standardization Procedure

1. Remove sensor from process medium. Refer to sensor Master Instruction. Wash the immersion end in distilled water.

2. Dry the sensor completely and let it sit for a minimum of five minutes to ensure that it has reached room temperature. Verify by pressing TEMP key.

3. Unlock analyzer using Security Code ("Unlocking Analyzer Using Security Code" on page 24).

4. Analyzer must have zero damping. Refer to Table 7 and change the Cd Code, if necessary, so that Digit 1 = 0.

5. With the sensor dry and in air, press SHIFT and while holding, press Cal Lo. Release fingers from both keys. User NEXT and Δ until the display reads 0. Press ENTER.
   OR
   Alternately, the sensor may be immersed in a known solution of low conductivity. The conductivity should be known at the reference temperature if temperature compensation is used.
   Press SHIFT and while holding, press Cal Lo. Release fingers from both keys. Use NEXT and Δ until the display reads the solution conductivity. Press ENTER.

   ⚠ **CAUTION**
   Standard conductivity solutions may degrade or become contaminated.

6. Immerse the sensor in the known solution (of higher value). Allow at least one sensor diameter (see Table 20) of solution in all directions around the sensor. Allow the sensor to stabilize for at least ten minutes. Ensure that there are no air bubbles trapped in the sensor "donut."

7. Press SHIFT and while holding, press Cal Hi. Release fingers from both keys.

8. Use NEXT and Δ until the display reads conductivity value of known solution.

9. Press ENTER.

10. Remove the sensor from the known solution. Wash the immersion end with distilled water.

11. Lock analyzer using Security Code.

12. Reinstall sensor in process solution.

Table 20. Sensor Diameters

Sensor Types	Diameters
NL, SP, HP, PP, PT, PN, and PX	1.4 in
TF	1.5 in
RE, LB, BW, and UT	2.5 in
EV	3.2 in

The use of an 871FT Flowthrough sensor obviates the need for "minimum mounting" diameters.

Temperature Cell Factor (TCF1) Adjustments

An accurate temperature signal is required for proper temperature compensation, especially when measuring over a large temperature range. The temperature cell factor (tCF1) is used to offset deviations from ideality for the temperature transducer and to compensate for long cable lengths.

Determining tCF

1. Place 871EC sensor and an accurate Centigrade thermometer (with 0.10 °C resolution) into a container of water. Allow the system to reach thermal equilibrium. Keep all sensor cable connected to analyzer, especially if extension is used.

2. Press Temp. Put the analyzer into Automatic Temperature Compensation, no decimal after the "C". If there is a decimal after the "C", it should be removed. Press Δ once after pressing Temp; then press ENTER.

3. After equilibrium is reached (several minutes), read the temperature displayed on the 873 to the hundredths place. When Temp is pressed, the current temperature value with tenths place will alternate with the "C" legend. The value read by the 873 must now be viewed to the hundredths place. Press Temp followed by NEXT five times. Only three numbers may be viewed on the display, and the first digit will not be visible (e.g., 25.20 will be displayed as 5.20).

4. Determine the difference in values between the two temperature devices; e.g., the thermometer reads 24.70 °C, and the 873 says (2)5.20 C; Difference = 0.50 °C.

5. Subtract this value from 25.00 (e.g., 25.00 - .50 = 24.50).

— **NOTE** ———

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

——

Entering a tCF value

— **NOTE** ———

Perform this procedure:

1. Before doing the standardization procedure explained in "Standardization Using a Known Solution" on page 71.

2. After the Bench Calibration procedure explained in "Electronic Bench Calibration" on page 67.

——

1. Unlock analyzer ("Unlocking Analyzer Using Security Code" on page 24).

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 is displayed.

7. Press ENTER, then use NEXT and ∆ until desired value is displayed.

8. Press ENTER.

9. Recheck any differences that exist between a thermometer and temperature displayed on the 873 using the technique described in "Determining tCF" on page 74. Repeat tCF1 entry as necessary.

10. Lock analyzer.

Table 21. Resistance - Temperature Table
Applicable to 871EC "Thermistor" Sensors

100K6A1, 100,000 Ohms @ 25° C ±0.2° C to +70° C					
° C	Ro	° C	Ro	° C	Ro
-40	4,015.500	23	109,850	86	8,816.0
-39	3,750,000	24	104,800	87	8,522.7
-38	3,503,500	25	100,000	88	8,240.6
-37	3,274,600	26	95,447	89	7,969.1
-36	3,062,000	27	91,126	90	7,707.7
-35	2,864,000	28	87,022	91	7,456.2
-34	2,680,400	29	83,124	92	7,214.0
-33	2,509,400	30	79,422	93	6,980.6
-32	2,350,200	31	75,903	94	6,755.9
-31	2,202,100	32	72,560	95	6,539.4
-30	2,064,000	33	69,380	96	6,330.8
-29	1,935,400	34	66,356	97	6,129.8
-28	1,815,500	35	63,480	98	5,963.1
-27	1,703,700	36	60,743	99	5,749.3
-26	1,599,400	37	58,138	100	5,569.3
-25	1,502,000	38	55,658	101	5,395.7
-24	1,411,100	39	53,297	102	5,228.2
-23	1,326,200	40	51,048	103	5,066.7
-22	1,246,900	41	48,905	104	4,910.8
-21	1,172,800	42	46,863	105	4,760.4
-20	1,103,400	43	44,917	106	4,615.2
-19	1,038,600	44	43,062	107	4,475.1
-18	977,910	45	41,297	108	4,339.8
-17	921,100	46	39,605	109	4,209.2
-16	867,910	47	37,995	110	4,082.9
-15	818,070	48	36,458	111	3,961.2
-14	771,370	49	34,991	112	3,843.5

Table 21. Resistance - Temperature Table
Applicable to 871EC "Thermistor" Sensors (Continued)

° C	Ro	° C	Ro	° C	Ro
100K6A1, 100,000 Ohms @ 25° C

° C	Ro	° C	Ro	° C	Ro
-13	727,590	50	33,591	113	3,729.8
-12	686,530	51	32,253	114	3,619.9
-11	648,020	52	30,976	115	3,513.7
-10	611,870	53	29,756	116	3,411.1
-9	577,940	54	28,590	117	3,311.9
-8	546,070	55	27,475	118	3,215.9
-7	516,130	56	26,409	119	3,123.1
-6	488,000	57	25,390	120	3,033.4
-5	461,550	58	24,415	121	2,946.6
-4	436,680	59	23,483	122	2,862.6
-3	413,280	60	22,590	123	2,781.4
-2	391,270	61	21,736	124	2,702.8
-1	370,540	62	20,919	125	2,626.7
0	351,020	63	20,136	126	2,553.1
1	332,640	64	19,386	127	2,481.8
2	315,320	65	18,668	128	2,412.7
3	298,990	66	17,980	129	2,345.9
4	283,600	67	17,321	130	2,281.1
5	269,080	68	16,689	131	2,218.4
6	255,380	69	16,083	132	2,157.7
7	242,460	70	15,502	133	2,098.8
8	230,260	71	14,945	134	2,041.8
9	218,730	72	14,410	135	1,986.5
10	207,850	73	13,897	136	1,932.9
11	197,560	74	13,405	137	1,880.9
12	187,840	75	12,932	138	1,830.6
13	178,650	76	12,479	139	1,781.8
14	169,950	77	12,043	140	1,734.4
15	161,730	78	11,625	141	1,688.5
16	153,950	79	11,223	142	1,643.9
17	146,580	80	10,837	143	1,600.7
18	139,610	81	10,467	144	1,558.8
19	133,000	82	10,110	145	1,518.1
20	126,740	83	9,767.2	146	1,478.7

Table 21. Resistance - Temperature Table
Applicable to 871EC "Thermistor" Sensors (Continued)

100K6A1, 100,000 Ohms @ 25° C ±0.2° C to +70° C					
° C	Ro	° C	Ro	° C	Ro
21	120,810	84	9,437.7	147	1,440.3
22	115,190	85	9,120.8	148	1,403.1
				149	1,366.9
				150	1,331.9

6. Diagnostics

Troubleshooting

Table 22. Troubleshooting Symptoms

Symptom	Approach
Noisy Signal	May be flow related 　　1. Increase damping. 　　2. Reorient sensor. May be RFI related. See "Standard Specifications" on page 4. May be inappropriate sensor for full scale range chosen. See Table 15.
Conductivity Decreases	Gas bubbles may be trapped or sensor coated.
Temperature Reads Incorrectly	1. Check to see if correct tCF is being used. Extension cables and junction box use will require a new tCF be determined. See "Temperature Cell Factor (TCF1) Adjustments" on page 74. 2. Verify 873 is set up for proper temperature transducer. See "Electronic Bench Calibration" on page 67.
Accuracy	1. Accuracy of the sensor may be affected by deposits from the process liquid. Consult sensor MI for cleaning recommendations. 2. Wall effects (see "Standardization Using a Known Solution" on page 71). 3. Magnetic field changes (see "Electronic Bench Calibration" on page 67).

Error Codes

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

Table 23. Error/Alarm Messages

Alternate Display	Condition	Priority	Action Required to Clear Message
Er 1	Instrument Fault, RAM/ROM, software watchdog timer	1 (Highest)	1.Reenter security code using procedure. 2.Power down unit.
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 50.
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 will flash only the error with the highest priority. If the highest priority error is cleared and a lower priority error still remains, the analyzer will then flash the highest priority error of the remaining errors.

Detachable Configuration Field Sheets

Configuration Setup Entries

Symbol	Parameters and Values Accessed	User Settings
CELL	Configuration of Display and Analog Outputs	
Hold	Analog output hold	
Cd	Temperature Compensation and Damping Damping Factor Units of Measurement Chemical Temperature Compensation	
HAC	H Alarm Configuration Measurement Selection Low/High/Instrument plus Passive/Active State % Hysteresis	
HAtt	High Alarm Trigger Time	
HAFt	High Alarm Feed Time	
HAdL	High Alarm Delay Time	
LAC	L Alarm Configuration Measurement Selection Low/High/Instrument plus Passive/Active State % Hysteresis	
LAtt	Low Alarm Trigger Time	
LAFt	Low Alarm Feed Time	
LAdL	Low Alarm Delay Time	
UL	User-Defined Upper Measurement Error	
LL	User-Defined Lower Measurement Error	
UtL	User-Defined Upper Temperature Error	
LtL	User-Defined Lower Temperature Error	
HO1	100% Analog Output - Channel 1	
LO1	0% Analog Output - Channel 1	
HO2	100% Analog Output - Channel 2	
LO2	0% Analog Output - Channel 2	

Cd Code - Compensation and Damping

Digit 1	Digit 2	Digits 3 and 4
Damping	**Units of Measurement**	**Temperature Compensation to Match Process Composition**
0 = none 1 = 10 seconds 2 = 20 seconds 3 = 40 seconds	0 = % Legend disabled. Use for µS/cm and mS/cm measurements. 1 = % Legend enabled.	99 = Special
		00 = No temperature compensation
		01 = Dilute NaCl
		02 = NaCl, from dilute solutions up through 25%
		03 = HCl, from dilute solutions up through 15%
		04 = HNO_3, from dilute solutions up through 10%
		05 = H_2SO_4, from dilute solutions up through 25%
		06 = H_2SO_4 from 93% to 99.5%.
		07 = Green Liquor.
		08 = H_3PO_4, from dilute solutions up through 35%.
Minimum Sensor Mounting ID; Large bore = 6" I.D. (e.g. LB, RE, UT, 8W, EV, AB) Small bore = 3" I.D. (e.g. Sp, nL, Tf, Hp, Pn, Px)		09 = Oleum from 18% to 42%.
		10 = NaOH, from dilute solutions up through 15%.
		11 = NaOH, from dilute solutions up through 20%.
		12 = Black Liquor

Basic Setup Entry Selection

Symbol	Parameter and Value Accessed	User Settings
bL	Basic Setup Lock Control	
Ct	Cell Type	
FSC	Full Scale Value	
tCF 1	Temperature Cell Factor	
tEC 1	Thermistor Temperature Electronics Calibration	
tCL 1	RTD Low Temperature Electronics Calibration	
tCC 1	RTD Mid Temperature Electronics Calibration	
tCH 1	RTD High Temperature Electronics Calibration	
LCC	Lock Code Change	
tCt	Custom Temperature Compensation Curve	
PCt	Custom Percent Concentration Curve	
LCCO1	Analog Out 1 Electronics Lower Calibration	
HCO1	Analog Out 1 Electronics Lower 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	

CELL Code - Output Configuration

Digit 1	Digit 2	Digit 3	Digit 4
1 = Only Choice	0 = Only Choice	1 - Conductivity 3 - Temperature 5 - Log of Conductivity	1 - Conductivity 3 - Temperature 5 - Log of Conductivity

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

HAC and LAC Codes - Alarm Configuration

Digit 1	Digit 2	Digits 3 & 4
Meas. Selection	Configuration	Hysteresis
1 - Conductivity 3 - Temperature	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

HAFt, HAdL, LAFt, and LAdL Time Codes

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

UL= The Upper Limit is 999.9.
LL = The Lower Limit is -.999.
UtL= The Upper Limit is 200×C.
LtL= The Lower Limit is -20×C (-5×F).
H01=May be set to any value between -09.99 and 999.9.
L01= May be set to any value between -09.99 and 999.9.
H02=May be set to any value between -09.99 and 999.9.
L02= May be set to any value between -09.99 and 999.9.

Troubleshooting Symptoms

Symptom	Approach

Noisy Signal	May be flow related
	    1. Increase damping.
	    2. Reorient sensor.
	May be RFI related. See "Standard Specifications" on page 4
	May be inappropriate sensor for Full Scale Range chosen. See Table 15.

Conductivity Decreases	Gas Bubbles may be trapped or sensor coated.
Temperature Reads Incorrectly	1. Check to see if correct TCF is being used. Extension cables and junction box use will require a new TCF to be determined. 2. Verify 873 is set up for proper temperature transducer.
Accuracy	1. Accuracy of the sensor may be affected by deposits from the process liquid. Consult sensor M1 for cleaning recommendations. 2. Wall effects. 3. Magnetic field changes. See "Electronic Bench Calibration" on page 67.

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
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 50.
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		Check code and reenter.

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

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. User Notes

When changing applications, the 873EC must be reconfigured. Perform these procedures in the following order:

1. Choose and enter the appropriate Ct Code. See "Changing the Cell Type (Ct)" on page 44.

2. Choose and enter the appropriate FSC Code. See "Selecting a Full Scale Range" on page 45.

3. Connect sensor and perform the Electronic Bench Calibration. Temperature Circuit Configuration must be checked during this procedure. See "Electronic Bench Calibration" on page 67.

4. Enter sensor tCF factor.

─ **NOTE** ───
Extra cable lengths or junction require determination of this factor. See "Temperature Cell Factor (TCF1) Adjustments" on page 74.
──

5. a. mS/cm or µS/cm Mode

   ♦ Set Configuration Setup entries and alarms.

─ **NOTE** ───
May also be done before the Electronic Bench Calibration. See "Configuration Setup Entries" on page 24.
──

   ♦ Set Cd to appropriate temperature compensation code. See "Compensation and Damping (Cd)" on page 28.

   ♦ Off-line or in-line sensor standardizations should be performed in appropriate order with the sensor installation. See "Standardization Using a Known Solution" on page 71.

   b.Percent Concentration Mode

   ♦ Set Cd to appropriate temperature compensation code and percent mode. See "Compensation and Damping (Cd)" on page 28

   ♦ Set and enter other Configuration Setup entries and alarms. See "Configuration Setup Entries" on page 24.

   ♦ Off-line or in-line sensor standardizations should be performed in appropriate order with the sensor installation. See "Standardization Using a Known Solution" on page 71.

A number of "White Papers" are available which detail various topics applicable to the 873 Analyzers and Electrochemical Processes, Procedures, etc.

A list of some of these follows.

ISE Principles	Details the principles of Ion Selective Electrodes.
ISE Interference Corrections with the 873DPX	Details unique algorithms inherent to the 873DPX Analyzer.
Degaussing of Electrodeless Sensors	Details the effects of magnetized sensors, determination of, and procedure for degaussing.
Temperature Correction of the 873CC Analyzer	Details the Temperature correction used for very clean water, and the differences between it and the NACL curve.
Effects of Temperature on pH and pH Measurements	Details what changes as a result of Temperature, and how to approach lab result comparisons.
Log Output Function of the 873 Analyzer	Details the Log output, benefits of, and how to derive and configure.
Four Electrode Conductivity	Basics, potential advantages/disadvantages, comments, and more.

A number of PADS (Product Application Data Sheets) are also available

PAD D3620-001	873RS Analyzers & 871CC Sensors for Control of Water Purity in Semicon Wafer Washing
PAD D3620-007	873 Analyzers in Power Generation Processes
PAD D3620-008	873 pH & ORP for Control and Monitoring in Chromate Waste Treatment
PAD D3620-009	873EC Analyzers and 871EC Sensors for Non Fouling Solution Concentration Control
PAD B2000-009	873EC Analyzers and 871EC Sensors for Make-up Chemical Control in Cip Systems
PAD Q9900-014	873 EC Analyzers & 871EC-TF2-V Sensors for Oleum Strength Analysis

And others. To obtain any of these White Papers or PADs or to suggest other topics for future releases, contact IPS at: 1-866-746-6477.

8. Alarm Contact Maintenance

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

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

IPS recommends contact resistance be assessed on a yearly basis.

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 28 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.
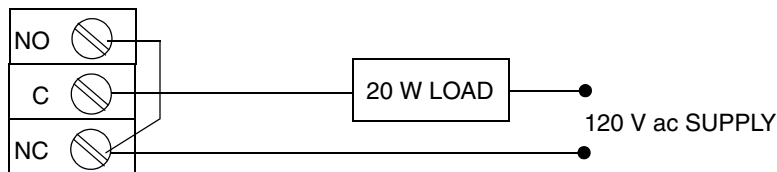
Figure 28. Alarm Contact Reconditioning Circuit

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