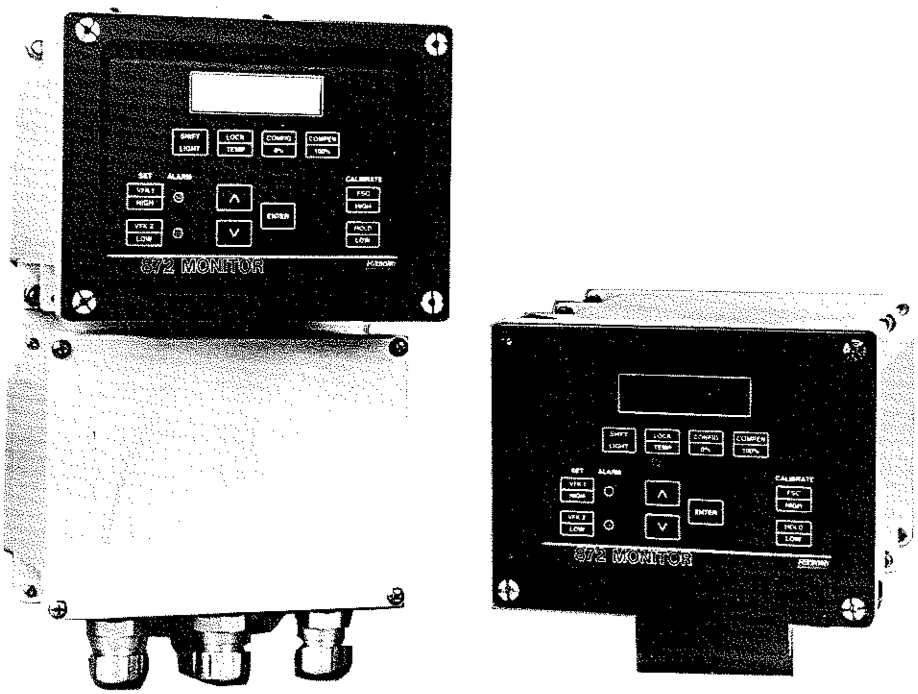
Instruction

MI
611-159
July 1990

872 ELECTROCHEMICAL MONITOR
STYLE B

for Electrodeless Conductivity Measurement



Surface- or Pipe-Mounted Version   Panel-Mounted Version

Figure 1.
Surface-, Pipe-, or Panel-Mounted Monitor

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APPENDIX

FIGURES

TABLES

ALPHABETICAL LISTING OF CONTENTS

INTRODUCTION

The 872 Electrochemical Monitor (see Figure 1) for Electrodeless Conductivity applications provides measurement, display, and transmission of the conductivity level or % concentration, and the temperature of the process medium.

The Monitor converts the varying signals received from a sensor immersed in the process medium, to a direct digital display in the appropriate engineering units. In parallel with this measurement display, the 872 Monitor simultaneously transmits two analog signals, one proportional to measurement, and one proportional to temperature. These output signals may be 0 to 10 V dc, 0 to 20 mA dc, or 4 to 20 mA dc, in conformance with the user's external receivers.

Standard Specifications

Supply Voltage: 100, 120, 220, or 240 V ac +10, -15%.

Supply Frequency: 50 or 60 Hz, ±3 Hz

Output Signal

- Code L[1]: Nonisolated measurement and temperature outputs, 0 to 10 V dc
- Code M[1]: Isolated measurement output, 0 to 10 V dc, 4 to 20 mA dc, or 0 to 20 mA dc, and nonisolated temperature output, 0 to 10 V dc
- Code T[1]: Isolated measurement and temperature outputs, 0 to 10 V dc, 4 to 20 mA dc, or 0 to 20 mA dc

Ambient Temperature Limits: -25 and +55°C (-15 and +130°F).

Accuracy: ±0.5% of conductivity upper measurement range value (sensor not included).

Monitor Identification Refer to Figure 2.

Enclosure: RFI/EMI shielded, high-impact thermoplastic.

Dimensions: See Dimensional Print DP 611-154.

Approximate Mass

- Surface- or Pipe-Mounted Version: 3.6 kg (8 lb)
- Panel-Mounted Version: 2.9 kg (6.5 lb)

Alarm Relay Contacts: Rated at 3A, 120 V, Noninductive Load.

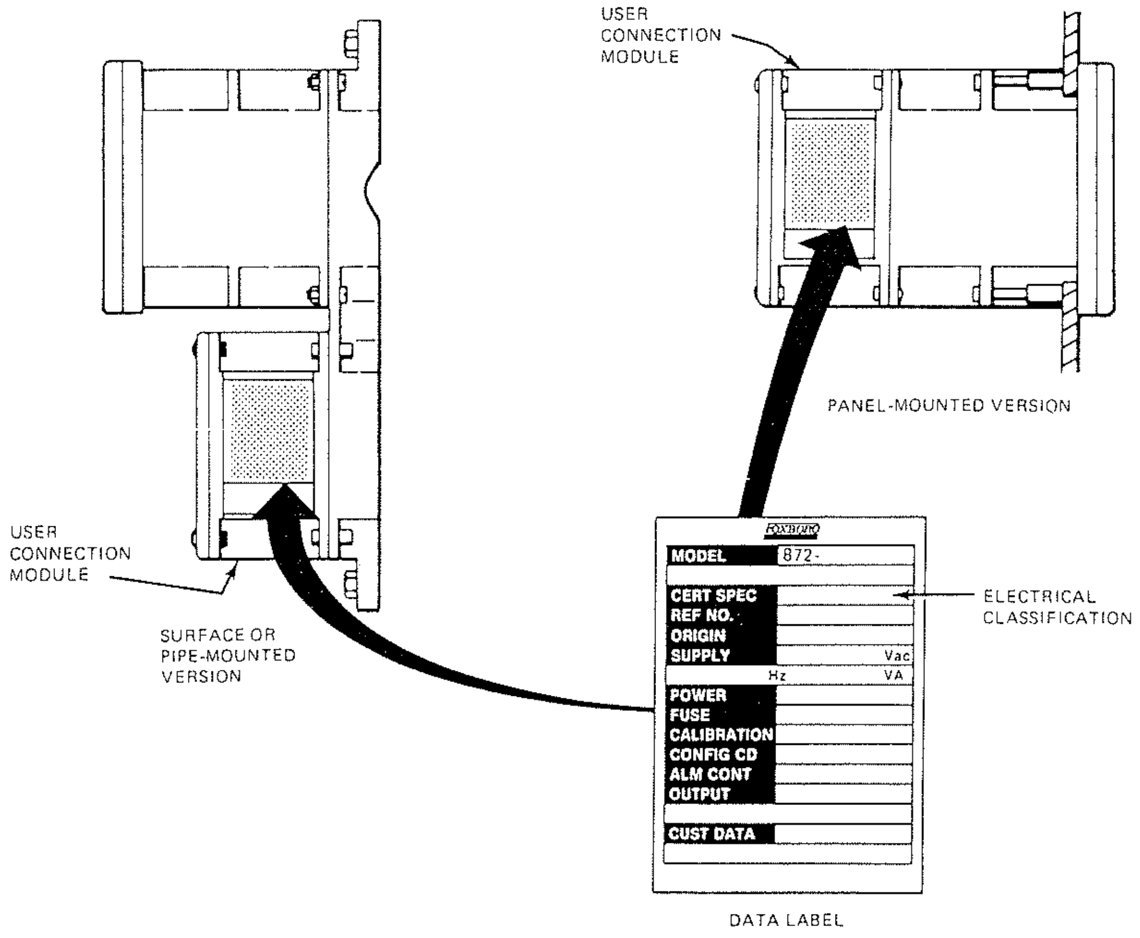

Figure 2. Monitor Identification

(1) Refer to Data Label in Figure 2.

Electrical Classification

TESTING LABORATORY, TYPES OF PROTECTION, AND AREA CLASSIFICATION	CONDITIONS OF CERTIFICATION	ELECTRICAL CERTIFICATION SPECIFICATION
BASEEFA certified nonincendive Ex N, II, T5 (T_{AMB} = 55°C) for use in Zone 2 hazardous locations.		CS-E/BN-A
CSA certified for use in General Purpose (Ordinary) locations		CS-E/CG-A
Foxboro certified for use in Ordinary Locations.		CS-E/FG-F
Foxboro certified nonincendive for Class I, Groups A, B, C, and D, Division 2 and Class II, Groups E and G, Division 2 hazardous locations.	Temperature Class T6. Not available with general purpose alarm contacts (optional feature Codes -3 and -4).	CS-E/FN-F
FM certified nonincendive for Class I, Groups A, B, C, and D, and Class II, Group G, Division 2 hazardous locations.	Temperature Class T6. Not available with general purpose alarm contacts (optional feature Codes -3 and -4).	CS-E/FN-A

INSTALLATION

Mounting Monitor To Panel

1. Size panel opening in accordance with dimensions specified on DP 611-154.

2. Check distance between clamp surface and rear surface of front plate bezel, for all four clamps, to confirm that sufficient distance is provided to accommodate thickness of panel. Refer to Figure 3.

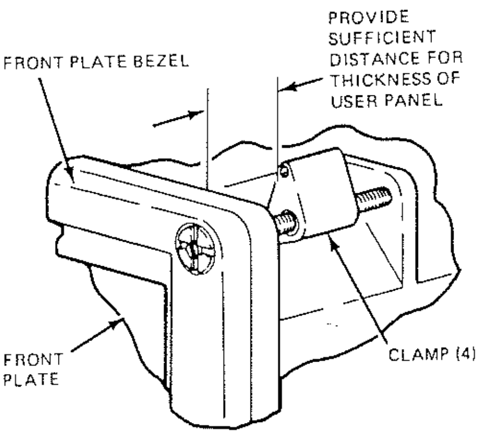

Figure 3.
Provisions for Panel Mounting

3. If insufficient distance between clamp and rear surface of front plate bezel, use small slotted screwdriver to adjust inner screw of front plate screw. Turn inner screw counterclockwise to increase the distance between clamp and rear surface of front plate bezel. Refer to Figure 4.

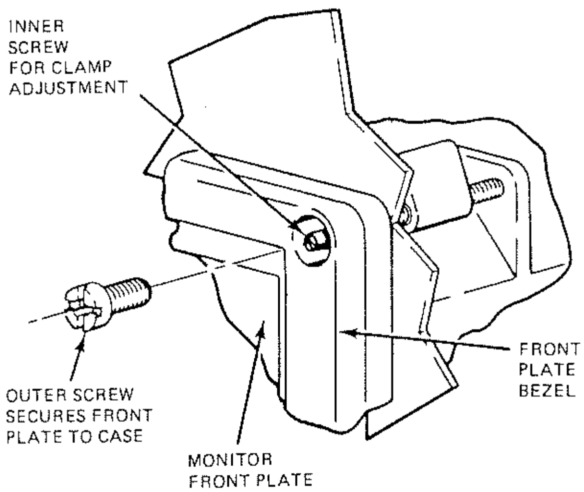

Figure 4.
Location of Clamp Adjustment

4. By hand, push the elongated portion of each clamp against the Monitor case so that the clamps will not interfere when moving Monitor into panel opening.

5. Move the Monitor into the panel opening from the front of user's panel until firmly seated against panel.

6. Secure Monitor to panel by turning the four inner screws on the front plate screws. Turn screws clockwise to tighten clamps against panel.

Mounting Monitor To Surface

1. Drill mounting holes or mount on studs in bulkhead, distanced and sized for surface mounting in accordance with DP 611-154.

2. Position Monitor against bulkhead so that monitor surface mounting holes align with studs or holes drilled in bulkhead per Step 1. Refer to Figure 5.

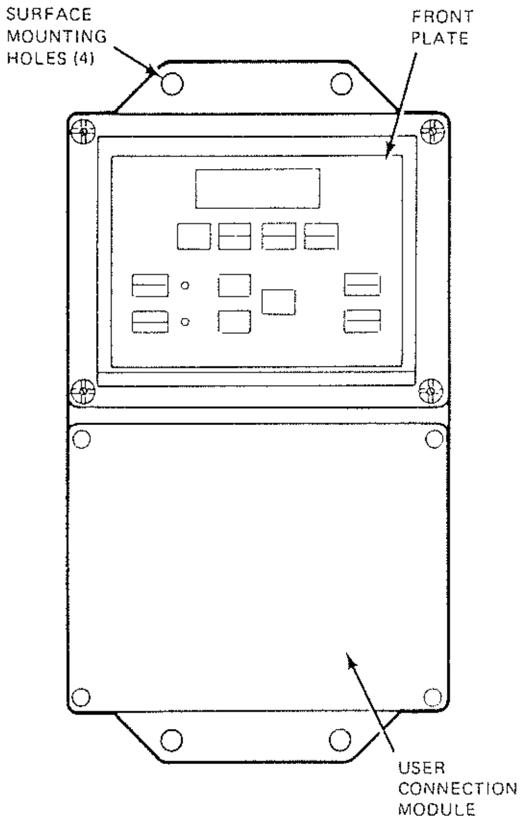

Figure 5. Hole Locations for Surface Mounting

3. Secure Monitor to bulkhead using user-supplied choice of 9.5 mm (0.38 in) diameter fasteners (bolts, screws, studs, weld nuts, etc.).

Mounting Monitor To Pipe

Outside diameter of pipe must not be less than 25 mm (1 in), nor exceed 75 mm (3 in).

Pipe mounting hardware is provided with Model Code Suffix -8 (see Data Label). The hardware provided is listed below.

Qty	Description
2	Pipe bracket, Part No. AS300AJ
4	Columns, Part No. BS805FP
4	Lockwashers, Part No. X0143SE
8	Nuts, Part No. X0142BW

1. Screw four columns into Monitor back panel in four locations as shown in Figure 6.

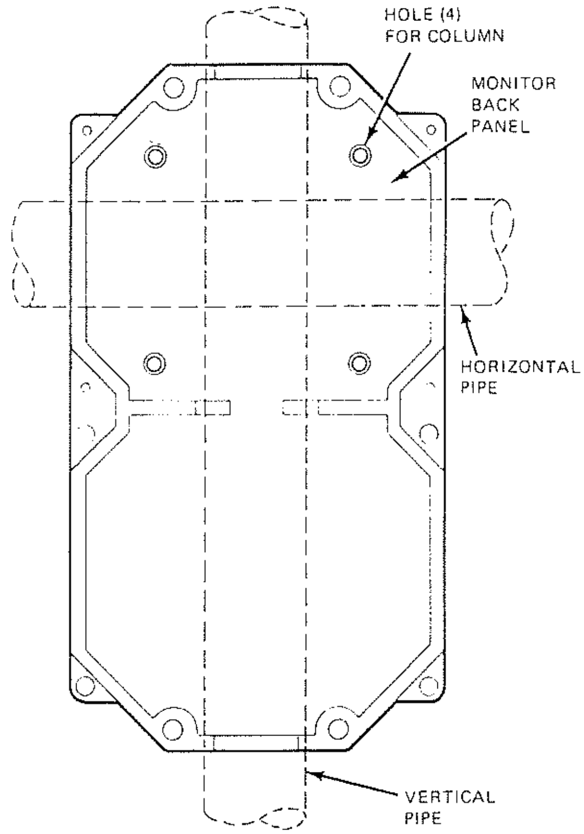

Figure 6. Back Panel of Monitor with Mounting Holes Shown for Pipe Mounting

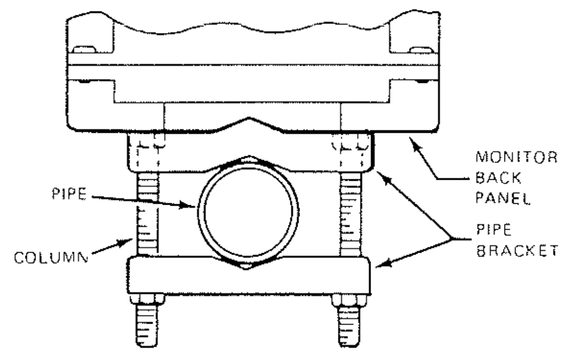

Figure 7.
Pipe-Mounted Version, Hardware Orientation

2. Place one pipe bracket over four columns with flat side against Monitor back panel. Position bracket so that notches in bracket will contact pipe. Secure bracket with four nuts. See Figure 7.

3. Hold Monitor against either horizontal or vertical pipe and slide the remaining pipe bracket over the four columns so that notches in bracket contact pipe (Figure 7).

4. Mount a lockwasher and nut onto each column and tighten to secure Monitor to pipe.

Wiring

1. Remove four screws from cover of Monitor user connection module (Figure 2). On the panel-mounted version, the user connection module is located at the rear of the Monitor, opposite the front plate. On both the surface-mounted and pipe-mounted versions, the user connection module is located directly below the front plate.

2. Remove cover from user connection module.

3. Remove plastic shipping caps from three openings at bottom of user connection module.

   NOTE
   All input and output wiring should be run though metal conduit to reduce the effects of EMI/RFI.

4. If Monitor has been supplied with optional alarms, bring external alarm circuit wires up through center opening in bottom of user connection module.

5. Connect two High Alarm wires between TB2A COMMON (C) and, depending on user's external circuit, either TB2A Normally Closed (NC) or TB2A Normally Open (NO). Refer to Figure 8.

6. Connect two Low Alarm wires between TB2B COMMON (C) and, depending on user's external circuit, either TB2B Normally Closed (NC) or TB2B Normally Open (NO). Refer to Figure 8.

   NOTE
   To maintain NEMA 4X enclosure rating, the user must use appropriate fittings in three 1/2 NPT wiring entrance openings in bottom of user connection module.

7. Bring wires, from user's external circuits, for connection to Monitor measurement output and optional temperature output, up through center opening in bottom of user connection module.

8. Connect wires from external circuit for Monitor measurement output to terminals TB4A-1(+) and TB4A-2(-). Refer to Figure 8.

9. Connect wires from external circuit for Monitor temperature output to terminals TB4A-3(+) and TB4B-1(-).

   NOTE
   Only 871EC Sensors can be used with the 872 Monitor. Model 1210 Sensors cannot be used with 872 Monitor.

10. Bring sensor wires up through leftmost opening in bottom of user connection module.

11. Connect sensor wires to Monitor terminal block in accordance with Figure 8. Wrap unused leads from 871EC Sensor if a (user supplied) 100 Ω RTD is used for temperature compensation input.

    NOTE
    871EC Sensor types -RE, -LB, -NL, -TF, -SP, -EV, and -AB contain integral 100 KΩ thermistors. The 871EC-HP, -BW, and -UT sensors contain an integral 100 Ω RTD.

12. The 872 Monitor has four potential positions for two supply voltage jumpers (see Figure 8). Confirm that the two power supply voltage jumpers are positioned in accordance with user's supply voltage as follows:

    Each jumper position is labeled with two voltages. Example 120/240. If one of the two voltages (labeled on each jumper position) is the user's supply voltage, then that jumper position must be occupied by a jumper.

    For example; For 120 V ac, one jumper should occupy the 120/240 position and the other jumper should occupy the 100/120 position. For 220 V ac, one jumper should occupy the 100/220 position and the other jumper should occupy the 220/240 position.

13. With power off, bring three power wires up through rightmost opening in bottom of user connection module.

14. Connect power wires to power connection terminal as shown in Figure 8.

15. Return cover to user connection module and secure with four screws.

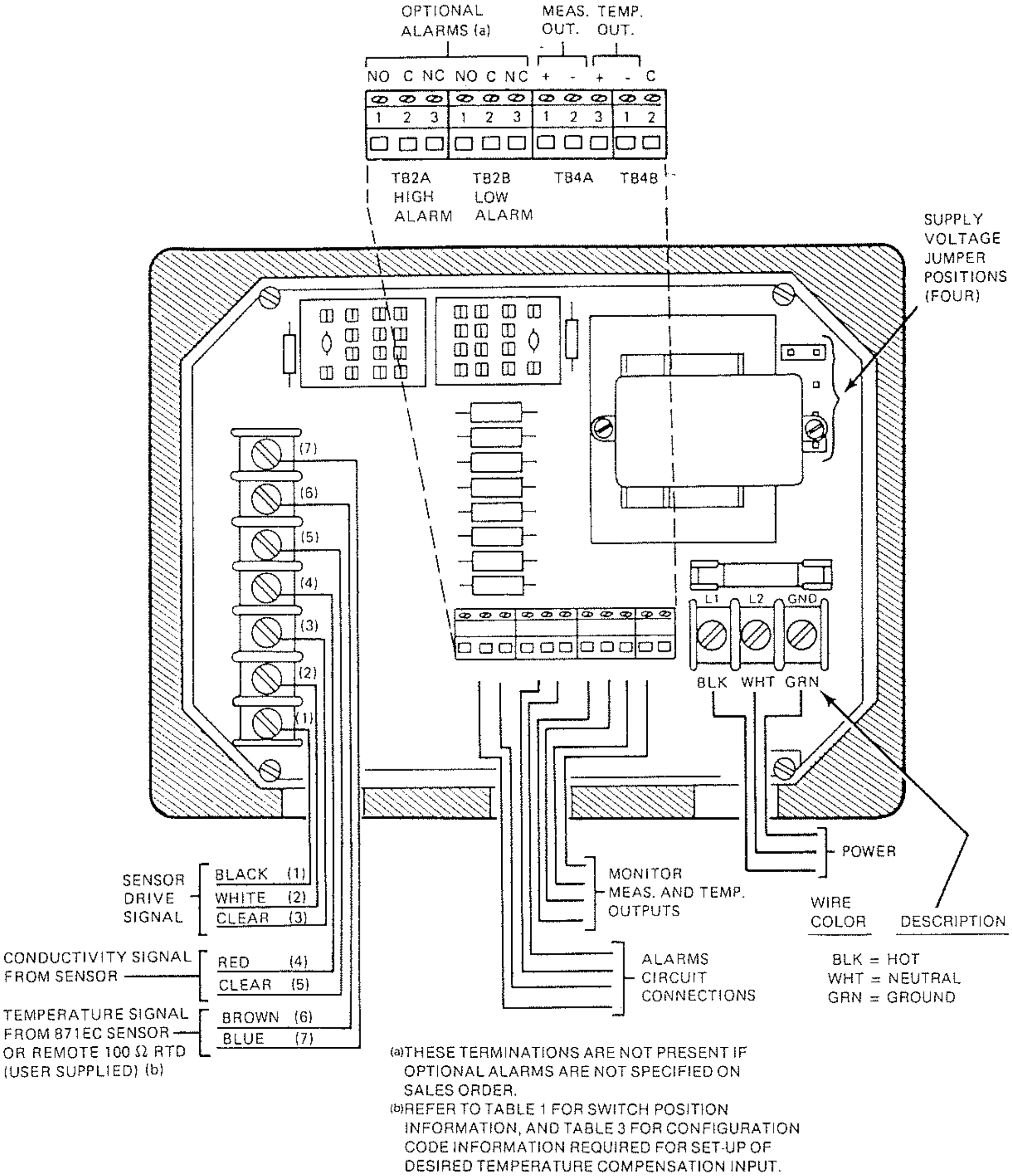

Figure 8.
Connections to User Connection Module

BASIC KEYPAD INFORMATION

General

- When using the front panel "keys" (see Figure 9), the user has approximately eight seconds from the time the last key is pressed, to press the next key in the desired sequence. Otherwise, the display returns to the measured value.

- To prevent "time-out" after eight seconds, the SHIFT/LIGHT key may be pressed and held. This may be done in the middle of any sequence without disturbing the procedure being followed.

- When in operation, the 872 Monitor continuously displays the process measurement value. Pressing the TEMP key causes the process medium temperature to be displayed for approximately eight seconds.

- If the "Illuminated LCD Display" option has been ordered, the display background is illuminated by pressing the LIGHT key. The display background remains illuminated for three minutes after the LIGHT key is pressed.

- Improper sequencing of any dual-function key (i.e., failure to precede with shift) causes a non-desired display to appear. To clear, either press any dual function key other than that key originally incorrectly sequenced, or wait approximately eight seconds so that the Monitor will time out and default back to measurement.

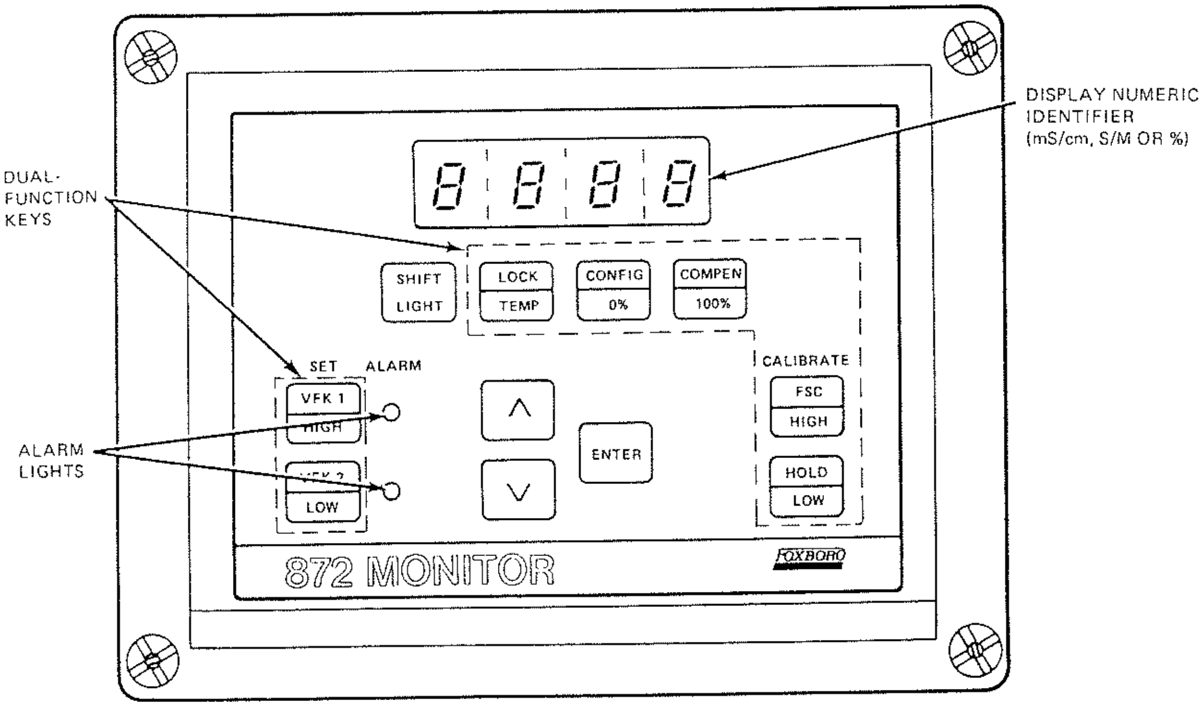

Figure 9. Front Panel

Key Function Summary

(Complete Key sequences are presented, as needed, in appropriate sections.)

Key		Function
∧	=	Increment Key: Press to increase number appearing on display.
∨	=	Decrement Key: Press to decrease number appearing on display.
SHIFT / LIGHT	=	Press and hold prior to pressing any dual-function key, to activate upper function on dual function key. Can be held between entries to avoid time-out. Additionally, if "illuminated LCD display" option has been ordered, momentarily pressing this key or holding to activate upper function, will cause the background of the display to be illuminated.
ENTER	=	Used to enter the desired value or code.

DUAL FUNCTION KEYS

Key		Function
VFK 1 / HIGH	=	VFK 1 (Variable Function Key): Used during curve generation programming. Refer to "Use of the Curve Generation Program." HIGH: Used to check or set the high alarm level.
VFK 2 / LOW	=	VFK 2 (Variable Function Key): Releases the Monitor display and output from hold status. LOW: Used to check or set the low alarm level.
LOCK / TEMP	=	LOCK: Used to check lock/unlock status. Used to lock an unlocked unit or to unlock a locked unit. TEMP: Used to display process medium temperature.
CONFIG / 0%	=	CONFIG: Used to display configuration code. 0%: Used to check or assign the 0% analog output level to the minimum process medium measurement or temperature level. Refer to "Scaling the Analog Output".
COMPEN / 100%	=	COMPEN: Used to display Compensation Code. 100%: Used to check or assign the 100% analog output level to the maximum process medium measurement or temperature level. Refer to "Scaling the Analog Output".
FSC / HIGH	=	FSC (Fullscale): Used to display, in conductivity units, the upper measurement range value. FSC may not be changed with this key. HIGH: Used when calibrating, to display the conductivity level corresponding to the maximum signal received from sensor.
HOLD / LOW	=	HOLD: Used when servicing sensor. Holds the Monitor analog output and display at constant value. LOW: Used when calibrating, to display the conductivity level corresponding to the minimum signal (zero) received from sensor.

INITIAL SETUP

Before placing the Monitor into operation, there are several setup procedures that should be performed. These procedures are described in the following sections:

- Security Code
- Full Scale Range
- Setting Alarm Levels
- Configuration Code
- Compensation Code
- Scaling the Analog Outputs

Security Code

The Monitor first must be "unlocked" using a 4-digit Security Code whenever the operator wishes to calibrate the instrument, or change any of the following:

- Compensation Code
- Configuration Code
- Alarm Level(s)
- Hold Status
- Analog Output Scaling

After performing one or more of the above, the Monitor can then be "locked" using the same 4-digit Security Code.

The standard, factory-set, Monitor Security Code is 0800.

Changing the Security Code

1. Leave power on.
2. Remove the four screws from the front panel. If storm door option has been ordered, removal of upper two screws loosens the hinge covers holding the storm door. Temporarily place storm door aside.

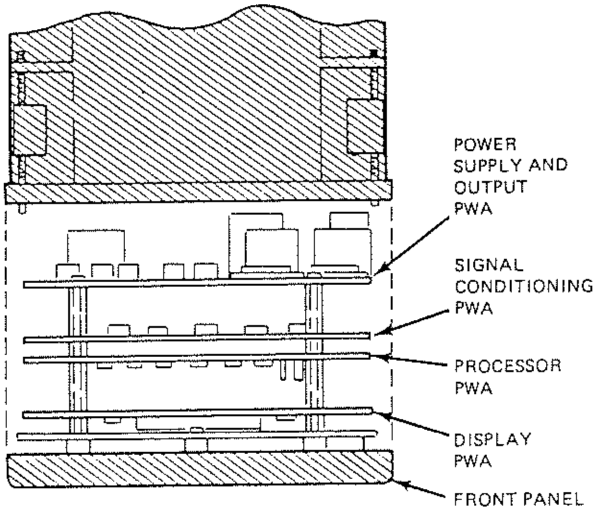

Figure 10. PWA Identification (Top View)

*** CAUTION ***

Components on Power Supply and output PWA may be hot.

3. Pull forward the front panel with the attached four PWA's.
4. Refer to Figure 10 and locate the "display" PWA, immediately behind front panel.

NOTE
If unit has LCD display, refer to APPENDIX at end of this MI.

5. Refer to Figure 11 for location of DIP SW1 on the display PWA. SW1 has two switches numbered 1 and 2.

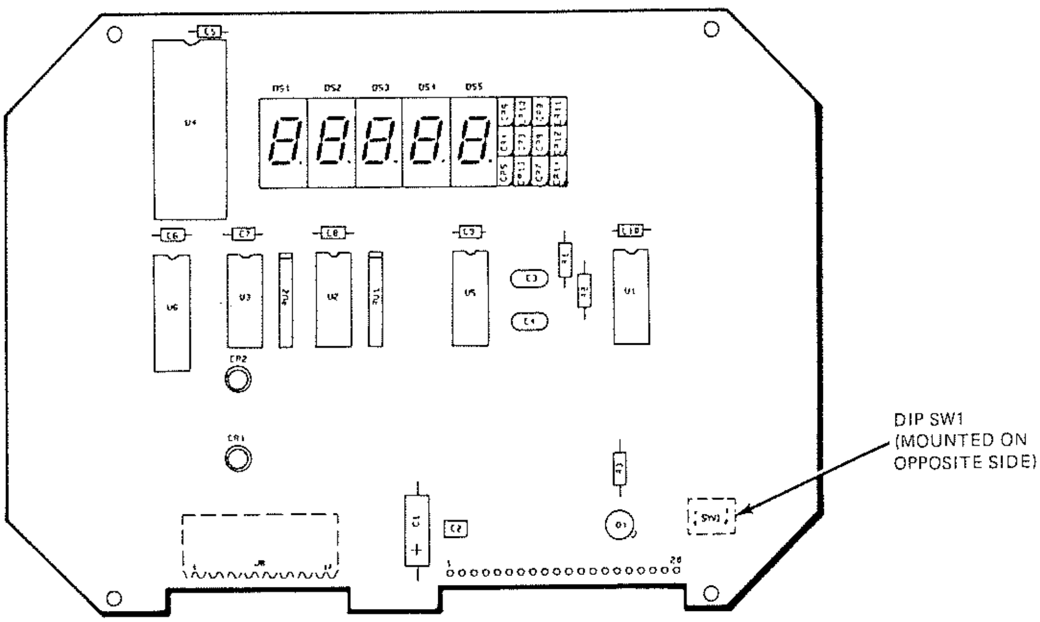

Figure 11. LED Display PWA

6. Using a small screwdriver or similar tool, close SW1-2. Refer to Figure 12.

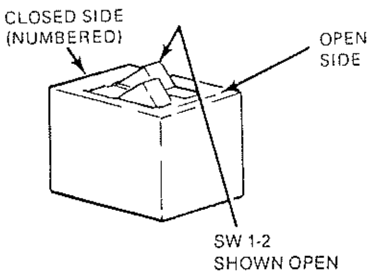

Figure 12.
DIP Switch Positions

7. Perform the following key sequence at the front panel.

   <SHIFT>, and while holding, press <LOCK>

   Use increment key (Λ) or decrement key (V) to change the number appearing on the front panel display to the desired security number.

   When changing the display number, the increment (Λ) or decrement (V) key is depressed and held until the leftmost digit requiring change, reaches the number desired, the key is then released. The increment or decrement key is again depressed until the next leftmost digit requiring change reaches the number desired, again, the key is released. The operator continues until the full display reads the number desired.

   Press <ENTER>

8. Return SW1-2 on the display PWA to the OPEN position.

9. Return front panel with attached four PWA's to case and secure with four screws.

Unlocking Monitor Using Security Code

To unlock the Monitor, perform the following key sequence:

<SHIFT>, and while holding, press <LOCK>

This causes 0000 to appear on the display. Use increment (Λ) until Security Code (either factory set "0800" or user-set value from previous section) is reached.

Press <ENTER>

The Monitor is now unlocked.

Locking Monitor Using Security Code

To lock the Monitor, perform the following key sequence:

<SHIFT>, and while holding, press <LOCK>

This causes the Security Code to appear on the display.

Momentarily press increment (Λ) or decrement (V) to change the displayed number to any value other than the Security Code.

Press <ENTER>

The Monitor is now locked.

Full Scale Range

Through the use of three DIP switches located on the signal conditioning PWA (Figure 13), the 872 Monitor may be set in any of several standard zero-based ranges. Because the accuracy of the Monitor is based on the full scale range value, it is recommended that the lowest possible full scale range be selected, while still assuring that the highest expected measurements will fall within the selected range.

NOTE
For any selected full scale range, the 872 Monitor has the ability to make measurements up to approximately 3.5 times the range, although at decreased accuracy. At conductivity values above 3.5 times the range, the Monitor goes into an overrange condition which yields erroneous results.

Selecting a Full Scale Range

FOR MEASUREMENTS IN CONDUCTANCE UNITS (mS/cm) -- Determine the highest conductivity reading expected. Determine the type of sensor being used. Refer to Table 1 and choose an appropriate full scale range.

Example

Application - Measurement of Cooling Tower Water in the Range of 0 to 2.5 mS/cm with a Sensor Type "SP" (871EC-SP0).

From Table 1, the choice of full scale range 3.829 mS/cm would be appropriate.

FOR MEASUREMENTS IN CONCENTRATION UNITS (%) -- Each 872 Monitor has the following standard % concentration calibration curves preprogrammed in memory:

CALIBRATION CURVE	REF. TEMP.
Hydrochloric acid (HCl); 0 to 15%	25°C
Nitric acid (HNO_3); 0 to 10%	25°C
Sulfuric acid (H_2SO_4); 0 to 25%	25°C
Sulfuric acid (H_2SO_4); 99.5 to 96%	50°C
Oleum; 42 to 18%	65°C
Sodium hydroxide (NaOH); 0 to 15%	25°C
Sodium hydroxide (NaOH); 0 to 20%	100°C

Any % concentration measurement which falls within the bounds of the calibration curves shown above can be accomplished with a standard 872 unit, configured appropriately.

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 measurement which fall outside the bounds of the standard calibration curves are usually achievable through the use of the optional curve generation feature. (Monitor must have optional suffix "-5" in Model Code.)

Examples of feasible nonstandard applications include:

- Sodium Chloride, 0 to 5%
- Sulfuric Acid, 99.5 to 93%
- Oleum, 0 to 10%

For details concerning the use of the curve generation program for nonstandard % concentration applications, refer to "Use of the Curve Generation Program" section in this document.

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 2 for a listing of many common electrolytes. Determine the type of sensor being used. Refer to Table 1 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-SP0).

1. Refer to Table 2. The conductance of 3% NaOH is 145 mS/cm at 25°C reference temperature.

2. From Table 1, the choice of full scale range 153.1 mS/cm would be appropriate.

Application 2 - Measurement of Sulfuric Acid (H_2SO_4) in the Range of 96 to 99.5% with a Sensor Type "TF" (871EC-TF2-V).

1. Refer to Table 2. At reference temperature of 50°C, the conductivity of 96% H_2SO_4 is 204.1 mS/cm; that of 99.5% H_2SO_4 is 65.3 mS/cm. Thus, even though the highest % reading expected is 99.5%, the Monitor must be ranged for conductance readings as high as 204.1 mS/cm.

2. From Table 1, the choice of 329.1 mS/cm would be appropriate.

Table 1. Full Scale (FSC) Range Settings

SENSOR BODY TYPE WITH SENSOR UPPER RANGE LIMIT (mS/cm / S/m)							DIP SWITCH 1 (SW1) SWITCH POSITION								DIP SWITCH 2 (SW2) SWITCH POSITION								DIP SWITCH 3 (SW3) SWITCH POSITION							
871EC SENSOR TYPE																														
LB/UT	NL	RE/BW & EV	AB	PN/PX	TF	SP/HP	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
0.0333 / 0.0033	0.5226 / 0.0523	0.1000 / 0.0100	0.1307 / 0.0130	0.5450 / 0.0545	0.5137 / 0.0514	0.4781 / 0.0478	0	1	1	0	0	0	0	1					0	0	0	0	0	0	1	0	0	0	0	1
0.0667 / 0.0067	1.046 / 0.1046	0.2001 / 0.0200	0.2615 / 0.0261	1.091 / 0.1091	1.028 / 0.1028	0.9563 / 0.0957	0	1	1	0	0	0	1	0					0	0	0	0	0	0	1	0	0	0	1	0
0.1334 / 0.0133	2.092 / 0.2092	0.4003 / 0.0400	0.5230 / 0.0523	2.182 / 0.2182	2.057 / 0.2057	1.914 / 0.1914	0	1	1	0	0	1	0	0					0	0	0	0	0	0	1	0	0	1	0	0
0.2668 / 0.0267	4.185 / 0.4185	0.8006 / 0.0801	1.047 / 0.1047	4.364 / 0.4364	4.114 / 0.4114	3.829 / 0.3829	0	1	1	0	1	0	0	0					0	0	0	0	0	0	1	0	1	0	0	0
0.5330 / 0.0533	8.362 / 0.8370	1.601 / 0.1600	2.092 / 0.2090	8.720 / 0.8720	8.220 / 0.8220	7.650 / 0.7650	0	1	1	1	0	0	0	0					0	0	0	0	0	0	1	1	0	0	0	0
1.067 / 0.107	16.74 / 1.674	3.202 / 0.3200	4.184 / 0.4180	17.45 / 1.745	16.45 / 1.645	15.31 / 1.531	0	1	0	0	0	0	1	0					0	0	0	0	0	0	0	0	0	0	1	0
2.135 / 0.214	33.48 / 3.348	6.405 / 0.6410	8.368 / 0.8370	34.91 / 3.491	32.91 / 3.291	30.63 / 3.063	0	1	0	0	0	1	0	0					0	0	0	0	0	0	0	0	0	1	0	0
4.270 / 0.427	66.96 / 6.700	12.82 / 1.280	16.75 / 1.670	69.82 / 6.980	65.82 / 6.580	61.26 / 6.130	0	1	0	0	1	0	0	0	SEE BELOW				0	0	0	0	0	0	0	0	1	0	0	0
5.330 / 0.533	83.62 / 8.370	16.01 / 1.600	20.92 / 2.090	87.20 / 8.720	82.20 / 8.220	76.50 / 7.650	0	0	0	0	0	0	0	1					0	1	0	1	0	0	0	0	0	0	0	1
10.67 / 1.067	167.4 / 16.74	32.02 / 3.200	41.84 / 4.180	174.5 / 17.45	164.5 / 16.45	153.1 / 15.31	0	0	0	0	0	0	1	0					0	1	0	1	0	0	0	0	0	0	1	0
21.35 / 2.135	334.8 / 33.48	64.05 / 6.410	83.68 / 8.370	349.1 / 34.91	329.1 / 32.91	306.3 / 30.63	0	0	0	0	0	1	0	0					0	1	0	1	0	0	0	0	0	1	0	0
42.70 / 4.270	669.6 / 67.00	128.2 / 12.80	167.5 / 16.70	698.2 / 69.80	658.2 / 65.80	612.6 / 61.30	0	0	0	0	1	0	0	0					0	1	0	1	0	0	0	0	1	0	0	0
---	836.2 / 83.70	160.1 / 16.00	209.2 / 20.90	872.0 / 87.20	822.0 / 82.20	765.0 / 76.50	1	0	0	0	0	0	0	1					1	0	1	0	0	0	0	0	0	0	0	1
---	1674 / 167.4	320.2 / 32.00	418.4 / 41.80	1745 / 174.5	1645 / 164.5	1531 / 153.1	1	0	0	0	0	0	1	0					1	0	1	0	0	0	0	0	0	0	1	0
---	3348 / 334.8	640.5 / 64.10	836.8 / 83.70	3491 / 349.1	3291 / 329.1	3063 / 306.3	1	0	0	0	0	1	0	0					1	0	1	0	0	0	0	0	0	1	0	0
---	---	1282 / 128.0	1675 / 167.0	---	---		1	0	0	0	1	0	0	0					1	0	1	0	0	0	0	0	1	0	0	0
---	---	2564 / 256.0	3350 / 335.0	---	---		1	0	0	1	0	0	0	0					1	0	1	0	0	0	0	1	0	0	0	0
THERMISTOR 100 kΩ (from any 871EC Sensor except -HP, -BW, -UT)															0	1	0	1												
RTD 100 Ω (either user-supplied or from -HP, -BW, or -UT sensor)															1	0	1	0												

NOTE

In the first seven columns of the table above,

153.1
15.31

means 153.1 mS/cm or 15.31 S/m, depending on user's choice of units of measurement. See Table 3.

NOTE

In the "SWITCH POSITION" columns above,

0 = OPEN
1 = CLOSED

For convenience, Table 2 is provided for conversion from % concentration to mS/cm when Monitor is to be used in % concentration mode.

Table 2. 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 189	25
0 to 25% NaCl	0 to 248	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(4)	0 to 410	25
0 to 20% NaOH(1,4)	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(4)	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 (4)	0 to 790	25
99.5 to 96% H_2SO_4 (2,4)	65.3 to 204.1	50
0 to 10% Oleum	0 to 35	65
42 to 18% Oleum(3,4)	15.0 to 78.6	65
0 to 10% HNO_3 (4)	0 to 500	25

(1) Reference temperature = 100°C (212°F); thermistor value = 5569.3 Ω; RTD Value = 138.5 Ω.
(2) Suppressed-zero conductivity = 65.3 mS/cm; reference temperature = 50°C (122°F); thermistor value = 33 591 Ω.
(3) Suppressed-zero conductivity = 15 mS/cm; reference temperature = 65°C (149°F); thermistor value = 18 668 Ω.
(4) Standard Ranges. Refer also to Table 4, Compensation Code.

Checking the Factory Set Full Scale Range

Based on information received from the customer order, Foxboro presets the full scale range of each 872 Monitor. If the range is not specified on the order, Foxboro presets the FSC to be 61.26 mS/cm (Sensor Type "SP").

Determine the existing full scale range by performing the following key sequences:

1. Unlock Monitor using Security Code.
2. Check Configuration Code by pressing SHIFT and while holding, press CONFIG. Refer to "Configuration Code" section. If first digit is either 7 or 8, proceed to Step 4.
3. Change first digit in Configuration Code from 9 to either 7 or 8, as applicable. Press <ENTER>.
4. Press <SHIFT>, and while holding, press <FSC>.

   The value appearing on the display is the full scale range value. The FSC value can only be displayed, not modified from the front keypad.
5. If FSC is acceptable (see previous section), change Configuration Code back to original value, if it had been changed.

Changing the Full Scale Range

All 872 ranges are zero-based. Range selections are dictated by the sensor type used. Refer to Table 1 for a list of all available ranges.

To change the Monitor full scale range, proceed as follows:

1. Unlock Monitor using Security Code.
2. Check Configuration Code by pressing <SHIFT> and while holding, press <CONFIG>. Refer to "Configuration Code" section. If first digit is a 7 or an 8, go to Step 4.
3. Change first digit in Configuration Code from 9 to either 7 or 8, as applicable. Press <ENTER>.
4. Externally remove power from Monitor.
5. Remove four screws from front panel.
6. Lift out the front panel with the attached four PWA's.
7. Refer to Figure 10 and locate the signal conditioning PWA.
8. Refer to Figure 13 for location of DIP switches 1, 2, and 3. Each DIP switch has eight small, 2-position switches. The switch positions are open (0) or closed (1). Refer also to Figure 12.
9. Set all switches in accordance with Table 1 for appropriate sensor type.
10. Return front panel with attached four PWA's to case and secure with four screws.
11. Externally apply power to Monitor.
12. Verify that the new full scale range is properly set by performing the following key sequence:

    <SHIFT> and while holding, press <FSC>

    The value appearing on the display should correspond with the value selected from Table 1. This is the new full scale range value.
13. Unit must now be calibrated. Refer to "Bench/Dry Calibration" section.
14. If Configuration Code was changed in Step 3, change Configuration Code back to original value.

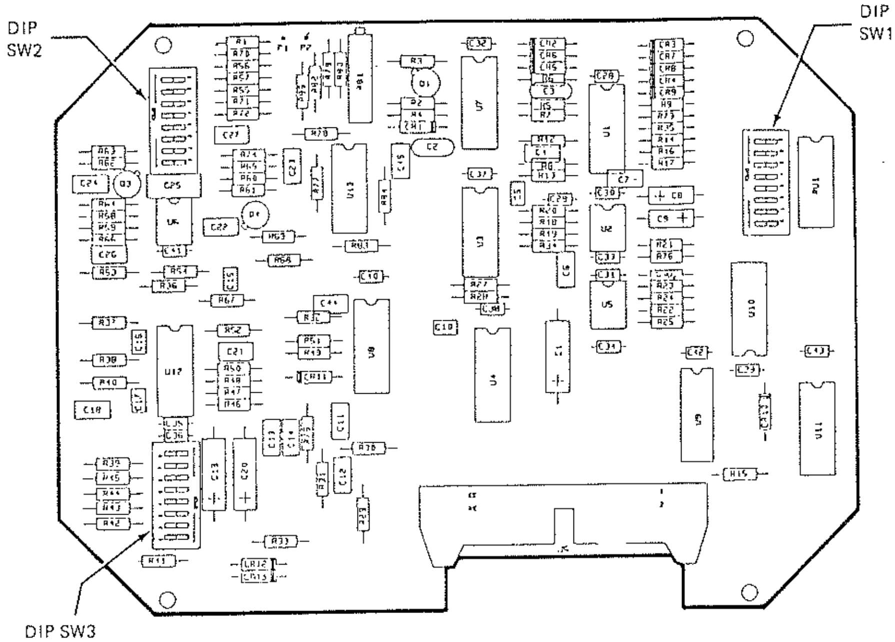

Figure 13. Signal Conditioning PWA

Setting Alarm Level(s)

Proceed as follows to set alarm level(s).

NOTE
Check that the alarm configurations (Hi/Lo) are set as desired. Refer to "Configuration Code" Section.

1. Unlock Monitor using Security Code.

2. To set high alarm, perform the following key sequence.

   Press <HIGH> (Use VFK1/HIGH Key)

Use increment (Λ) or decrement (V) to change the number appearing on the display to the high alarm level desired.

   Press <ENTER>

3. To set low alarm level, perform the following key sequence.

   Press <LOW> (Use VFK2/LOW Key)

Use increment (Λ) or decrement (V) to change the number appearing on the display to the low alarm level desired.

   Press <ENTER>

4. Lock Monitor using Security Code.

Configuration Code

The configuration code is a 4-digit number that allows the user to choose units of measurement, sensor type, temperature compensation input, and alarm configuration.

When choosing units of measurement, the user should also consider related choices of chemical concentration range and/or temperature compensation. These choices are explained in the "Compensation Code" section of this document.

If the units of measurement are chosen to be <u>conductance</u> units (either mS/cm or S/m), then a choice of temperature compensation (see "Compensation Code" section) will provide for a conductance reading referenced to a particular temperature for a particular solution composition.

If the units of measurement are chosen to be percent (%), then the chemical concentration range and temperature compensation selection is fixed by the selection from the Compensation Code (see "Compensation Code" section).

Temperature compensation input may be via either 100 kΩ thermistor or 100 Ω platinum RTD. Sensor types EV, AB, TF, NL, SP, LB, RE, PN, and PX all contain an integral 100 kΩ thermistor. Sensor types HP, UT, and BW contain an integral 100 Ω platinum RTD. The user may connect his own external 100 Ω platinum RTD in place of the sensor temperature signal wires (leads 6 and 7) for any of the sensor installations, if desired. Refer also to Table 1, which shows the proper switch positions for DIP switches 2-5, 2-6, 2-7, and 2-8 for temperature compensation input selection.

Table 3. Configuration Code

CONFIGURATION DIGIT T
UNITS OF MEASUREMENT
7 = Electrodeless Conductivity in CGS units (mS/cm)
8 = Electrodeless Conductivity in MKS (SI) units (S/m)
9 = Electrodeless Conductivity in Percent units

CONFIGURATION DIGIT U
SENSOR TYPE
1 = EV, RE, BW
2 = AB
3 = TF
4 = NL
5 = SP or HP
6 = PN or PX
7 = LB or UT

CONFIGURATION DIGIT V
TEMPERATURE COMPENSATION INPUT(A)
0 = 100 KΩ Thermistor (from 871EC Sensor Types EV,AB,TF, NL,SP,LB,RE,PN, or PX)
2 = 100 Ω RTD (from 871EC Sensor Types HP, BW, or UT; or from user-supplied element)

CONFIGURATION DIGIT W
ALARM CONFIGURATION
1 = Hi/Lo
3 = Lo/Lo
5 = Hi/Hi

(A)Also refer to Table 1 for proper switch positions for DIP switches 2-5, 2-6, 2-7, and 2-8.

Checking the Factory Set Configuration Code

Based on information received from the customer order, Foxboro presets the Configuration Code. If information is not specified on the order, Foxboro presets the Configuration Code to 7501.

1. Refer to Table 3. T, U, V, and W represent the four configuration digits which will appear on the display, following completion of the next step.
2. Perform the following key sequence:

   <SHIFT>, and while holding, press <CONFIG>

Changing the Configuration Code

1. Referring to Table 3, determine the 4-digit Configuration Code required.
2. Unlock Monitor using Security Code.
3. Press <SHIFT>, and while holding, press <CONFIG>
4. Use increment (∧) or decrement (∨) key to place required four digits in display.
5. Press <ENTER>.

   If a change to the Configuration Code is confined to T or W, calibration is not required. If U or V is changed, however, calibration is required.
6. If required, perform calibration. Refer to "Bench/Dry Calibration" section.
7. Lock Monitor using Security Code.

Compensation Code

The Compensation Code is a 4-digit number that allows the user to choose temperature compensation, chemical concentration range (when used with percent (%) measurement units selection), damping time, and temperature units display.

Several different temperature compensation selections are available. If Monitor is being used in the conductance mode (either mS/cm or S/m), then the choice of temperature compensation should be made which most closely matches that of the user's process. Refer to Table 4.

Examples

Application 1 - Measurement of a Caustic Cleaning Solution in the Range of 0 to 30 mS/cm.

Refer to Table 4. The choice of Compensation Code digits XX = 17 would be appropriate.

Application 2 - Measurement of River Water in the Range of 0 to 2 mS/cm.

Refer to Table 4. The choice of Compensation Code digits XX = 11 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 4. The choice of Compensation Code digits XX = 18 would be appropriate.

If in doubt as to the correct choice of temperature compensation, contact Foxboro.

If the Monitor is being used in the percent (%) mode, the choice of Compensation Code digits XX = 12 through 18 allows the user to select one of several preprogrammed chemical concentration ranges. See Table 4. When the Monitor 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 4. The choice of Compensation Code digits XX = 17 would be appropriate. Refer also to Table 3. Configuration digit T should be set as a "9".

Table 4. Compensation Code

COMPENSATION DIGITS XX(a)

DIGITS XX (a)	TEMPERATURE COMPENSATION TO MATCH PROCESS COMPOSITION	PROCESS TEMP. RANGE (b)	REFERENCE TEMP.	PROGRAMMED PERCENT (%) CONCENTRATION RANGE
09	Special. Use in conjunction with curve generation program.	Special	Special	Special
10	No temperature compensation. Absolute electrodeless conductivity.	Not Applicable	Not Applicable	Special
11	Sodium Chloride (NaCl). From dilute through concentrated solutions.	32°F to 392°F	25°C (77°F)	Special
12	Hydrochloric Acid (HCl). From dilute solutions up through 15%.	14°F to 252°F	25°C (77°F)	0 to 15%
13	Nitric Acid (HNO_3). From dilute solutions up through 10%.	19°F to 249°F	25°C (77°F)	0 to 10%
14	Sulfuric Acid (H_2SO_4). From dilute solutions up through 25%.	32°F to 216°F	25°C (77°F)	0 to 25%
15	Sulfuric Acid (H_2SO_4). From 96% to 99.5%.	29°F to 249°F	50°C (122°F)	99.5 to 96%
16	Oleum (Concentrated Sulfuric Acid). From 18% to 42%.	89°F to 249°F	65°C (149°F)	42 to 18%
17	Sodium Hydroxide (NaOH). From dilute solutions up through 15%.	31°F to 250°F	25°C (77°F)	0 to 15%
18	Sodium Hydroxide (NaOH). From dilute solutions up through 20%.	147°F to 252°F	100°C (212°F)	0 to 20%
19	Black Liquor in Pulp and Paper Digesters. Nominal 2.7 lb Na_2O per ft^3	115°F to 411°F	160°C (320°F)	Special

COMPENSATION DIGIT Y(a)

DIGIT Y (a)	DAMPING
0	No Damping
1	10 Seconds
2	20 Seconds
3	40 Seconds

COMPENSATION DIGIT Z(a)

DIGIT Z (a)	TEMPERATURE UNITS DISPLAY	CURVE GENERATION PROGRAM STATUS
0	Fahrenheit	Monitor in "run" mode. Custom curves may not be programmed.
1	Fahrenheit	Monitor in "programming" mode. Temperature (°F) vs. conductivity data may be programmed.
2	Fahrenheit	Monitor in "programming" mode. Concentration vs. conductivity data may be programmed.
4	Celsius	Monitor in "run" mode. Custom curves may not be programmed.
5	Celsius	Monitor in "programming" mode. Temperature (°C) vs. conductivity data may be programmed.
6	Celsius	Monitor in "programming" mode. Concentration vs. conductivity data may be programmed.

(a) | X | X | Y | Z | = 4-Digit Display

(b) Actual application ratings may be reduced by sensor ratings.

Application 2 - Measurement of 0 to 10% H_2SO_4 in a Deionization Bed Regeneration Application.

Refer to Table 4. The choice of Compensation Code digits XX = 14 would be appropriate. Refer also to Table 3. Configuration digit T should be set as a "9".

Application 3 - Measurement and Control of 98% Sulfuric Acid (H_2SO_4) in a Refinery.

Refer to Table 4. The choice of Compensation Code digits XX = 15 would be appropriate. Refer also to Table 3. Configuration digit T should be set as a "9".

Damping time refers to an interval over which all measurement readings are averaged. The average measurement is then displayed on the Monitor and transmitted.

Refer to Table 4 and Compensation Digit Z. In normal operation, digit Z should be set to read either "0" or "4", depending on the user's choice of temperature units display. Selections "1", "2", "5", and "6" should be used only during a programming operation in conjunction with the optional curve generation program. Refer to "Use of the Curve Generation Program" section of this document for further details.

Checking the Factory Set Compensation Code

Based on information received from the customer order, Foxboro presets the Compensation Code. If information is not specified on the order, Foxboro presets the Compensation Code to be 1100.

1. Refer to Table 4. XX, Y, and Z represent the four compensation digits which will appear on the display following completion of the next step.

2. Perform the following key sequence.

   <SHIFT>, and while holding, press <COMPEN>

Changing the Compensation Code

1. Referring to Table 4, determine the appropriate 4-digit Compensation Code required.

2. Unlock Monitor using Security Code.

3. Press <SHIFT>, and while holding, press <COMPEN>

4. Use the increment (Λ) or decrement (V) key to place required four digits in the display.

5. Press <ENTER>.

6. Lock Monitor using Security Code.

   If a change to the Compensation Code is confined to Y or Z, calibration is not required. If XX is changed, however, calibration is required.

7. If required, perform calibration. Refer to "Bench/Dry Calibration" section of this document.

Scaling the Analog Outputs

Each 872 Monitor has two analog output signals as standard, one for conductivity and one for temperature. Refer to "Standard Specifications" for definition, and Figure 2 for identification. Each output signal is linearly proportional to the measured variable. In the case of the conductivity output, the signal is linearly proportional to the displayed variable, either mS/cm, S/m, or percent (%). Refer to "Configuration Code" section for details on units of measurement.

Both analog output signals may be scaled so as to improve the sensitivity of the analog output in the range of interest. For 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. For example, in the measurement of 96 to 99.5% 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.

Alarm set-point hysteresis is related to the conductivity analog output span. The hysteresis at either alarm point is 3% of the analog output span. For example, if the minimum analog output is assigned to 50 mS/cm and the maximum analog output to 500 mS/cm, the alarm hysteresis is ±13.5 mS/cm (±3% of 450 mS/cm). Thus, to "sharpen" the action at the alarm set points, it is advisable to reduce the analog output span (by either increasing the value assigned to the minimum analog output, decreasing the value assigned to the maximum analog output, or both).

Checking the Factory Set Analog Output Values

Based on information received from the customer order, Foxboro presets the analog output values. If information is not specified on the order, Foxboro presets the conductivity analog output values to be 0 and 50 mS/cm.

<u>CHECKING THE FACTORY SET ANALOG OUTPUT VALUES FOR CONDUCTIVITY (mS/cm, S/m, %) Output</u> --

1. Perform the following key sequence:

   Press <0%>.

   The value appearing on the display is the conductivity or % value corresponding to the minimum analog output (e.g., 0 V dc or 4 mA dc).

2. Perform the following key sequence:

   Press <100%>.

   The value appearing on the display is the conductivity or % value corresponding to the maximum analog output (e.g., 10 V dc or 20 mA dc).

<u>CHECKING THE FACTORY SET ANALOG OUTPUT VALUES FOR TEMPERATURE OUTPUT</u> --

1. Perform the following key sequence:

   Press <TEMP>, then (within 8 seconds) press <0%>.

   The value appearing on the display is the temperature value corresponding to the minimum analog output (e.g., 0 V dc or 4 mA dc).

2. Perform the following key sequence:

   Press <TEMP>, then (within 8 seconds) press <100%>.

   The value appearing on the display is the temperature value corresponding to the maximum analog output (e.g., 10 V dc or 20 mA dc).

Changing the Analog Output Values for Conductivity (mS/cm, S/m, %) Output

1. Unlock Monitor using Security Code.

2. Perform the following key sequence:

   Press <0%>.

   Use the increment (Λ) or decrement (V) key until display shows desired value corresponding to the minimum analog output (e.g., 0 V dc or 4 mA dc).

3. Press <ENTER>.

4. Perform the following key sequence:

   Press <100%>.

   Use the increment (Λ) or decrement (V) key until display shows desired value corresponding to the maximum analog output (e.g., 10 V dc or 20 mA dc).

5. Press <ENTER>.

6. Lock Monitor using Security Code.

<u>NOTE</u>
Calibration is not required after scaling the analog output.

Changing the Analog Output Values for Temperature Output

1. Unlock Monitor using Security Code.

2. Perform the following key sequence:

   Press <TEMP>, then (within 8 seconds) press <0%>.

   Use the increment (Λ) or decrement (V) key until display shows desired value corresponding to the minimum analog output (e.g., 0 V dc or 4 mA dc).

3. Press <ENTER>.

4. Perform the following key sequence:

   Press <TEMP>, then (within 8 seconds) press <100%>.

   Use the increment (Λ) or decrement (V) key until display shows desired value corresponding to the maximum analog output (e.g., 10 V dc or 20 mA dc).

5. Press <ENTER>.

6. Lock Monitor using Security Code.

<u>NOTE</u>
Calibration is not required after scaling the analog output.

OPERATION

Standardization

Standardization is a procedure used to set the Monitor/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;
- 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 872 Monitor is calibrated at Foxboro, and unless a recalibration is performed prior to initial installation, a standardization procedure is the final step necessary before operation of the system.

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 872 Monitor is adjusted as necessary to agree with the off-line device.

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 872/871 system is then checked in either a process sample or with standard conductivity solutions. If checked against a process sample, the use of a second conductivity analyzer is required to verify the value of the solution.

ADVANTAGES OF OFF-LINE TYPE STANDARDIZATION --

- Several different values may be checked
- Eliminates the need for a second analyzer if standard solutions are used

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.

Standardization Procedure

NOTE
If using the In-Line method described above, perform Steps 11 through 13 only.

1. Remove sensor from process medium. Refer to sensor Master Instruction (MI). Wash the immersion end in distilled water.
2. Dry the sensor completely and let it sit for five minutes to ensure that it has reached room temperature.
3. Unlock Monitor using Security Code.
4. Monitor must not be in the % measurement mode to perform Steps 6, 7 and 8. Refer to Table 3 and change the Configuration Code, if necessary, to either "7□□□" or "8□□□", as applicable.
5. Monitor must have zero damping. Refer to Table 4 and change the Compensation Code, if necessary, to "□□0□".
6. With the sensor dry and in air, press the <Calibrate LOW> key (use the key that says HOLD/LOW).
7. Use increment (Λ) or decrement (V) key until the display reads 0.
8. Press <ENTER>.
9. Immerse the sensor in the known solution. Allow at least one sensor diameter[1] of solution in all directions around the sensor. Allow the sensor to stabilize for at least five minutes. Ensure that there are no air bubbles trapped in the sensor "donut".

[1] Sensor Diameters
-Types NL, SP, and HP = 1.4 in; Type TF = 1.5 in
-Types RE, LB, BW, and UT = 2.5 in; Type EV = 3.2 in

10. If the solution is to be measured in units of %, change the Monitor Configuration Code back to "9□□□". Refer to Table 3.

NOTE
<Calibrate HIGH> key may require several seconds to move displayed value using increment (Λ) or decrement (V) keys. Keep finger on key until desired value is attained.

11. Press <Calibrate HIGH> (use FSC/HIGH key).

12. Use increment (Λ) or decrement (V) key until the display reads conductivity value of known solution.

13. Press <ENTER>.

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

15. Lock Monitor using Security Code.

16. Reinstall sensor in process solution.

Placing Output and Display on Hold

If the user wishes to inspect or service the sensor, a hold function is available which locks the Monitor measurement and optional temperature outputs, and display readings, at their present value or any desired value.

Activating Hold

1. Unlock Monitor using Security Code.

2. Perform the following key sequence.

   Press <SHIFT> and while holding, press <HOLD>

   NOTES
   a. The legend on the display blinks continuously to indicate hold status.

   b. The display and output is now "on hold" at present value for both measurement and temperature.

   c. If user wishes to change the output measurement value at which the Monitor is to be held, use the increment (Λ) or decrement (V) key after performing the above SHIFT and HOLD sequence until desired value is reached, then

      press <ENTER>.

If user wishes to change the output temperature value at which the Monitor is to be held,

press <TEMP>

Use the increment or decrement key until desired value is reached, then

press <ENTER>

If, after placing the output temperature value on hold, the user wishes to again display the held output measurement value,

press <SHIFT>, and while holding, press <HOLD>

Removing Hold

1. Perform the following key sequence.

   Press <SHIFT>, and while holding, press <VFK2>

The display and output is now released from hold for both measurement and temperature.

NOTE
The legend on the display stops blinking.

2. Lock Monitor using Security Code.

BENCH/DRY CALIBRATION

Equipment Required

- Digital Voltmeter (DVM)
- Small Screwdriver, Common
- Decade Resistance Box, 0 to 100 kΩ ±0.1%
- Fixed Resistor ±0.1% selected in accordance with compensation (reference) temperature. Refer to Table 5 for standard reference temperatures. Refer to Table 10 for other reference temperature equivalents.

Table 5. Compensation Resistance[A]

COMPENSATION	REQUIRED RESISTOR FOR 100 kΩ THERMISTOR	REQUIRED RESISTOR FOR 100 Ω RTD
Referenced to 25°C (77°F)	100 kΩ ±0.1%	109.73 Ω ±0.1%
Referenced to 50°C (122°F)	33.591 kΩ ±0.1%	119.39 Ω ±0.1%
Referenced to 65°C (149°F)	18.668 kΩ ±0.1%	125.16 Ω ±0.1%
Referenced to 100°C (212°F)	5.569 kΩ ±0.1%	138.5 Ω ±0.1%
Referenced to 160°C (320°F)	Not Applicable	161.04 Ω ±0.1%

[A]For resistance values at reference temperatures other than those shown, refer to Table 10.

Bench/Dry Calibration Procedure

NOTE
An example of this general procedure is found at the end of this section.

1. Remove sensor from process medium. Clean and dry thoroughly.

2. Unlock Monitor using Security Code.

3. Bench calibration is always performed with Monitor in the conductance (either mS/cm or S/m) mode. Thus, Configuration Code digit T must be either 7 or 8, but not 9. Set Configuration Code to be either "7□□□" or "8□□□", as applicable. Refer to Table 3.

4. Bench calibration is always performed with no damping applied. Thus, Compensation Code digit Y must be 0. Set Compensation Code to be either "□□00" or "□□04". Refer to Table 4.

5. Verify that the desired Full Scale Range is set. Refer to "Full Scale Range" section in this MI.

6. Externally remove power from Monitor.

7. Remove four screws from cover of user connection module and remove cover. Refer to Figure 2.

8. Disconnect sensor leads 6 and 7 from Monitor terminal strip. Refer to Figure 14.

9. To simulate reference temperature as identified in Compensation Code digits XX (Table 4), connect a fixed resistor between terminals 6 and 7 as shown in Figure 14. Refer to Table 5 or Table 10 for resistance value.

   If Monitor is normally used without automatic temperature compensation (Compensation Code digits XX = 10), use 25°C as the reference temperature for the purposes of this procedure.

10. Externally apply power to Monitor.

11. Press <TEMP>. Use increment (Λ) or decrement (V) key until correct reference temperature is displayed. Reference temperature is determined by choice of digits XX in Compensation Code (Table 4).

12. Press <ENTER>.

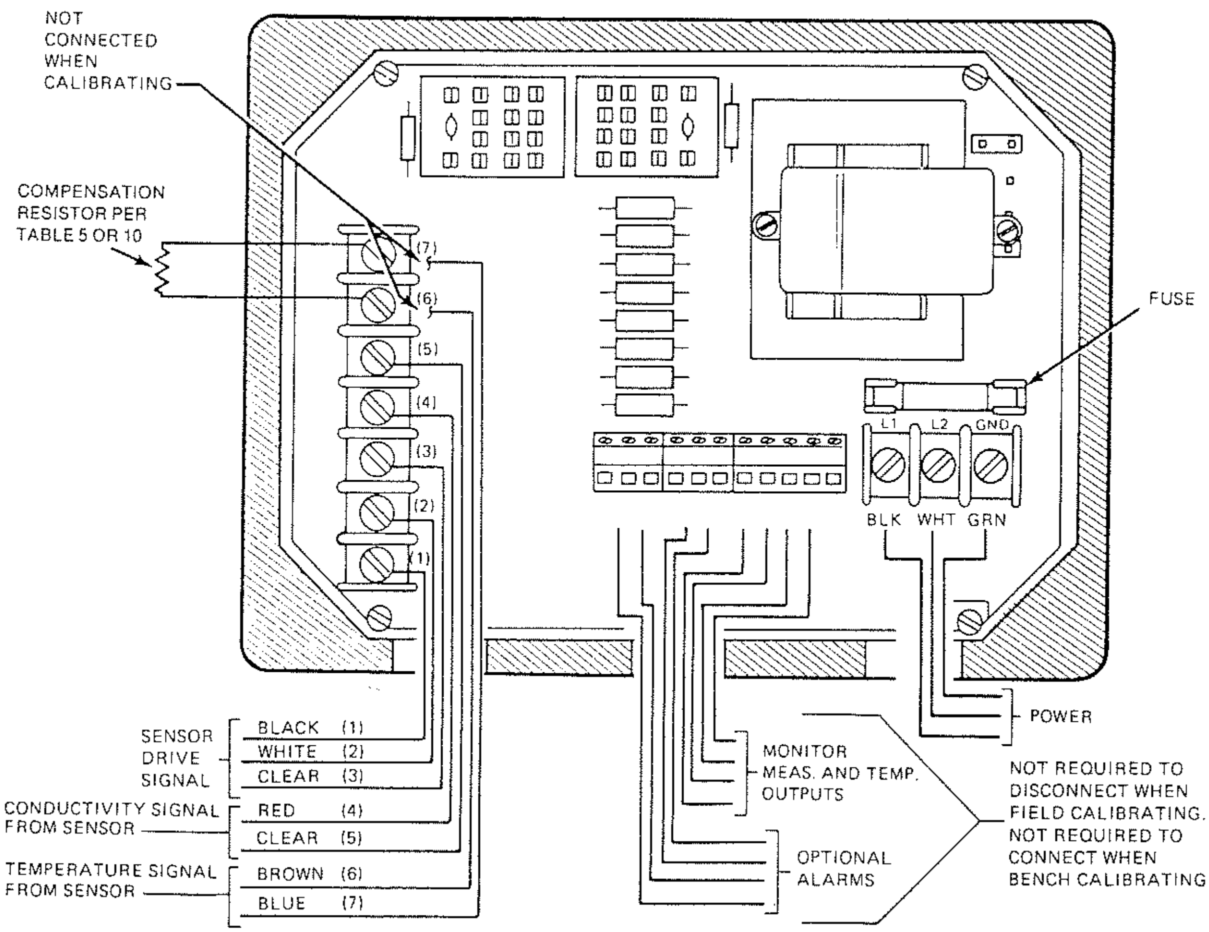

Figure 14. Monitor Connections for Calibration

13. Leave fixed resistor across terminals 6 and 7. Leave sensor leads 1 through 5 connected per Figure 14. Sensor is clean, dry, and on the bench, exposed only to air. To set the system zero point, press <Calibrate LOW>. Use increment (Λ) or decrement (V) key until display reads 0. Press <ENTER>.

14. Route resistance loop from decade box through sensor as shown in Figure 15.

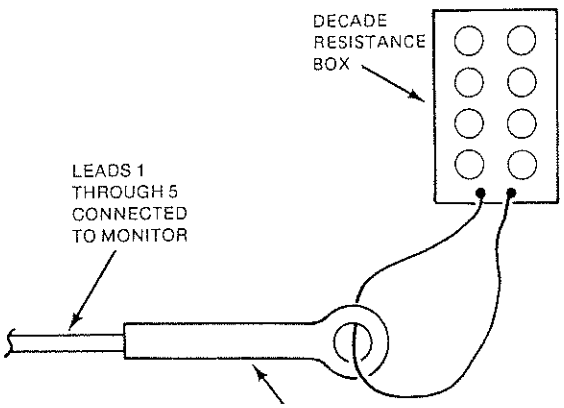

Figure 15.
Sensor/Decade Box Configuration for Calibration

15. Choose a conductivity value somewhere between 50% and 100% of full scale at which to perform a high calibrate procedure. Then, to simulate this conductivity value using a resistance, solve for the resistance using this formula:

CONFIGURATION CODE DIGIT "T" = 7

$$R_L = \frac{(\text{Cell Factor})(1000)}{\text{High Calibrate Value in mS/cm}}, \text{ or}$$

CONFIGURATION CODE DIGIT "T" = 8

$$R_L = \frac{(\text{Cell Factor})(100)}{\text{High Calibrate Value in S/m}}$$

where,

R_L = Loop resistance from decade box

Cell Factor = A number taken from Table 6 below.

Table 6.
Sensor Body Type with Cell Factor

SENSOR BODY TYPE	CELL FACTOR
AB	0.588
EV	0.45
NL	2.35
PN and PX	2.45
TF	2.31
SP and HP	2.15
RE, LB, UT, or BW	0.873

Example

FSC (Table 1) = 61.26 mS/cm
Sensor Type = SP
Desired High Calibrate Value = 50 mS/cm

$$R_L = \frac{(2.15)(1000)}{50} = 43\ \Omega$$

16. Set the decade box to the value (R_L) found in Step 15.

NOTE
The value calculated for R_L in the preceding formula assumes a single loop (or turn) through the sensor as shown in Figure 15. If values calculated are not easily obtainable using decade box, the user may loop decade box wire several times through sensor and then multiply R_L by square of the number of loops used. EXAMPLE: If R_L is calculated as being 0.45 Ω, user may choose to put 10 loops through sensor. The square of 10 is 100. 100 x 0.45 = 45. R_L = 45 Ω.

17. Press <Calibrate HIGH>.

NOTE
<Calibrate HIGH> key may require several seconds to move displayed value using increment (Λ) or decrement (V) keys. Keep finger on key until desired value is attained.

18. Use increment (Λ) or decrement (V) key until calibrate high value is displayed.

19. Press <ENTER>.

20. If Configuration Code was changed in Step 3 and/or Compensation Code was changed in Step 4, reset these codes to their original values.

NOTE
If a calibration of the analog outputs is not desired/required, skip to Step 44.

21. Connect the DVM between MEAS.+ and MEAS.- on TB4A (see Figure 8) and set DVM to measure appropriate output.

22. Check to see what the current minimum analog output value is set at by pressing <0%>. Record this value. Check to see what the current maximum analog output value is set at by pressing <100%>. Record this value.

23. Press <SHIFT> and while holding press <HOLD>.

24. Use increment (Λ) or decrement (V) key until the displayed value is equal to the minimum analog output value as checked in Step 22.

25. Press <ENTER>.

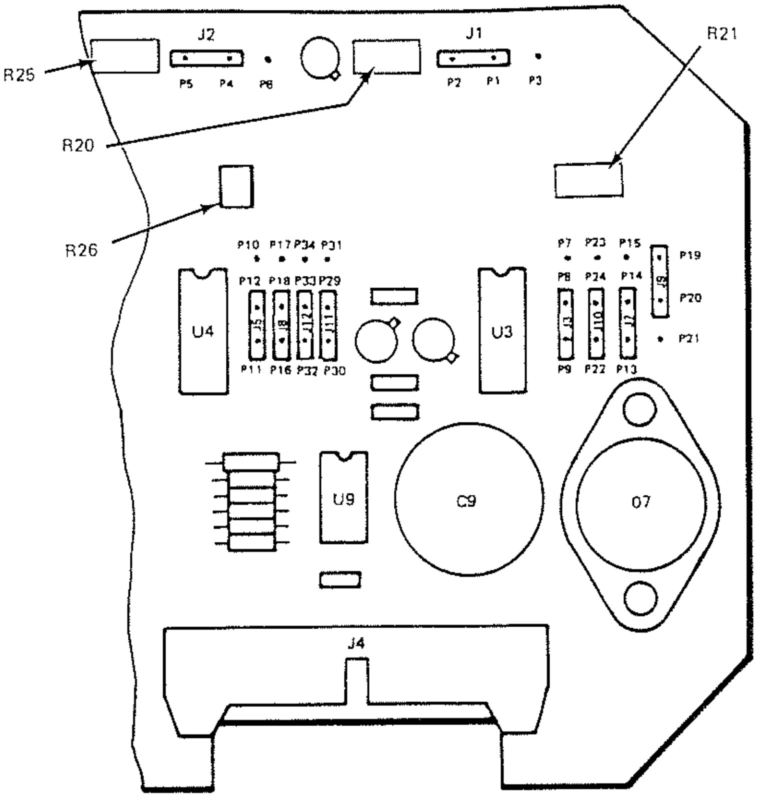

Figure 16. Power Supply and Output PWA Output Jumper and Position Locations

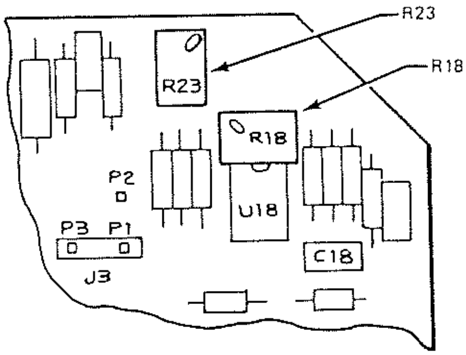

Figure 17.
Processor PWA Output Jumper and Position Locations

26. Check or perform a, b, or c depending upon the type of output.

    a. Output 0 to 10 V dc - Reading must be less than 0.040 V dc.

    b. Output 0 to 20 mA - Reading must be less than 0.1 V dc across 250 Ω load.

    c. Output 4 to 20 mA - Adjust R20 on power supply board until a reading of 1.00 V dc is achieved across a 250 Ω load (See Figure 16).

27. Use increment (∧) key until the displayed value is equal to the maximum analog output value as checked in Step 22.

    NOTE

    The analog output should not change until the ENTER key is used.

28. Press <ENTER>.

29. Perform a, b, or c depending upon the type of output.

    a. 0 to 10 V dc Nonisolated - Adjust R18 on the processor board for a 10.00 V dc reading (See Figure 17).

    b. 0 to 10 V dc Isolated - Adjust R21 on power supply board until a reading of 10.00 V dc is achieved (See Figure 16).

    c. 0 to 20 or 4 to 20 mA - Adjust R21 on power supply board until a reading of 5.00 V dc is achieved across a 250 Ω load (See Figure 16).

30. Press <SHIFT> and while holding, press <VFK2>.

31. Connect the DVM across TEMP+ and TEMP- on TB4A and TB4B (See Figure 8) and set DVM to appropriate output.

32. Check to see what the current minimum analog temperature output value is set at by pressing <TEMP> followed by <0%>. Record this value. Check to see what the current maximum analog temperature value is set at by pressing <TEMP> followed by <100%>. Record this value.

33. Press <SHIFT> and while holding, press <HOLD>.

34. Press <TEMP>.

35. Use decrement key until the displayed value is equal to the minimum analog temperature output value as checked in Step 32.

36. Press <ENTER>.

37. Check or perform a, b, or c depending upon the type of output.

    a. Output 0 to 10 V dc - Reading must be less than 0.040 V dc.

    b. Output 0 to 20 mA - Reading must be less that 0.1 V dc across 250 Ω load.

    c. Output 4 to 20 mA - Adjust R25 on power supply board until a reading of 1.00 V dc is achieved acress a 250 Ω load (See Figure 16).

38. Use increment (Λ) key until the displayed value is equal to the maximum analog temperature output value as checked in Step 32.

39. Press <ENTER>.

40. Perform a, b, or c depending upon the type of output.

    a. Output 0 to 10 V dc Nonisolated - Adjust R23 on processor board until a reading of 10.00 V dc is achieved (see Figure 17).

    b. Output 0 to 10 V dc Isolated - Adjust R26 on power supply board until a reading of 10.00 V dc is achieved (see Figure 16).

    c. Output 0 to 20 or 4 to 20 mA - Adjust R26 on power supply board until a reading of 5.00 V dc is achieved across a 250 Ω load (see Figure 16).

41. Press <SHIFT> and while holding press <VFK2>.

42. Lock Monitor using Security Code.

43. Disconnect DVM.

44. Externally remove power from Monitor.

45. Disconnect fixed resistor from Monitor terminals 6 and 7.

46. Remove decade box resistance loop from sensor.

47. Reconnect sensor leads 6 and 7 to Monitor terminal strip.

48. Return sensor to process medium.

49. Secure module cover with four screws.

50. Externally return power to Monitor.

Example of Bench/Dry Calibration

Requirements Given

- Application: Measurement of Cooling Tower Water
- Conductivity Range: 1.5 to 2.5 mS/cm
- Sensor Type: SP
- FSC: 3.829 mS/cm
- Configuration Code: 7501
- Compensation Code: 1100
- Reference Temperature: 25°C (77°F)

Procedure

1. Remove sensor from process. Clean and dry thoroughly.

2. Externally remove power from Monitor.

3. Disconnect sensor leads 6 and 7 from Monitor.

4. Connect a 100 kΩ resistor across Monitor terminals 6 and 7 to simulate reference temperature of 25°C (77°F).

5. Externally supply power to Monitor.

6. Unlock Monitor using Security Code.

7. Press <TEMP>. Use increment (Λ) or decrement (V) key until Monitor display reads 77.0°F.

8. Press <ENTER>.

9. To set the system zero point, press <Calibrate LOW>. Use increment or decrement key until display reads 0. Press <ENTER>.

10. Route resistance loop from decade box through sensor as shown in Figure 15.

11. To perform a high calibrate function at 2.5 mS/cm, calculate loop resistance R_L, as follows:

$$R_L = \frac{(\text{Cell Factor})(1000)}{\text{High Calibrate Value in mS/cm}}$$

$$R_L = \frac{(2.15)(1000)}{2.5} = 860\ \Omega$$

12. Set the decade box to 860 Ω.

13. Press <Calibrate HIGH>.

14. Use increment (Λ) or decrement (V) key until the Monitor display reads 2.5 mS/cm.

15. Press <ENTER>.

16. Lock Monitor using Security Code.

17. Externally remove power from Monitor.

18. Disconnect 100 kΩ resistor from Monitor terminals 6 and 7.

19. Remove decade box resistance loop from sensor.

20. Reconnect sensor leads 6 and 7 to Monitor terminal strip.

21. Return sensor to process.

USE OF THE CURVE GENERATION PROGRAM

Temperature Compensation

If the user wishes to provide his own custom temperature compensation, and the Monitor has been ordered with the "Curve Generation Program" option, Suffix -5, (see Data Label in Figure 2), proceed as follows:

1. The user-supplied compensation information to be applied to the Monitor will consist of increasing values of temperature (Fahrenheit recommended) and the corresponding conductivity in mS/cm or S/m for each temperature, with the % concentration of the desired solution known to be constant.

2. Unlock the Monitor using Security Code (see "Security Code" section).

3. The Compensation Code "Z" digit must read 1 or 5. Change to XXY1 or XXY5, as applicable. Refer to "Compensation Code" section.

NOTES
The values to be applied to the Monitor should be prepared in advance. When preparing this information, note that:

a. The difference between successive temperature values, applied to the Monitor, must be constant (i.e., 65.0°F, 67.5°F, 70.0°F, 72.5°F).

b. The conductivity value for any temperature must not vary by more than 7% from the previous conductivity value applied to the Monitor.

c. The number of data pairs applied to Monitor must not exceed 57.

The example below has a total number of 21 (N) temperature or conductivity values or 20 steps (N-1).

Reference Conductivity*: 255.0 mS/cm
Reference Temperature: 86°F
Number of Steps: 20
Number of Data Pairs: 21

Special Temperature Compensation[A]

TEMPERATURE, °F	CONDUCTIVITY mS/cm
32.0	135.1
36.5	140.4
41.0	147.8
45.5	155.5
50.0	167.8
54.5	176.8
59.0	186.2
63.5	196.5
68.0	206.7
72.5	218.2
77.0	230.0
81.5	242.3
86.0	255.0
90.5	267.3
95.0	278.6
99.5	291.8
104.0	204.9
108.5	318.4
113.0	330.7
117.5	343.0
122.0	354.1

[A]21 data pairs - 20 steps

NOTE
It is more accurate to do Temperature Compensation in degrees Fahrenheit than in degrees Celsius.

NOTE
Steps 1 through 6 that follow must be completed without pause. Do not let the display time out between entries. If this occurs, the program must be restarted. To avoid time out, press and hold the <SHIFT/LIGHT> key between entries.

1. Perform the following key sequence:

<SHIFT>, and while holding, press <VFK1>

NOTE
If 0004 appears on display, required software is not available.

*Reference Conductivity is the conductivity of the sample at selected reference temperature.

2. Use increment (Λ) or decrement (V) to display reference conductivity.

   Example: 255

   Press <ENTER> key.

   NOTE
   Increment (Λ) and decrement (V) keys may work in reverse for the first few values inserted. Location of decimal point on Monitor does not matter.

3. Use increment (Λ) or decrement (V) keys to display number of steps (N-1).

   Example: 20

   Press <ENTER>.

4. Use increment (Λ) or decrement (V) keys until first (lowest) temperature in data table is displayed.

   Example 32.0°F

   Press <ENTER>.

5. Use increment (Λ) or decrement (V) keys to display first conductivity in data table.

   Example: 135.1 mS/cm

   Press <ENTER>.

6. Repeat Steps 4 and 5 until all points have been entered.

7. To exit curve entry, either wait eight seconds or press any other function key, such as <ALARM-LOW>.

8. If chemical concentration curve (below) is not to be programmed, change Compensation Code to "09Y0" or "09Y4" for operation.

Chemical Concentration

If the user wishes to provide his own custom chemical concentration curve, and the Monitor has been ordered with the "Curve Generation Program" option, Suffix -5 (see Data Label in Figure 2), proceed as follows:

1. Ensure that a custom temperature compensation curve has been programmed. Refer to previous section.

2. The user-supplied compensation information to be applied to the Monitor will consist of increasing values of % concentration and the corresponding conductivity in mS/cm or S/m for each % concentration, with the temperature of the desired solution known to be constant.

3. Unlock Monitor using Security Code (see "Security Code" section).

4. The Compensation Code "Z" digit must read 2 or 6. Change to XXY2 or XXY6, as applicable. Refer to "Compensation Code" section.

   NOTES
   The values to be applied to the Monitor should be prepared in advance. When preparing this information note that:

   a. The difference between successive conductivity values, applied to the Monitor, must be constant (i.e., 230.0 ms, 232.0 ms, 234.0 ms, etc.).

   b. The % concentration must not vary by more than 2.5 absolute percent from the previous concentration value applied to the Monitor.

   c. The number of data pairs applied to Monitor must not exceed 56.

   The example below has a total number of 21 (N) concentration or conductivity values or 20 steps (N-1).

   Number of Steps: 20

Special % Curve[A]

CONDUCTIVITY, mS/cm	% CONCENTRATION
230.0	62.25
232.0	63.12
234.0	64.00
236.0	64.92
238.0	65.87
240.0	66.84
242.0	67.81
244.0	68.85
246.0	69.91
248.0	71.01
250.0	72.13
252.0	73.34
254.0	74.56
256.0	75.86
258.0	77.24
260.0	78.67
262.0	80.19
264.0	81.80
266.0	83.54
268.0	85.43
270.0	87.47

[A]21 data pairs - 20 steps

NOTE
Steps 1 through 5 that follow must be completed without pause. Do not let the display time out between entries. If this occurs, the program must be restarted. To avoid time out, press and hold the <SHIFT/LIGHT> key between entries.

1. Perform the following key sequence:

   <SHIFT>, and while holding, press <VFK1>

   NOTE
   If 0004 appears on display, required software is not available.

   NOTE
   Increment (Λ) and decrement (V) keys may work in reverse for the first few values inserted. Location of decimal point on Monitor does not matter.

2. Use increment (Λ) or decrement (V) keys to display number of steps (N-1).

   Example: 20

   Press <ENTER>.

3. Use increment (Λ) or decrement (V) keys to display first conductivity point in data table.

   Example: 230

   Press <ENTER>.

4. Use increment (Λ) or decrement (V) keys to display first % concentration point in data table.

   Example: 62.25

   Press <ENTER>.

5. Repeat Steps 3 and 4 until all points have been entered.

6. To exit curve entry, either wait 8 seconds or press any other function key, such as <ALARM-LOW>.

7. Change Compensation Code to "09Y0" or "09Y4" for operation. In operation, the Monitor uses both the custom temperature compensation curve (previous section) and the custom % concentration curve to process the data received from the conductivity sensor.

Table 7. Power Supply and Output PWA Jumper and Position Designations

<table>
<tr><th rowspan="2">OUTPUT</th><th colspan="5">MEASUREMENT OUTPUT JUMPERS</th><th colspan="5">TEMPERATURE OUTPUT JUMPERS</th></tr>
<tr><th>J1 JUMPER BETWEEN</th><th>J3 JUMPER BETWEEN</th><th>J7 JUMPER BETWEEN</th><th>J9 JUMPER BETWEEN</th><th>J10 JUMPER BETWEEN</th><th>J2 JUMPER BETWEEN</th><th>J5 JUMPER BETWEEN</th><th>J8 JUMPER BETWEEN</th><th>J11 JUMPER BETWEEN</th><th>J12 JUMPER BETWEEN</th></tr>
<tr><td>0 to 10 V dc Isolated</td><td>P1 and P3</td><td>P8 and P9</td><td>P14 and P15</td><td rowspan="3">P19 and P20</td><td rowspan="3">P22 and P24</td><td>P4 and P6</td><td>P11 and P12</td><td>P17 and P18</td><td rowspan="3">P29 and P30</td><td rowspan="3">P32 and P33</td></tr>
<tr><td>4 to 20 mA dc Isolated</td><td>P1 and P2</td><td rowspan="2">P7 and P8</td><td rowspan="2">P13 and P14</td><td>P4 and P5</td><td rowspan="2">P10 and P12</td><td rowspan="2">P16 and P18</td></tr>
<tr><td>0 to 20 mA dc Isolated</td><td>P1 and P3</td><td>P4 and P6</td></tr>
<tr><td>0 to 10 V dc Non-Isolated</td><td>N/A</td><td>N/A</td><td>N/A</td><td>P20 and P21</td><td>P23 and P24</td><td>N/A</td><td>P11 and P12</td><td>N/A</td><td>P29 and P31</td><td>P33 and P34</td></tr>
</table>

CHANGING THE ANALOG OUTPUT

If Monitor, as received, is 0 to 10 V dc non-isolated version, the analog output may not be changed. All others may be changed (includes change to 0 to 10 V dc nonisolated).

1. Externally remove power from Monitor.
2. Remove four screws from cover of user connection module and remove cover.

   For panel-mounted version: the cover is located opposite the front panel at the rear of the unit.

   For field-mounted version: the cover is located directly below the front panel.
3. Remove four screws from front panel.
4. Pull forward the front panel with the attached four PWA's.
5. Refer to Figure 10 and locate the power supply and output PWA and also the processor PWA.
6. Refer to Table 7 for power supply and output PWA output jumpers and their appropriate positions with respect to the instrument output.
7. Refer to Figure 16 for power supply and output PWA output jumper and position locations.
8. Refer to Table 8 for processor PWA output jumper and its appropriate position with respect to the instrument output.

Table 8.
Processor PWA Jumper and Position Designations for Temperature Output

OUTPUT	J3 JUMPER BETWEEN
Isolated	P1 & P2
Nonisolated	P1 & P3

9. Refer to Figure 17 for processor PWA output jumper and position locations.
10. Move each jumper to its appropriate position.
11. Refer to "Bench/Dry Calibration" section. Perform Steps 21 through 50.

MAINTENANCE

Operational Malfunction

Symptom: With power connected, Monitor is inoperative (blank display).

Corrective Action: Externally remove power and check fuse in user connection module. Refer to Figure 14.

Symptom: With known conductivity other than zero, display remains fixed at zero.

Corrective Action: Externally remove power and perform the following continuity measurement (sensor remains connected). Remove cover from user-connection module and connect Ohmmeter between terminals 1 and 2. Refer to Figure 8. Ohmmeter should read less than 10 Ω. Connect Ohmmeter between terminals 4 and 5. Again, Ohmmeter should read less than 10 Ω. If either reading exceeds 10 Ω, replace sensor.

Symptom: Measurement or temperature output, as transmitted by Monitor, suspected of being at incorrect value.

Corrective Action: Perform calibration.

Error Messages on Display

Certain problems, which may occur during operation, are detected by the Monitor and reported to the user via the Monitor numeric display. When the problem occurs, the Monitor display continuously alternates between the present measurement value and zero or a numeric error message.

If the Monitor display continuously blinks, the process measurement is either below the 0% value or above the 100% value. Refer to "Scaling the Analog Output" section.

If the Monitor alternately displays a numeric error message, the meaning of the numeric error message is determined by the number displayed.

Each numeric error message and its definition is shown in Table 9.

If two or more problems should exist at the same time, then the numerical error message shown on the display will be the sum of the individual numeric error messages.

Example: If the Monitor display was alternating between the measurement value, and the number 65, then both problems "TEMPERATURE TABLE OVERFLOW" and NOVRAM CHECK ERROR" would be present.

Table 9. Error Messages

ERROR MESSAGE	DEFINITION
1	Temperature table overflow.
2	Sensor circuit problem.
4	Option error.
8	Value to be displayed exceeds display capability (>9999).
16	ROM check/sum error.
32	Internal RAM check error.
64	NOVRAM check error.

TEMPERATURE TABLE OVERFLOW: Process temperature exceeds programmed temperature range of Monitor.

Corrective Action: Using Ohmmeter, check resistance between terminals 6 and 7 at sensor leads, with sensor disconnected. Refer to Table 10. Resistance should approximate the value given in Table 10 for the appropriate temperature. If not, replace sensor. Refer to measurement sensor instruction.

Table 10. Temperature Sensor Resistance

PROCESS TEMPERATURE °C	PROCESS TEMPERATURE °F	RTD RESISTANCE Ω ±0.1%	100 KΩ THERMISTOR RESISTANCE Ω ±0.1%
-5	+20	98.04	461 550
0	32	100.00	351 020
10	50	103.90	207 850
20	68	107.79	126 740
25	77	109.73	100 000
30	86	111.67	79 422
40	104	115.54	51 048
50	122	119.40	33 591
60	140	123.24	22 590
70	158	127.07	15 502
80	176	130.89	10 837
90	194	134.70	7 707.7
100	212	138.50	5 569.3
105	225	140.39	4 760.3
110	230	142.28	4 082.9
120	248	146.06	3 033.3
130	266	149.82	2 281.0
160	320	161.04	---

SENSOR CIRCUIT PROBLEM:

Corrective Action: Check all sensor connections to assure continuity. Replace sensor. Refer to Measurement Sensor Instruction.

OPTION ERROR

1. Refer to Data Plate for legal entries of options.

2. Check that custom curve entry points do not exceed maximum number of points allowed (57).

VALUE TO BE DISPLAYED EXCEEDS DISPLAY CAPABILITY (>9999):

Corrective Action: Confirm correct sensor and that sensor is operational. Refer to Foxboro.

ROM CHECK/SUM ERROR:

Problem present in processor PWA.

Corrective Action: Same as Internal RAM check error.

INTERNAL RAM CHECK ERROR: Problem present in microprocessor circuit.

Corrective Action: Replacement of processor PWA and display PWA required. Replacement PWA's will be joined by ribbon cable as received. Proceed as follows:

1. Remove power from Monitor.
2. Remove four screws from front panel.
3. Pull forward the front panel with attached four PWA's.
4. Disconnect ribbon cable between user connection module and power supply PWA. Do so by opening tabs on connector on power supply PWA. Refer to Figure 18.
5. Disconnect remaining ribbon cable connected to power supply PWA, as shown in Figure 19.
6. Remove four screws on columns.
7. Remove power supply PWA and place aside.
8. Unscrew four columns exposed by removal of power supply PWA.
9. Remove ribbon cable connector from the signal conditioning PWA in same manner as shown in Figure 18.
10. Remove signal conditioning PWA, and place aside.
11. Remove four short columns exposed by removal of signal conditioning PWA.
12. Loosen processor PWA and move forward (remains attached by cable to display PWA) to access the four columns beneath the processor PWA.

    Disconnect clear ribbon cable from display PWA as shown in Figure 20.
13. Remove four columns which supported the processor PWA.
14. Remove the display PWA and processor PWA (still connected) from the Monitor and discard.
15. Mount replacement display PWA and processor PWA combination to Monitor and reassemble using above steps in reverse order.

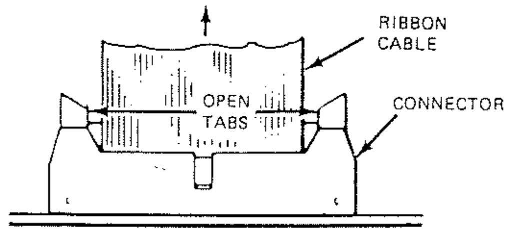

Figure 18.
Removal of Power Supply/
User Connection Module Ribbon Cable

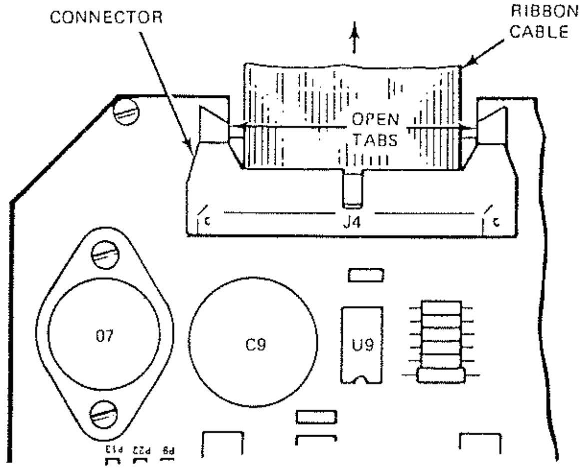

Figure 19.
Removal of PWA Interconnection
Ribbon Cable from Power Supply PWA

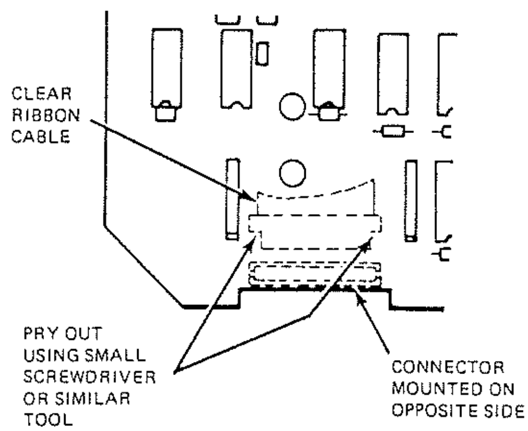

Figure 20.
Disconnecting Clear Cable from Display PWA

NOVRAM CHECK ERROR: Problem present in non-volatile RAM circuit.

Corrective Action: Same as for INTERNAL RAM CHECK ERROR.

CONVERTING EC MONITOR TO CC OR PH MONITOR

1. Remove power from Monitor.
2. Remove four screws from front panel.
3. Pull forward the front panel with attached four PWA's.
4. Disconnect ribbon cable between user connection module and power supply PWA. Do so by opening tabs on connector on power supply PWA. Refer to Figure 18.
5. Disconnect two wire cable that connects to signal conditioning PWA (Figure 21).
6. Disconnect remaining ribbon cable connected to power supply PWA (Figure 20).
7. Remove four screws on columns.
8. Remove power supply PWA and place aside.
9. Unscrew four columns exposed by removal of power supply PWA.
10. Remove ribbon cable connector from the signal conditioning PWA in same manner as shown in Figure 18.
11. Remove signal conditioning PWA.
12. Install new CC or pH signal conditioning PWA.
13. Remove four screws from cover of user connection module and remove cover.

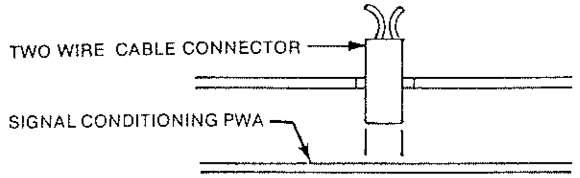

Figure 21. Two Wire Cable

For Panel-Mounted Version: cover is located opposite front panel at rear of unit.

For Field-Mounted Version: cover is located directly below front panel.

14. Disconnect two-wire cable connector from connection module (see Figure 22).
15. Remove four mounting screws.
16. Slide two-wire cable out. It is not required on the CC or pH Monitor.
17. Reinstall connection module making sure that the two wires on the bottom two mounting holes are in place.
18. Move jumper to the center position.
19. Reinstall connection module cover.
20. Reassemble using Steps 1 through 10 in reverse order.
21. See MI 611-158 (pH) or MI 611-160 (CC) to reconfigure and recalibrate Monitor.

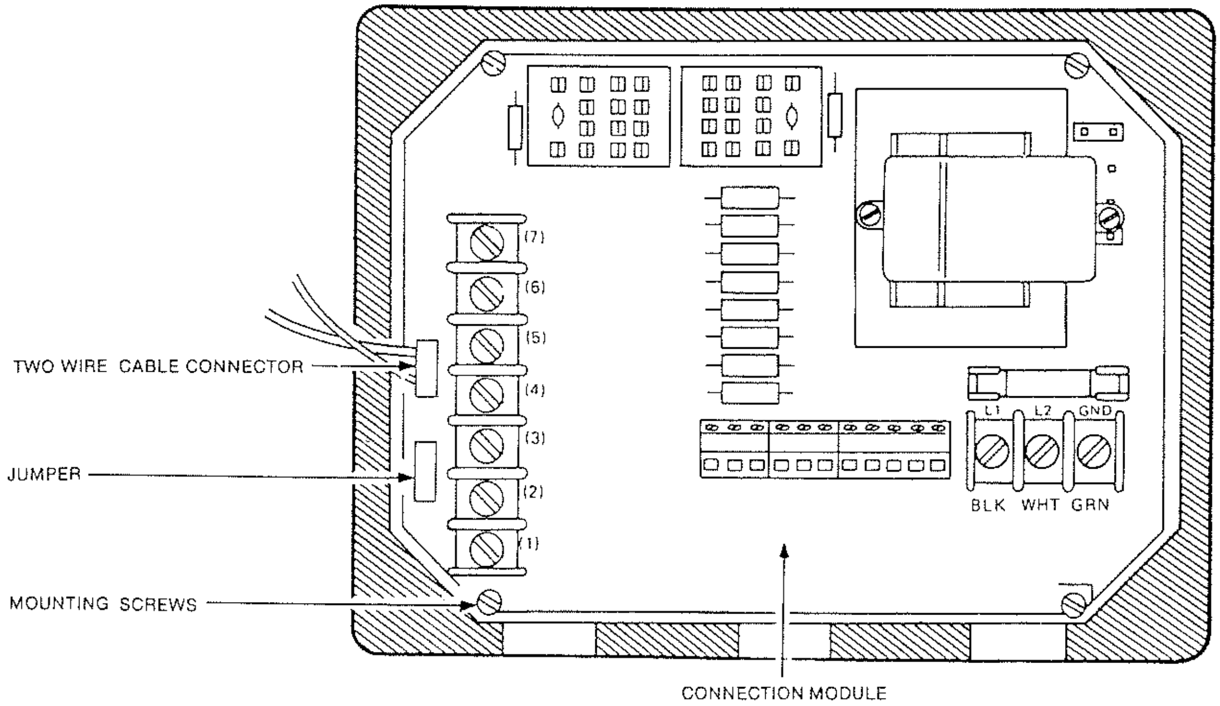

Figure 22. Connection Module

APPENDIX

LCD DISPLAY OPTION

CHANGING THE SECURITY CODE

1. Remove the four screws from the front panel. If storm door option has been ordered, removal of upper two screws loosens the hinge covers holding the storm door. Temporarily place storm door aside.

2. Pull forward the front panel with the attached four PWA's.

3. Refer to Figure 10 and locate the "display" PWA immediately behind the front panel.

4. Refer to Figure A-1 for location of DIP switch 1 on the display PWA. Switch 1 has eight switches numbered 1 through 8.

5. Using a small screwdriver or similar tool, close switch 1-7. Refer to Figure A-2.

NOTE

Figure A-2 is not intended to show all required switch positions. It is presented only to show DIP switch configuration and to identify the "open" and "closed" positions.

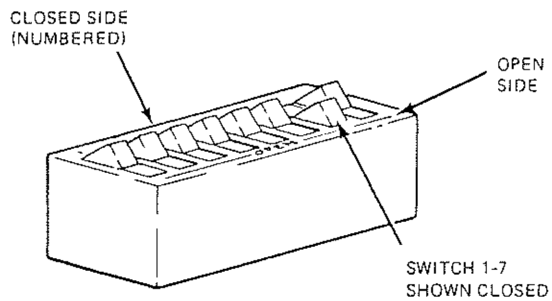

Figure A-2.
DIP Switch Positions

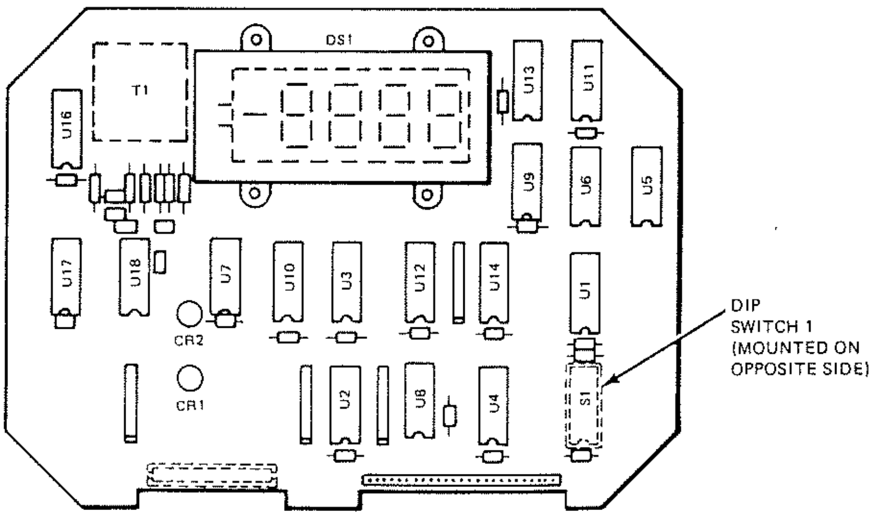

Figure A-1. LCD Display PWA