Instruction Manual
PN 51-1181pH/rev.B
March 2003

Model 1181 pH/ORP

Combination pH/ORP Two-Wire Transmitters

ROSEMOUNT® Analytical

EMERSON™ Process Management

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product. If this Instruction Manual is not the correct manual, telephone 1-800-654-7768 and the requested manual will be provided. Save this Instruction Manual for future reference.
- If you do not understand any of the instructions, contact your Rosemount representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

DANGER

HAZARDOUS AREA INSTALLATION

INTRINSICALLY SAFE INSTALLATION

Transmitter/Sensor is not Intrinsically safe. Installations in hazardous area locations must be carefully evaluated by qualified on site safety personnel. To secure and maintain an intrinsically safe installation, an appropriate safety barrier must be used and the installation must be performed in accordance with the governing approval agency (FM, CSA or BASEEFA/ CENELEC) installation drawing requirements (see Section 2.0-Installation).

EXPLOSION-PROOF INSTALLATION

Sensors are not explosion-proof and must be installed in a non-hazardous location. If the sensor must be installed in a hazardous location an intrinsically safe system must be implemented. To maintain the explosion-proof rating of the transmitter, the following conditions must be met:

- Discontinue power supply before removing enclosure covers.
- Transmitter covers must be properly installed during power on operation.
- Explosion proof "Y" fittings must be properly installed with sealing compound prior to applying power to the transmitter.
- Serial tag cover over the external Zero and Span adjustments must be in place.
- See Installation Section for details.

Proper installation, operation and servicing of this instrument in a Hazardous Area Installation is entirely the responsibility of the user.

About This Document

This manual contains instructions for installation and operation of the Model 1181 pH/ORP Two-wire transmitter. The following list provides notes concerning all revisions of this document.

Rev. Level	Date	Notes
A	7/01	This is the initial release of the product manual. The manual has been reformatted to reflect the Emerson documentation style and updated to reflect any changes in the product offering and agency certification.
B	3/03	Updated CE information.

Emerson Process Management

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QUICK START-UP

The 1181pH two-wire transmitter is factory configured to work, right out of the box, for many applications. Factory Settings:

- 0-14pH measurement range: 0pH (low range) corresponds to 4mA output; 14pH (high range) corresponds to 20mA output.
- Automatic temperature compensation is utilized.
- (Optional LCD is set for 0-100% read out) If these settings are acceptable to your process you can utilize this quick start up procedure.

I. Set up

1. For non-hazardous areas or bench testing, set-up the transmitter & sensor as illustrated in Figure A.
2. For hazardous or intrinsically safe installations, set-up the transmitter & sensor as illustrated in the appropriate agency drawing (Figure 2-5 through 2-12).

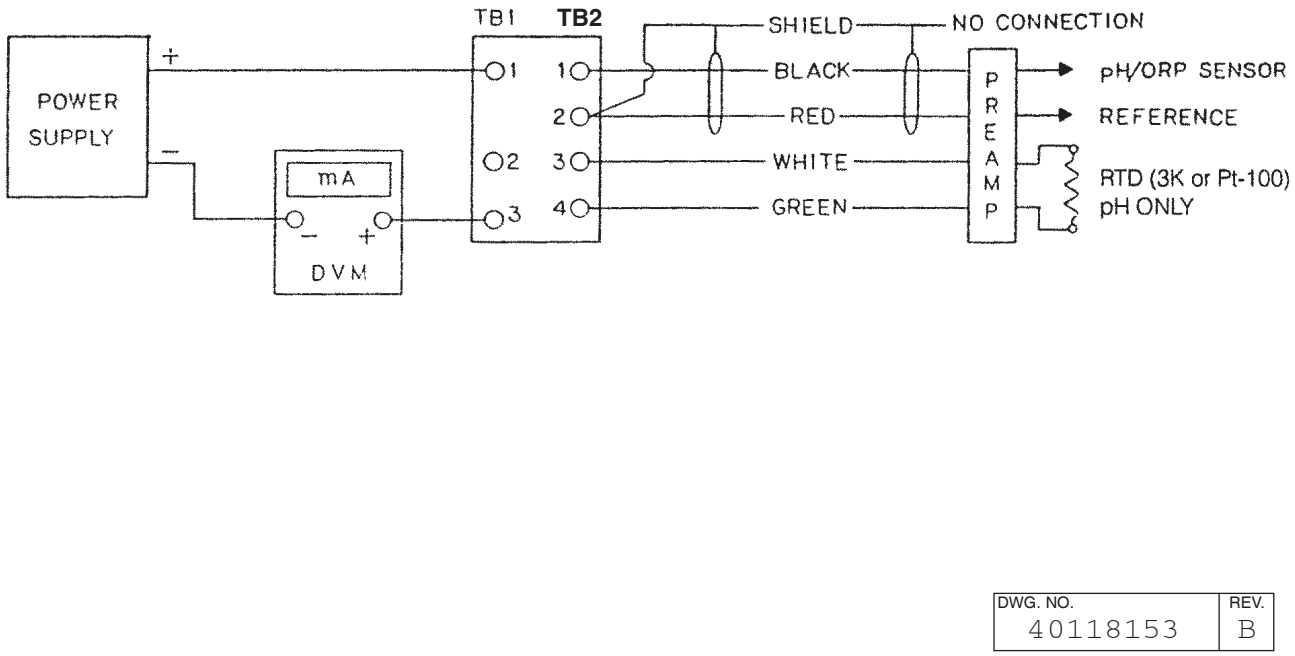

FIGURE A

II. **Solution Calibration**

1. Obtain two buffer solutions. One should represent a low range, and the other a high range value. Typical buffer solution values 4pH, 7 pH & 10 pH.
2. Place the sensor in the lower range buffer solution, allow the reading to stabilize.
3. a. adjust ZERO control (under the serial label) until the DVM reads the current output value that corresponds to the buffer value.

$$\text{mA} = \frac{\text{Buffer value-Low pH range}}{\text{High pH range-Low pH range}} \times 16 \text{ mA} + 4 \text{ mA}$$

Example: For 4 pH buffer solution;
Range of 0-14 pH

$$\text{Ex.} = \frac{4 \text{ pH-0 pH}}{14 \text{ pH-0 pH}} \times 16 \text{ mA} + 4 \text{ mA} = 8.57 \text{ mA}$$

b. If a liquid crystal display is installed, adjust the LCD ZERO pot (on LCD face) until the display indicates the proper percentage of full scale value.

$$\% \text{ Reading} = \frac{\text{Buffer pH value}}{\text{High pH range}} \times 16 \text{ mA} + 4 \text{ mA}$$

$$\text{Ex.} = \frac{4 \text{ pH}}{14 \text{ pH}} \times 100 = 28.6\%$$

4. Remove the sensor from the low range buffer, and rinse it in clean water.
5. Place the sensor in high range buffer, and allow the reading to stabilize.
6. a. adjust the SPAN control (under serial label) until DVM reads the current output value that corresponds to the computed buffer value.

$$\text{Ex.} = \frac{10 \text{ pH-0 pH}}{14 \text{ pH-0 pH}} \times 16 \text{ mA} + 4 \text{ mA} = 15.43 \text{ mA}$$

b. If a LCD is installed, adjust the LCD SPAN pot (on LCD face), until the display indicates the proper percentage of the computed full-scale value.

$$\text{Ex.} = \frac{10 \text{ pH}}{14 \text{ pH}} \times 100 = 71.4\%$$

7. Repeat Step 2 through 7 until no further adjustments are required. Rinse the sensor in clean water prior to placing it in a different buffer solution.
8. Remove DVM and connect power supply end directly to the transmitter.

III. **Standardize to the Process**

A slight adjustment of the 1181 ZERO pot may be necessary to fine tune the loop to your process.

1. Install sensor into it's final mounting position, and allow sensor to acclimate to the process temp. (Wait for reading to stabilize).
2. Take a grab sample of the process, close to the sensor, and have it analyzed. Note the pH value.
3. Adjust the 1181 ZERO control (under serial label) until the display reads the percentages of full-scale that corresponds to the grab sample pH value.

$$\frac{\text{Grab Sample pH}}{14 \text{ pH}} \times 100 = \% \text{ of full scale}$$

$$\frac{6.86}{14 \text{ pH}} \times 100 = 49.0 \%$$

4. Start-up and calibration is now complete. Refer to 1181pH manual for further details on 1181 features.

MODEL 1181pH/ORP
TWO-WIRE TRANSMITTERS

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SECTION 1.0
DESCRIPTION AND SPECIFICATIONS

- *TWO-WIRE FIELD MOUNTED TRANSMITTERS. Ideal for multiple loop installations where central data processing and control are required. Field mounting near the sensor for ease in routine calibration.*
- *NEMA 4X WEATHERPROOF, CORROSION-RESISTANT, DUAL COMPARTMENT HOUSING provides maximum circuit protection for increased reliability in industrial environments.*
- *HAZARDOUS AREA INSTALLATION. Certified NEMA 7B explosion-proof and intrinsically safe when used with an approved sensor and safety barrier.*
- *COMMONALITY OF PARTS reduces inventory required to support different field measurements.*
- *SWITCH SELECTABLE RANGES further reduces inventory by permitting calibration of one Model to virtually any Tag Number requiring the same measurement.*
- *EXTERNAL ZERO AND SPAN, 20-turn potentiometers provide for fine calibration of the isolated 4-20 mA output signal.*

1.1 FEATURES AND APPLICATIONS

The Rosemount Analytical Two-Wire field mounted transmitters, with the appropriate sensors, are designed to continuously measure the pH, ORP, Conductivity, Dissolved Oxygen, or Free Residual Chlorine in industrial processes.

The Model 1181 Transmitters include all the circuitry necessary for the measurement and transmission of an isolated 4-20 mA linear signal. Measurement range selection is made through internal range switches that are easily accessed by removing a housing cover. No further disassembly is required. A matrix is provided which conveniently indicates the proper switch position. Range selection can be made without the use of the instruction manual. Fine calibration of the 4-20 mA signal is accomplished with the 20-turn external Zero and Span potentiometers.

The electronic printed circuits are protected from the environment by the NEMA 4X weatherproof, corrosion resistant enclosure. The printed circuit cards plug into a moisture barrier which is isolated from the field wiring and calibration terminals. Routine field calibration does not require exposing the electronics to harsh industrial environments. All PCBs are conformal coated for maximum protection. The PCBs are removed as a unit and may be individually replaced. The transmitter housing covers are sealed with large cross sectional O-rings and need not be replaced each time the cover is removed.

The Model 1181 is available with or without an analog or digital display. The digital display may be calibrated in engineering units and the analog display features multiple scales in engineering units.

The transmitters are certified explosion-proof, NEMA 7B, and intrinsically safe when installed with an approved barrier and sensor. Hazardous area certificates are provided by BASEEFA to CENELEC regulations, FM, CSA, SAA, SEV, and TUV. CSA has determined that the moisture barrier qualifies as Factory Sealed which means Explosion Proof Y fittings and sealing compound are not required for installation when this approval is selected.

Accessory items are available for the two-wire transmitters. The Model 515 Isolated Power Supply provides power for up to 20 transmitters. Two transmitters may be wired directly to the power supply. For more than two transmitters, junction boxes are available, each accommodating wiring for a maximum of ten transmitters. Remote alarms are available with independently adjustable set points and hysteresis. Contacts of the Model 230A may be specified for high/low, high/high, or low/low operation. The impedance of the Model 230A Alarm Module is less than 100 ohms. For further information on the Models 515 and 230A, please refer to to their respective product data sheet.

1.2 PERFORMANCE SPECIFICATIONS – GENERAL

Power Supply Requirements: (See Load/Supply Chart)

Lift Off Voltage: Blind & Analog: 10 VDC
Digital: 12.5 VDC

Maximum Operating Power: 40 milliwatts

Output: Blind & Analog: Isolated 4-20 mA into 700 ohms at 24 VDC
Digital: Isolated 4-20 mA into 575 ohms at 24 VDC

Input/Output Isolation: 600 Volts

Ambient Temperature: –30° to 55°C

Ambient Humidity: 0-99% RH

Digital Display Accuracy: 0.1% reading ±1.0 count

Analog Display Accuracy: ±2.0%

External Zero: ±7.5% full scale (25% for 1181T)

External Span: ±7.5% full scale (50% for 1181T)

Shock: 10G maximum for 10 milliseconds

Vibration: 0.025 inches double amplitude
5 to 50 Hz for 2 hours

EMI/RFI: EN61326 CE

FIGURE 1-1
BLIND & ANALOG DISPLAY
LOAD/POWER SUPPLY REQUIREMENTS

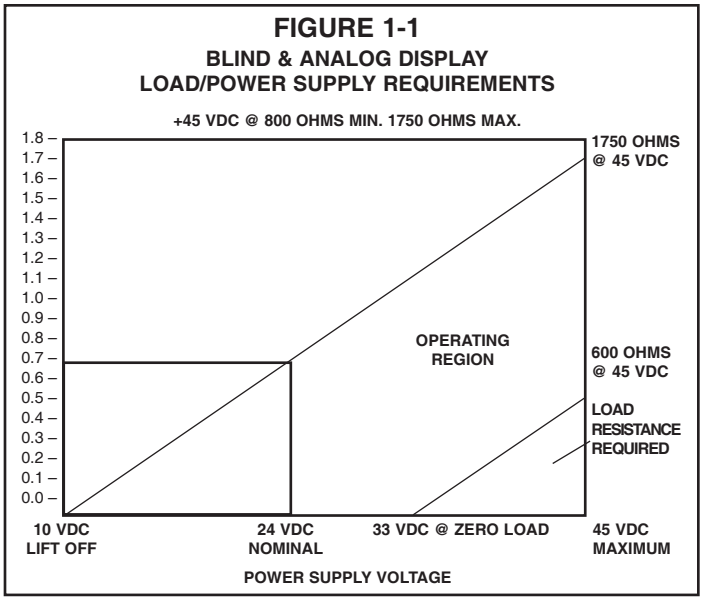
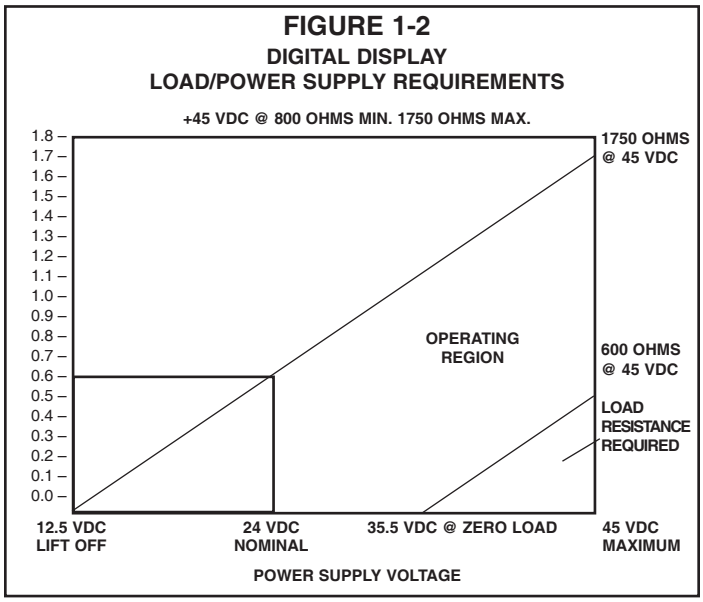


FIGURE 1-2
DIGITAL DISPLAY
LOAD/POWER SUPPLY REQUIREMENTS



1.3 PHYSICAL SPECIFICATIONS - GENERAL

Enclosure: NEMA 4X, weatherproof and corrosion-resistant
NEMA 7B, explosion proof

Hazardous Area Classification:

Explosion Proof:

FM: Class I, Groups B, C, & D, Div. 1
Class II, Groups E, F, & G, Div. 1
Class III
60°C Maximum

CSA: Class I, Groups C, & D,
Class II, Groups E, F, & G
Class III, Encl 4
Class I, Groups A, B, C, & D, Div. 2
Encl 4, Factory Sealed

Intrinsic Safety:

FM: Class I, II, & III, Div. 1
Temperature Code T4

CSA: Class I, Groups A, B, C, & D, Encl 4
Temperature Code T4

CENELEC: Ex ia IIB T4 (Tamb = 55°C)

Display:

Analog: plug in, 90 degree, 2.5 inch diameter

1181pH:	dual scale, 0-100% & 0-14pH
1181ORP:	dual scale, 0 center, ±1.0 & 0-100%
1181C:	single scale, 0-100%
1181T:	single scale, 0-100%
1181DO:	triple scale, 0-5, 0-10, 0-20 ppm
1181PB:	triple scale, 0-5, 0-10, 0-20 ppb X10
1181SO:	triple scale, 0-100, 0-200, 0-800 mm Hg
1181RC:	triple scale, 0-5, 0-10, 0-20 ppm

Digital: 3.5 digit, LCD, adjustable range in engineering units

Recommended Cable: Transmitter to Power Supply
Two Wire, 18 AWG, shielded, Belden 8760
or equal (Rosemount Analytical P/N 9200001)

Weight/Shipping Weight:

1181pH, ORP, DO, PB, SO, RC, CL:
Blind: 1.44 kg/1.89 kg (3.18 lbs/4.18 lbs)
Analog/Digital: 2.15 kg/2.6 kg (4.74 lbs/5.75 lbs)

1181C, T:
Blind: 1.8 kg/2.25 kg (4.0 lbs/5.0 lbs)
Analog/Digital: 2.48 kg/2.93 kg (5.5 lbs/6.5 lbs)

1.4 MODEL 1181pH TRANSMITTER The Model 1181 pH Transmitter measures over the full range of 0-14 pH. The 4-20 mA isolated output may be field calibrated to represent any 2 to 14 pH span. Two digital displays are offered with the 1181pH. The Code 04 LCD display receives its input from the pH preamplifier. The advantage of the Code 04 display is that it will continue to display the measured pH regardless of the calibrated output. The Code 06 LCD display and the analog display receive their input from the 4-20 mA loop current and will display pH to the calibrated output only.

The 1181pH Transmitter is available with an integral preamp. The Code 43 integral preamp is for use with sensors having a PT100 temperature compensator and the Code 44 internal preamp is for use with the Rosemount Analytical standard 3K temperature compensator. An integral preamp is not compatible with the Code 04 LCD display and Code 02 Blind. These options require a Tall Housing Cover (P/N 3002468). The maximum recommended distance between the sensor and integral preamp is 15 feet (4.5 meters).

PERFORMANCE SPECIFICATIONS @ 25°C

(Electronics only)

Measurement Range: 0-14 pH

Internal Range Select: Any 2 to 14 pH span in one pH steps

Accuracy: ±0.1% F.S.

Stability: ±0.1%/month

Repeatability: ±0.1 pH

Temperature Coefficient: +0.0028 pH/ÞC F.S.

Automatic Temperature Compensations: 0-100ÞC

RECOMMENDED SENSORS:

Model 300 Retractable pH Sensor
Model 320B Flow Through pH Sensor
Model 320HP High Purity pH Sensor
Model 328A Steam Sterilizable pH Sensor
Model 381 Insertion/Submersion/Flow pH Sensor
Model 385 Retractable pH Sensor
Model 389 Disposable ORP Sensor
Model 396 TUpH Disposable Sensor
Model 399 Disposable pH Sensor

1.5 MODEL 1181ORP TRANSMITTER The Model 1181 ORP Transmitter measures over the range of ±1200 mV. The 4-20 mA isolated output may be calibrated to represent any 200 to 2400 mV range.

PERFORMANCE SPECIFICATIONS @ 25°C

Measurement Ranges Span: 200 mV to 2400 mV in 200 mV steps
Zero: 0 to ± 1200 mV in 200 mV steps

Accuracy: ±0.1% full scale
±2.0 mV full scale

Stability: ±0.1% F.S./month
±2.0 mV/month non-cumulative

Repeatability: ±2.0 mV/month
±0.1% full scale

Temperature Coefficient: ±0.4 mV/°C F.S.
±200 ppm/°C full scale

Automatic Temperature Compensations: N/A

RECOMMENDED SENSORS:

Model 300 Retractable ORP Sensor
Model 330B Flow Through ORP Sensor
Model 381 Insertion/Submersion/Flow ORP Sensor
Model 385 Retractable ORP Sensor
Model 389 Disposable ORP Sensor
Model 399 Disposable ORP Sensor

1.6 ORDERING INFORMATION

Model 1181 Two Wire Transmitter is housed in a NEMA 7B explosion-proof, 4X weatherproof, corrosion-resistant enclosure and includes all the circuitry necessary for measurement and transmission of an isolated 4-20 mA signal. The transmitter may be selected with or without an analog or digital display.

MODEL 1181 TWO-WIRE TRANSMITTER

CODE	INPUT (Required Selection)
pH	pH measurement in an aqueous solution
ORP	Oxidation Reduction Potential

CODE	DISPLAY (Required Selection)
01	Analog display
02	Blind, without indication
03	Analog display
06	Digital display

CODE	OPTIONS
07	Two-inch pipe/wall mounting bracket
11	Stainless steel nameplate (specify marking)

CODE	AGENCY APPROVALS
67	FM Explosion proof and Intrinsically Safe
69	CSA Explosion proof and Intrinsically Safe
73	CENELEC Intrinsically Safe/CE (not available with Code 01)

1181	pH	01	07-11	67	EXAMPLE

SECTION 2.0
INSTALLATION

2.1 GENERAL. The transmitter may be installed in harsh environmental locations. The transmitter should, however, be located to minimize the effects of temperature gradients and temperature fluctuations, and to avoid vibration and shock.

CAUTION

AVOID GROUND LOOPS:(Sensor's shield wire must not contact a grounded surface).

1. Use well insulated wire. Clean up all metal burrs on conduit before pulling cable.
2. Follow wiring instructions for the sensor. Shields aren't grounded on our analyzers.
3. Seal the sensor conduit from liquids, which can cause a short.

NOTE

Intrinsically safe units must be installed in accordance with their designated drawing numbers. See Section 2.5 for details. Further non-certified components CANNOT be substituted with certified units. This would void all certifications.

2.2 MECHANICAL INSTALLATION. Two threaded mounting holes are located in the bottom of the transmitter housing (see Figure 2-1). These holes are provided for mounting to a flat surface or for attaching the transmitter to the pipe mounting bracket (see Figure 2-1).

NOTE

If the transmitter is mounted in a vertical position, the sensor leads should come into the top of the housing and the power leads should come into the bottom of the housing.

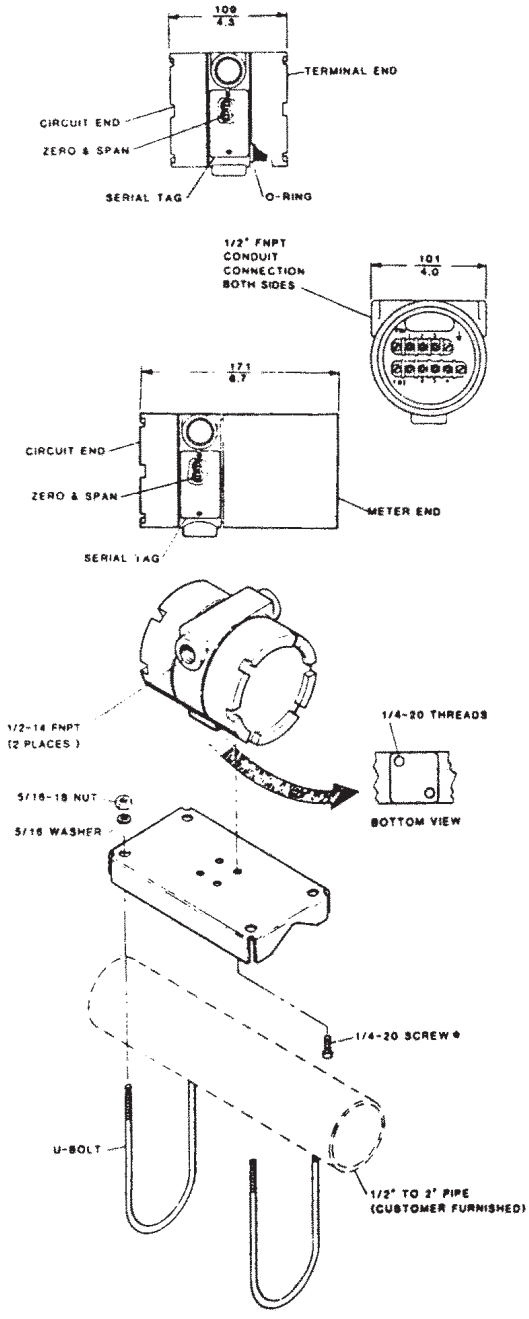


FIGURE 2-1. Transmitter Mounting Details

2.3 ELECTRICAL INSTALLATION. The transmitter has two ¼-inch conduit openings, one on each side of the housing. One opening is for the power or signal wiring, and the other is for the input wiring from the sensor.

NOTE

On models with the meter, make sure the meter wiring is securely connected after the signal and input wiring have been attached.

2.3.1 Sensor input wiring terminals are located on the side of the housing designated TERM SIDE on the serial label, and are the lower set of terminals (TB2). Remove the end cap from the TERM SIDE of the housing to gain access to the terminals (see Figure 2-2).

If the Model1181pH/ORP transmitter has been supplied with an integral preamplifier (Code Preamp Options 43 or 44), please refer to Figure 2-3 Integral Preamp Installation, and Figure 2-4 Wiring Details Integral Preamp for sensor input wiring instructions.

2.3.2 Power and signal wiring terminals are located directly above the sensor input wiring terminals and are designated TBl. For models with a meter, the terminals leads are also attached to TBl.

2.3.3. Conduit connection on the transmitter housing should be sealed or plugged (using a sealing compound) to avoid accumulation of moisture in housing. If the connections are not sealed, the transmitter should be mounted with the electrical housing downward for draining.

2.3.4. The transmitter case shall be grounded. Power supply regulation is not critical. Even with the power supply ripple, of one volt peak to peak, the ripple in the output signal would be negligible.

NOTE

For best EMI/RFI protection, the power supply/signal cable must be shielded and placed in an earth grounded, rigid metal conduit. Connect the outer shield to the earth ground terminal provided next to TB1.

The sensor cable should also be shielded. Connect the sensor cable's outer shield to the transmitter's earth ground via the ground terminal next to TB1. If the sensor cable's outer shield is braided an appropriate metal cable gland fitting may be used to connect the braid to earth ground via the instrument case.

A new addition to the suite of tests done to ensure CE compliance is IEC 1000-4-5. This is a surge immunity test that simulates overvoltages due to switching and lightning transients.

In order to meet the requirements of this test, additional protection must be added to the instrument in the form of a Transient Protector such as the Rosemount Model 470D. This is a 3½-inch tube with ½-inch MNPT threads on both ends. Inside the tube are gas discharge and zener diode devices to limit surges to the transmitter from the current loop. No additional protection is needed on the sensor connections.

TB1-1 Loop Signal (Power Supply + Vdc)
TB1-2 Meter (+) Red
TB1-3 Meter (–) Black & Loop Signal (4-20 mA Output)

TB2-1 pH/ORP Signal (Black)
TB2-2 Reference (Shield) & TC (Red)
TB2-3 Preamp (+5V, White)
TB2-4 Preamp (–5V, Green)

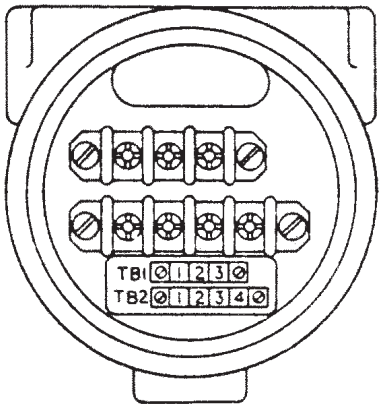


FIGURE 2-2. Transmitter Wiring Detail

2.4 HAZARDOUS LOCATIONS-EXPLOSION PROOF INSTALLATIONS. In order to maintain the explosion proof rating for installed transmitter, the following conditions must be met.

1. The transmitter enclosure covers must be on hand tight and the threads must not be damaged.

   NOTE

   These covers seat on rings which serve to provide a dust proof enclosure for Class II and Class III installations.

2. Explosion proof "Y" fittings must be properly installed and plugged with a sealing compound to prevent explosive gases from entering the transmitter. CSA has determined that the transmitter housing is "Factory Sealed". Installation of "Y" fittings and the use of sealing compound is not required for CSA approved Explosion Proof installations.

   NOTE

   Do not install sealing compound until all field wiring is completed.

   CAUTION

   Sealing compound must be installed prior to applying power to the transmitter.

3. If one of the conduit connections on the housing is not used, it must be closed with a threaded metal plug with at least five threads engaged.
4. The serial tag cover on the external ZERO and SPAN adjustments must be in place.
6. Explosion proof installation must be in accordance with Drawing Number 1400155 (see Figure 2-12).
5. For sensors in hazardous area locations, explosion proof junction boxes can be provided to house the preamplifier. This does not warrant the pH or ORP sensor explosion-proof. Maximum safety can be achieved by installing an intrinsically safe system where Hazardous Area requirements must be met.

2.5 HAZARD LOCATIONS - INTRINSICALLY SAFE INSTALLATIONS. To secure and maintain intrinsically safe installations for the appropriate approval agency, the following conditions must be met:

1. Code 73 must be specified when ordering CENELEC/BASEEFA units. Installation must be performed in accordance with Drawing Number 1400143 (see Figures 2-5, 6 & 7).
2. Code 69 must be specified when ordering C.S.A. (Canadian Standards Association) units. Installation must be in accordance with Drawing Number 1400123 (see Figure 2-8).
3. Code 67 must be specified when ordering F.M. (Factory Mutual) units. Approved “Entity” installation must be in accordance with Drawing Number 1400153 (see Figures 2-9, 2-10, and 2-11).

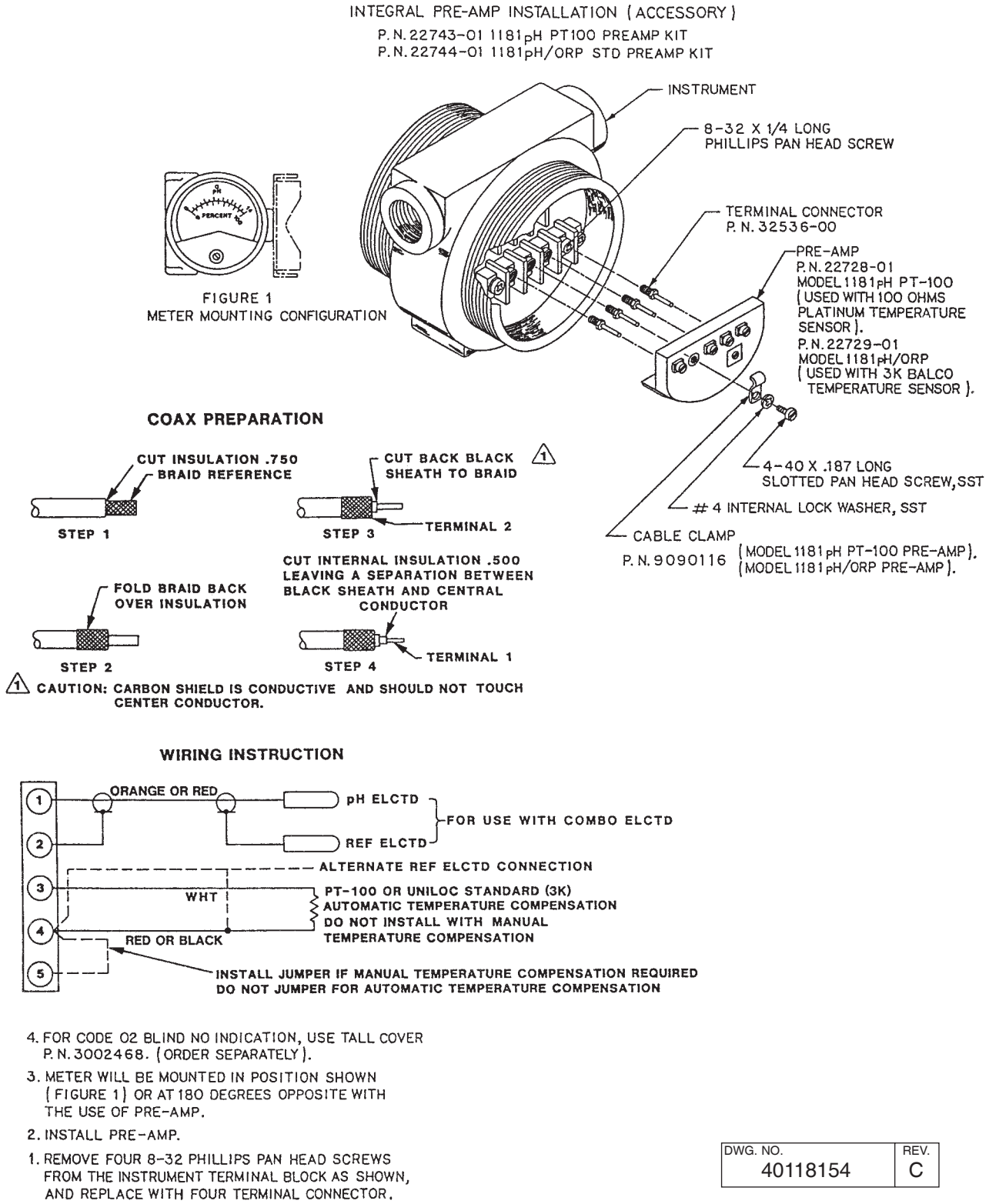


FIGURE 2-3. Integral Preamp Installation

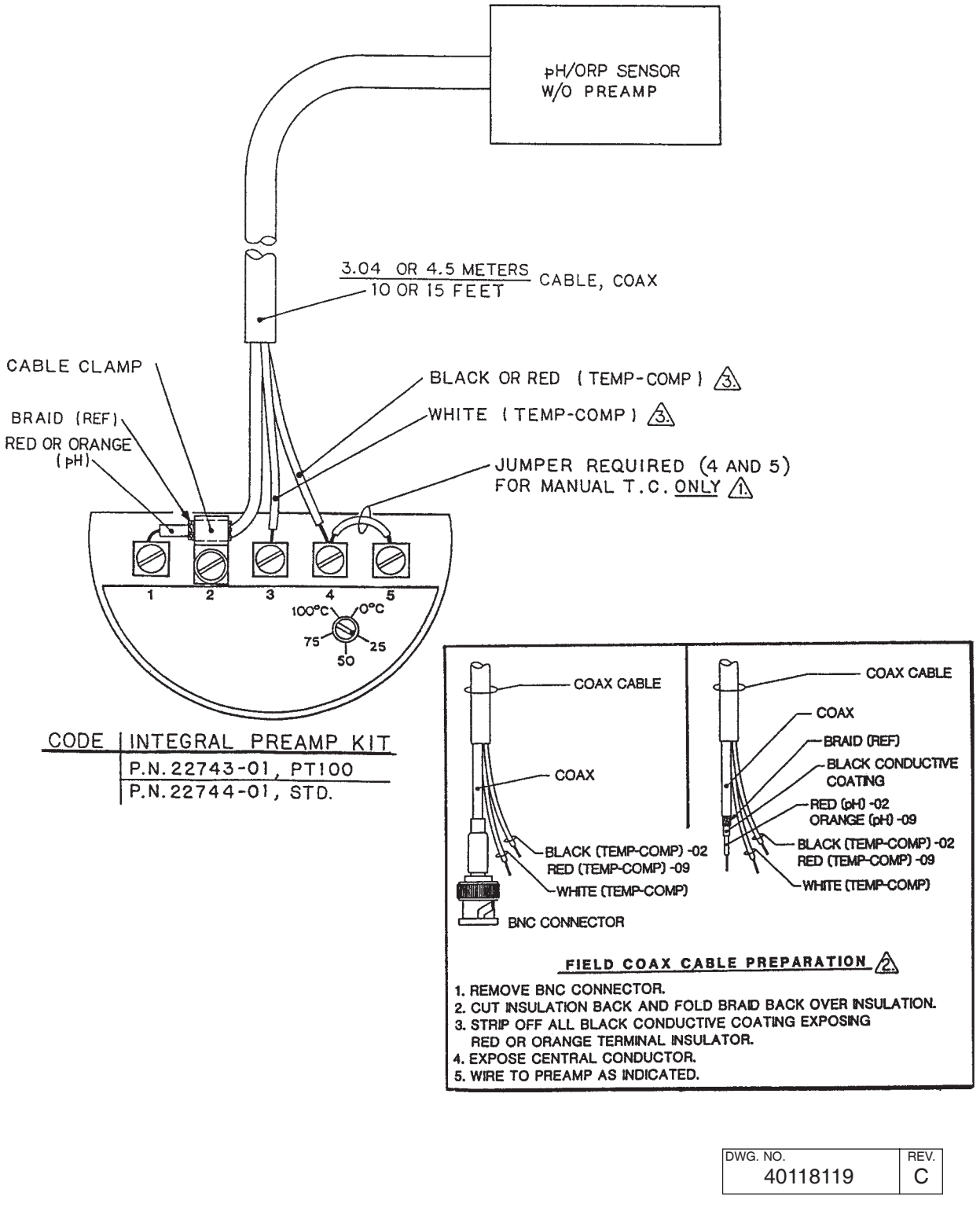


FIGURE 2-4. Wiring Details Integral Preamp

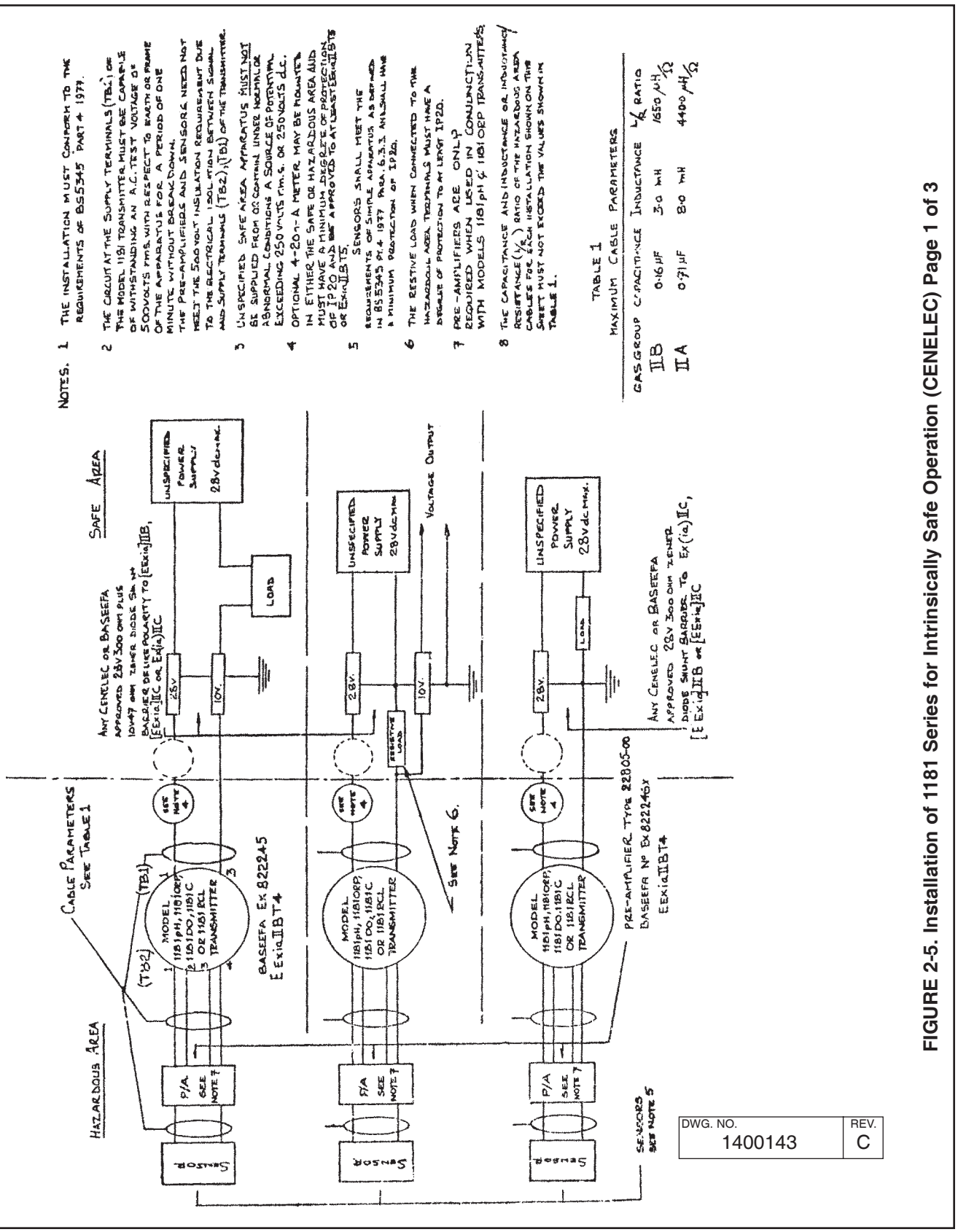


FIGURE 2-5. Installation of 1181 Series for Intrinsically Safe Operation (CENELEC) Page 1 of 3

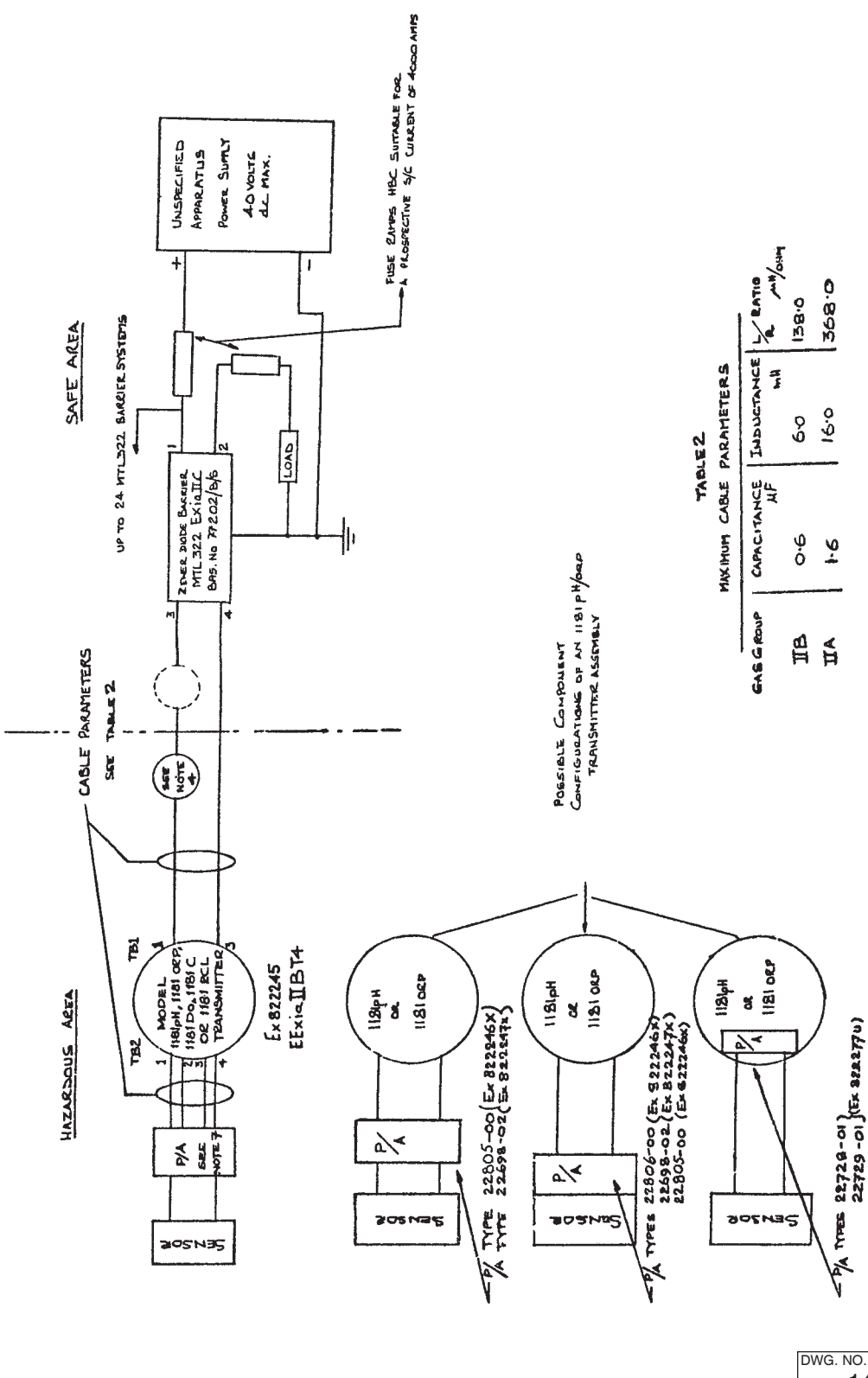


FIGURE 2-6. Installation of 1181 Series for Intrinsically Safe Operation (CENELEC) Page 2 of 3

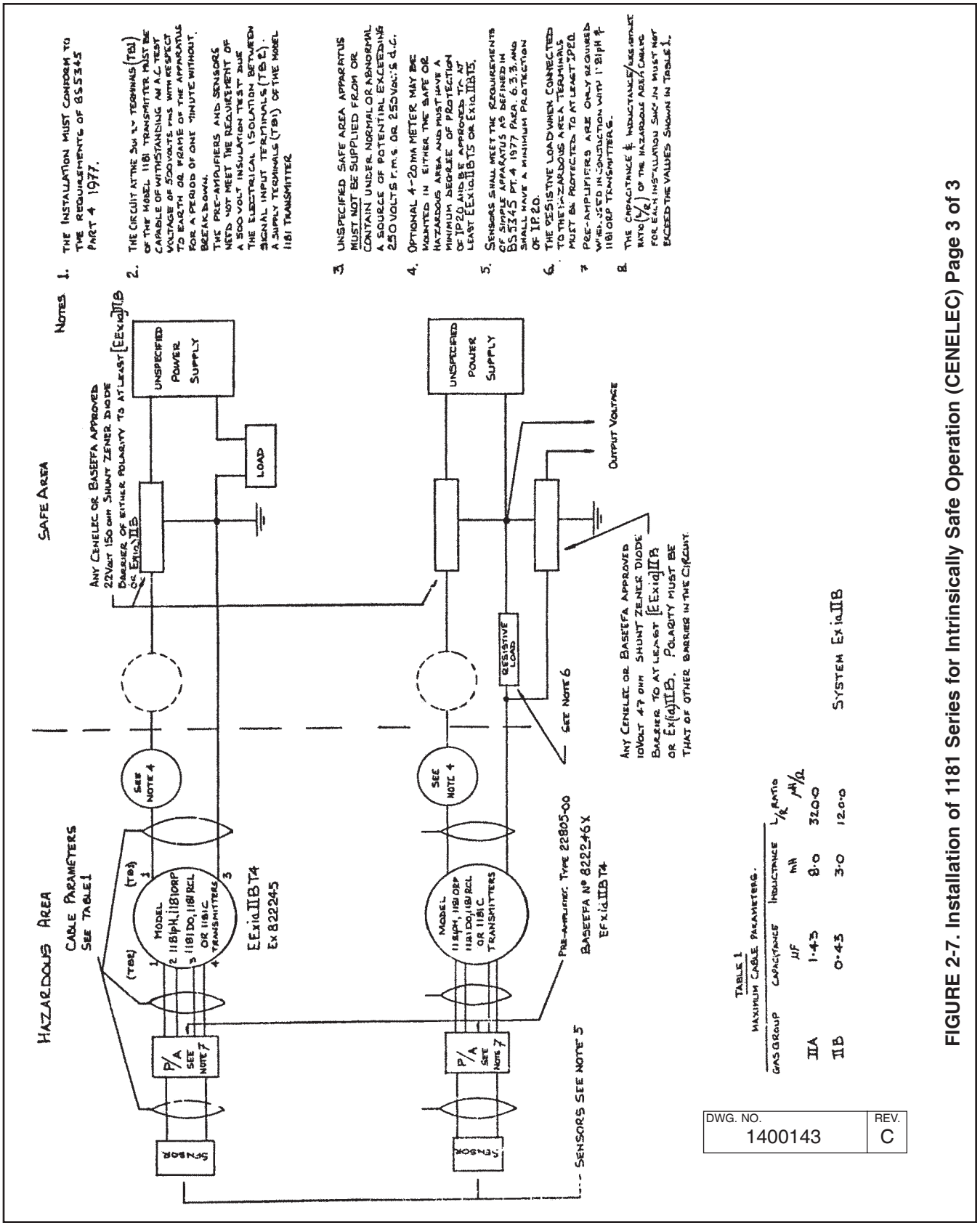
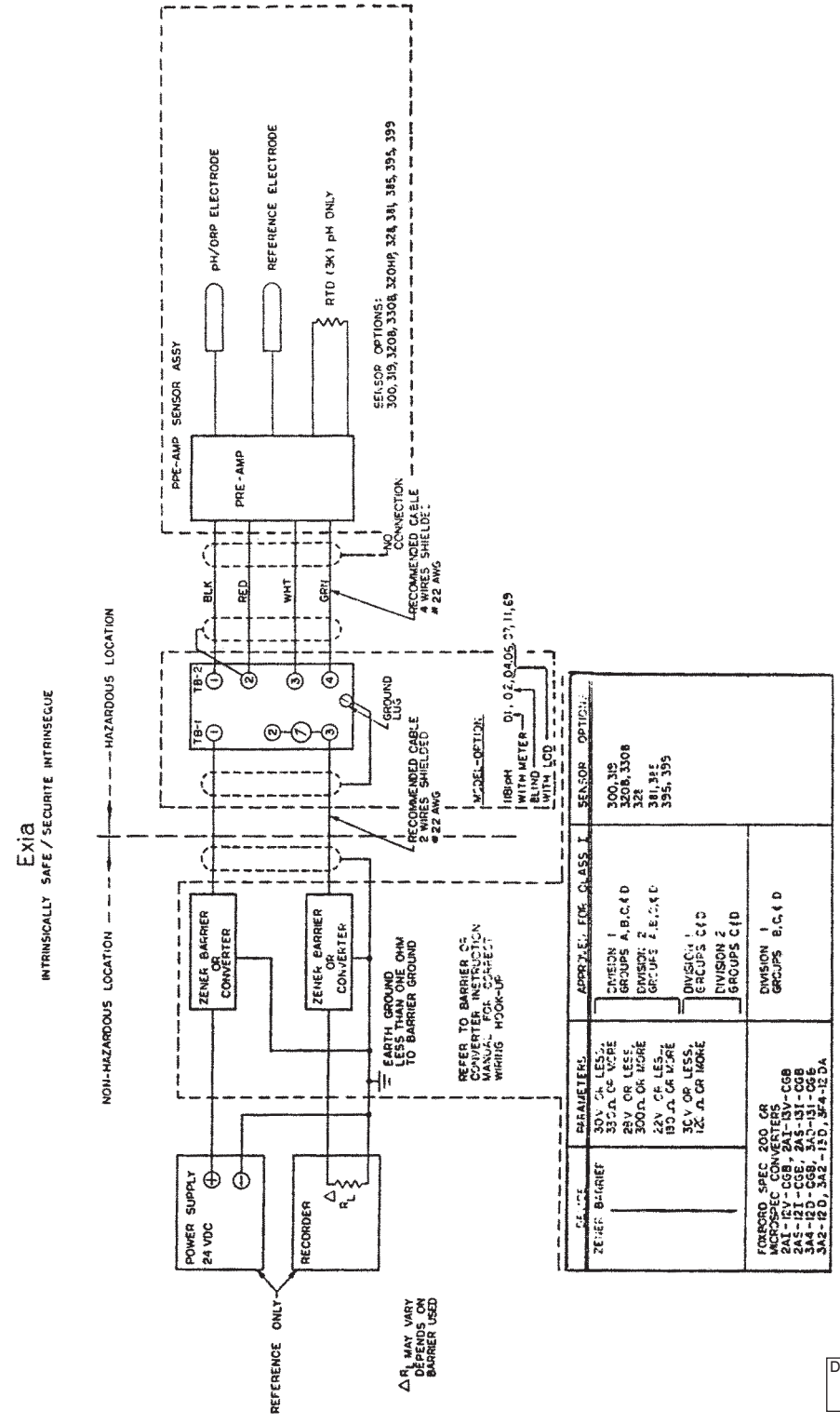
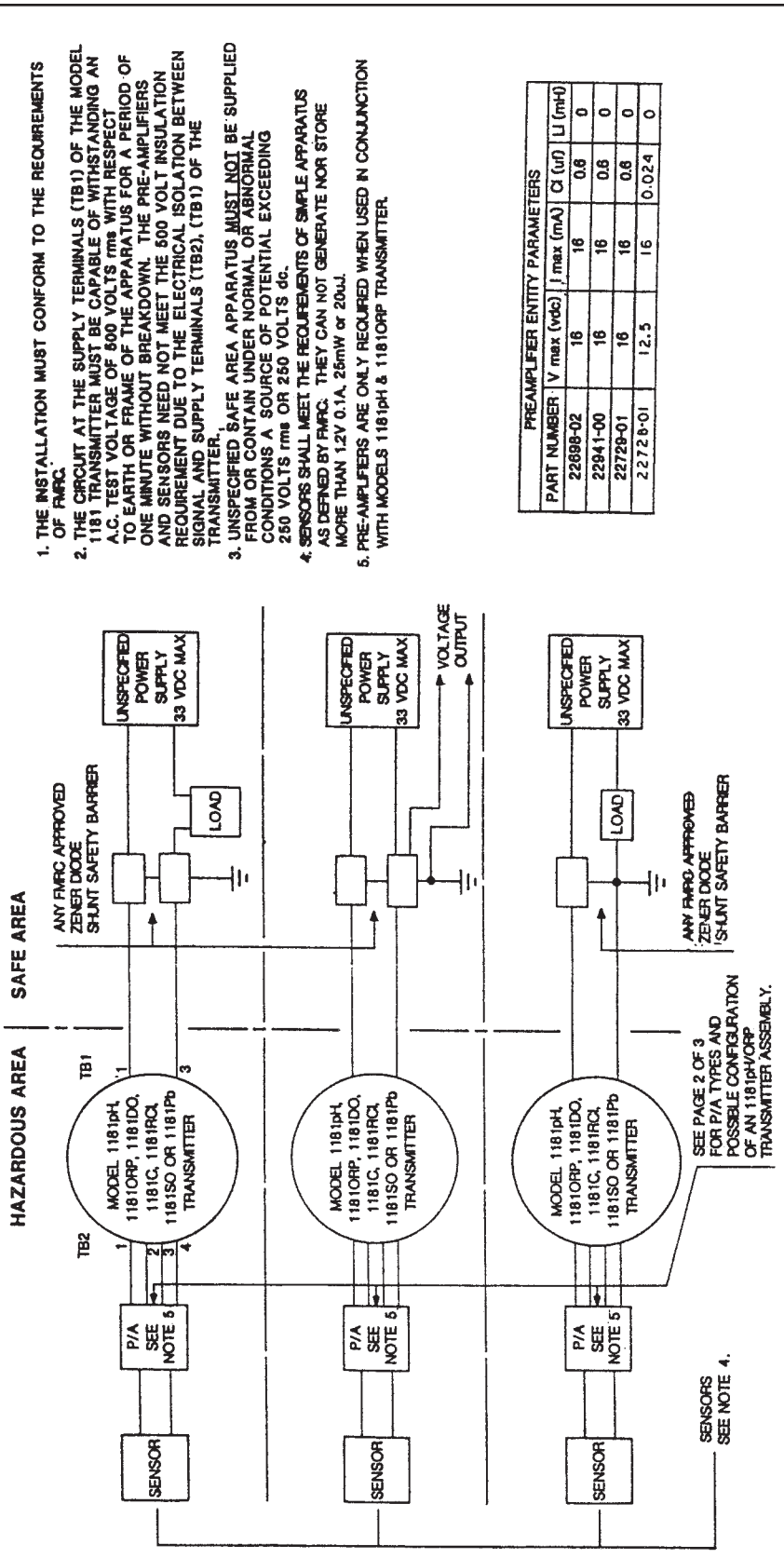


FIGURE 2-7. Installation of 1181 Series for Intrinsically Safe Operation (CENELEC) Page 3 of 3



DWG. NO.	REV.
1400123	E

FIGURE 2-8. Schematic, System 1181 pH & ORP, CSA



PREAMPLIFIER ENTITY PARAMETERS				
PART NUMBER	V max (vdc)	I max (mA)	Ci (uf)	Li (mH)
22698-02	16	16	0.6	0
22941-00	16	16	0.6	0
22729-01	16	16	0.6	0
22728-01	12.5	16	0.024	0

1181 ENTITY PARAMETERS - SUPPLY/SIGNAL TERMINALS 1 & 3				
MODEL NO.	V max (vdc)	I max (mA)	Ci (uf)	Li (mH)
1181pH/ORP	33	230	0.08	0.15
1181C	33	230	0.08	0.15
1181DO/RCI	33	230	0.08	0.15
1181SO/Pb	33	230	0.08	0.15

1181 ENTITY PARAMETERS - SENSOR TERMINALS 1, 2, 3 & 4 GROUPS A & B				
MODEL NO.	Voc max (vdc)	Isc max (mA)	Ca max (uf)	La max (mH)
1181pH/ORP	11.8	12.5	1.0	200.0
1181C	11.8	20.5	1.0	80.0
1181DO/RC	11.8	6.9	1.0	600.0
1181SO/Pb	11.8	6.8	1.0	700.0

DWG. NO.	REV.
1400153	D

FIGURE 2-9. 1181 Schematic, System F.M. I.S. Approved - Entity Page 1 of 3

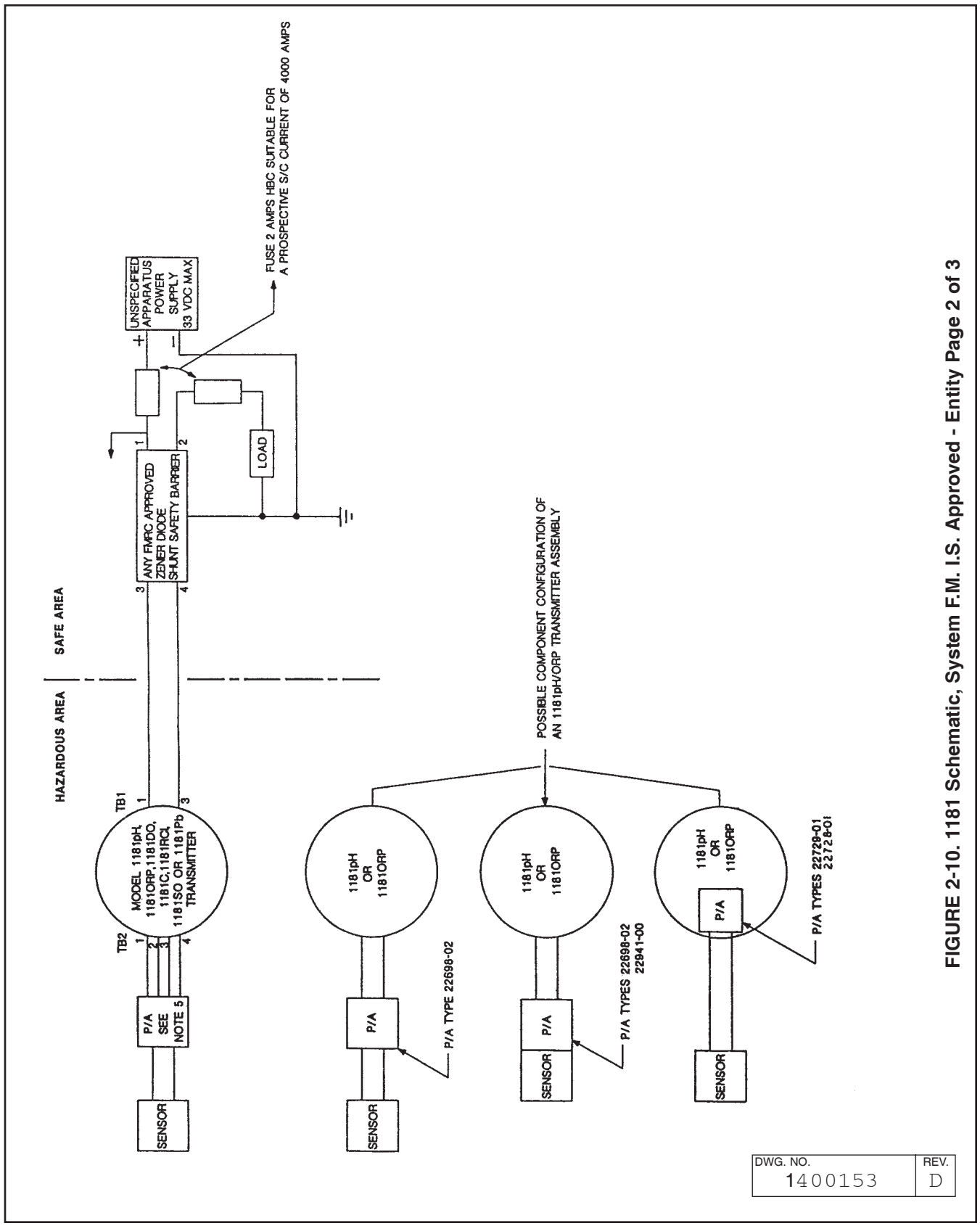
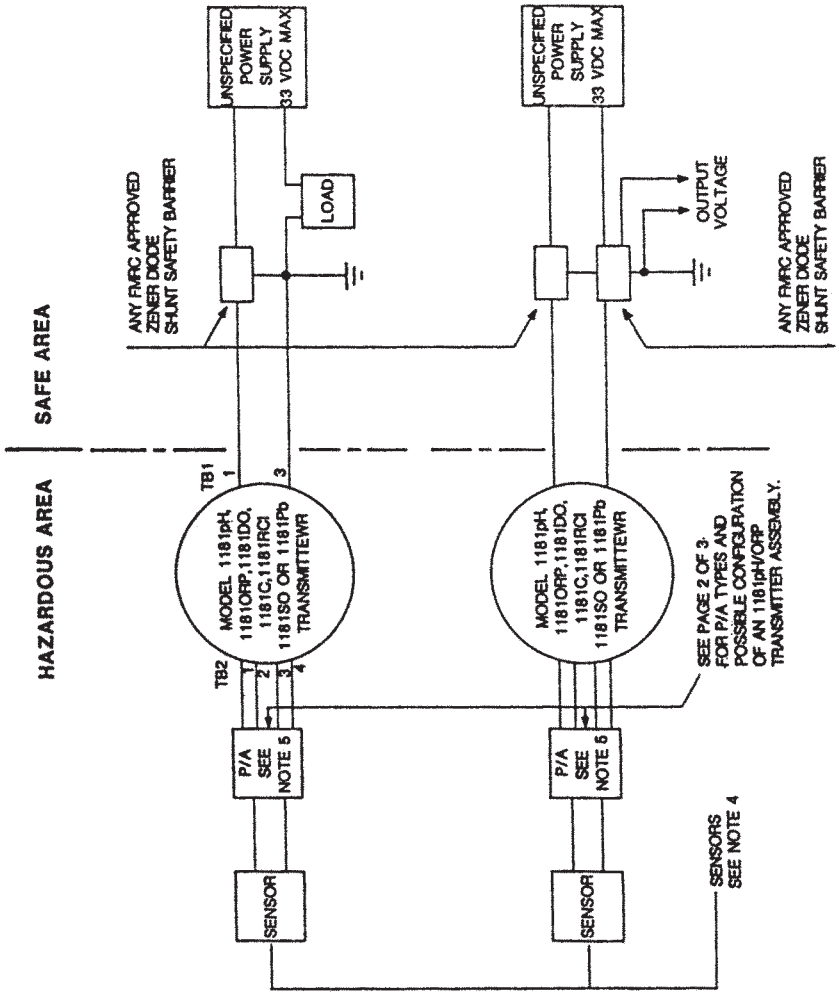


FIGURE 2-10. 1181 Schematic, System F.M. I.S. Approved - Entity Page 2 of 3



DWG. NO.	REV.
1400153	D

FIGURE 2-11. 1181 Schematic, System F.M. I.S. Approved - Entity Page 3 of 3

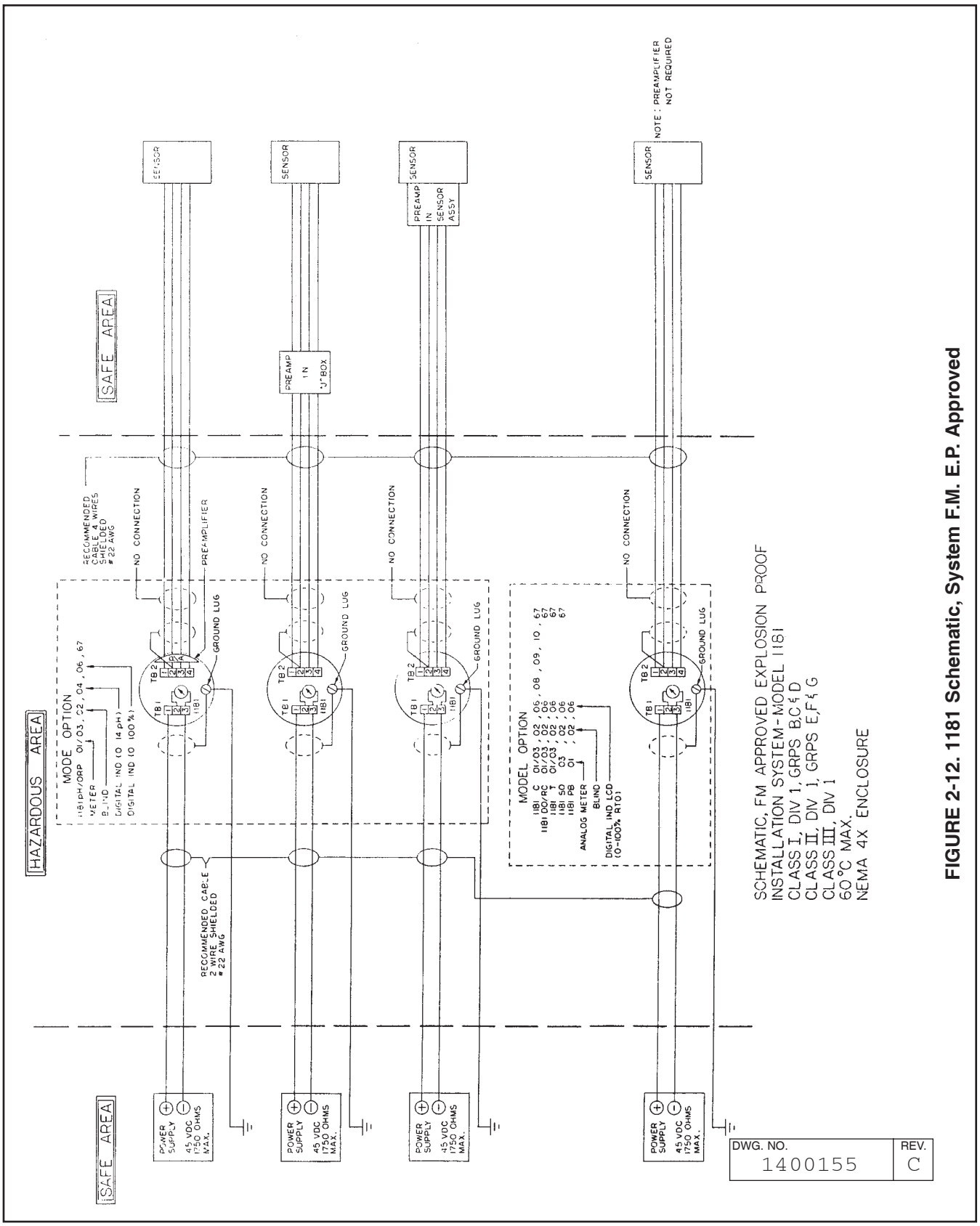


FIGURE 2-12. 1181 Schematic, System F.M. E.P. Approved

SECTION 3.0
START UP AND CALIBRATION

3.1 START-UP. With the transmitter installed as described in Section 2.0, perform the applicable start-up procedure.

3.2 MODEL 1181pH START-UP. The following describes the range selection, electronic calibration, and system calibration of the transmitter. The Model 1181 pH is factory calibrated for a pH range of 0 to 14. If a different range is desired, refer to paragraph 3.2.1. Typical pH range switch settings are offered in Table 3-1 if a custom range is desired.

3.2.1 Range Selection. A matrix showing the switch positions of S1 is in Figure 3-1. Remove the cover from the circuit side of the enclosure for access to the switches. See Figure 3-1 for pH range switch setting procedure and Table 3-1 for typical range switch settings. The following is an example of a pH range of 5 to 9 and the appropriate switch positions.

1. The mid-scale pH between 5 and 9 is 7. Therefore, switches 5, 6 and 7 should be closed; and switch 8 should be opened.
2. A span of 4 pH is desired. Therefore, switch 3 must be closed; and switches 1, 2 and 4 must be opened.
3. Any mid-scale pH between 1 and 13 may be selected.
4. Spans between 2 and 14 are available.

TABLE 3-1 Typical pH Range Switch Settings

Range Switches	Range = 4-10 Span = 6 M.S. = 7	Range = 5-9 Span = 4 M.S. = 7	Range = 2-10 Span = 8 M.S. = 6	Range = 6-12 Span = 6 M.S. = 9	Range = 3-7 Span = 4 M.S. = 5
1	Open	Open	Open	Open	Open
2	Closed	Open	Open	Closed	Open
3	Closed	Closed	Open	Closed	Closed
4	Open	Open	Closed	Open	Open
5	Closed	Closed	Open	Closed	Closed
6	Closed	Closed	Closed	Open	Open
7	Closed	Closed	Closed	Open	Closed
8	Open	Open	Open	Closed	Open

3.2.2 Electronic Calibration Using the Preamplifier. The Model 1181 pH may be electronically calibrated using the preamplifier within the sensor.

1. Retain all connections from the pH sensor to the transmitter.
2. Use a Model 213 Simulator or equivalent, refer to Table 3-2 for the appropriate millivolt input to simulate pH values.
3. For a pH range of 0 to 14 pH, remove the glass electrode connector from the preamplifier and install connector from the Model 213.
4. Install a 4 to 20 mADC ammeter between TB1-2 and TB1-3 of the transmitter. Disconnect the indicating meter during this test.
5. Place pH range switch of the Model 213 in 0 pH output position. Adjust ZERO control (under serial label) for 4 mADC output.
6. Place pH range switch of the Model 213 in 14 pH output position. Adjust SPAN control (under serial label) for a 20 mADC output.

NOTE

The internal coarse adjustment should be initially set in the midway position. If proper Zero adjustment is not obtainable with the external Zero potentiometer (usually in the smaller spans), the Internal Zero pot can be adjusted to compensate for this accordingly (see Figure 3-1).

NOTE

Both ZERO and SPAN controls are 20-turn potentiometers. Several turns may be required for proper calibration. The internal coarse zero adjustment control is a 1-3¼4 turn potentiometer.

7. Repeat Steps 5 and 6 until calibration is correct.
8. Reinstall analog/digital meter if necessary.

TABLE 3-2.
Test Unit Output Voltage in pH Mode at Four Temperatures

	Millivolts*			
pH	15°C	25°C	50°C	80°C
0	396	410	444	486
1	340	351	381	416
2	283	293	317	347
3	226	234	254	277
4	170	176	190	208
5	113.2	117.1	127.0	138.7
6	56.6	58.6	63.5	69.4
7	0	0	0	0
8	–56.6	–58.6	–63.5	–69.4
9	–113.2	–117.1	–127.0	–138.7
10	–170	–176	–190	–208
11	–226	–234	–254	–227
12	–283	–293	–317	–347
13	–340	–351	–381	–416
14	–396	–410	–444	–486

*Test unit output voltage corresponding to 99% of theoretical electrode response. This corresponds to the output of an electrode operating at typical efficiency.

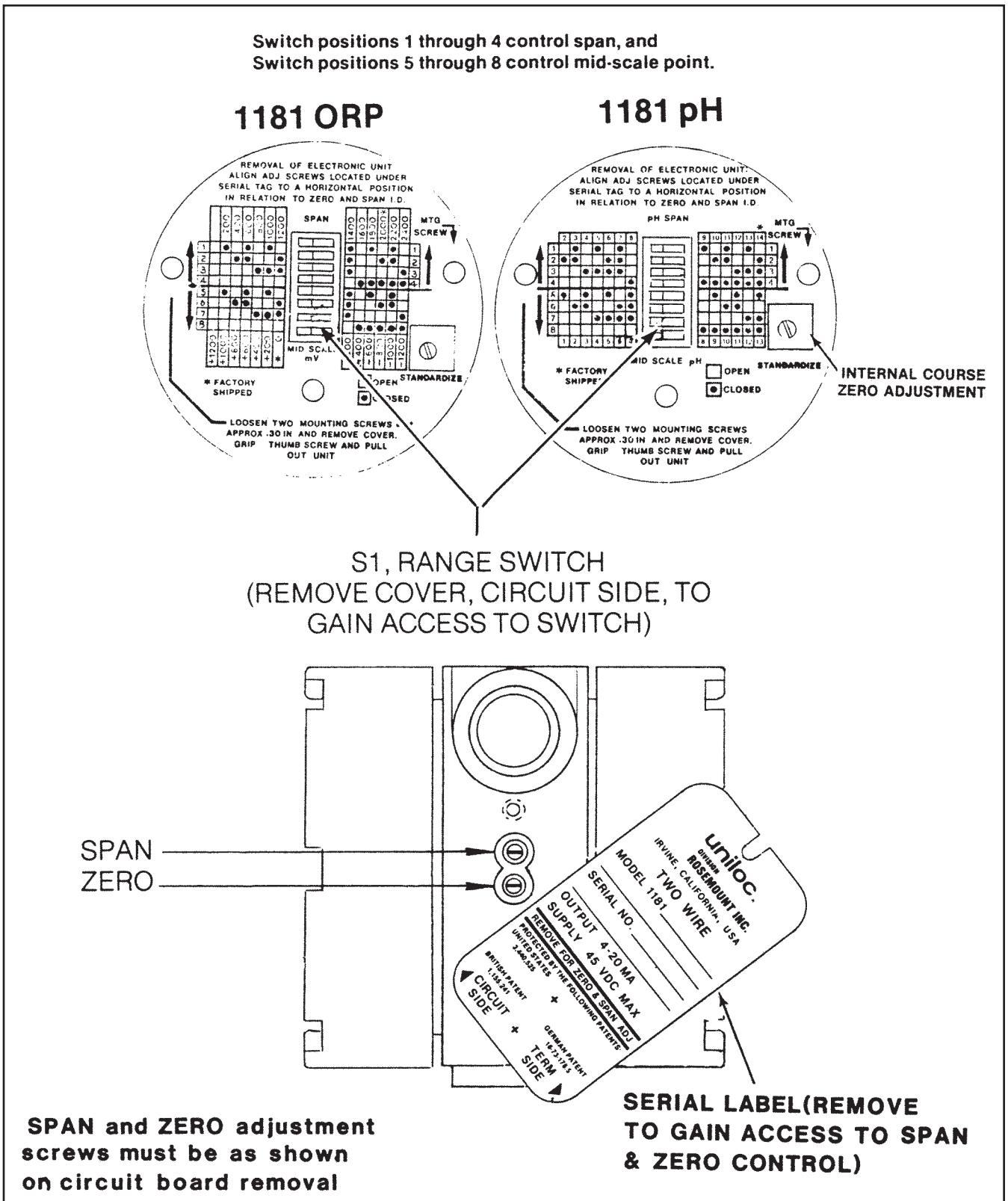


FIGURE 3-1. Location of Controls

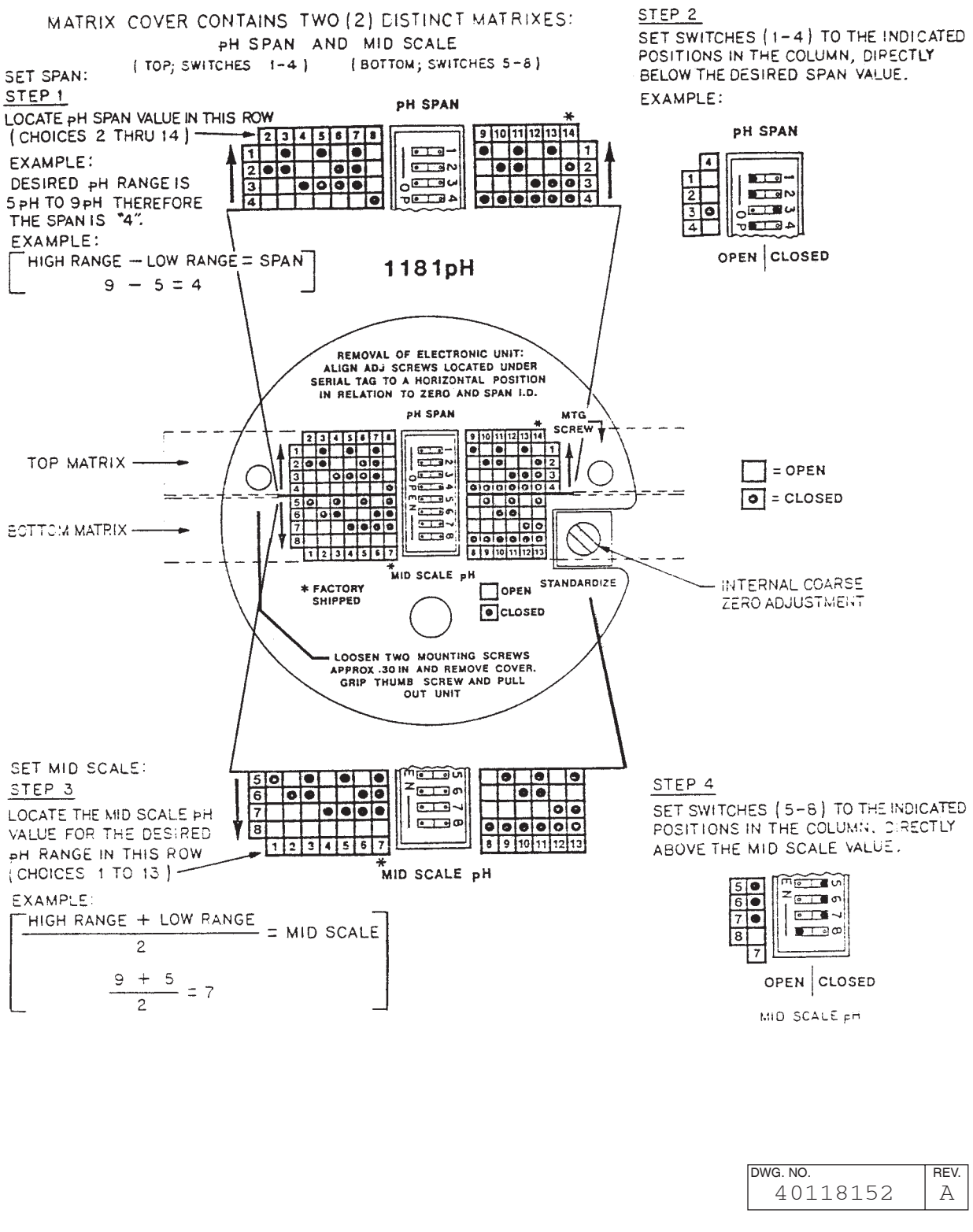


FIGURE 3-2. pH Range Selection Switches

3.2.3 Electronic Calibration using a DC Voltage Source. A ±2.500 volt DC input is required for calibrating a 0 to 14 range of the Model 1181 pH. Refer to Table 3-3 for the appropriate voltage required to simulate other pH values .

1. For pH range of 0 to 14 pH, install the connections from the DC voltage source to TB2-1 and TB2-2 of the Model 1181 pH. Be sure to remove sensor wires from TB2-1 and TB2-2 while applying this voltage source.
2. Connect an ammeter between TB1-2 and TB1-3 to indicate the 4 to 20 mADC output of the transmitter. Be sure to disconnect the 1181 indicating meter first.
3. Generate a +2.500 VDC signal from the voltage generator. Adjust ZERO control (under serial label) for a 4 mADC indication.
4. Generate a –2.500 VDC signal from the voltage generator. Adjust SPAN control (under the serial label) for a 20 mADC indication.
5. Repeat Steps 3 and 4 until no further calibration is required.
6. Reinstall sensor wires and indicating meter (if necessary) .

TABLE 3-3.
pH vs Voltage Input

pH	Voltage Input	pH	Voltage Input
0	+2.500VDC	8	–0.357VDC
1	+2.143VDC	9	–0.714VDC
2	+1.786VDC	10	–1.072VDC
3	+1.429VDC	11	–1.429VDC
4	+1.072VDC	12	–1.786VDC
5	+0.714VDC	13	–2.143VDC
6	+0.357VDC	14	–2.500VDC
7	0.000VDC		

3.3 SYSTEM CALIBRATION. The pH sensor and Model 1181 pH Two-Wire Transmitter must be standardized as a system. Either the standard buffer solution method or the grab sample method may be used.

3.3.1 Buffer Solution Method. The following is the buffer solution method for standardizing the pH sensor and Model 1181 pH:

1. Obtain two buffer solutions. One should represent a low range, and the other a high range value. Typical buffer solution values are 4 pH, 7 pH, and 10 pH.
2. Remove the sensor from the sample and rinse it with clean water.
3. Immerse the sensor in a low range buffer solution and allow the reading to stabilize.

NOTE

The sensor must be at the same temperature as the buffer solution to obtain maximum accuracy. Allow several minutes for the sensor to reach ambient temperature.

4. Adjust the ZERO control (under the serial label) until the reading agrees with the buffer solution value.
5. Remove the sensor from the low range buffer solution and rinse it in clean water.
6. Immerse the sensor in the high range buffer solution .
7. Adjust the SPAN control (under serial label) until the reading agrees with the buffer solution value.
8. Repeat Step 3 through 7 until no further adjustments are required. Rinse the sensor in clean water prior to immersing it in a different buffer solution.

3.3.2 Grab Sample Method. The following procedure should be used to standardize the Model 1181 pH with grab sample.

NOTE

Make sure the temperature of the grab sample and the compensation of the analyzer used for calibration are the same. Since the indications are temperature sensitive, the reading will vary if the temperature is different.

1. With the sensor on-stream, wait at least two to three minutes for the meter reading to stabilize, particularly in very hot or cold streams, and the automatic temperature compensator to reach equilibrium.
2. When the meter reading is stable, make a note of its value and immediately obtain a sample of the solution from the stream as close to the sensor as possible.
3. Check the noted reading against the reading obtained from the other analysis method and standardize the transmitter by adjusting the ZERO control (under serial label).
4. To ensure greater accuracy, take at least three grab samples and repeat Steps 2 and 3 for each sample.

3.3.3 If it is not practical to take a grab sample, reasonable accuracy can be obtained by the buffer solution method (refer to paragraph 3.3.1). Exceptions to this are streams or processes with chemical compositions very different from buffer solutions such as high purity water, miscible solvents and other dilute solutions. The grab sample methods should be used for solutions of this type.

3.4 OPERATION WITH A FIXED T.C. In the event it is desired to operate the Model 1181 pH with a fixed T.C., refer to Table 3-4 for the proper resistance value.

TABLE 3-4.
Resistance Value for Fixed T.C.

Temperature	Ohms (3K RTC)	Ohms (Pt-100)
0°C	2663	100.00
10°C	2798	103.85
20°C	2833	107.70
25°C	3000	109.62
30°C	3067	111.55
40°C	3202	115.40
50°C	3337	119.25
60°C	3472	123.10
70°C	3607	126.95
80°C	3742	130.80
90°C	3877	134.65
100°C	4012	138.50

To compute the resistance values for temperature other than those listed, use the following equations:

RTC = 2663 + (13.5 x °C)
RDC = 100 + (.385 x °C)

NOTE

When using a fixed T.C. with the Rosemount Analytical Model 381 sensor, consult the 381 Instruction Manual.

After the appropriate resistor has been selected, disconnect the T.C. black and white leads going to preamp and connect the resistor in their place (see Figure 2-4).

3.5 MODEL 1181ORP START-UP. This paragraph describes the range selection, electronic calibration, and system calibration of Model 1181 ORP Two-Wire Transmitter. The Model 1181 ORP is factory calibrated for an ORP range of ±1000 mV. If a different range is desired, refer to paragraph 3.5.1. If the ±1000 mV range is suitable, proceed to paragraph 3.5.2.

3.5.1 Range Selection. A matrix showing the switch position of S1 for the various ranges is in Figure 3-1. This switch is located on the circuit side of the enclosure. See Figure 3-3 for ORP range switch selection procedure. The following is an example of the switch position required for ±200 mV range.

1. The mid-scale mV range is 0 mV. Switches 6 and 7 must be closed and switches 5 and 8 must be opened.
2. A span of 400 mV is required. Switch 2 must be closed and switches 1, 3, and 4 must be opened.
3. Any mid-scale mV range between –1200 and +1200 may be selected.
4. Spans between 200 to 2400 mV are available.

3.5.2 Polarity Selection. The Model 1181 ORP is calibrated in the American convention of millivolt measurement, with 0 millivolt (mV) being mid-scale (12 mADC). All positive potentials are downscale and all negative potentials are upscale. The measurement may be reversed to accommodate the European convention (see Figure 6-2).

1. Remove jumper from 2 and 3.
2. Install jumper 1 and 4.
3. The Model 1181 ORP has now been modified to accommodate the European convention. Negative potentials downscale and positive upscale.

NOTE

Negative potentials are reducing indications and positive potentials are oxidizing indications.

3.5.3 Electronic Calibration Using the Preamplifier. The Model 1181 ORP may be calibrated using the preamplifier within the ORP sensor.

1. Retain all connections from the ORP sensor to the Model 1181 ORP.
2. Using a Model 213 pH/ORP Simulator or equivalent, remove the ORP electrode connector from the preamplifier and install the connector from the Model 213 to the preamplifier.
3. Install an ammeter capable of indicating 4 to 20 mADC between TB1-2 and TB1-3 in the Model 1181 ORP. Disconnect the indicating meter during this test. If a LCD is used refer to paragraph 3.13 for calibration.
4. Place the Range Switch on the Model 213 for a +1000 mV output. Adjust ZERO control (under serial label) for a 4 mADC output.

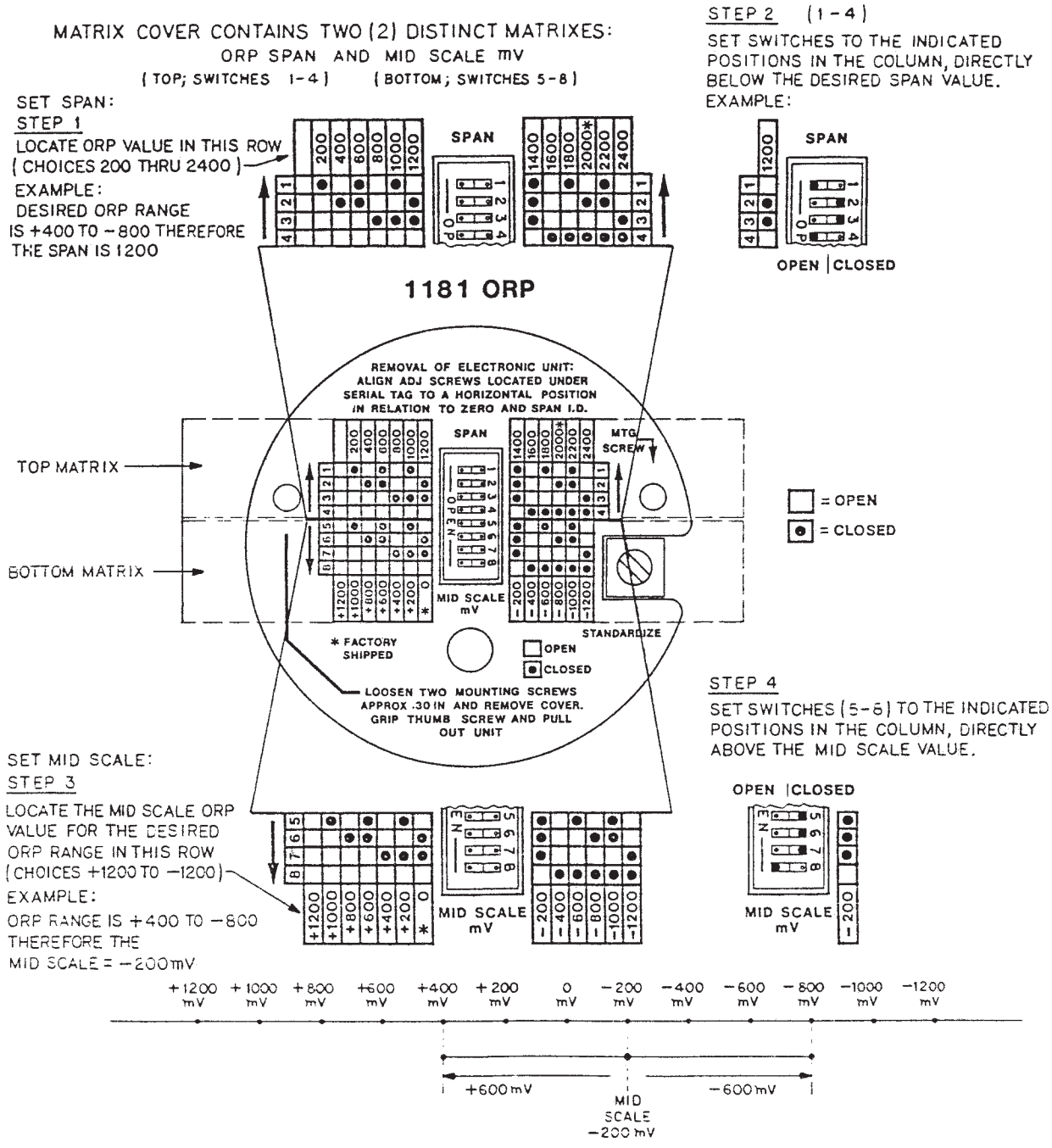


FIGURE 3-3. ORP Range Selection Switches

NOTE

Both ZERO and SPAN Controls are 20 turn potentiometers. Several turns may be required for proper calibration.

5. Generate a –1.000 VDC signal from the voltage source. Adjust span control (under serial label) for a 20 mADC output.
6. Repeat Steps 4 and 5 until calibration is correct.

3.5.4 Electronic Calibration Using a DC Voltage Source. An output up to ±1.000 VDC is required as an input to the 1181 ORP. Refer to Table 3-5 for the appropriate voltage required to simulate desired mV values.

NOTE

Voltage listed are the American Convention, reverse polarity for European Convention.

TABLE 3-5.
Millivolt vs. Voltage Input

Millivolt	Voltage Input	Millivolt	Voltage Input
+1000	+1.000 VDC	–200	–0.200 VDC
+800	+0.800 VDC	–400	–0.400 VDC
+600	+0.600 VDC	–600	–0.600 VDC
+400	+0.400 VDC	–800	–0.800 VDC
+200	+0.200 VDC	–1000	–1.000 VDC
0	0.000 VDC		

The following calibration procedure is for a ±1000 mV range.

1. Install connections from DC voltage source between TB2-1 and TB2-2 on the Model 1181 ORP. Be sure to remove sensor wires from TB2-1 and TB2-2 while applying this voltage source.
2. Connect an ammeter capable of indicating 4 to 20 mADC between TB1-2 and TB1-3 in the Model 1181 ORP. Disconnect the analog meter or LCD during this test.
3. Generate a +1.000 VDC signal from the voltage source. Adjust zero control (under serial label) for a 4 mADC output.
4. Generate a –1.000 VDC signal from the voltage source. Adjust SPAN control (under serial label) for a 20 mADC output.
5. Repeat Steps 3 and 4 until no further calibration is required.
6. Reinstall sensor wires and analog meter or LCD (if necessary). Refer to Figure 2-2, or 3-4.

3.6 MODEL 1181 ORP SYSTEM CALIBRATION. Upon completion of electrical calibration of the Model 1181 ORP, it may be desired to check the total system operation by using a solution with a known oxidation-reduction potential.

3.6.1 Quinhydrone Solution A commonly used ORP standard solution is the saturated quinhydrone solution. This can be made quite simply by adding a few crystals of quinhydrone to either pH 4 or pH 7 buffer. Quinhydrone is slightly soluble, so only a few crystals will be required. The solution is yellow-colored. The resulting potentials, measured with a clean platinum electrode and saturated KCl/AgCl reference electrode, should be within ±20 millivolts of the value shown in Table 3-6. These potentials may be measured from the electrode lead wires that connect to terminals TB 2-1 and TB 2-2 of the Model 1181 ORP Transmitter (see Figure 2-2). Solution must be noted to insure accurate interpretation of results. The ORP value of saturated quinhydrone solution is not stable over long periods of time. These standards should be made up fresh each time they are used.

CAUTION

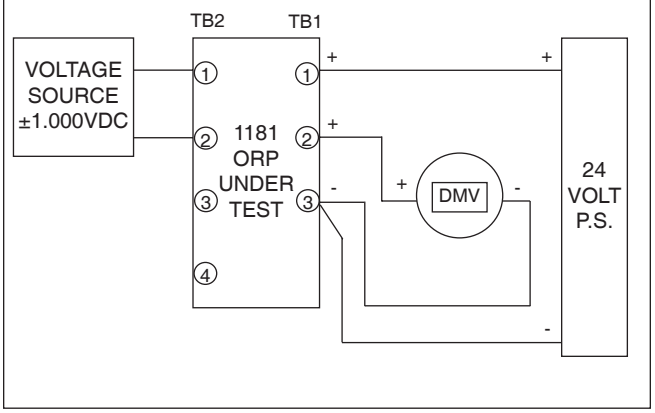
Quinhydrone is Highly Acidic

TABLE 3-6.
ORP of Saturated Quinhydrone Solution (Millivolts)

	pH 4			pH 7		
TEMPERATURE °C	20	25	30	20	25	30
Millivolt Potential	268	264	260	94	87	80

Adjust the ZERO Control for compensation of the measuring electrode output.

FIGURE 3-4
ORP Test Setup



3.6.2 Ferric-Ferrous Ammonium Sulfate Test. Although this standard ORP solution is not as easy to prepare as the quinhydrone solution in Section 3.6.1, it offers a much more stable solution which will maintain its millivolt value for approximately one year when stored in glass containers.

Dissolve 39.2 grams of reagent grade ferrous ammonium sulfate [Fe $(NH_4)_2(SO_4)_2$ • $6H_20$] and 48.2 grams of reagent grade ferric ammonium sulfate [$F2NH_4(SO_4)_2$ $12H_20$] in approximately 700 milliliters of water (distilled water is preferred, but tap water is acceptable). Slowly and carefully add 56.2 milliliters of concentrated sulfuric acid. Add sufficient water to bring the total solution volume up to 1,000 milliliters. This solution (ferric-ferrous ammonium sulfate) will produce a nominal ORP of 476 ±20 mV at 25°C when used with a saturated KCl/AgCI reference electrode (or 430 mV with a Calomel reference electrode) and platinum measuring electrode. The above potentials may be measured from the electrode lead wires that connect to TB 2-1 and TB 2-2 of the Model 1181 ORP Transmitter (see Figure 2-2).Some tolerance in mV values is to be expected due to the rather large liquid reference junction potentials which can arise when measuring this strongly acidic and concentrated solution. However, if the measuring electrodes are kept clean and in good operating condition, consistent repeatable calibrations can be achieved.

3.7 OPERATING WITH INTEGRAL PREAMP (ACCESSORY). The preamp may be ordered as an accessory to the Model 1181 pH/ORP. This enables the user to mount the preamp integral to the Model 1181 pH/ORP. This will eliminate the use of a junction box when remote preamps are required.

This preamp is applicable to explosion-proof (Class 1, Group C and D, Div. 1) installations and to applications where the preamp must be remote from the sensor due to high temperatures (above 80°C).

Two types of preamps are available. P/N 22744-01 is compatible with a 3K RTD. P/N 22743-01 is compatible with a 100 ohm RTD.

Please refer to Figure 2-3 for installation instructions. The user must remove the BNC electrode connector from the coax cable supplied with the sensor and prepare the coax as shown in Figure 2-4.

Due to space limitations the meter mounting position is restricted (see insert, Figure 2-3). Additionally, the integral preamp accessory must be used with the analog meter (Code 01 or Code 03) option, or with the LCD indication (Code 06) option. In order to use the integral preamp accessory with blind transmitters (Code 02), P/N 3002468 (tall cover) must be ordered as a spare part. The integral preamp accessory is not available with LCD indication (Code 04) option.

NOTE

The maximum distance between the Model 1181 pH/ORP with an integral preamp and the sensor is 15 feet (4.5m).

The Model 1181 pH/ORP with integral preamp should not be used with a ruggedized pH electrode at operating temperatures of less than 25°C (77°F).

3.8 START-UP. The LCD (option 04) is factory set for 00.00 to 14.00 pH, therefore no further adjustment should be necessary. The standard procedures in this instruction manual should be followed for proper instrument start-up and calibration (see the start-up and calibration section of the instruction manual).

If an operational test and adjustment of the LCD module is required, the following procedure should be followed. The object of this procedure is to test and calibrate the 1181 LCD, RTI (refer to input) display unit in conjunction with the complete 1181 pH instrument.

* Not available with integral preamp options.

3.9 TEST EQUIPMENT

1. DC power supply cable of 30V at 50mA. Hewlett Packard 6216A or equivalent Model 515.
2. Two digital voltmeters to measure ±2.5V and 4-20 mA (Fluke 8050A or equivalent)
3. Model 213 pH Simulator
4. 1181 pH pre-amp (part number 22698-02)

3.10 SET UP. The 1181 pH, with LCD (liquid crystal display) RTI (refer to input) installed, is connected with a pre-amp as per Figure 3-5 (1181 set to 14 pH span).

1. Connect voltmeter M2, minus lead, to TB2-2 (red wire) and the plus lead to TB2-1 (black wire).
2. Connect voltmeter M1 across a 600 ohm resistor as shown in Figure 3-5.

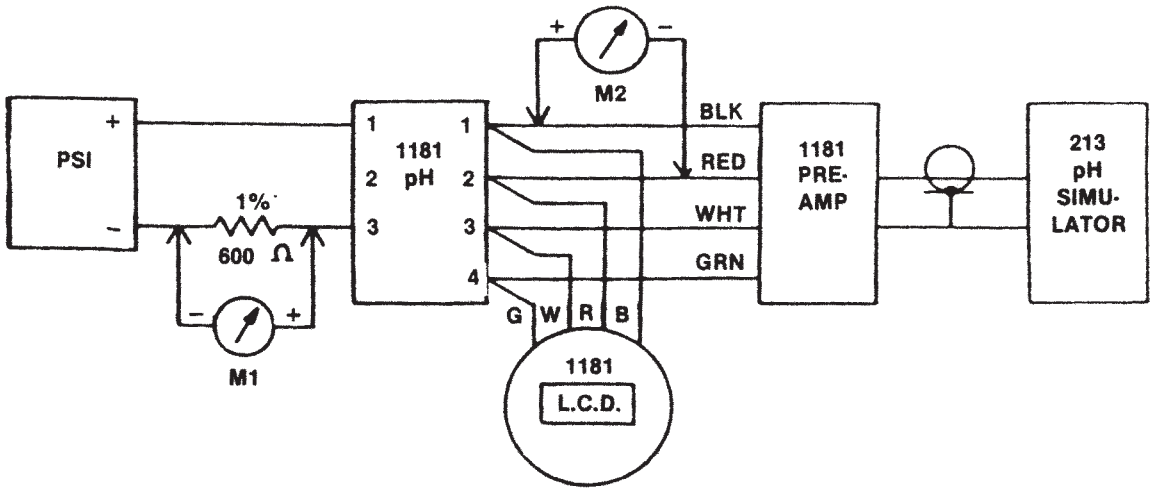


FIGURE 3-5. Test Wiring

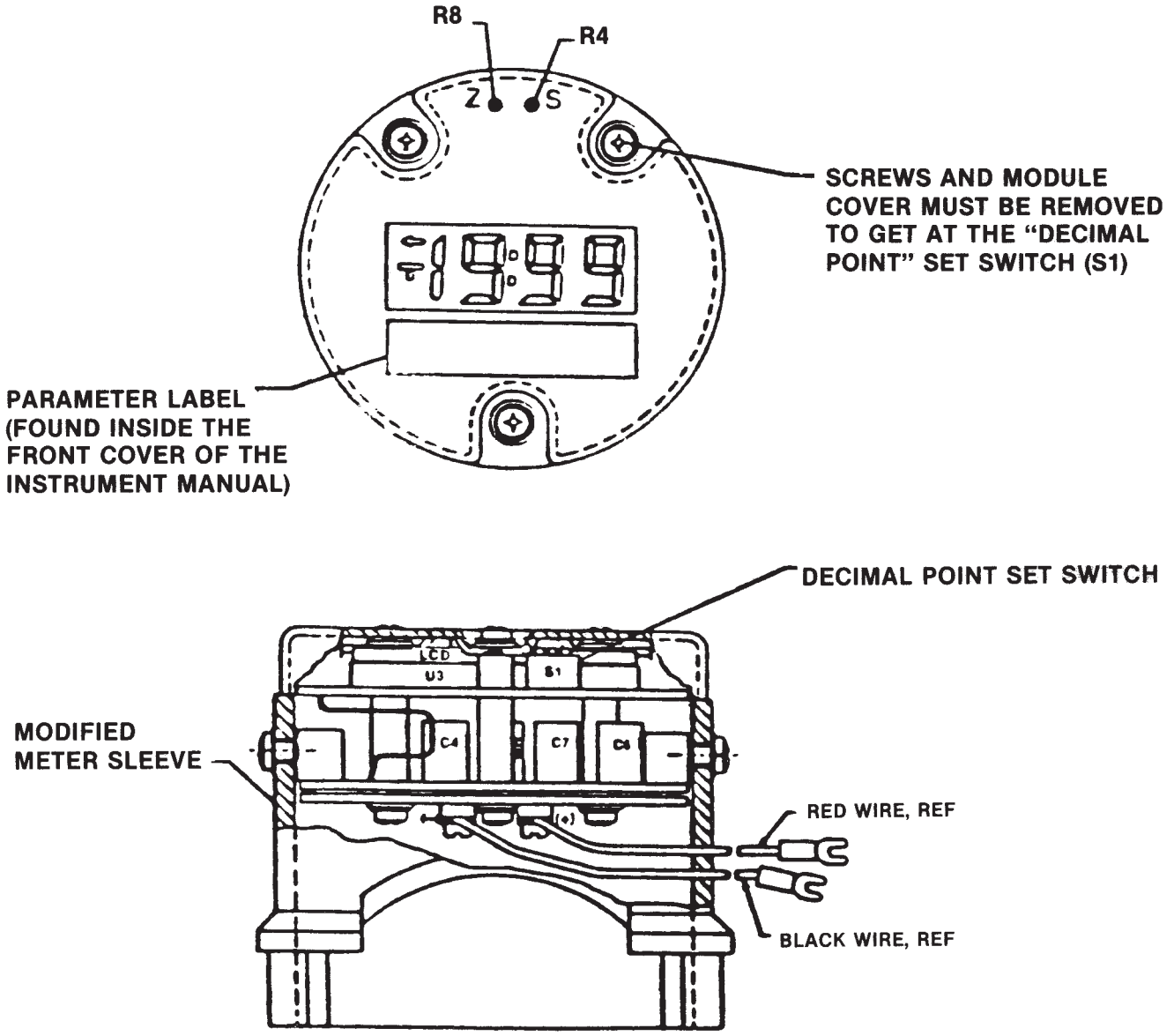


FIGURE 3-6. LCD Calibration

3.11 CALIBRATION

1. Turn on power supply and adjust to 24V ±.5V and observe that display is functioning.
2. Set Model 213 to zero pH (+414 millivolts DC) and adjust temperature compensation to obtain a reading of +2.5V ±.05V on the voltmeter M2. Adjust the zero pots on both the 1181 and on the LCD display for 2.4V ±15 mV on M1 and 000 pH ±1 digit on the display. Either one can be set first as one does not affect the other.
3. Set Model 213 to 14 pH (–414 millivolts DC) and adjust temperature compensation for –2.5V. Now adjust the span control on the 1181 for 12.00V ±1 digit on the display.
4. Set Model 213 to 7.00 pH and check that M1 reads 7.20V ±15 mV and display is 700 pH ±1 digit.

3.12 END TEST

3.13 START-UP. The LCD (liquid crystal display) is factory set for 000.00 reading at 4 mA to 100.0% at 20 mA. If this range is sufficient for the intended application, no further adjustment to the display is necessary. The standard procedures included in the 1181 instruction manual should be followed for proper instrument start-up and calibration (see the start-up and calibration section of the instruction).

If a range other than the factory set range, or testing of the LCD module is required, observe the following procedures. They are divided into two sections: (I) Testing the module by itself, and, (II) Testing it as an integral part of the 1181 instrument.

3.14 LCD: MODULE ONLY. The object of this procedure is to test and/or calibrate the LCD module for a range other than the factory set range of 0-100%.

3.14.1 Test Equipment

1. DC power supply (Hewlett Packard 6217A or equivalent) P1.
2. Digital DC current meter (Fluke 8050A or equivalent) M1.
3. 1.0K, .25W, ±5% resistor (R_L)

3.14.2 Set Up. The 1181 LCD unit under test, henceforth referred to as “the unit,” is connected in series with an adjustable DC power supply P1, a 1.0K ohm, ±5% resistor and a digital current meter M1 as shown in Figure 3-7.

3.14.3 Calibration.

1. Adjust the voltage output of P1 so that the current meter M1 reads 4.00 mA then adjust the zero pot on the LCD module (R8) until it displays 000 (see Figure 3-6 and Figure 3-7).
2. Refer to Table 3-7. Find out the requirements and corresponding parameters for the application.
3. Adjust power supply P1 so that the meter M1 reads 20.000 mA. Adjust the span pot (R4) of the LCD until it displays the “total span” of this application (see Figures 3-6 and 3-7, and Table 3-7).
4. Reduce power supply P1 until meter M1 reads 4.00 mA. Confirm that the unit still displays 000. If not, readjust the unit following steps 1 through 4.
5. According to the “Decimal Point Setting” column of Table 3-7 set switch S1 for this application (see Figure 3-6).
6. Refer to Table 3-7. Adjust the zero pot (R8) for the desired reading at 4 mA. Adjust the power supply P1 for an output of 20.00 mA and confirm that the reading coincides with the value in Table 3-6. If it does not, readjust the unit following Steps 1 through 6.
7. Adjust P1 so that M1 reads 12.000 mA. The unit should display “reading at 12 mA”.

TABLE 3-7. Parameters for Application

Requirements		Corresponding Parameters				
APPLICATION	RANGE	READING at 4mA	READING at 12mA	READING at 20mA	TOTAL SPAN	DECIMAL POINT SETTING
pH	0-14	+0.00	+7.00 ±0.02	+14.00	1400 counts	Turn on No. 2 of S1
pH	0-2 pH	+.000	+1.000 ±.002	+2.000*	2000 counts	Turn on No. 1 of S1
pH	2-4 pH	+2.00	+3.00 ±0.01	+4.00	200 counts	Turn on No. 2 of S1
pH	4-6 pH	+4.00	+5.00 ±0.01	+6.00	200 counts	Turn on No. 2 of S1
pH	6-8 pH	+6.00	+7.00 ±.0.01	+8.00	200 counts	Turn on No. 2 of S1
pH	8-10 pH	+8.00	+9.00 ±0.01	+10.00	200 counts	Turn on No. 2 of S1
pH	10-12 pH	+10.00	+11.00 ±0.01	+12.00	200 counts	Turn on No. 2 of S1
pH	12-14 pH	+12.00	+13.00 ±.0.01	+14.00	200 counts	Turn on No. 2 of S1
ORP	–1000 - +1000mV	–1000	000 ±0.03	+1000	2000 counts	Turn off all switches of S1

* Since the unit cannot display numbers more than +1999 (or +1.999, +19.99, +199.9), instead it will display +1 followed by three blank digits to indicate the situation of “overflow when the input exceeds the upper limit of the range. Therefore, if you wish the unit to read +2000 (or +2.000, 20.00, +200.0), you may adjust the unit so that the display barely overflows.

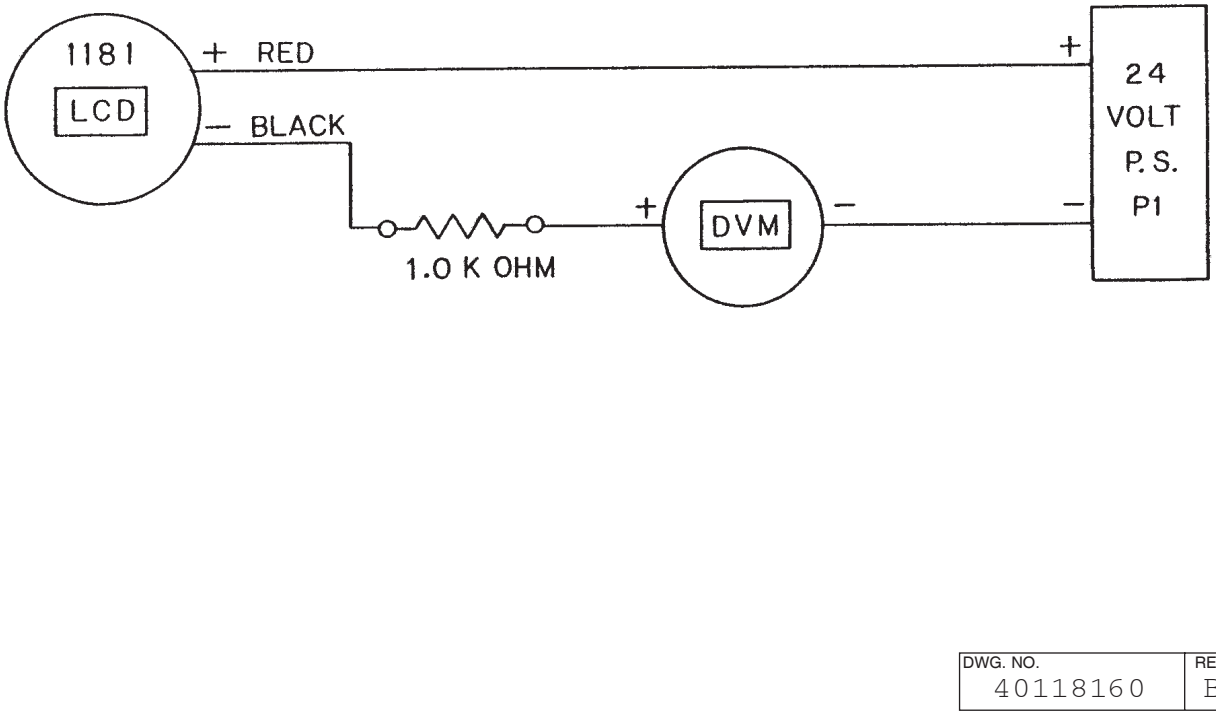


FIGURE 3-7. LCD Test Set Up Wiring

If you are **retrofitting** an LCD (RTD Style) to an **existing** 1181, you must insure that the instrument transmitter board is properly modified. There are two versions possible. If you have a P/N 22795-02 PCB, you simply move the jumper from the W5 position to the W6 position (or omit entirely). If your PCB is P/N 22795-01, you must clip and remove the diode, CR11. Refer below to Figures 3-8A and 3-8B.

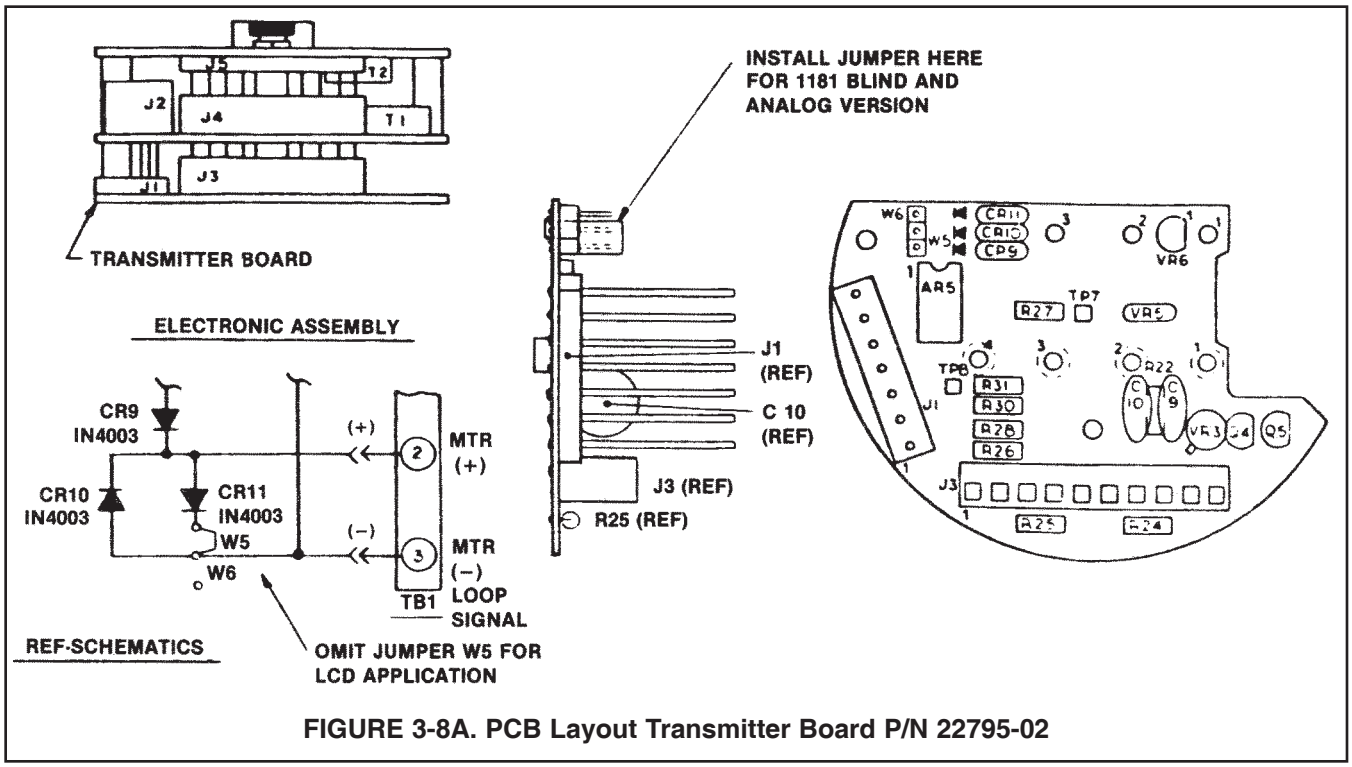


FIGURE 3-8A. PCB Layout Transmitter Board P/N 22795-02

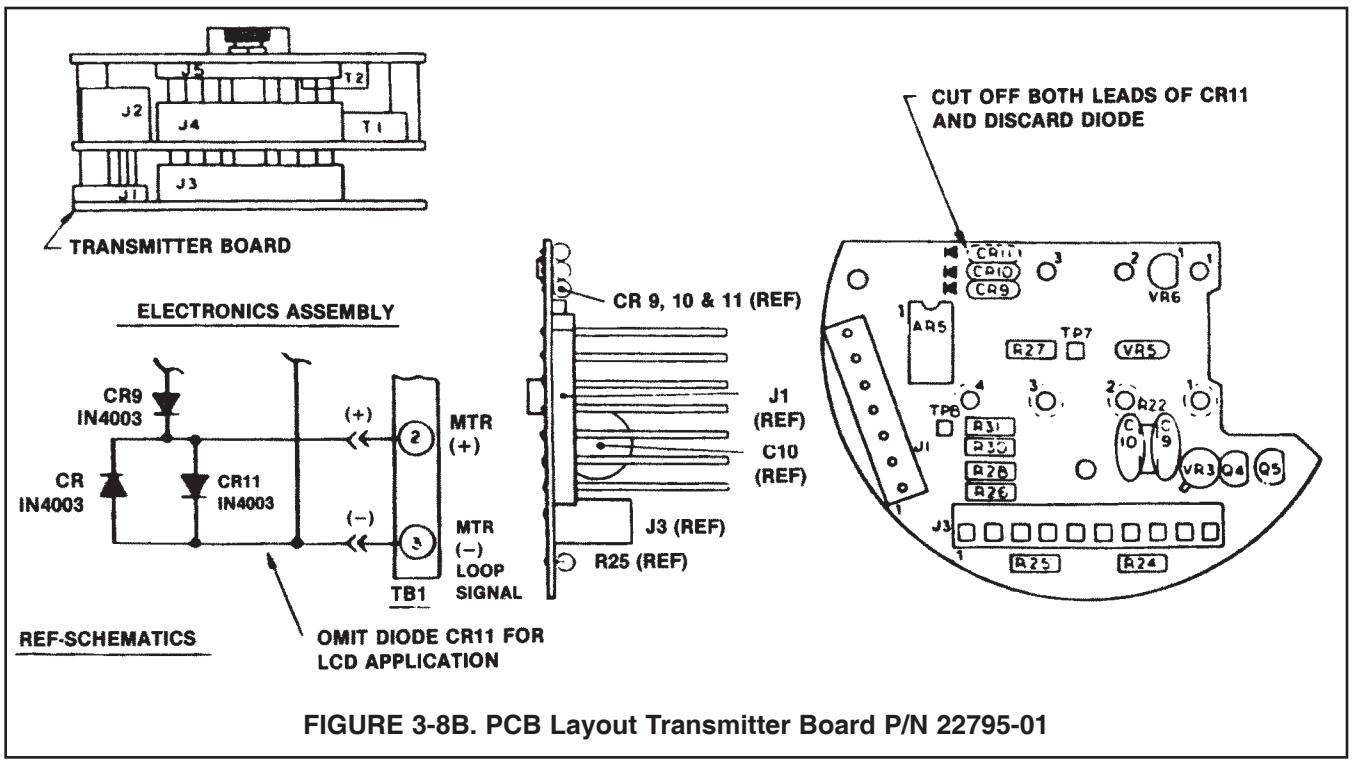


FIGURE 3-8B. PCB Layout Transmitter Board P/N 22795-01

SECTION 4.0
THEORY OF OPERATION

4.1 FUNCTION DESCRIPTION (see Figure 4-1). The Model 1181 operates from the power it receives from the loop current. At 4 milliamps, with 5 volt drop in the Model 1181, available power to operate the Model 1181 is 20 milliwatts typical (40 milliwatts maximum). The power supply (AR3) is a free CMOS multivibrator which drives the transformer (T1) at a frequency of 20 kHz. A transformer (T1) generates the ±5 volts power on the loop side (F) and on the sensor side (S). T1 also provides proper polarity by phase modulating the modulator and demodulator.

4.1.1 An external preamplifier is used which receives ±5 volts power from P.S. (S). ARl receives the signal input from the external preamplifier (+2.5 volts for pH; ±1.0 volt for ORP) and its gain is modified by the internal range select switches. The modulator is a current device and is coupled to the demodulator by an isolation transformer (T2). The output amplifier (AR5) drives the current generator which returns a 4 to 20 milliamp signal which is proportional to the demodulated signal. The external zero and span potentiometers calibrate the 4 to 20 milliamp output.

4.1.2 Diode (VR6) is a current diode which provides the initial start-up current. Diodes (CR10 and CR11) are meter protection diodes. The indicator is a 4 to 20 milliamp meter.

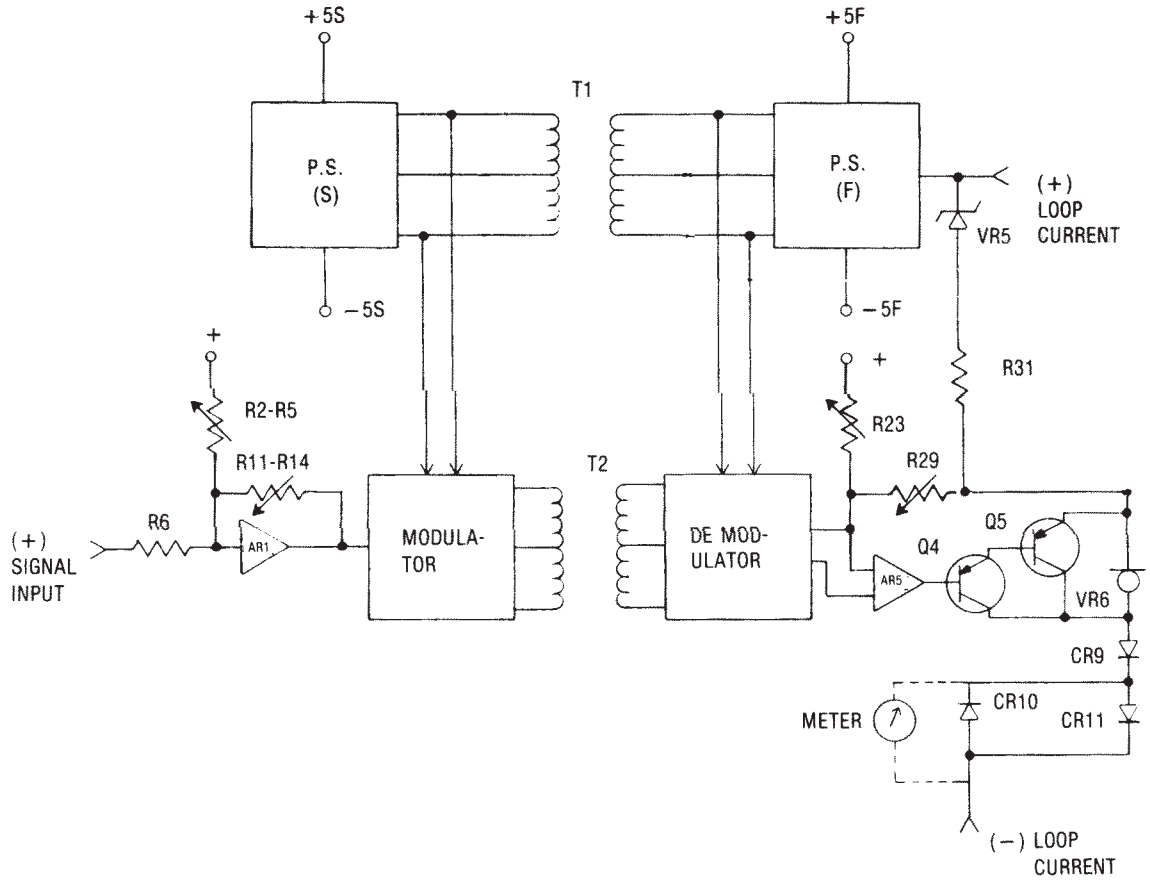


FIGURE 4-1. Simplified Block Diagram

SECTION 5.0
MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL. This section provides the maintenance and troubleshooting instructions for the Model 1181 pH and 1181 ORP Two-Wire Transmitters. These units have no moving parts and require a minimum of maintenance. Procedures for standardizing and calibrating the units are given in Section 3.0, and generally will be the only "maintenance" required to keep the units in good operating condition. If the unit is suspected of having a problem, refer to Table 5-1 Quick Troubleshooting. Refer to paragraph 5.2 if trouble cannot be identified and remedied and proceed as instructed to correct the problem.

5.2 TROUBLESHOOTING. In the event of failure, isolate the problem to one of the following areas: the measuring electrodes, the preamplifier located at the sensor assembly, or the Model 1181 Two-Wire Transmitter.

5.2.1 Perform the calibration procedure outlined in paragraph 3.2.2 (3.5.3 for ORP) using a mV generator. If the Model 1181 performs properly, the failure is in the measuring electrodes. Refer to the sensor manual for detailed troubleshooting of the electrodes.

5.2.2 If the Model 1181 does not calibrate properly as instructed in paragraph 3.2.2 (3.5.3 for ORP), proceed to the calibration procedure outlined in paragraph 3.2.3 (3.5.4 for ORP). This isolates the preamplifier from the Model 1181. If the Model 1181 calibrates as specified, the preamplifier is defective. Refer to the sensor manual for ordering information regarding a replacement preamplifier.

5.2.3 If the Model 1181 does not calibrate as specified in paragraph 3.2.3 (3.5.4 for ORP), one or more of the electronic circuit boards is defective. To minimize downtime, a complete set of circuit boards should be placed into service and calibrated.

5.2.4 To isolate which of the three circuit boards is defective, nominal voltages are shown in Figure 5-1. The test points referenced on the schematic diagram may be located on the individual circuit board locator diagrams (Figure 6-2, 6-3 and 6-4). For isolating component failure on an individual board, a block diagram and discussion of each function is included in Section 4.0 Theory of Operation.

5.3 MAINTENANCE. The following outlines the procedure for disassembly and reassembly of the 1181 pH/ORP transmitter.

5.3.1 Disassembly Procedure. Remove power prior to disassembly. Follow the steps below to disassemble the unit (see Figure 6-1).

1. Remove cover (1) or meter housing (10). If damaged, remove O-rings (2) from housing (3).
2. Remove screw retaining serial label to gain access to ZERO and SPAN adjustment screws.
3. Align the external ZERO and SPAN adjusting screws (3) so the slots are horizontal, pointing end cap to end cap (see Figure 3-1).
4. In circuit side of housing (3) remove circuit board retaining screws, washers (8) cover (9) and the matrix cover is secured to screws with nylon split washers, so remove screws in equal increments so the cover is not damaged .
5. Pull straight out on handle (knurled knob) of the circuit board assemblies.
6. To separate individual boards, remove the retaining screw located on the terminal side of the transmitter board (6).
7. Remove each board by pulling it straight out from connectors.

5.3.2 Reassembly Procedure.

1. Assemble the circuit boards and install the retaining screw.
2. Align the ZERO and SPAN adjusting screws (3) on the housing (3) to the horizontal position, slots pointing end cap to end cap.
3. Align the ZERO and SPAN potentiometers located on the power circuit board (5) to the horizontal position, with blades pointing to circuit boards (4) and (6).
4. Place circuit board assembly into housing (3) by pushing straight in on knurled knob. Make sure boards seat fully into terminals.
5. Install matrix cover (8 or 9), and secure with screws and washers.
6. Inspect thread connections on housing to make sure five undamaged threads will fully engage for explosion proof requirements.
7. Inspect the cover O-ring (2) and replace if necessary.
8. Install covers on transmitter housing (3).
9. Apply power to unit and perform appropriate calibration procedure as instructed in Section 3.0.

TABLE 5-1. QUICK TROUBLESHOOTING

DIAGNOSTIC MESSAGE	DESCRIPTION OF PROBLEM	REMEDY
There is no Loop Current	1. Voltage from power supply too low or missing. 2. Loop Polarity is not correct. 3. Open circuit or defective connection in current loop wiring. 4. Jumper (W5-W6) in wrong location (transmitter PCB). 5. Power PCB defective.	1. Correct voltage by installing proper resistor (See Figures 1-1, 1-2). 2. Correct Loop Polarity. (see Figure 2-2). 3. Repair current loop wiring or connection. 4. Install jumper in correct location (see Figures 3-8A and 3-8B). 5. Item 6. Figure 6-1 Needs replacement.
Indication does not respond to pH or mV changes	1. Wiring at TB2 connecting wrong. Connecting loose or wiring defective. 2. Span and/or mid-scale switches not set correctly. 3. Measuring electrode, preamp or electronics malfunction.	1. Correct wiring condition, tighten connections or repair defective wiring. 2. Set Switches accordingly. Refer to pH/ORP range selection. (Fig 3-1 & 3-2 location of controls). 3. Perform troubleshooting procedures under section 5.2 of this manual.
Reading offscale, can't span it in.	1. Miswire 2. Sensor is incompatible, has the wrong T.C. value.	1. Verify wiring, refer to Figure 2-2, (T.C. wires must be across TB 2-3 & TB 2-4). 2. Check label on sensor cable.
Loop operates correctly in a beaker, but is erratic or reads incorrectly in the process.	1. Possible Ground Loop. Transmitter has an extra ground connection that is not supposed to be there. 2. Sensor cable may have a nick in it and makes contact with conduit, especially if conduit has moisture in it (underground). 3. Power supply or distributed control system causing interference. 4. Improper grounding of auxiliary equipment connector to process ie. pumps, mixers,valves.	1. Check sensor wiring to ensure that the shield wire does not touch the transmitter, or sensor enclosure. 2. Remove sensor cable from conduit and retest, or run a cable outside of conduit. 3. Remove connections to P.S. or DCS, and test loop with a bench power supply. 4. Insure all electrical devices connected to process are properly grounded.

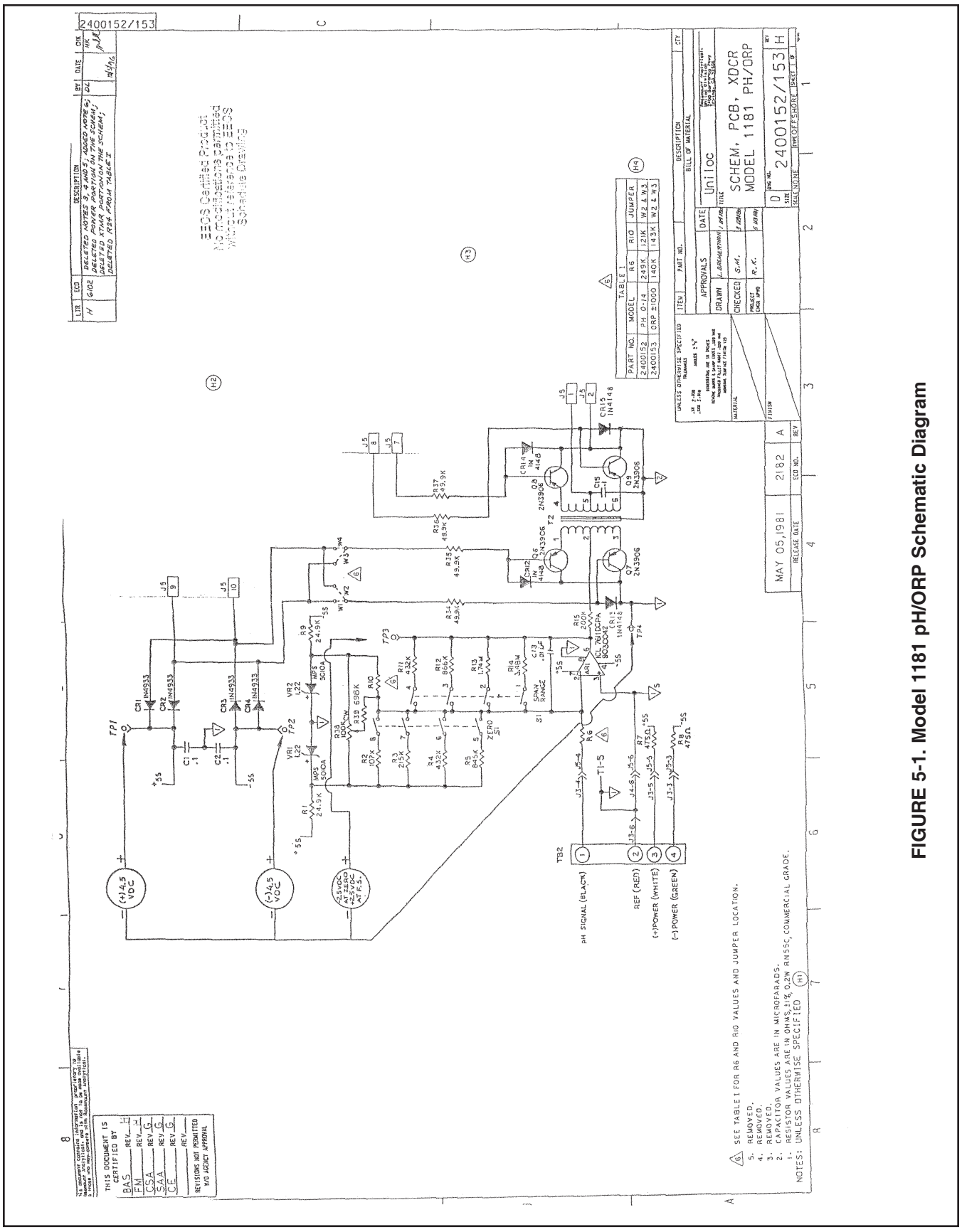


FIGURE 5-1. Model 1181 pH/ORP Schematic Diagram

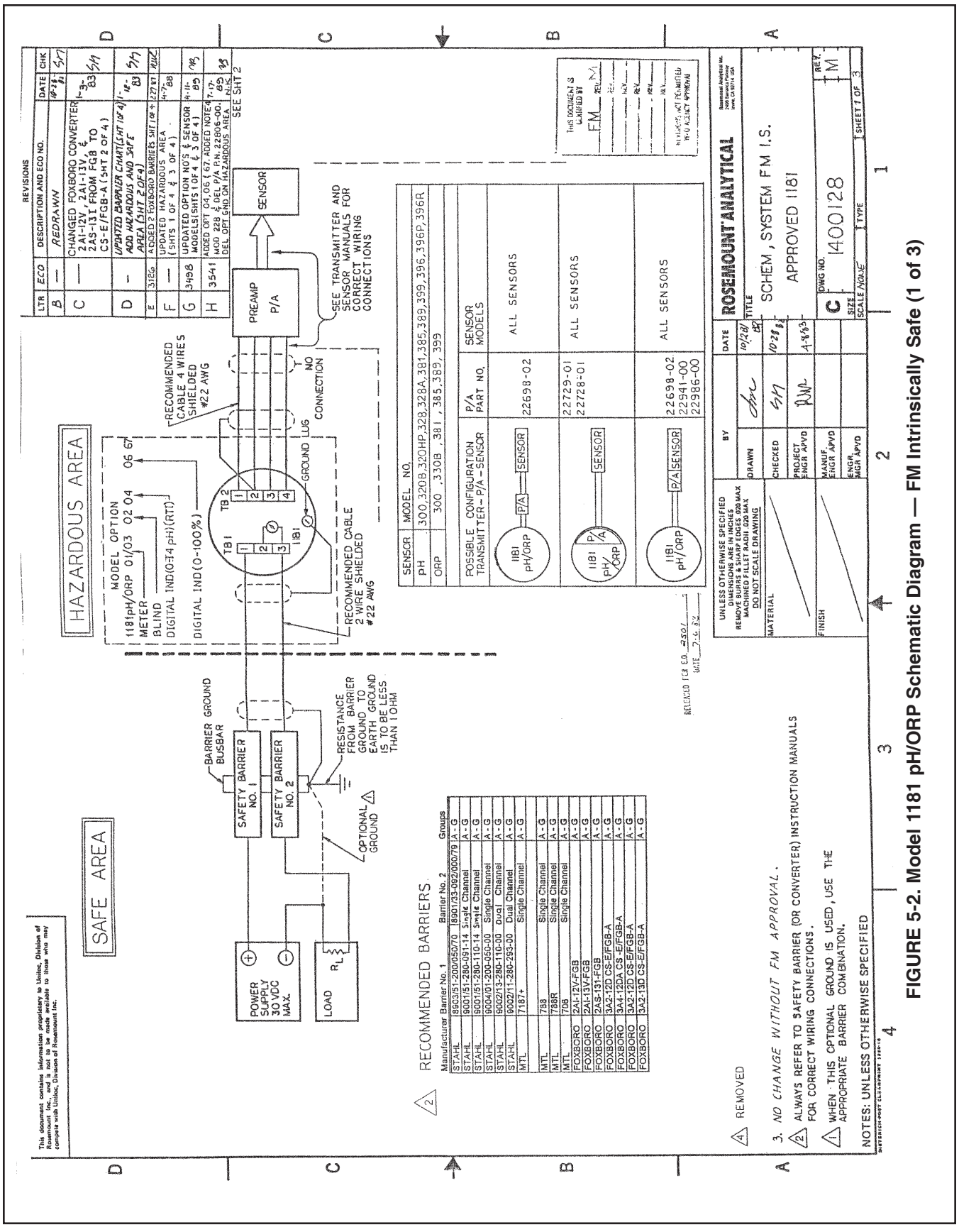


FIGURE 5-2. Model 1181 pH/ORP Schematic Diagram — FM Intrinsically Safe (1 of 3)

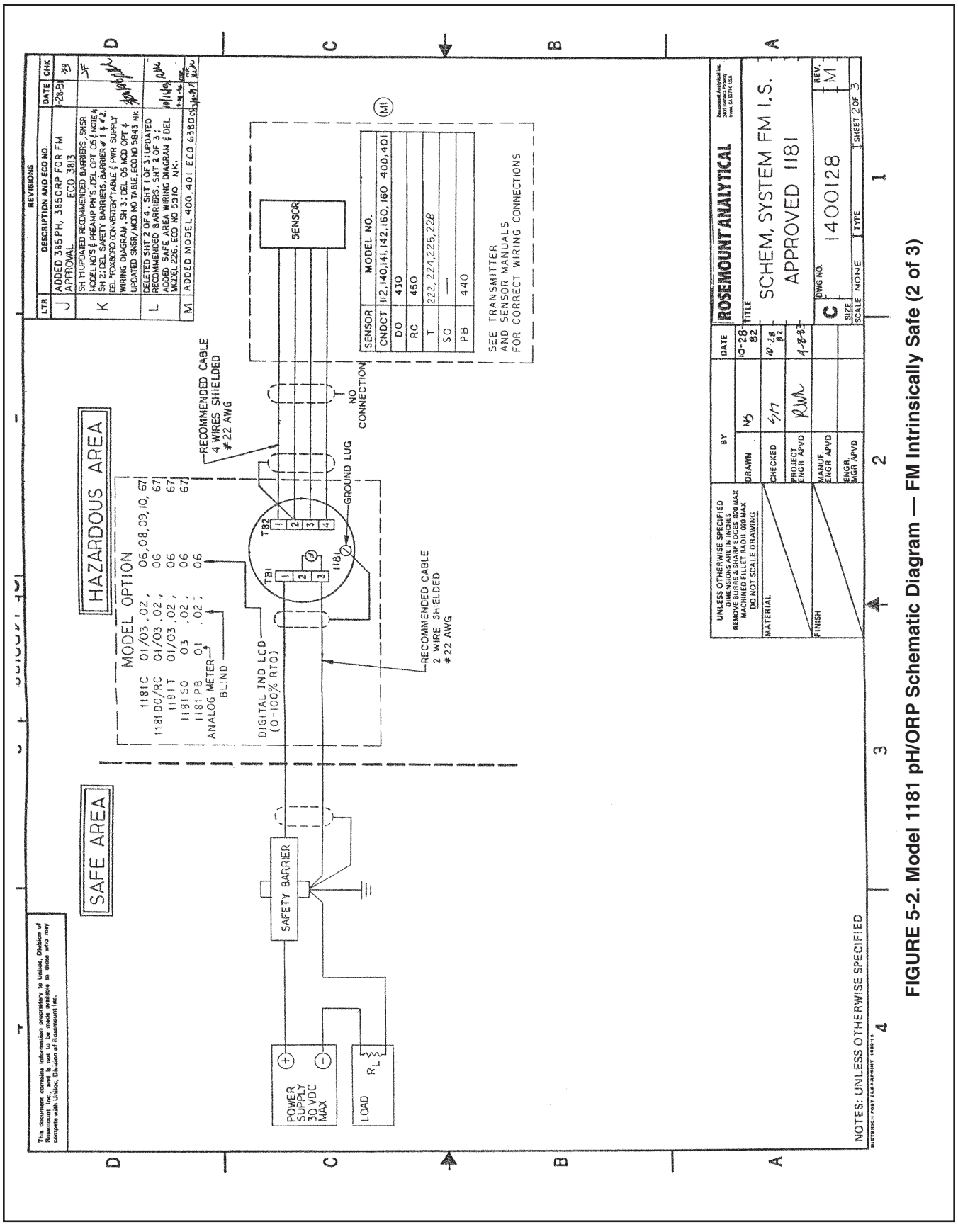


FIGURE 5-2. Model 1181 pH/ORP Schematic Diagram — FM Intrinsically Safe (2 of 3)

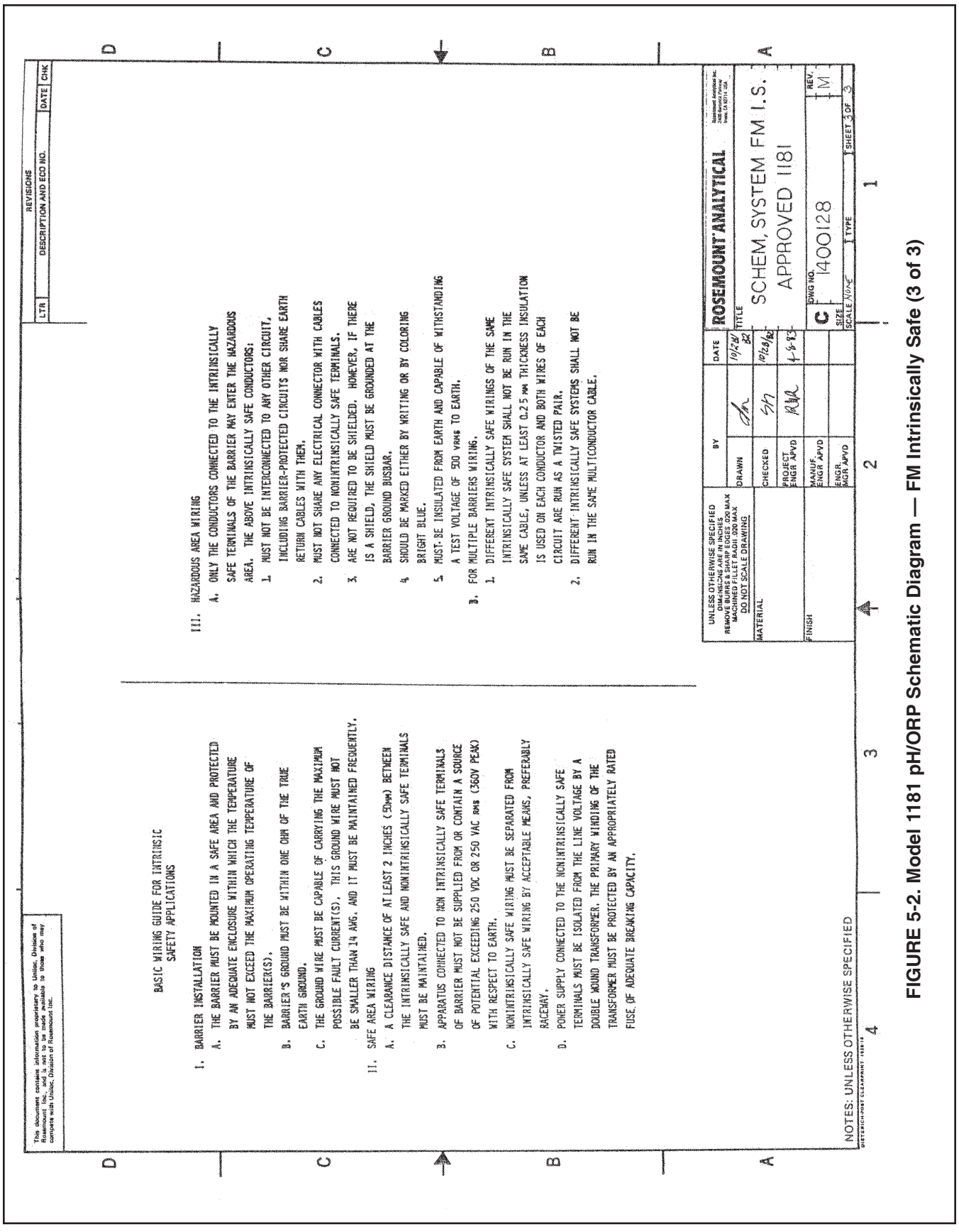


FIGURE 5-2. Model 1181 pH/ORP Schematic Diagram — FM Intrinsically Safe (3 of 3)

SECTION 6.0
PARTS LIST

6.1 GENERAL. Following are the parts list and illustrations for identifying the parts and assemblies of the Model 1181 pH and 1181 ORP Two-Wire Transmitters

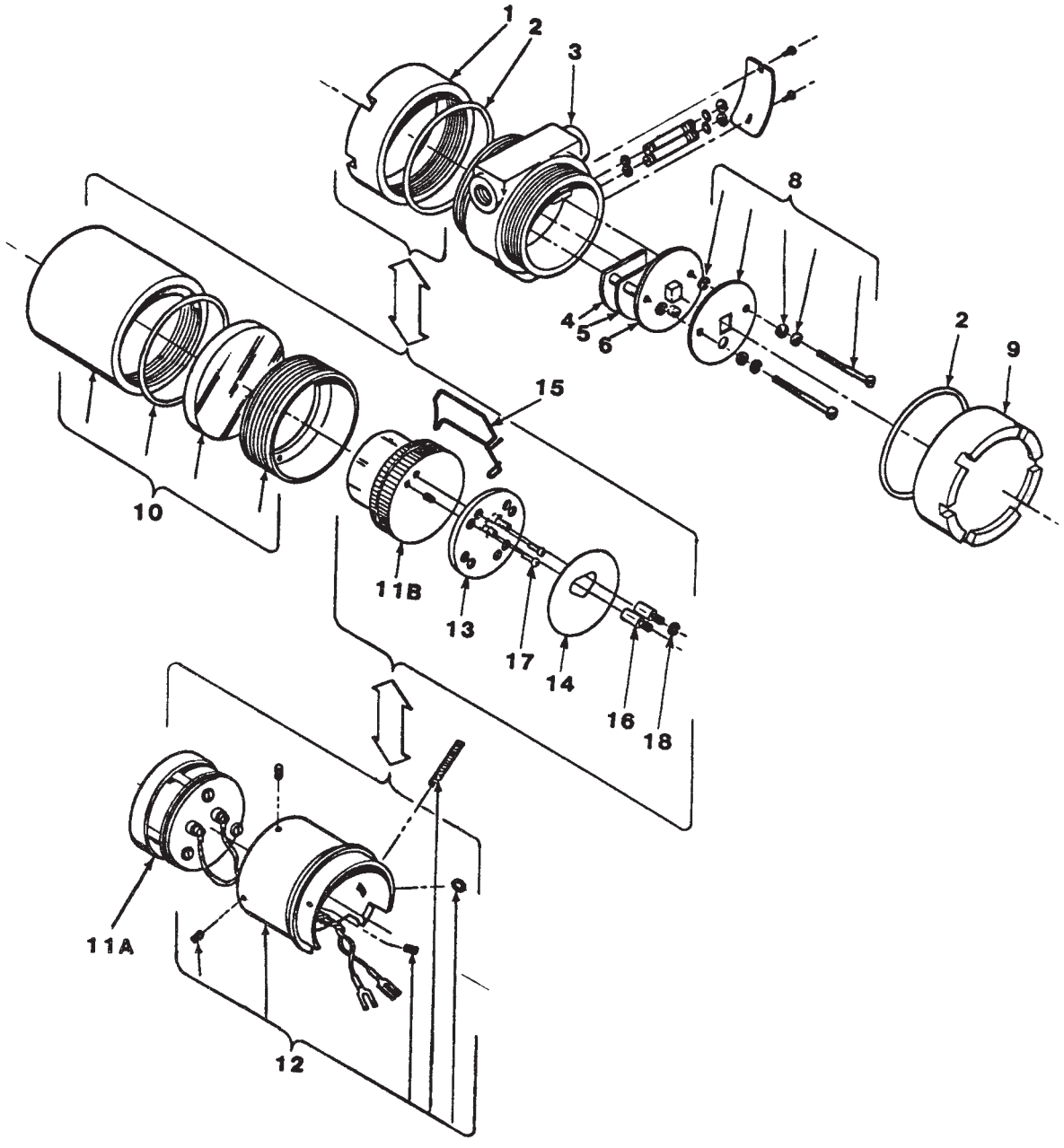


FIGURE 6-1. Model 1181 pH/ORP Two-wire Transmitters

TABLE 6-1.
Parts List for Figure 6-1.

Item	Part Number	Description	Qty
1	3002425	Cover (Blind)	1
2	2002604	O-Ring Kit	1
	Consists of: 2 ea		
	9550136	O-Ring	12
3	2002528	Housing includes zero and span adjusting screws	1
	2002598	Zero/span Screwkit	
4	22795-02	Transmitter, PCB Blind/Analog	
	22795-03	Transmitter, LCD	1
5	22796-00	Power, PCB	1
6	22797-00	Transducer PCB (1181 pH)	1
	22797-01	Transducer PCB (1181 ORP)	
8	22803-00	Matrix Cover Kit (1181 pH)	1
	Consists of:		
	32640-00	Cover, Matrix (1181 pH)	1
	9600620	Screw (short)	1
	9600628	Screw (long)	1
	9910404	Washer, Nylon	2
	9910600	Washer, Flat	2
	9910610	Washer, Lock	2
8	22803-01	Matrix Cover Kit (1181 ORP)	1
	Consists of:		
	32640-01	Cover, Matrix (Model ORP)	1
	9600620	Screw (Short)	1
	9600628	Screw (Long)	1
	9910404	Washer, Nylon	2
	9910600	Washer, Flat	2
	9910610	Washer, Lock	2
9	3002425	Cover	
10	23701-00	Meter Cover Kit	1
	Consists of:		
	3002429	Housing	1
	9550135	O-Ring	1
	3002421	Window	1
	32491-00	Ring, Retainer	1
11	9170161	Meter 1181 pH, Option 01	1
	9170162	Meter 1181 ORP, Option 01	1
11	9170165	Meter 1181 pH, Option 03	
	9170166	Meter 1181 ORP, Option 03	1
11	22940-00	Meter 1181 pH, Option 04 LCD, RTI	1
	22940-00	Meter 1181 ORP, Option 04 LCD, RTI	1
11	23122-00	Meter 1181 pH, Option 06 LCD, RTO	1
	23122-00	Meter 1181 ORP, Option 06 LCD, RTO	1
12	32822-00	Mounting Sleeve, LCD	1

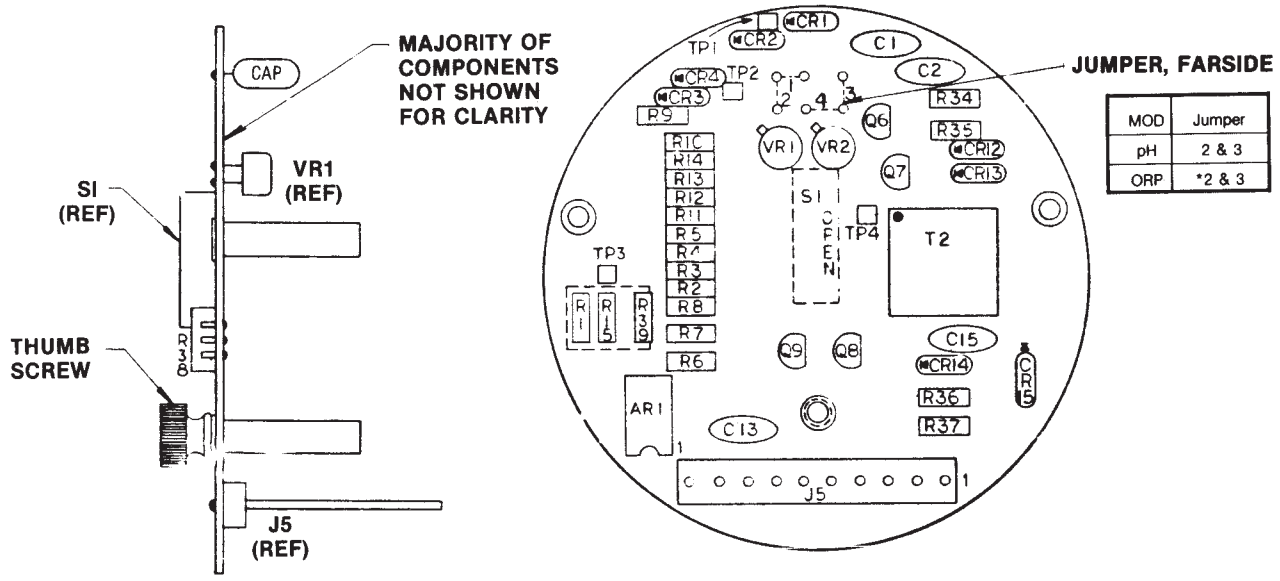


FIGURE 6-2. Transducer PCB (Part No. 22797-00/01)

Reference Designator Fig. 6-2	Description Transducer PCB	Reference Designator	Description
AR1	903994*	R5	845K
C1	0.1, 100WV	R6	249K (pH) / 140K (ORP)
C2	0.1, 100WV	R7	475
C13	0.01, 500V Ceramic	R8	475
C15	0.1, 100WV	R9	249K
CR1	1N4933	R10	121 (pH) / 143K (ORP)
CR2	1N4933	R11	432K
CR3	1N4833	R12	866K
CR4	1N4933	R13	1.74M
CR12	1N4148	R14	3.48M
CR13	1N4148	R15	221K
CR14	1N4148	R34	49.9K
CR15	1N4148	R35	49.9K
Q6	2N3906	R36	49.9K
Q7	2N3906	R37	49.9K
Q8	2N3906	R38	100K Pot
Q9	2N3906	R39	698K
R1	24.9K	S1	9100124*
R2	107K	T2	9080066*
R3	215K	VR1	MPS5020A
R4	432K	VR2	MPS5010A

Resistor are in ohms, ±1%, 0.2W, MF unless otherwise noted.
Capacitor values are in microfarads
*Rosemount Analytical parts numbers
W2 & W3 jumpered for pH
W2 & W3 jumpered for ORP (American Convention)
*W1 & W4 jumpered for ORP (European Convention)

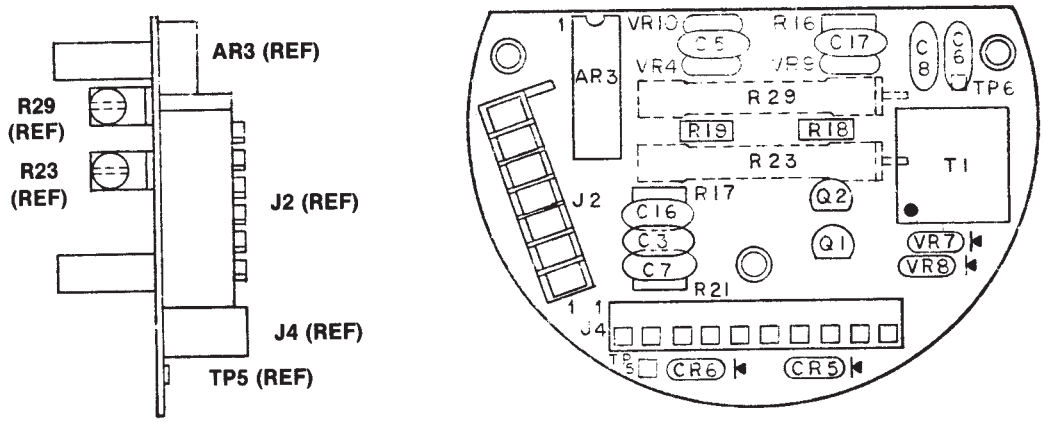


FIGURE 6-3. Power PCB (Part No. 22796-00)

Reference Designator Fig. 6-3	Description Power PCB	Reference Designator	Description
AR3	CD4047AE	R17	10K
C3	0.01 100V Ceramic	R18	30.1K
C5	0.01 500V Ceramic	R19	10K
C6	0.47	R21	200K
C7	100 Picofarads 100V Ceramic	R23	100K Zero Pot
C8	1uf	R29	5K Span Pot
C16	100 Picofarads 100V Ceramic	T1	9080066
C17	100 Picofarads 100V Ceramic	VR4	1N4734A
CR5	1N4933	VR7	964B
CR6	1N4933	VR8	964B
Q1	2N5087	VR9	1N4734A
Q2	2N5087	VR10	1N4734A
R16	30.1K		

Resistor are in ohms, ±1%, 0.2W, MF unless otherwise noted.
Capacitor values are in microfarads unless otherwise noted.

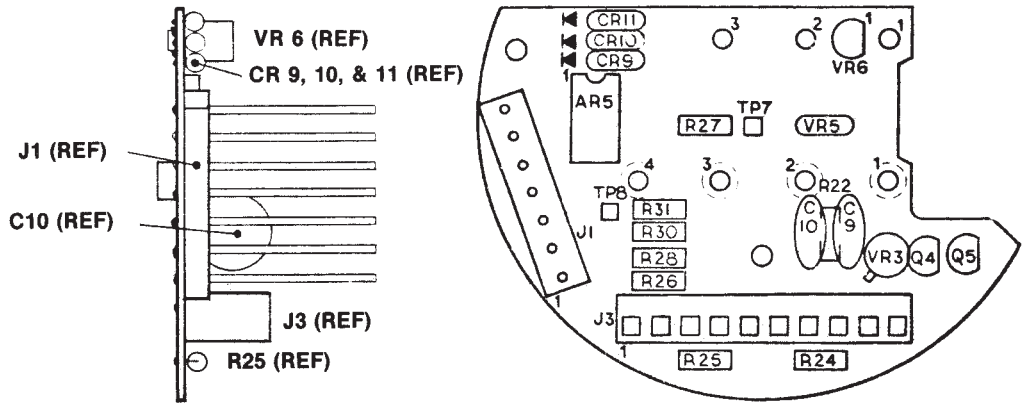


FIGURE 6-4. Transmitter PCB (Part No. 22795-00)

Reference Designator Fig. 6-2	Description Transmitter PCB	Reference Designator	Description
AR5	1CL7611DCPA (9030042*)	R25	162K
C9	0.01 500V Ceramic	R26	13K
C10	0.01 500V Ceramic	R27	10K
CR9	1N4003	R28	100K
CR10	1N4003	R30	165K
CR11	1N4003	R31	49.9 ±1%, 1W
Q4	2N5087	VR3	MPS5010A
Q5	92PU51A or 2N6727	VR5	V68MA3B
R22	24.9K	VR6	J507
R24	158K		

Resistor are in ohms, ±1%, 0.2W, MF unless otherwise noted.
Capacitor values are in microfarads.
*Rosemount Analytical parts numbers

SECTION 7.0
RETURN OF MATERIAL

7.1 GENERAL.

To expedite the repair and return of instruments, proper communication between the customer and the factory is important. Before returning a product for repair, call 1-949-757-8500 for a Return Materials Authorization (RMA) number.

7.2 WARRANTY REPAIR.

The following is the procedure for returning instruments still under warranty:

1. Call Rosemount Analytical for authorization.
2. To verify warranty, supply the factory sales order number or the original purchase order number. In the case of individual parts or sub-assemblies, the serial number on the unit must be supplied.
3. Carefully package the materials and enclose your "Letter of Transmittal" (see Warranty). If possible, pack the materials in the same manner as they were received.
4. Send the package prepaid to:

   Rosemount Analytical Inc., Uniloc Division
   Uniloc Division
   2400 Barranca Parkway
   Irvine, CA 92606

   Attn: Factory Repair

   RMA No. _____

   Mark the package: Returned for Repair

   Model No. ____

7.3 NON-WARRANTY REPAIR.

The following is the procedure for returning for repair instruments that are no longer under warranty:

1. Call Rosemount Analytical for authorization.
2. Supply the purchase order number, and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do Steps 3 and 4 of Section 7.2.

NOTE

Consult the factory for additional information regarding service or repair.

WARRANTY

Seller warrants that the firmware will execute the programming instructions provided by Seller, and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. **Consumables, such as glass electrodes, membranes, liquid junctions, electrolyte, o-rings, catalytic beads, etc., and Services are warranted for a period of 90 days from the date of shipment or provision.**

Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products.

If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, promptly correct any errors that are found by Seller in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services.

All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES.

RETURN OF MATERIAL

Material returned for repair, whether in or out of warranty, should be shipped prepaid to:

Emerson Process Management
Liquid Division
2400 Barranca Parkway
Irvine, CA 92606

The shipping container should be marked:

Return for Repair
Model _____

The returned material should be accompanied by a letter of transmittal which should include the following information (make a copy of the "Return of Materials Request" found on the last page of the Manual and provide the following thereon):

1. Location type of service, and length of time of service of the device.
2. Description of the faulty operation of the device and the circumstances of the failure.
3. Name and telephone number of the person to contact if there are questions about the returned material.
4. Statement as to whether warranty or non-warranty service is requested.
5. Complete shipping instructions for return of the material.

Adherence to these procedures will expedite handling of the returned material and will prevent unnecessary additional charges for inspection and testing to determine the problem with the device.

If the material is returned for out-of-warranty repairs, a purchase order for repairs should be enclosed.

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