Instruction Manual
PN 51-1054BLC/rev.B
April 2003

Model 1054B LC

Low Conductivity Microprocessor Analyzer

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 1-949-757-8500 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.

WARNING
ELECTRICAL SHOCK HAZARD

Making cable connections to and servicing this instrument require access to shock hazard level voltages which can cause death or serious injury.

Be sure to disconnect all hazardous voltage before opening the enclosure.

Relay contacts made to separate power sources must be disconnected before servicing.

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local codes.

Unused cable conduit entries must be securely sealed by non-flammable closures to provide enclosure integrity in compliance with personal safety and environmental protection requirements.

The unused conduit openings need to be sealed with NEMA 4X or IP65 conduit plugs to maintain the ingress protection rating (IP65).

For safety and proper performance this instrument must be connected to a properly grounded three-wire power source.

Proper relay use and configuration is the responsibility of the user.

No external connection to the instrument of more than 69VDC or 43V peak allowed with the exception of power and relay terminals. Any violation will impair the safety protection provided

Do not operate this instrument without front cover secured. Refer installation, operation and servicing to qualified personnel..

WARNING

This product is not intended for use in the light industrial, residential or commercial environment, per the instrument's certification to EN50081-2.

Emerson Process Management

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WARNING

HAZARDOUS VOLTAGE

Can cause severe injury or death. Disconnect power before servicing.

CAUTION

The analyzer has a metalized enclosure. Ground conduit to metal stiffener or to metal enclosure. Use non-flammable watertight conduit fittings/plugs to preserve rating.

VYSTRAHA

NEBEZPECNE NAPETI

Muze zpusobit vazne zraneni nebo smrt. Odpojte napajeni pred udrzbou

VAROVANI

Zemnici vodic musi byt vodive spojen s kostrou pristroje. Pouzivejte nehorlave vodotesne pruchodky, abyste zachovali stupen kryti pristroje.

AVISO

VOLTAJE PELIGROSO

Puede causar severas lesiones o muerte. Desconecte la alimentación antes del mantenimiento.

ATENCION

La toma a tierra debe hacerse a un contrafuerde metal o a la caja metálica.Utilice accesorios/enchufes no inflamables y estancos al agua para preservar las especificaciones de la caja.

ADVARSEL

FARLIG SPÆNDING

Kan forårsage alvorlige kvæstelser eller død.

Afbryd spænding før servicering

FORSIGTIG

Jordforbindelse til metal kapsel.

Brug uantændelig vandtæt forskruning som sikkerhed for bevaring af kapslings klasse.

ATTENTION

HAUTE TENSION

Peut provoquer des blessures graves ou la mort. Déconnecter l'alimentation avant manipulation.

ATTENTION

Raccorder le tube à la masse métallique d'une entretoise ou du coffret.Utiliser des raccords et des bouchons étanches ininflammables afin de preserver la classification du boîtier.

OSTRZEZENIE

NIEBEZPIECZNE NAPIECIE

Moze spowodowac uszkodzenie ciala lub smierc.Odlacz zasilanie przed przystapieniem do prac.

UWAGA

Uziemij przewod do metalowego plaskownika lub obudowy. Aby zachowac stopien szczelnosci obudowy stosuj niepalne, wodoszczelne dlawiki.

WARNUNG

GEFAEHRLICHE SPANNUNG

Am Geraet liegt eine gefaehrliche Spannung an. Schalten Sie immer vor dem Oeffnen des Geraetes alle Zuleitungen spannungsfrei.

ACHTUNG

Der Analysator ist vorschriftsmaessig zu erden. Um die Schutzart des Geraetes sicherzustellen ist es mit den entsprechenden Kabelverschraubungen und Blindkappen auszuruesten.

Waarschuwing

GEVAARLIJKE SPANNING

Kan ernstig of dodelijk letsel veroorzaken. Schakel de voeding uit voordat u onderhoudswerk zaamheden uitvoert.

Voorzichtig

Aardleiding naar metalen profiel of naar metalen behuizing. Gebruik onbrandbare, waterdichte wartels en pluggen orn de beschermingsklasse te handhaven.

Attenzione

ALTA TENSIONE

Può causare grave lesione o morte. Disattivare le tensioni prima di effettuare la manutenzione.

Attenzione

Tubo di protezione per messa a terra con elemento di ingresso in metallo o con custodia in metallo.

Utilizzare accessori/connettori del tubo di protezione a tenuta stagna, non infiammabili, per assicurare i limiti di resistenza della custodia

ADVARSEL

FARLIG SPENNING

Kan føre til alvorlige skader eller dødsulykker. Spenningstilførsel må frakobles før service utføres.

ADVARSEL

Kabelinnføring må jordes til metallavstiver eller til metallkapslingen. Bruk flammesikre og vanntette nipler\plugger slik at kapslingens tetthetsgrad opprettholdes.

VARNING

LIVSFARLIG SPÄNNING

Kan medföra allvarlig skada eller dödsfall.

Bryt spänning innan service utföres.

IAKTTAG FÖRSIKTIGHET

Anslutningspunkt är jordad till chassi. Använd brandsäker, vattentät kabelanslutning för att bevara klassificering av apparatskåp.

AVISO

TENSÃO PERIGOSA

Pode causar lesões graves ou a morte. Desligar a energia antes de proceder a trabalhos de manutenção.

ATENÇÃO

Ligar a conducta de cabos à terra através de suporte ou invólucro metálicos. Utilize bucins e acessórios ignífugos e estanques para preservação da estanquecidade.

About This Document

This manual contains instructions for installation and operation of the Model 1054BLC Low Conductivity Microprocessor Analyzer.

The following list provides notes concerning all revisions of this document.

Rev. Level	Date	Notes
A	1/96-3/99	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.
B	4/03	Update CE information.

MODEL 1054B LOW CONDUCTIVITY MICROPROCESSOR ANALYZER

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DESCRIPTION AND SPECIFICATIONS

- SPECIAL TEMPERATURE COMPENSATION for low conductivity (high resistivity) measurement.
- SELF DIAGNOSTICS with a user selectable fault alarm.
- KEYBOARD SECURITY is user selectable.
- NO BATTERY BACK-UP REQUIRED. Non-volatile EEPROM memory.
- DUAL ALARMS WITH PROGRAMMABLE LOGIC. A third relay is provided with timer functions.
- PROGRAMMABLE OUTPUT AND RELAY DEFAULTS for hold and fault modes.
- NEMA 4X (IP65) WEATHERPROOF CORROSION-RESISTANT ENCLOSURE.

1.1 FEATURES AND APPLICATIONS

The Model 1054B Microprocessor Analyzers, with the appropriate sensors, are designed to continuously measure and control pH, ORP, conductivity, resistivity, ratio, percent concentration, dissolved oxygen, ozone or total free chlorine in industrial and municipal processes.

The Model 1054B Conductivity Resistivity Analyzers are housed in a NEMA 4X (IP65) weatherproof, corrosion-resistant, flame retardant enclosure suitable for panel, pipe or wall mounting. All functions are accessed through the front panel membrane keyboard which features tactile feedback. Measurement data may be read at any time. However, settings may be protected against accidental or unauthorized changes by a user selectable security code. The display indicates the measured value in engineering units as well as temperature, alarm status, hold output and fault conditions.

The 1054B transmits a user selected isolated current output which is continuously expandable over the measurement range for either direct or reverse action and can be displayed in milliamps or percent. Output dampening of 0-255 secs. is user selectable.

The output and relay default settings are user selectable for hold or fault mode operation. The hold output function allows manual control during routine sensor maintenance.

Continuous self diagnostics alert the operator to faults due to analyzer electronics, integral RTD failures, open wiring and process variable range problems. In the event of a fault condition or hold mode diagnosed by the analyzer, the output will be set to a preset or last process value and the relays will be set to their default settings.

Dual alarms are a standard feature on the Model 1054B and are programmable for either high or low operation. Alarm 2 may be programmed as a fault alarm. Both alarms feature independent setpoints, adjustable hysteresis and time delay action. The time delay is convenient when an alarm is used for corrective action, such as shutting down a demineralizer for regeneration. Time delay will ignore a temporary breakthrough and prevent shutting down a de-mineralizer unit prematurely. A dedicated interval timer with relay is also provided.

Automatic neutral salt cation correction temperature compensation is standard. The process temperature is accurately measured by an integral RTD in the sensor assembly and is read on the display in °C. For greater accuracy, the temperature indication may be standardized to the process temperature.

Calibration is easily accomplished by entering the cell calibration constant (shown on the sensor tag) via the 1045B's keypad. Standardization can also be made with the cell in process of known conductivity (resistivity).

The Model 1054B Microprocessor Analyzer comes standard with an LCD display. An LED display is available as an option.

1.2 PHYSICAL SPECIFICATIONS - GENERAL

Enclosure: Black, ABS, NEMA 4X, IP65,

CSA Enclosure 4.

144 X 144 X 192 mm

(5.7 X 5.7 X 7.6 in.)

Front Panel: Membrane keyboard with tactile feed back and user selectable security.

Digital Display: LCD, black on grey

Optional, red LED

Character Height: 18mm (0.7 in.)

Electrical Classification:

FM Class I, Div. 2, Group A thru D
Relays: 28 Vdc - 5.0 amps resistive only
150 mA - Groups A & B; 400 mA - Group C
540 mA - Group D; Ci = 0; Li = 0

CSA Class I, Div. 2, Group A thru D
Relays: 28 Vdc, 110 Vac & 230 Vac
5.0 amps resistive only

Power: 100 - 127 VAC, 50/60 Hz ± 6%, 4.0 W

200 - 253 VAC, 50/60 Hz ± 6%, 4.0 W

Current Output: Isolated, 0-20 mA or 4-20 mA into 600 ohms maximum load at 115/230 Vac *or* 550 ohms maximum load at 100/200 Vac,
Direct or Reverse Output Dampening:
0-255 seconds.

EMI/RFI: EN61326 CE

LVD: EN61010-1

Ambient Temperature: -20 to 65°C (-4 to 149°F)

Ambient Humidity: LED max 95% RH

(LCD max 85% RH @ 50°C)

Alarms: Dual, field selectable High/Low, High/High,

Low/Low Alarm 2 configurable as a fault alarm

Time Delay 0 to 254 seconds

Dual Setpoints, continuously adjustable

Hysteresis is adjustable up to 25% full scale

for low side/High Alarm and high side/Low Alarm

Interval Timer: Interval: 10 min. to 2999 days

On Counts: 1 to 60

On Duration: 1 to 299.9 seconds

Off Duration: 1 to 299.9 seconds

Wait Duration: 1 to 299.9 seconds

Controls dedicated relay

Relay Contacts: Epoxy Sealed Form A contacts, SPST, Normally Open.

	Resistive	Inductive
28 VDC	5.0 Amps	3.0 Amps
115 VAC	5.0 Amps	3.0 Amps
230 VAC	5.0 Amps	1.5 Amps

Weight/Shipping Weight: 1.1 kg/1.6 kg (2.5 lb/3.5 lb)

The **Model 1054B Low Conductivity Analyzer** measures 0-20 µS/cm or 0-18.3 megohm/cm. It is commonly known that in measuring the resistivity or conductivity of ultrapure water, temperature compensation is very critical. The temperature coefficient of ultrapure water depends both on the temperature and resistivity/conductivity of the water being tested. The Model 1054BLC incorporates a 1000 ohm RTD for temperature measurement, and is capable of measuring and displaying temperature accurately within ± 0.1°C. Temperature measurement is resolved to 0.025°C and this precise measurement is used in the analyzer's temperature compensation calculation. Temperature compensation formula appropriate for water contaminated with minute quantities of sodium chloride is user selectable. For Cation resin columns, a formula specific to the characteristics of pure water contaminated with minute quantities of hydrochloric acid is user selectable.

1.3 ANALYZER SPECIFICATIONS @ 25°C

Measurement Range: 0 - 20 µS/cm or
0 - 18.3 megohm/cm.

Output Scale: Zero suppression: up to 90% full scale. Span: from 10% to 100% full scale

Measurement Accuracy:

Conductivity: ±1% of reading or .002us/cm (whichever is greater)

Resistivity: ±0.2 megohms-cm, temperature corrected resistivity to 25°C

Temperature Accuracy: ±0.1°C (0-100°C), ±0.2°C (0-100°C) cable lengths over 50 ft

Repeatability: ±0.25% of reading

Stability: ±0.25% month, non-cumulative

Temperature Effect: 0.02% of reading/°C

Temperature Compensation: 0 to 100°C (32 to 212°F)

Temperature Compensation: Neutral Salt or Cation

1.4 RECOMMENDED SENSORS:

CONDUCTIVITY CELLS FOR MODEL 1054B LC	
P/N	Description
400-11	Screw-in Cell
400-11-36	Screw-in Cell with 6 in. insertion
400-11-50	Screw-in Cell with 50 ft cable
451	Dip Cell
455, 404-11	Flow Cell, Stainless Steel
PD-441	Flow Cell, Plastic
IB-441	Plastic Ball Valve Cell
IB(SS)-441, 402-12	Ball Valve Cell, Stainless Steel
460, 403-11-20	1-1/2 in. Sanitary Fitting
456, 403-11-21	2 in. Sanitary Fitting

SECTION 2.0
INSTALLATION

2.1 GENERAL. This analyzer's enclosure is suitable for outdoor use. However, it should be located in an area where temperature extremes and vibrations are minimized or absent. Installation must be performed by trained technician.

2.2 UNPACKING AND INSPECTION. Inspect the analyzer for shipping damage. If damaged, notify the carrier immediately. Confirm that all items shown on the packing list are present. Notify Rosemount Analytical if items are missing.

2.3 MECHANICAL INSTALLATION. Select an installation site that is at least one foot from any high voltage conduit, has easy access for operating personnel, and is not in direct sunlight. Mount the analyzer as follows:

1. Remove the four screws that secure the rear cover of the enclosure.
2. Remove the four screws holding the front panel assembly of the enclosure and carefully pull the front panel and connected printed circuit boards straight out.
3. Follow the procedure for the appropriate mounting configuration: Section 2.3.1 for panel mounting, Section 2.3.2 for wall mounting, Section 2.3.3 for pipe mounting.

2.3.1 Panel Mounting (Standard). The Model 1054B is designed to fit into a DIN standard 137.9 mm X 137.9 mm (5.43 inch X 5.43 inch) panel cutout (Refer to Figure 2-1 and Figure 2-2).

1. Prepare the analyzer as described in Section 2.3.
2. Install the mounting latches as described in Figure 2-2 (latches are shown oversize for clarity). If the latches are not installed exactly as shown, they will not work correctly. The screws provided are self-tapping. Tap the screw the full depth of the mounting latch (refer to side view) leaving a gap greater than the thickness of the cutout panel.
3. Align the latches as shown and insert the analyzer enclosure through the front of the panel cutout. Tighten the screws for a firm fit. To avoid damaging the mounting latches, do not use excessive force.
4. Replace the front panel assembly. Circuit boards must align with the slots on the inside of the enclosure. Assure that the continuity wire is connected to the rear cover and the interface board's closest mounting screw. Replace the door and four front panel screws.

2.3.2 Wall Mounting Plate with Junction Box (P/N 23054-01). Refer to Figure 2-3 and Figure 2-4.

1. Prepare the analyzer as described in Section 2.3.
2. Mount the junction box and bracket to the analyzer with the hardware provided. All wiring can be brought to the terminal strip prior to mounting the analyzer.
3. Place the metal stiffener on the inside of the analyzer and mount the two 1/2 inch conduit fittings using two each weather seals as shown. Mount NEMA 4X conduit plug (included) into center conduit hole.
4. Mount the analyzer to the junction box using the 1/2 inch conduit fittings.
5. Complete wiring from the analyzer to the junction box (Refer to Figure 2-4).

NOTE

Run sensor wiring out of the left opening (From front view) to junction box. All others out right opening to junction box.

2.3.3 Pipe Mounting (P/N 23053-00). The 2 inch pipe mounting bracket includes a metal plate with a cutout for the analyzer (Refer to Section 2.3 for mounting the analyzer into the plate). Mounting details are shown in Figure 2-5.

2.4 ELECTRICAL WIRING. The Model 1054B has three conduit openings in the bottom rear of the analyzer housing which will accommodate 1/2 inch conduit fittings. From the front view, the conduit opening on the left is for sensor wiring; the center is for signal output and the opening on the right is for timer, alarm, and AC connections. Sensor wiring should always be run in a separate conduit from power wiring. AC woring should be 14 guage or greater.

NOTE

For best EMI/RFI protection the output cable should be shielded and enclosed in an earth grounded rigid metal conduit. When wiring directly to the instrument connect the output cable's outer shield to the transmitter's earth ground via terminal 8 on TB3 (Figure 2-6). When wiring to the wall mounting junction box connect the output cable's outer shield to the earth ground terminal on TB-A (Figure 2-4).

The sensor cable should also be shielded. When wiring directly to the instrument connect the sensor cable's outer shield to the transmitter's earth ground via terminal 8 on TB-2 (Figure 2-6). If the sensor cable's outer shield is braided an appropriate metal cable gland fitting may be used to connect to braid to earth ground via the instrument case. When wiring to the wall mounting junction box connect the sensor cable's outer shield to the earth ground terminal on TB-A (Figure 2-4).

The user must provide a means to disconnect the main power supply in the form of circuit breaker or switch. The circuit breaker or the switch must be located in close proximity ot the instrment and identified as the disconnecting devie for the instrument.

2.4.1 Power Input Wiring. The Model 1054B can be configured for either 115 VAC or 230 VAC power.

Connect AC power to TB1-8 and -9 (115 VAC) or TB1-7 and -8 (230 VAC) ground to the ground terminal at TB3-8 (refer to Figure 2-6).

CAUTION

The sensitivity and stability of the analyzer will be impaired if the input wiring is not grounded. DO NOT apply power to the analyzer until all electrical connections are verified and secure. The following precautions are a guide using UL 508 as a safeguard for personnel and property.

1. AC connections and grounding must be in compliance with UL 508 and/or local electrical codes.
2. The metal stiffener is required to provide support and proper electrical continuity between conduit fittings.
3. This type 4/4X enclosure requires a conduit hub or equivalent that provides watertight connect, REF UL 508-26.10.
4. Watertight fittings/hubs that comply with the requirements of UL 514B are to be used.
5. Conduit hubs are to be connected to the conduit before the hub is connected to the enclosure, REF UL 508-26.10.
6. If the metal support plate is not used, plastic fittings must be used to prevent structural damage to the enclosure. Also, appropriate grounding lug and awg conductor must be used with the plastic fittings.

2.4.2 Output Wiring. The signal output and alarm connections are made to terminals 1 through 6 of TB1 and TB3-1 and 2. (Refer to Figure 2-6).

2.5 Sensor Installation. The Model 1054BLC is designed to work with sensor Models 441, 455, and Endurance line. These cells are of stainless steel construction with titanium-palladium electrodes. Standard 3/4 in. NPT mounting threads are provided on Model 441, 1/4 in. FPT on the Model 455. In these cells the RTD temperature compensator is located within the center element where it makes optimal thermal contact with the process stream. The cells are equipped with integrally connected cable (10 ft standard). Refer to Figure 2-6 for sensor wiring.

For Endurance line sensors, please refer to the Endurance instruction manual.

2.5.1 Cell Location.A mounting location should be chosen to meet the following considerations:

1. Avoid dead ends or pipe stubs or any location where circulation might be poor.
2. If velocity is very low, mount the cell so that the stream is directed against the end of the electrodes and the water will flow between the electrodes.
3. Be sure that the pipe is full of water and that the cell is completely immersed up to the pipe threads.
4. Cell mounting vertically downward is not recommended due to possible air entrapment.

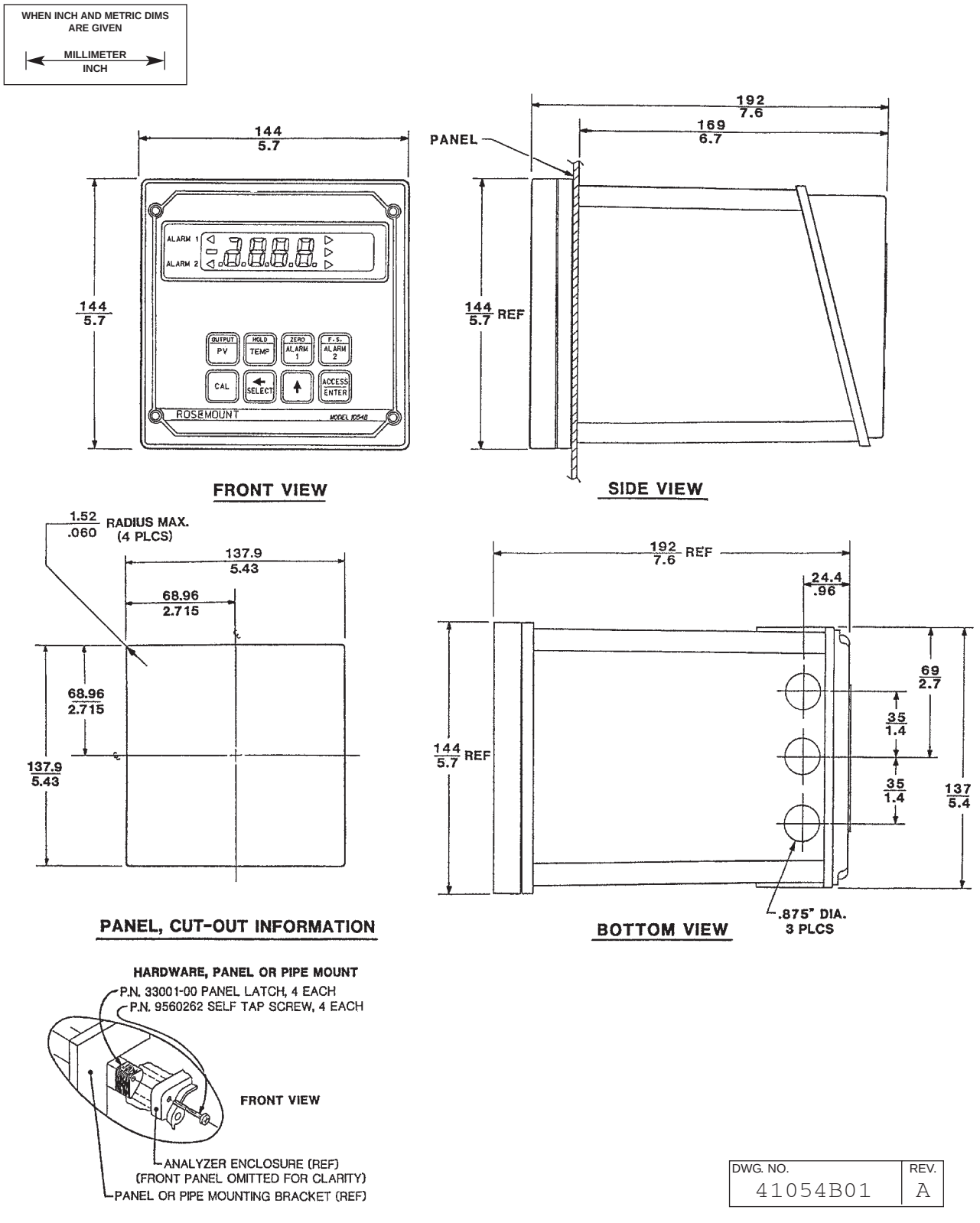

FIGURE 2-1. Panel Mounting Cutout

2.5.2 Model 441 Installation. The Model 441 should be screwed gently into a 3/4 in. NPT female pipe fitting using a parallel jaw wrench. The stainless steel threads should be coated with a suitable pipe compound which will act to seal the threads, and prevent the need for overtightening. Teflon thread tape is recommended for this purpose. After the cell is installed, the cell cable should be supported in such a way as to reduce strain and minimize the danger of the cable becoming snagged and pulled from the cell.

2.5.3 Model 455 Installation. The Model 455 is provided with 1/4 in. Swagelok™ tube fittings. These are suitable for direct insertion into 1/4 in. O.D. sample lines. If connection to the plastic tubing is desired, the Swagelok™ fittings may be removed and replaced with 1/4 in. FPT - hose barb fittings. Fitting threads should be coated with a suitable pipe compound which will act to seal the treads, and prevent the need for overtightening. Teflon thread tape is recommended for this purpose. After the cell is installed, the cell cable should be supported in such a way as to reduce strain and minimize the danger of the cable becoming snagged and pulled from the cell.

2.5.4 Endurance Line Installation. Please refer to the Endurance line instruction manual. Other installation information can be found in Figures 2-4 and 2-6.

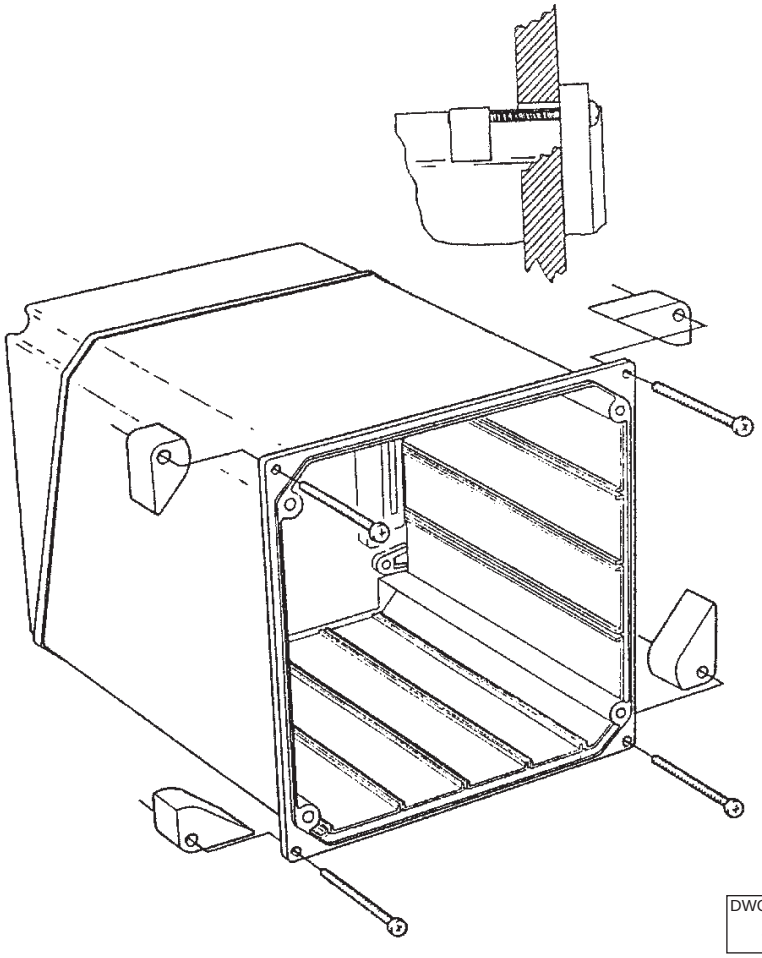

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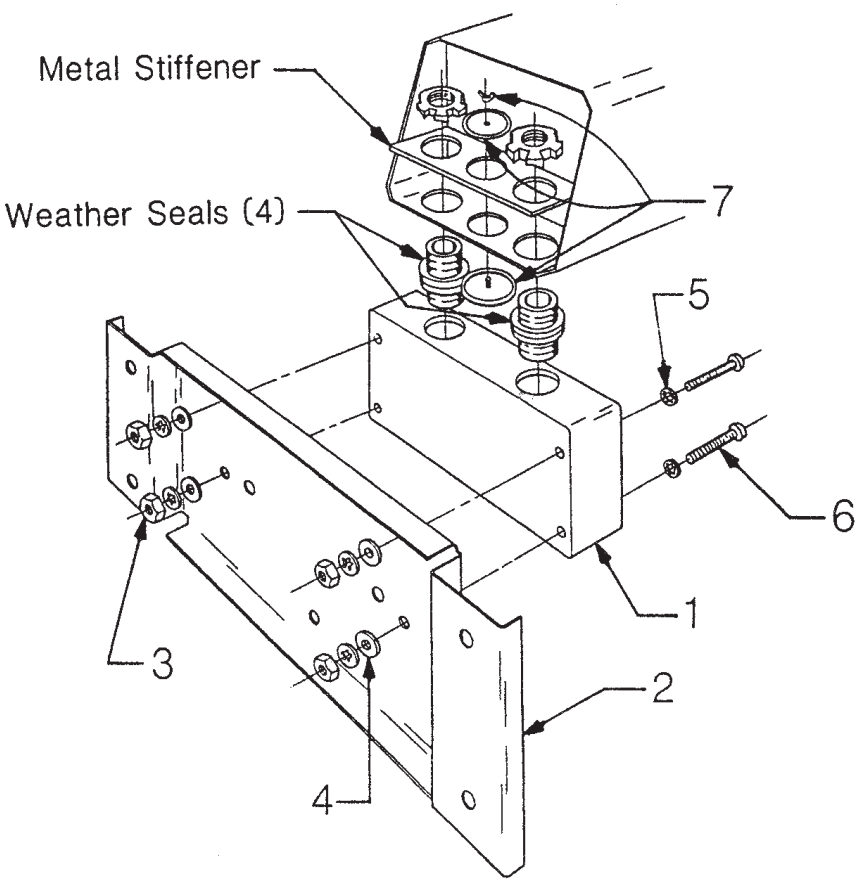
FIGURE 2-2. Panel Mounting Tab Installation



ITEM	PART NUMBER	DESCRIPTION	QTY
1	23058-01	S Assy, J-Box	1
2	33030-00	Bracket, wall mtg	1
3	9900600	Nut, 6-32 Hex	4
4	9910600	Washer, Flat #6	4
5	9910610	Washer, Lock Int. #6	8
6	9600612	Screw, 6-32 X .75	4
7	9510048	Seal, Weathertight	1

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FIGURE 2-3. Wall Mounting Junction Box Installation

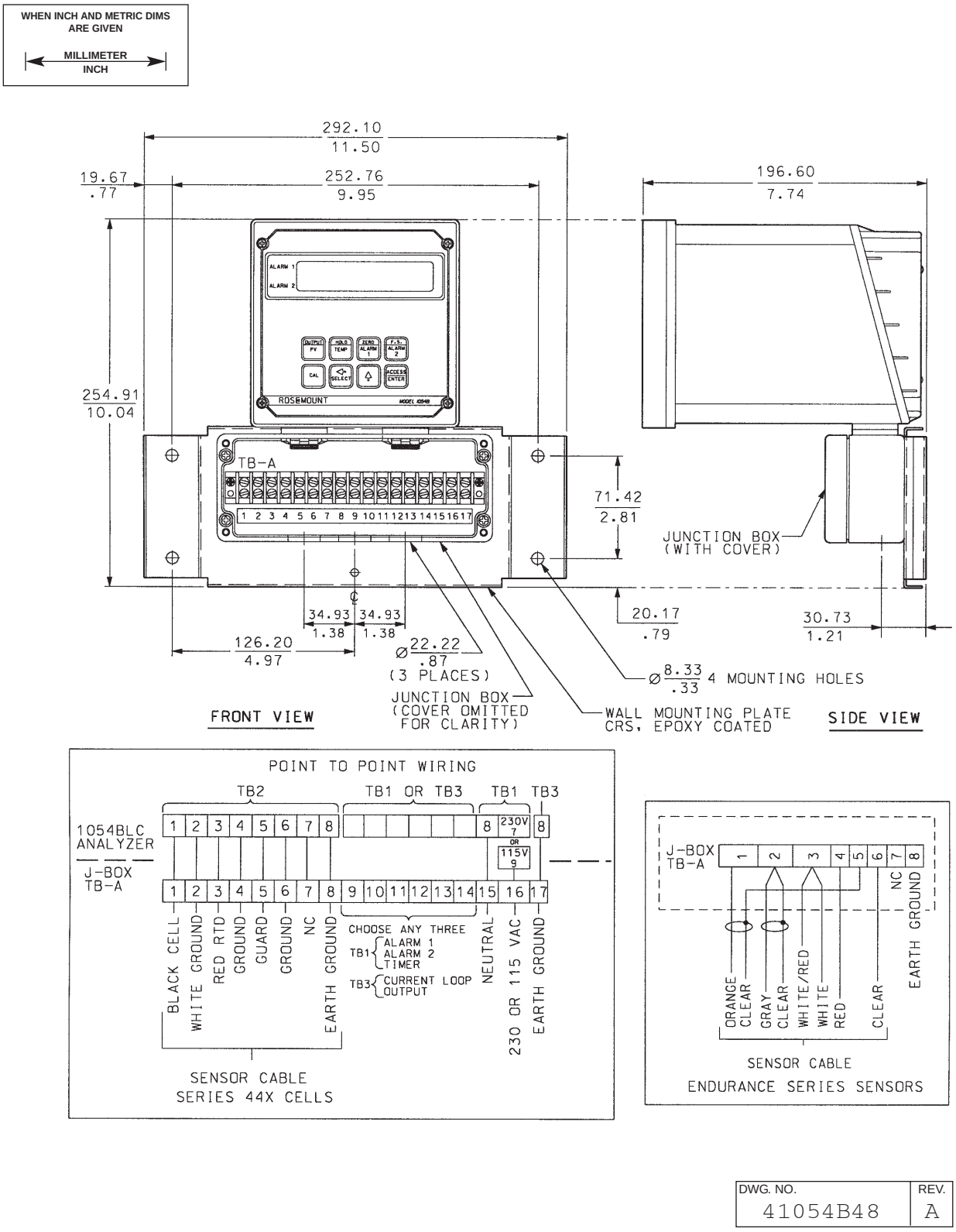


FIGURE 2-4. Wall Mounting Junction Box Wiring

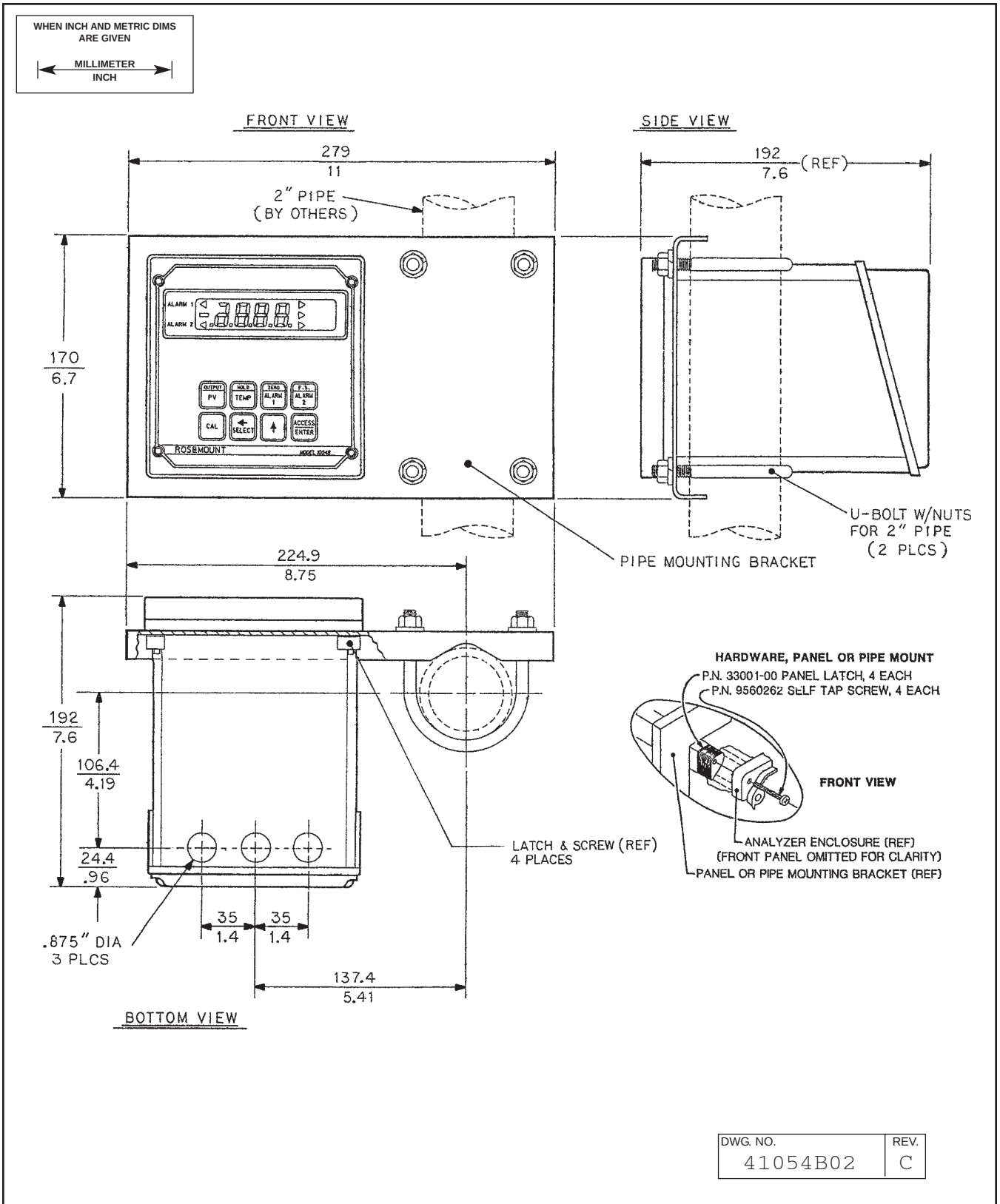
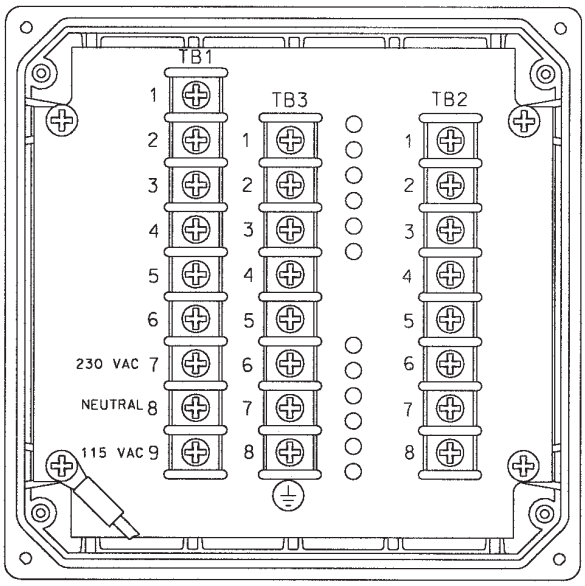
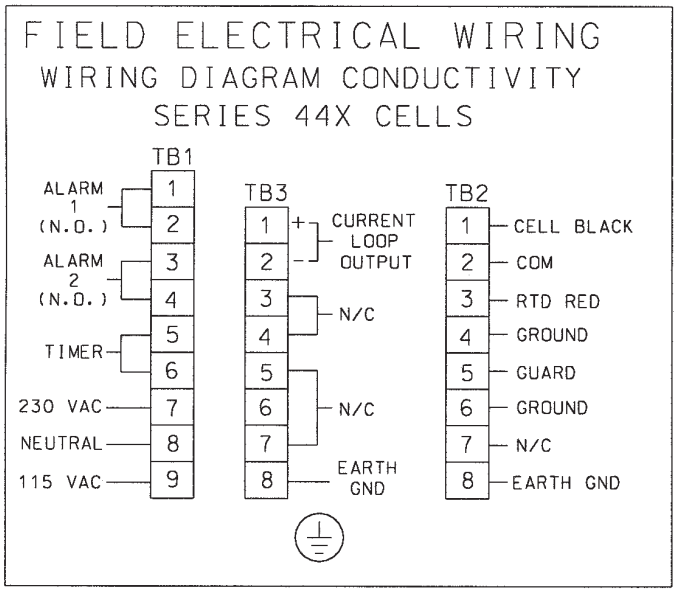


FIGURE 2-5. Pipe Mounting Installation



BACK VIEW / COVER OMITTED



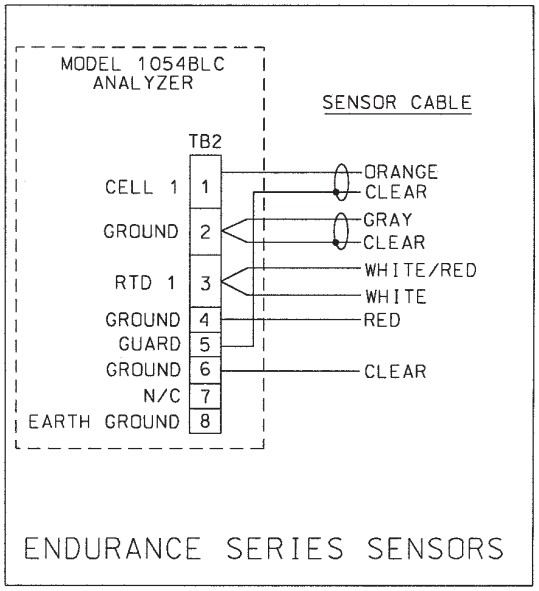


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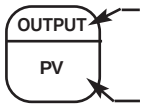
FIGURE 2-6. Electrical Wiring

SECTION 3.0
DESCRIPTION OF CONTROLS

3.1 KEYBOARD FUNCTIONS. All operations of the Model 1054B microprocessor Analyzer are controlled by the 8 keypads on the front of the instrument. These keypads are used to :

1. Display parameters other than the primary parameter.
2. Edit setpoints for alarms, set up specific output current value for simulation, calibrate temperature, conductivity, etc.
3. Configure display for temperature units, for automatic temperature compensation, alarm usage, setting timer functions, security, and output range.

To view, and not change parameters, other than the primary parameter requires only a simple keystroke routine. As shown in Figure 3-1 below, a single keypress accesses the lower function printed on the keypad. Quick, double keypresses access the top function printed on the keypad.



Quick double press will access the current output current value in mA or %. Read only.

Single press of the keypad will access the present Conductivity reading. Read only.

FIGURE 3-1. Function Select on Keypad.

To edit any of these parameters, requires one more operation. After displaying the value associated with the parameter selected, press the **SELECT** keypad. As seen in Figure 3-2 below, this will display the numerical value, and the first digit will be flashing to indicate this value may be edited.

All changes to the operating program that set-up the instrument display are made through the set menu program. See Figure 3-5 at the end of this section.

1 .Press Key twice.
2. Lo shows briefly.
3. Zero point is displayed.

1. Press Key.
2. AdJ shows briefly.
3. Numbers show with digit flashing.

FIGURE 3-2. Accessing Editing Function.

Configuration is all accomplished through a series of menus located within the set mode menu. To access these set mode menus the **ACCESS** keypad is pressed **TWICE** in **RAPID** succession.

1. Press twice in rapid succession.

2. See SEt on display. Confirms entry into set mode menu.

3. First menu item is displayed. Analyzer now ready to configure.

4. Use the SCROLL keypad to rotate through the available menus.

FIGURE 3-3. Accessing Configuration Menus

Once inside the Set mode menu, use the scroll keypad to scroll through the menu list. When the menu desired is displayed, release the scroll keypad.

To enter the submenus press the **SELECT** keypad. If the submenu allows editing, the item will flash that can be edited. If not, use the scroll keypad to scroll through the next list of submenus. **SELECT** will enter this submenu and if it is editable, the field will flash.

To exit the menu and SAVE the new value, press the **ENTER** keypad.

To exit the menu without saving the edited value, press the PV keypad to jump out of the set menu program with out saving value. To change other parameters will require re-entering the set menu program.

Figure 3-4 explains the various fields surrounding the Primary process on the LC display.

Table 3-1 describes the functions accessible with the 8 keypads, the number of times to press the keypad to access, and its' function when used with the select keypad and set menu.

Tables 3-2 and 3-3 describe the meaning of the various mnemonics used on the display. They are categorized by their use in either menus, or as process information.

3.1.1 Item Selection and Value Adjustment Keys. The three keys located on the lower right side of the keypad are used for menu navigation, value adjustment and entry, and item selection. These keys perform the following functions:

A. SELECT/Shift (⬅) Key. This key is used to select the displayed menu, or for shifting to the next digit in the Numeric Display.

B. SCROLL Key (⬆). This key is used to scroll through menu when selected, or scroll through digits on the active (flashing) Numeric Display, or move the decimal point.

C. ACCESS/ENTER Key. This key is used to **ACCESS** the Set Mode (Section 4.1.2) and to **ENTER** the displayed value into memory (from Numeric Display).

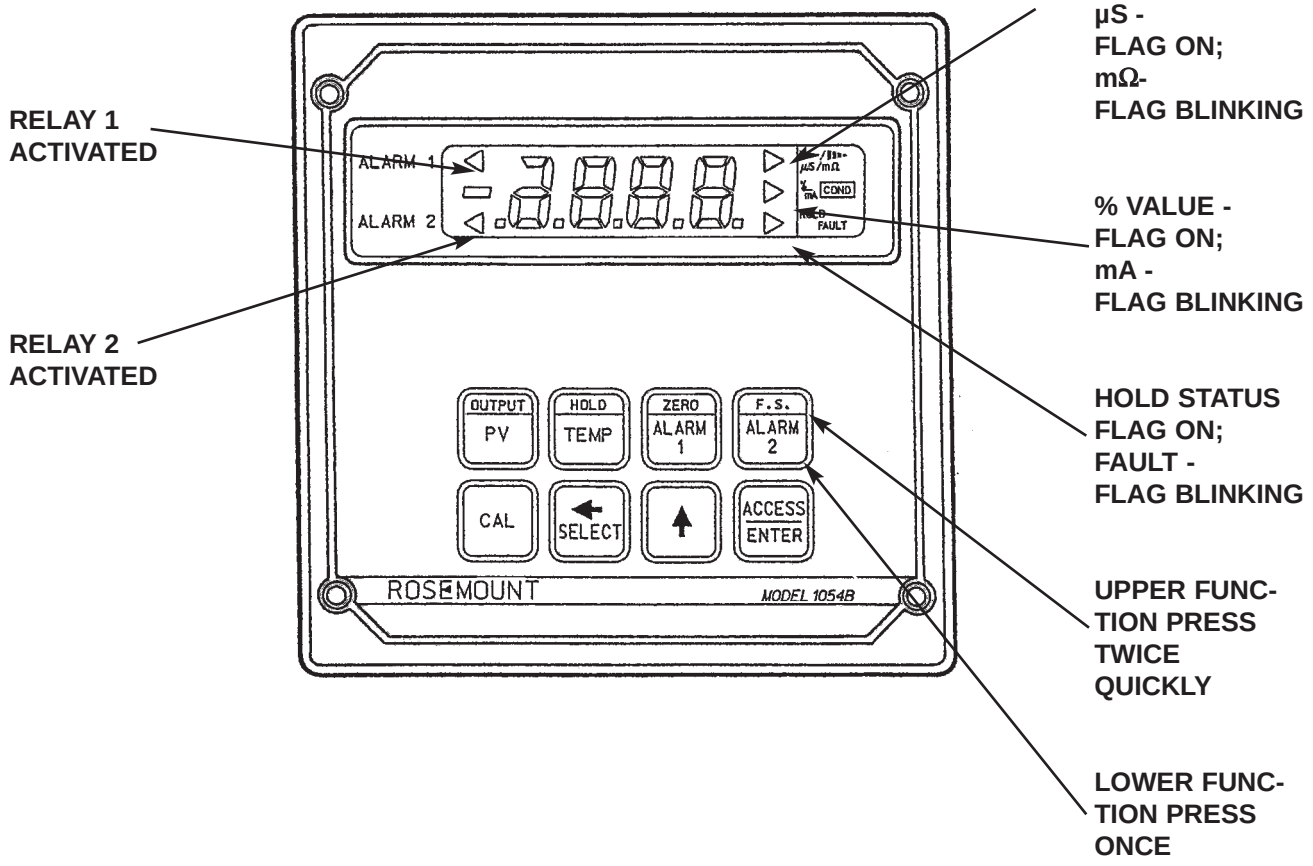


FIGURE 3-4. Keyboard and Display

TABLE 3-1. Key Description

	MAIN FUNCTION (PRESS ONCE)	SECOND FUNCTION (PRESS TWICE QUICKLY)
OUTPUT / PV	Displays - conductivity (resistivity). (PV=Process Variable)	Displays - current output (mA or % full scale). Set Function (w/SELECT) - Simulates current output.
HOLD / TEMP	Displays - process temperature (°C). Set Function (w/SELECT) - One point standardization of temperature.	Initiates or removes analyzer from hold condition.
ZERO / ALARM 1	Displays - Alarm 1 setpoint. Set Function (w/SELECT) - Sets Alarm 1 setpoint.	Displays - low current setpoint. Set Function (w/SELECT) - Sets low current point.
F.S. / ALARM 2	Displays - Alarm 2 setpoint. Set Function (w/SELECT) - Sets Alarm 2 setpoint.	Displays - full scale output setpoint. Set Function (w/SELECT) - Sets full scale output point.
CAL	(w/Select) One point standardization.	

SELECT (➡)	Select sub menu (mnemonic display). Shift to next digit (numeric display).
⬆	Scroll through menu (mnemonic display). Scroll digits (numeric display). Scroll decimal position.
ACCESS / ENTER	Press twice to access set-up menu. Enter displayed value into memory. Enter displayed menu item (flashing) into memory.

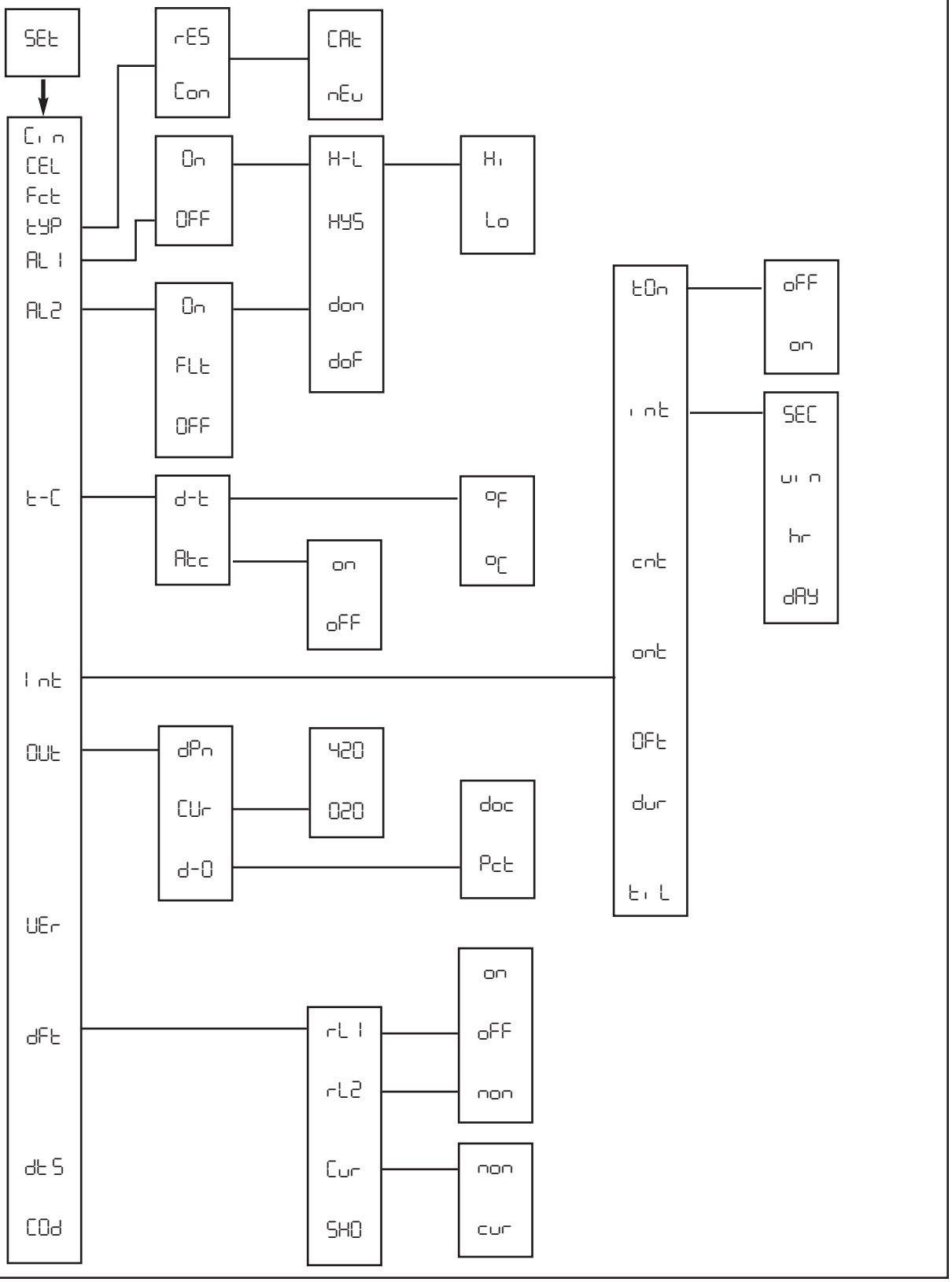
TABLE 3-2. Information Mnemonics

MNEMONIC	DESCRIPTION
AdJ	Adjustment to value reading
bAd	Incorrect entry
Con	Conductivity Display
°C	Temperature °C
dOC	Displays conductivity output (mA)
HLd	Analyzer in Hold Position
HI	Displays high range value for current output
ıtr	Interval timer activated
LO	Displays low range value for current output
LOC	Access locked – enter security code
Pct	Displays conductivity (resistivity) output (percent)
rES	Resistivity Display
SEt	Set mode
SıP	Simulates current output (percent)
SıC	Simulates current output (mA)
SP1	Displays Alarm 1 setpoint
SP2	Displays Alarm 2 setpoint
Std	Standardize conductivity

TABLE 3-3. Set Function Mnemonics

AL1	Alarm 1 setup	don	Delay on time	on	Relay closed on fault
AL2	Alarm 2 setup	dPn	Dampen output	On	Use alarm as process alarm
AtC	Auto temp compensation	dtS	LCD/LED Display test	OFt	Timer off time
°C	Temperature °C	dur	Timer duration	OUt	Current output
CAt	Cation Compensation	°F	Temperature °F	Pct	Display output in percent
CEL	Cell Constant	Fct	Calibration Factor	rES	Resitivity Display
Cın	Display Sensor input	FLt	Use alarm as fault alarm	rL1	Relay 1 fault setup
COd	Security Code	Hı	Relay action - high	rL2	Relay 2 fault setup
cnt	Timer count	H-L	Alarm logic	SEC	Seconds
Con	Conductivity Display	Hr	Hours	SHO	Show fault history
CUr	Config. current output	HYS	Hysteresis	t-C	Temperature configuration
Cur	Config. fault output	ınt	Interval period	t4P	P.V. Displayed
cur	Default current setpoint	Int	Timer setup	tı L	Timer - time remaining
dAY	Days	Lo	Relay action - low	tOn	Timer status
dFt	Fault Configuration	non	No action on fault	UEr	User version
d-O	Display output	nEu	Neutral Salt Compensation	uın	Minutes
d-t	Display temperature	oFF	Relay open on fault	420	4mA to 20mA output
doc	Display output in mA	OFF	Alarm not used	020	0mA to 20mA output
doF	Delay off time	ont	Timer on time		

FIGURE 3-5. Set Menu Items



SECTION 4.0
CONFIGURATION

4.1 GENERAL. This section details all of the items available in the Set Mode to configure the analyzer to a specific application.

4.1.1. Configuration Worksheet. The configuration worksheet on page 18 should be filled out before proceeding with the analyzer's configuration. This sheet gives a brief parameter description, the factory setting, and a space for user setting.

4.1.2 Set Mode Display Mnemonic "SEt"**.** Most of the analyzer's configuration is done while in the Set Mode. Please refer to Figure 3-5 for the layout of all menu items. All menu variables are written to the analyzer's EEPROM (memory) when selected and remain there until changed. As these variables remain in memory even after the analyzer's power is removed, the analyzer configuration may be performed prior to installing it.

1. Power up the analyzer. Only power input wiring is required for analyzer configuration (Refer to Section 2.4.1). The analyzer's display will begin showing values and/or fault mnemonics. All fault mnemonics will be suppressed while the analyzer is in Set Mode (the fault flag will continue to blink).

2. Enter Set Mode. Pressing the **ACCESS** key twice in rapid succession will place the analyzer in Set Mode. The display will show "SEt" to confirm that it is in Set Mode. It will then display the first item in the set menu. The analyzer is now ready for user configuration.

   NOTE:
   If "LOC" displays, the Keyboard Security Code must be entered to access the Set Mode. (Refer to Section 6.0.)

3. Analyzer variables can be entered in any order. On initial configuration, however, it is recommended that the variables be entered in the order shown on the worksheet. Refer to the configuration worksheet (Table 4-1). This will reduce the chance of accidentally omitting a needed variable.

4.2 PROCESS VARIABLE. Display Mnemonic "tYP". Used to select display convention of the primary variable and to select the temperature compensation curve.

A. Conductivity. Display Mnemonic "Con". Select this item to display conductivity in µS/cm.

B. Resistivity. Display Mnemonic "rES". Select this item to display resistivity in megohms/cm.

C. Neutral Salt. Display Mnemonic "nEu". Select this item for temperature compensation appropriate for water contaminated with minute quantities of sodium chloride.

C. Cation. Display Mnemonic "CAt". Select this item for temperature compensation for water contaminated with minute quantities of hydrochloric acid, as would be the case for the effluent from a cation resin column.

4.2.1 Primary Variable Configuration (tYP). Refer to Figure 4-1.

1. Enter Set Mode by pressing **ACCESS** key twice.
2. **SCROLL** (⬆) until "tYP" appears on the display.
3. **SELECT** to move to the next menu level. "Con"or "rES" will display.
4. **SCROLL** (⬆) to display desired item then **ENTER**. "nEu" or "cAt" will display.
5. **SCROLL** (⬆) to display desired item then **ENTER**. Display will return to "tYP".

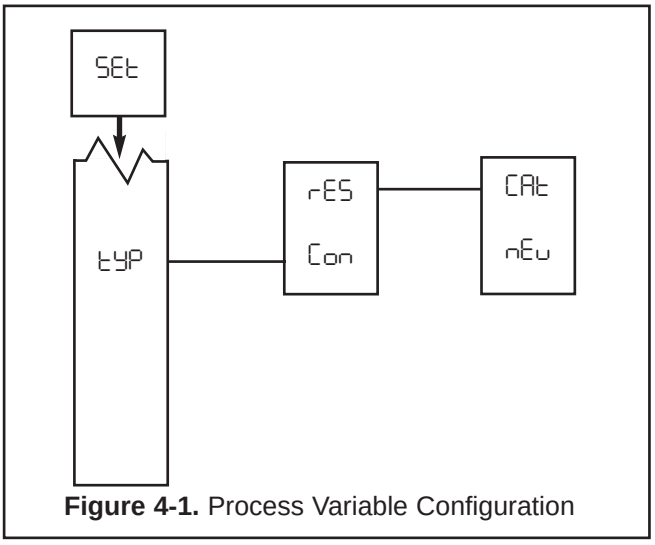


Figure 4-1. Process Variable Configuration

TABLE 4-1.
CONFIGURATION WORKSHEET

Use this worksheet to assist in the configuration of the analyzer. Date: _____

	RANGE	FACTORY SET	USER SET
A. Process Variable Display (typ)			
1. Conductivity or Resistivity (Con/rES)		Con	_____
2. Temperature Compensation (nEu/CAt)		nEu	_____
B. Alarm 1 Setup (AL 1)			
1. Alarm Configuration (On/OFF)		On	_____
2. High or Low (H-L) (Hi /Lo)		Lo	_____
3. Hysteresis (HYS)	0-25 % of setpoint	0.00%	_____
4. Delay Time On (don)	0-255 sec.	000 Seconds	_____
5. Delay Time Off (doF)	0-255 sec.	000 Seconds	_____
C. Alarm 2 Setup (AL2)			
1. Alarm Configuration (On/FLt/OFF)		On	_____
2. High or Low (H-L) (Hi /Lo)		Hi	_____
3. Hysteresis (HYS)	0-25 % of setpoint	0.00%	_____
4. Delay Time On (don)	0-255 sec	000 Seconds	_____
5. Delay Time Off (doF)	0-255 sec	000 Seconds	_____
D. Interval Timer (I nt)			
1. Active Status (tOn) (oFF/on)		oFF	_____
2. Interval Time (i nt)	minimum 10 minutes	1 Day	_____
3. Count (cnt)	1 to 60	5	_____
4. On Time (ont)	0 to 299.9 sec	1 Second	_____
5. Off Time (OFt)	0 to 299.9 sec	1 Second	_____
6. Duration (dur)	0 to 299.9 sec	2 Seconds	_____
E. Current Output Setup (OUt)			
1. mA Output (CUr) (020/420)		420	_____
2. Display Current Output (d-O) (Pct/doc)		doc	_____
3. Dampen Current Output (dPn)	0-255 sec.	0.0 Seconds	_____
F. Default Setup (dFt)			
1. Relay 1 Default (rL 1) (non/oFF/on)		non	_____
2. Relay 2 Default (rL2) (non/oFF/on)		non	_____
3. Current Output Default (Cur) (non/cur)		non	_____
G. Keyboard Security Setup (COd)			
1. Keyboard Security Required	001-999	_	_____
2. Keyboard Security Not Required	000	000	_____
Alarm Set Points			
1. Alarm 1 (SP 1)	0-20 µS or 0-18.3 meg Ω	0.00 µS	_____
2. Alarm 2 (SP2)	0-20 µS or 0-18.3 meg Ω	10 µS	_____
Current Output			
1. Zero (0 or 4 mA) (Lo)	0-20 µS or 0-18.3 meg Ω	0.00 µS	_____
2. F.S. (20 mA) (HI)	0-20 µS or 0-18.3 meg Ω	10 µS	_____

4.3. ALARM 1 AND 2. Display Mnemonic "AL 1" or "AL2". Used to set alarm relay logic. The alarms may be used to perform on-off process control. See note below.

A. ON. Display Mnemonic "On". Select this item if Alarm 1 or 2 is to be used as a process alarm. See Steps D through G for further configuration.

B. OFF. Mnemonic "OFF". Select this item if alarm 1 or 2 will not be used or to temporarily disable the alarm. Alarm 1 or 2 setpoint will display "oFF" if this item is selected. Omit Steps D through G.

C. Fault. Display Mnemonic "FLt". (Alarm 2 only). Select to make Alarm 2 a fault alarm. Relay 2 will energize when the unit shows a fault condition. See Table 8-1 for a listing of the fault mnemonics and their descriptions. Alarm 2 setpoint will display "FLt" if this item is selected. Omit Steps D through G.

D. Alarm Logic. Mnemonic "H-L". Select this item for high or low alarm logic. High logic activates the alarm when the reading is greater than the set point value. Low logic activates the alarm when the reading is less than the set point value.

E. Relay Hysteresis. Display Mnemonic "HYS". Sets the relay hysteresis (dead band) for deactivation after reading has passed the alarm set point. May be set from 0 to 25%. Use hysteresis when a specific conductivity should be reached before alarm deactivation.

F. Delay Time On. Display Mnemonic "don". Sets time delay for relay activation after alarm set point is reached. May be set from 0 to 255 seconds.

G. Delay Time Off. Display Mnemonic "doF". Sets time delay for relay deactivation after alarm set point is reached. May be set from 0 to 255 seconds. Alarm state restarts time from zero. Use when a fixed time should pass before relay deactivation occurs.

4.3.1 Alarm Configuration (AL 1/AL2). Refer to Figure 4-2.

1. Enter Set Mode by pressing **ACCESS** key twice.
2. **SCROLL** (⬆) until "AL 1" or "AL2" appears on the display.
3. **SELECT** to move to the next menu level. "On", "OFF" or ("AL2" only) "FLt" will display.
4. **SCROLL** (⬆) to display desired item then **SELECT**.
5. If "OFF" is selected, display will show "oFF" to acknowledge. Press **ENTER** key to return to "AL 1" or "AL2", concluding routine. Skip to Step 11.

   If "On" is selected, display will show "on" to acknowledge, then display "H-L". Proceed to Step 6.

   If "FLt" is selected, display will show "FLt" to acknowledge. Press **ENTER** key to return to "AL2".
6. **SELECT** "H-L". "Hi " or "Lo" will display (flashing).
7. **SCROLL** (⬆) to the desired item and ENTER it into memory. Display will return to "H-L". If changes to relay activation logic are desired, proceed to Step 8, otherwise Step 12.
8. **SCROLL** (⬆) to display "HYS", "don" or "doF" then **SELECT** desired item. Numerical display will flash to indicate that a value is required.
9. Use **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value.
10. **ENTER** value into memory. The analyzer will acknowledge and return to display of last item selected. Repeat Step 8 if further changes are desired, otherwise Step 12.
11. Repeat Step 3 for the other Alarm's settings as required.
12. To return to the first level of the Set Mode, Press the **ACCESS** key.

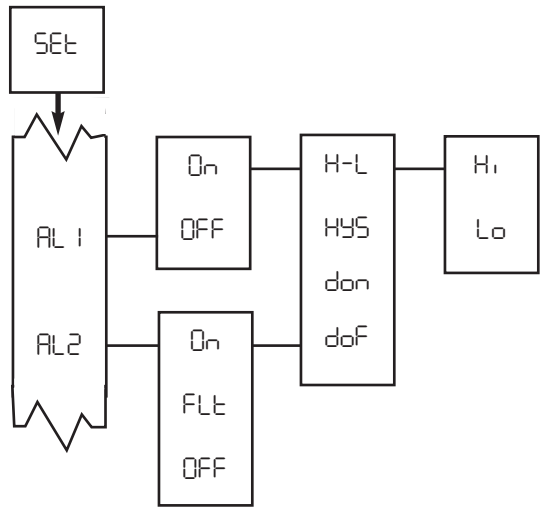


Figure 4-2. Alarm 1 and Alarm 2 Configuration

4.4 INTERVAL TIMER. Display Mnemonic "int". This item is used to set the interval timer's relay logic. The timer can be used for sensor maintenance, such as a wash cycle to clean the sensor in a bypass line. Choices are:

A. Interval Timer Enable/Disable. Display Mnemonic "ton". Select this item to begin interval cycle "on" or disable interval cycle "oFF".

B. Interval Period. Display Mnemonic "int". Select this item to set the time period between control cycles. "SEC" for seconds, "min" for minutes, "hr" for hours, and "dAY" for days. May be set from a minimum of 10 minutes.

C. "On" Periods Per Cycle. Display Mnemonic "cnt". Select this item to enter the number of on periods per cycle. May be set from 1 to 60 on periods.

D. Duration of "On" Periods. Display Mnemonic "ont". Select this item to enter the relay activation time for each on period. May be set from 0.1 to 299.9 seconds.

E. Duration of "OFF" Periods. Display Mnemonic "oFt". Select this item to enter the relay deactivation time between each "on" period during the control cycle. Valid when "cnt" is 2 or greater. May be set from 0 to 299.9 seconds.

F. Sensor Recovery Time. Display Mnemonic "dur". Select this option to enter the duration time after the last "on" period in a cycle. May be set from 0 to 299.0 seconds. The wait duration can be used for electrode recovery after a wash cycle.

G. Interval Time remaining. Display Mnemonic "tiL". Select this item to display the time remaining to the next control cycle. If selected during the control cycle, display will show "---".

NOTE

The Model 1054B is placed *on hold* during the control cycle (from first "on" period through the wait duration). The analyzer will simulate a fault condition and briefly show "itr" every eight seconds. The display will continue to show the measured value.

4.4.1 Interval Timer Configuration (int). Refer to Figures 4-3 and 4-4.

1. Enter Set Mode by pressing **ACCESS** Key twice.
2. **SCROLL** (⬆) until "int" appears on the display.
3. **SELECT** to move to the next menu level. "ton" will display.

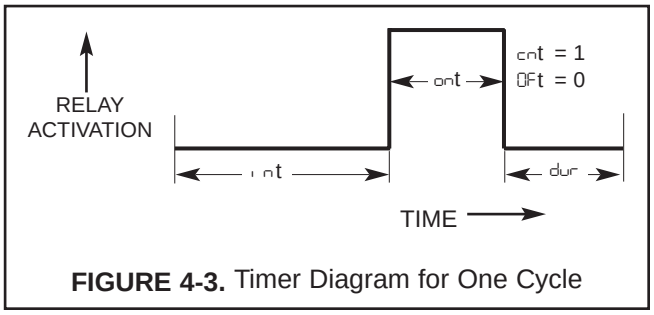


FIGURE 4-3. Timer Diagram for One Cycle

4. **SCROLL** (⬆) to display "on" or "oFF" and **ENTER** it into memory. If interval configuration is required, proceed to Step 5, otherwise Step 10.
5. **SCROLL** (⬆) to display desired menu item. If "int" is selected, go to Step 6, otherwise Step 10.
6. **SCROLL** (⬆) to display desired interval period and **SELECT** it. Numerical Display will flash.
7. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value and **ENTER** it into memory. Display will return to interval period menu.
8. Repeat Steps 6 and 7 as needed.
9. Press the **ENTER** key to return to the main timer menu.
10. **SELECT** the desired item. The Numerical Display will flash.
11. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value and **ENTER** it into memory.
12. Repeat Steps 5, 10, and 11 as required.
13. Press the **ENTER** key to return to Set Menu.

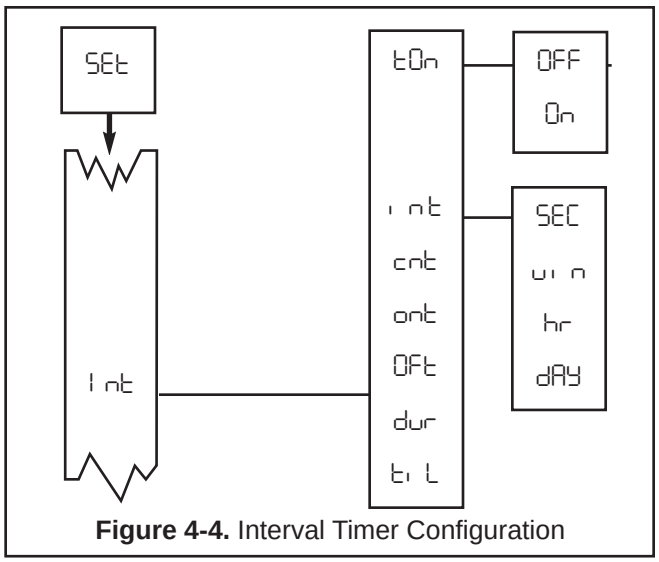


Figure 4-4. Interval Timer Configuration

4.5 CURRENT OUTPUT. Display Mnemonic is "OUt". This item is used to configure the output signal.

A. Output Dampening. Display Mnemonic "dPn". Dampens the response of the signal output. This option is useful to minimize the effect of a noisy reading. The number entered is the sample time (in seconds) for an averaged output. Zero to 255 seconds may be entered.

B. mA Output Range. Display Mnemonic "CUr". Selection of this item will allow choice of 0 to 20 mA or 4 to 20 mA output range.

C. Display Output. Display Mnemonic "d-0". This item is used to select logic of output display. Selecting this item will allow the analyzer to display current output as mA ("doc") or as a percent of full scale output range ("Pct").

4.5.1 Current Output Configuration "OUt". Refer to Figure 4-5.

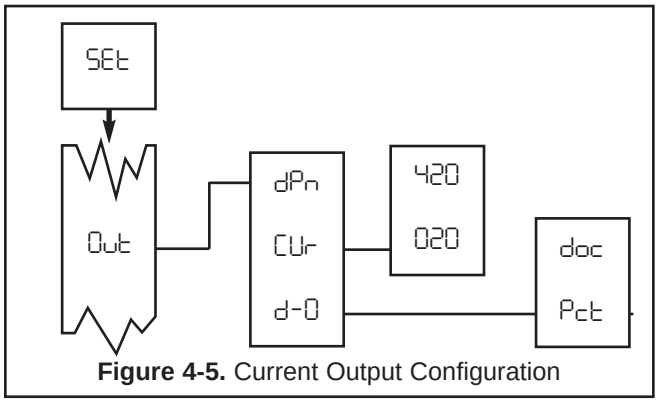


Figure 4-5. Current Output Configuration

1. Enter Set Mode by pressing the **ACCESS** key twice.
2. **SCROLL** (⬆) until "OUt" appears on the display.
3. **SELECT** to move to the next menu level. "dPn" will display.
4. **SCROLL** (⬆) then **SELECT** desired item.
5. If "dPn" is selected, numerical display will flash indicating that a value is required (proceed to Step 6).

   If "CUr" or "d-0" is selected, proceed to Step 7.
6. **SCROLL** (⬆) then **SHIFT** (⬅) to display the desired value. **ENTER** into memory
7. **SCROLL** (⬆) then **ENTER** desired item.
8. Repeat Steps 4-7 as required.
9. Press the **ENTER** key to return to the Set Menu.

4.6 DEFAULTS. Display Mnemonic "dFt". This item is used to set the configuration of relays and output default conditions during fault or hold status. See Table 8-1 for a listing of the possible fault conditions which can be diagnosed by the analyzer. A hold status is initiated by pressing the **HOLD** key twice. (Press twice again to remove the hold.)

A. Relay 1 and 2. Display Mnemonic "rL 1" and "rL2". The relays can be set to activate "on", deactivate "oFF", or hold present status "non". See Table 4-2.

B. Current Output. Display Mnemonic "Cur".The current output is held "non" or goes to a specified value "cur" during a fault condition. "cur" will probably be the most informative selection.

C. Fault History. Display Mnemonic "SHO". Selecting this item will display the most recent detected faults. Press the **SCROLL** key once for each previous fault history. Pressing **ACCESS** will clear "SHO" history.

4.6.1 Default Configuration ("dFt"). Refer to Figure 4-6.

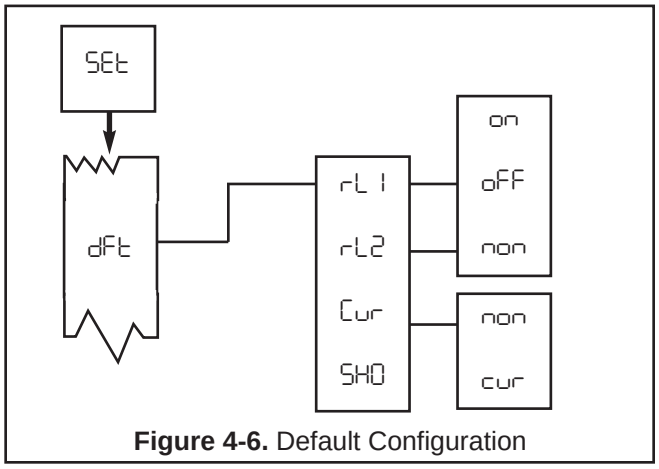


Figure 4-6. Default Configuration

1. Enter Set Mode by pressing the **ACCESS** key twice.
2. **SCROLL** (⬆) until "dFt" appears on the display.
3. **SELECT** to move to the next menu level. "rL 1" will display.
4. **SCROLL** (⬆) then **SELECT** desired item.
5. Display will show next item selection. **SCROLL** (⬆) and **ENTER** desired item.
6. Repeat Steps 4 and 5 as required for other default settings "rL2" and "Cur". If "cur" is selected for "Cur", press **ENTER** then use the **SCROLL** (⬆) and **SHIFT** (⬆) keys to enter the desired current value in mA.
7. Press the **ENTER** key to return to Set Menu.

TABLE 4-2. Relay States for Various Conditions and Alarm/Default Configurations

Set Menu default (dFt) setting rL 1/rL2	ANALYZER CONDITION								
	NORMAL			HOLD			FAULT		
	Set menu AL 1/AL2 setting			Set menu AL 1/AL2 setting			Set menu AL 1/AL2 setting		
	On	OFF	FLt (Alarm 2 only)	On	OFF	FLt (Alarm 2 only)	On	OFF	FLt (Alarm 2 only)
on	Proc. det.	–	–	+	–	–	+	–	+
oFF	Proc. det.	–	–	–	–	–	–	–	+
non	Proc. det.	–	–	Proc. det.	–	–	Proc. det.	–	+

Proc. det.: Alarm state is determined by the process value.

+ : Relay will activate.

– : Relay will not activate.

Example: If you want the analyzer to activate relay 1 in hold mode during calibration, set "AL 1" to "On" in Section 4.3, and set "rL 1" to "on".

4.7 ALARM SETPOINT. The alarm setpoints should be adjusted after completing the configuration procedure outlined in Sections 4.1 to 4.6. (Refer to Figure 4-7.)

1. Press the **PV** key to ensure that the analyzer is not in Set Mode.

2. Press the **ALARM 1** or **ALARM 2** key. "SP 1" or "SP2" will show briefly, followed by the Alarm 1 or Alarm 2 Setpoint.

NOTE:
If the alarm is set to OFF or FAULT (Alarm 2 only), the analyzer will display "oFF" or "FLt" respectively (refer to Section 4.2, Alarm Configuration).

3. Press **SELECT** to adjust the value. The display will acknowledge briefly with "AdJ" followed by the Numeric Display with digit flashing.

4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value.

5. **ENTER** value into memory.

6. Repeat Steps 2 to 5 for the second setpoint.

NOTE
Alarm logic may be changed from normally open (N.O.) to normally closed (N.C.) by cutting circuits (W5, W7 & W9) on the power supply PCB and adding jumpers (W4, W6, & W8).

Selection of the decimal position is achieved by pressing **SHIFT** (⬅) until the decimal point flashes*, The **SCROLL** (⬆) until the decimal point is in the proper position.

*Decimal position to the right of least signficant digit does not display.

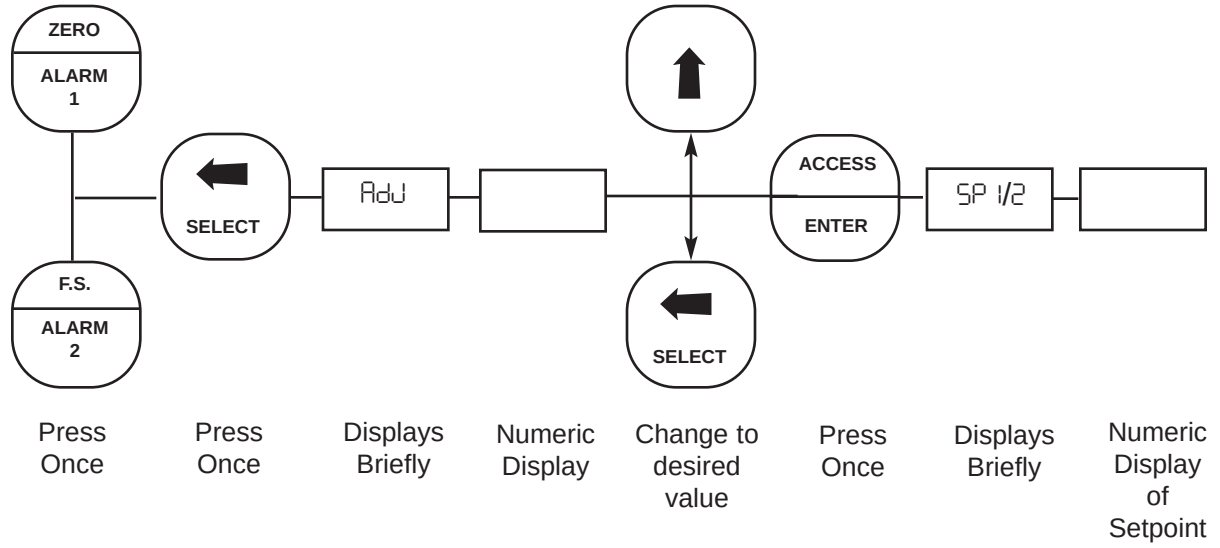


FIGURE 4-7. Alarm Setpoint

4.8 OUTPUT SCALE EXPANSION. This section should be followed if it is desired to scale the current output range other than the factory setting of 0-10 µS/cm. The output zero and full scale value should be adjusted after completing the configuration procedure as outlined in Sections 4.1 to 4.6. (Refer to Figure 4-8.)

A. ZERO POINT (0 mA or 4 mA) "LO"

1. Press the **PV** key to ensure that the unit is not in Set Mode.
2. Press the **ALARM 1** key twice. The display will show "LO" briefly then display the ZERO point.
3. Press **SELECT** to adjust the value. The display will acknowledge briefly with "AdJ" followed by the Numeric Display with digit flashing.
4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value.
5. **ENTER** value into memory. The display will show "LO" and display the entered value.

B. Full Scale (F.S.) Point (20 mA) "HI "

1. Press the **PV** key to ensure that the analyzer is not in Set Mode.
2. Press the **ALARM 2** key twice. The display will show "HI " briefly then display the FULL SCALE point.
3. Press **SELECT** to adjust the value. The display will acknowledge briefly with "AdJ" followed by the Numeric Display with digit flashing.
4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value.
5. **ENTER** value into memory. The display will show "HI " and display the entered value.

NOTE

For a reverse output, enter the higher value for zero, and the lower value for the Full Scale.

NOTE

Selection of the decimal position is achieved by pressing **SHIFT** (⬅) until the decimal point flashes*, The **SCROLL** (⬆) until the decimal point is in the proper position

* Decimal position to the right of the least significant digit does not display.

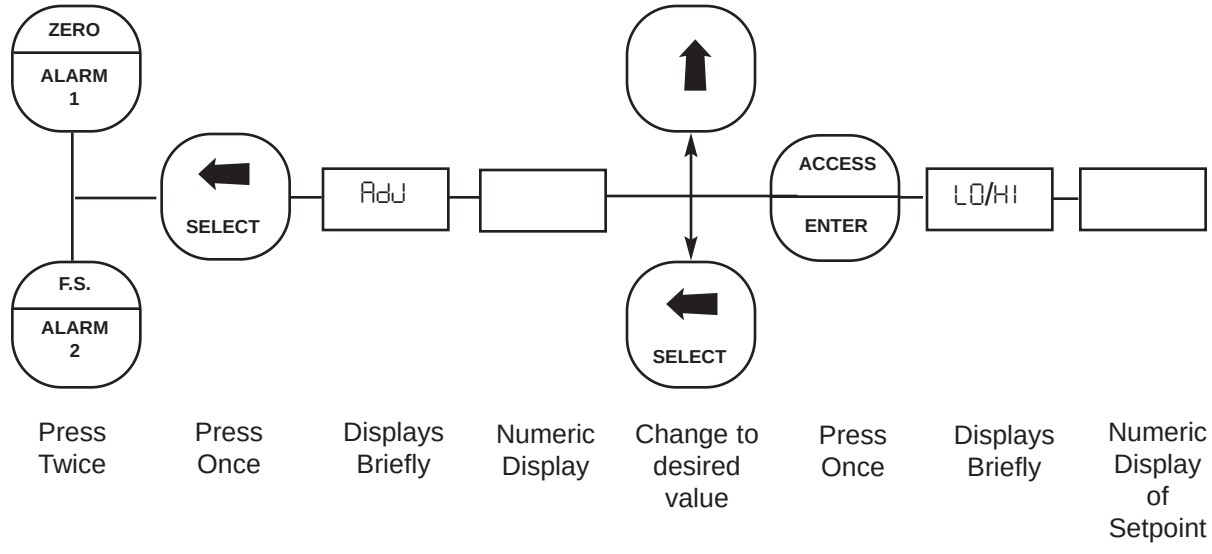


FIGURE 4-8. Output Scale Expansion

4.9 SIMULATE CURRENT OUTPUT. The output can be simulated to check the operation of devices such as valves, pumps, or recorders. The output can be simulated in either current (mA) or percent of full scale, depending on how the output display "d-O" was configured in Section 4.5. (Refer to Figure 4-9.)

A. Simulate Output in Percent "SI P". The output can be simulated in percent if "d-O" in Section 4.5 was configured to display percent "Pct".

1. Press the **PV** key once to insure that the analyzer is not in the Set Mode.

2. Press the **OUTPUT** key twice. The display will show "Pct" briefly, then display the output value in percent of full scale.

3. Press **SELECT** to simulate the output. The display will briefly acknowledge with "SI P" followed by the Numeric Display with digit flashing.

4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value.

5. **ENTER** value into memory. The display will show "Pct" and display the entered value. Also, the display will flash to acknowledge that the analyzer is placed on hold "HLd". In hold mode the relays will be set as determined in Section 4.6.

6. To remove the analyzer from hold, press the **HOLD** key twice. The hold flag on the display will be removed and the display will stop flashing.

B. Simulate Output in Current "SI C". The output can be simulated in mA units if "d-O" in Section 4.5 was configured to display current "doc".

1. Press the **PV** key once to insure that the analyzer is not in the Set Mode.

2. Press the **OUTPUT** key twice. The display will show "dOC" briefly, then display the output value in mA.

3. Press **SELECT** to simulate the output. the display will briefly acknowledge with "SI c" followed by the Numeric Display with digit flashing.

4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value.

5. **ENTER** value into memory. The display will show "dOC" and display the entered value. Also, the display will flash to acknowledge that the analyzer is placed on hold "HLd". In hold mode the relays will be set as determined in Section 4.6.

6. To remove the analyzer from hold, press the **HOLD** key twice. The hold flag on the display will be removed and the display will stop flashing.

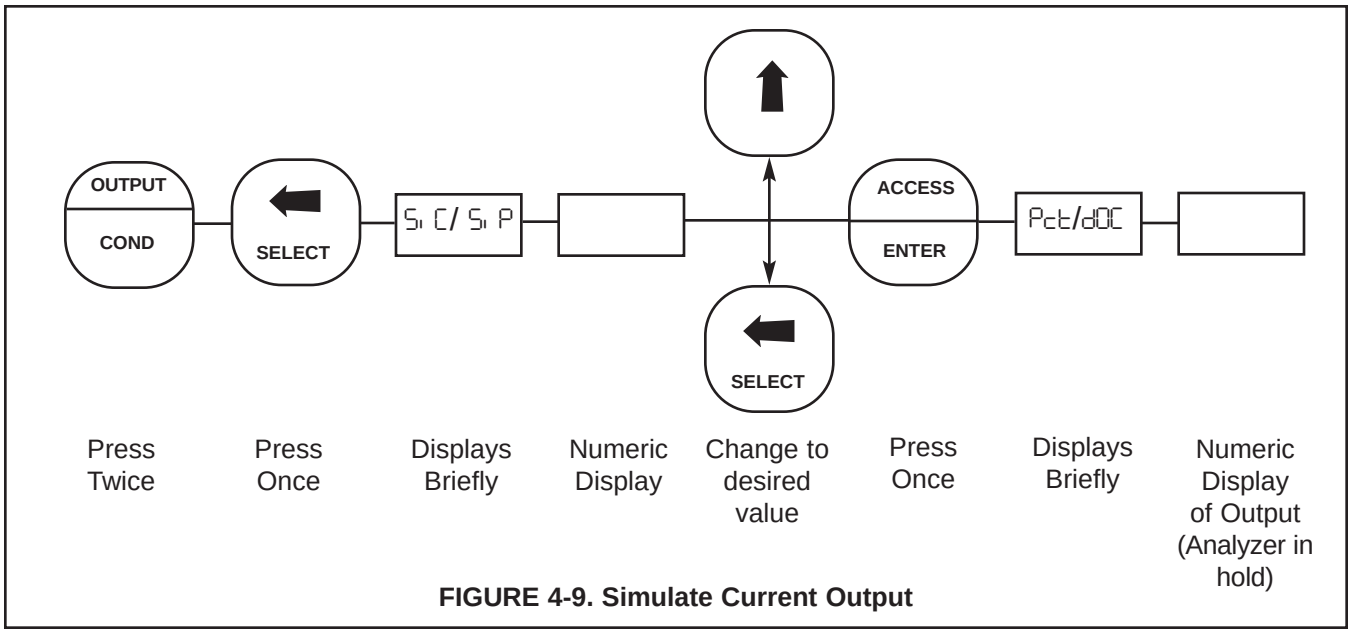


FIGURE 4-9. Simulate Current Output

SECTION 5.0
START-UP AND CALIBRATION

5.1 START-UP AND CALIBRATION. Calibration and operation of the Model 1054B should begin only after completion of configuration of the analyzer. The sensor must be wired (including junction box and interconnecting cable) as it will be in operation.

5.1.1 Entering the Cell Constant. The cell constant is factory set for a .01 cell constant. Ifthe Model 441 or 455 is used, this value need not be changed. If a cell with a constant other than .01 is used, enter the appropriate value as follows:

l. Enter the Set Mode by pressing the **ACCESS** key twice in rapid succession. The analyzer will display "SEt" briefly then display "C. n".

2. **SCROLL** (⬆) the menu until "CEL" is displayed, then **SELECT** it. The Numerical display will flash to indicate that a value is desired.

3. Use **SCROLL** (⬆) and **SHIFT** (⬅) to display the correct sensor cell constant and **ENTER** it into memory.

5.1.2 Entering the Cell Calibration Constant (Factor). Each Rosemount Analytical Inc. conductivity cell intended for use with the 1054B LC includes a tag giving its calibration constant, "Cal Const." This number is between 0 and 999 specifying the cell's exact cell constant. Entering this value into the 1054B LC allows increased measurement accuracy. Enter the number provided on the Cell's tag as follows:

1. Enter the Set Mode by pressing the **ACCESS** key twice in rapid succession. The analyzer will display "SEt" briefly then display "C. n".

2. **SCROLL** (⬆) the menu until "FCt" is displayed, then **SELECT** it. The Numerical display will flash to indicate that a value is desired.

3. Use **SCROLL** (⬆) and **SHIFT** (⬅) to display the correct calibration constant and **ENTER** it into memory.

5.1.3 Temperature Calibration. Precise measurement of high purity water requires accurate temperature measurement. For this reason it is recommended that the cell be temperature calibrated.

To calibrate a conductivity cell, place the cell and a high accuracy mercury thermometer into a beaker of water. It is best, though not essential, that the sample be near the temperature of the intended process stream. Allow several minutes for the sensor and thermometer to come to equilibrium.

1. Observe the analyzer temperature reading by pressing **TEMP** key. Assure that the reading is stable and the sensor acclimated to the process temperature.

2. Compare the analyzer reading to the thermometer reading. If the readings are different, proceed to Step 3.

3. Press the **TEMP** key then the **SELECT** key to correct the temperature display. The analyzer will display "AdJ" briefly, then the Numeric Display will show with digit flashing.

4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the correct value and **ENTER** it into memory.

5.1.4 Cell Single Point Calibration. The "Single Point" calibration adjustment is for use only in calibrating the Model 1054B LC to match a reference instrument of known high accuracy. To use it otherwise will result in a reduction in system accuracy. By performing a single point calibration, the user overrides the calibration constant setting.

NOTE

To completely undo the single point calibration adjustment, re-enter either the cell constant or cell calibration constant (Section 5.1.1 - 2).

NOTE

After initial installation or any cleaning procedure, the conductivity cell will require I to 2 days after insertion into the ultrapure water stream before accurate readings may be obtained. In many cases, the full 1% system accuracy will not be obtainable until the cell has remained in the ultrapure water stream a full 5 days.

3. Press the **CAL** key then press the **SELECT** key. "Std" will display followed by the Numeric Display with digit flashing.
4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the conductivity value of known high accuracy and **ENTER** it into memory.

NOTE

The standardization routine requires entry of a conductivity value, to convert a resistivity value to a conductivity value, divide one by the resistivity value.

SECTION 6.0
KEYBOARD SECURITY

6.1 KEYBOARD SECURITY. Display Mnemonic "COd". Select this feature to display the user defined security code. Any three digit number may be used for this code. "000" will disable the security feature. This item is used to prevent accidental changes to the calibration and configuration of the analyzer. When activated, the analyzer will allow all read functions to read normally. If an attempt is made to change a value, "LOC" will display followed by the Numeric Display ready for the code to be entered. A proper code will unlock the analyzer and the analyzer will return to the last function attempted. Any incorrect value will result in "bAd" briefly displaying. The analyzer will then return to numeric display and await the entry of the code. Once unlocked, the analyzer will allow access to all functions until the analyzer is either powered down or no keystrokes are made for a period of 2 minutes. If the code should be forgotten, pressing and holding the **ACCESS** key for 5 seconds will result in display of the code. Releasing the **ACCESS** key, then pressing **ENTER** will unlock the analyzer.

6.1.2 Keyboard Security Configuration ("COd").

1. Enter Set Mode by pressing **ACCESS** key twice.
2. **SCROLL** (⬆) until "COd" appears on the display.
3. Press **SELECT.**
4. **SCROLL** (⬆) and **SHIFT** (⬅) to display the desired value, then **ENTER** it into memory.

NOTE

Entering "000" disables the keyboard security.

NOTE

Security feature will not activate until 2 minutes without keyboard activity or power is removed from the analyzer then restored.

SECTION 7.0
THEORY OF OPERATION

7.1 THEORY OF OPERATION. This section is a general description of how the analyzer operates. This section is for those users who desire a greater understanding of the analyzer's operation.

Utilizing a square wave measurement circuit for improved linearity and accuracy, the Model 1054B LC measures the absolute conductivity/resistivity of the measured process. The analyzer then references the conductivity/resistivity to 25°C by accurately measuring the process temperature by means of a Pt- 1000 RTD located in the cell.

It is commonly known that in measuring the resistivity or conductivity of ultrapure water, temperature compensation is very critical. The temperature coefficient of ultrapure water depends both on the temperature and the resistivity/conductivity of the water being tested. Figure 7-1 illustrates the relationship between the resistance and the temperature of pure water from 2 megohm/cm to 18 megohm/cm quality.

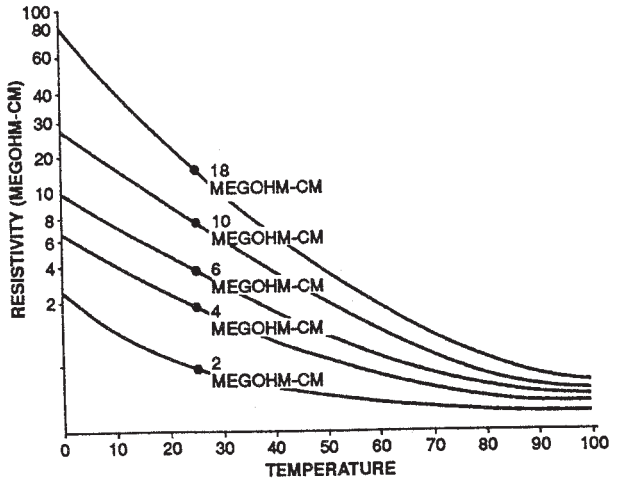


FIGURE 7-1. Resistance vs. Temperature of Pure Water

The Model 1054B LC incorporates a 1000 ohm RTD for temperature measurement, and is capable of measuring and displaying temperature accurately to within ±0.1°C. Temperature measurement is resolved to .025°C and this precise measurement is used in the analyzer's temperature compensation calculation.

For neutral salts the equation that the analyzer utilizes to calculate temperature compensation is derived from the equivalent conductance of the separate ions in the total solution system. The equation is the form of:

$$C_t = C_{25}Q_S - \frac{(Q_S - Q_W)}{(18.25)}$$

Where C_t = Specific conductivity at temperature

C_{25} = Conductivity at 25°C

Q_S = Temperature coefficient of neutral salt

Q_W = Temperature coefficient of pure water

This formula takes into account the temperature coefficient of the neutral salt component and the pure H_2O component and separately calculates the conductive contribution of the solvent and solute.

This temperature compensation method not only achieves the same accuracy for water over the range of 15°C to 60°C as the General Electric equation, but also extends the accuracy from 0°C to 100°C.

For Cation resin columns, a formula specific to the characteristics of pure water contaminated with minute quantities of hydrochloric acid is used to provide accuracy for Cation solutions up to 9.99 microSiemens/cm over a temperature range of 0°C to 100°C.

SECTION 8.0
DIAGNOSTICS AND TROUBLESHOOTING

8.1 DIAGNOSTICS. The Model 1054B analyzer has a diagnostic feature which automatically searches for fault conditions that would cause an error in the measured conductivity value. If such a condition occurs, the current output and relays will act as configured in default and the fault flag and display will flash. A fault code mnemonic will display at frequent intervals. If more than one fault condition exists, the display will sequence the faults at one second intervals. This will continue until the cause of the fault has been corrected. Display of fault mnemonics is suppressed when in Set Mode. Selecting the "SHO" item will display a history of the two most recent fault conditions unless "SHO" was cleared (refer to Section 4.6).

NOTE

If the analyzer is in hold and a fault occurs, the mnemonic "HLd" will display during the fault sequence.

8.1.1 Fault Mnemonics. Table 8-1, below, lists the fault mnemonics and describes the meaning of each.

TABLE 8-1. Fault Mnemonics

Display	Description
"EEP"	EEPROM write error (bad EEPROM chip).
"CHS"	ROM failure (check sum error) (bad ROM chip).
"CLH"	Overrange.
"COP"	Computer not operating properly.
"tcH"	High temperature compensation error.
"tcL"	Low temperature compensation error.
"Si n"	Input shorted.
"ri n"	Sensor miswired.
"FAC"	Factory calibration required.

8.1.2 Temperature Compensation. Table 8-2, below, is a ready reference of RTD resistance values at various temperatures. These are used for test and evaluation of the sensor.

TABLE 8-2. RTD Resistance Values

Temperature	Resistance
0°C	**1000 ohms**
10°C	1039.0 ohms
20°C	1077.0 ohms
25°C	1096.2 ohms
30°C	1116.7 ohms
40°C	1155.4 ohms
50°C	**1194.0 ohms**
60°C	1232.4 ohms
70°C	1270.7 ohms
80°C	1308.9 ohms
90°C	1347.0 ohms
100°C	**1385.0 ohms**
110°C	1422.9 ohms
120°C	1460.6 ohms
130°C	1498.2 ohms
140°C	1535.8 ohms
150°C	**1573.1 ohms**
160°C	1610.4 ohms
170°C	1647.6 ohms
180°C	1684.6 ohms
190°C	1721.6 ohms
200°C	**1758.4 ohms**

NOTE

Ohmic values are read across the T.C. element and are based on the stated values (R_O ± .12%). Allow enough time for the T.C. element to stabilize to the surrounding temperature. Each 1°C change corresponds to a change of 3.85 ohms.

8.2 TROUBLESHOOTING. The Model 1054B analyzer is designed with the state of the art microprocessor circuitry. This design incorporates programmed features that provide constant monitoring for fault conditions, and the reporting of these faults via Mnemonics on the instrument display screen. This aids in determining where to start checking for the cause of failures, and in some instances, the ability to see changes that can be used to predict future degeneration of assemblies before their complete failure.

8.2.1 Installation Failure. After completion of installation the instrument should be checked for operation. Normally this would consist of Powering up the instrument and checking for:

1. A self diagnostic fault display. Refer to Table 8-1 for brief description of problem indicated by mnemonic. Table 8-3 provides a more comprehensive problem explanation and actions that may help solve the problem.
2. A conductivity reading that is approximately correct (depending upon sensor installation in either air or process). Refer to Section 8.2.2 for sensor checks.
3. Pressing several of the keypads to determine whether programming appears to be operational. Table 8-3 explains problems and actions that may be helpful in solving them.
4. Checking output for 4-20 mA output current.

8.2.2 After Operation. Troubleshooting this instrument after previous operation should follow normal troubleshooting procedures. Check display. If power is O.K. the display mnemonic will direct you to the basic area of malfunction (Sensor, Printed Circuit Boards, calibration, or temperature compensation).

Use Tables 8-1 and 8-3 to determine area, possible problem and actions to take to remedy fault.

Faulty display. If a faulty display is suspected, enter the **SET** menu and scroll through to the "dtS" option. This option will activate all display segments. See Figure 3-5.

Output Circuit Testing. To check for problems in the output circuit, bypass the sensor input and analyzer calculations by setting a known output current and checking item driven by output current and checking the operation of valves, pumps, recorders, etc. For directions on how to set output current, refer to Section 4.9.

8.2.3 Sensor Troubleshooting. In addition to the sensor fault mnemonics, the analyzer can display information pertinent to determining if sensor has become coated, or if there is a conductivity versus temperature problem, or an application problem.

Sensor Coated. Conductivity cells used in pure water service require little maintenance. As with any type of in-line instrumentation, the cell should be inspected periodically. During these inspections, the following items should be checked:

NOTE

After initial installation or any cleaning procedure, the conductivity cell will require I to 2 days after insertion into the ultrapure water stream before accurate readings may be obtained. In many cases, the full 1% system accuracy will not be obtainable until the cell has remained in the ultrapure water stream a full 5 days.

1. Are the cell cable and connections in good condition? Is there evidence of corrosion?
2. Is the cell bent or dented? Blow dry with compressed air and inspect carefully for physical damage.
3. Is there any extraneous material lodged between the electrodes? The cell is easily inspected and can be cleaned with a blast of compressed air or by holding it holder hot tap water. Hot tap water may be run through the cell by slipping a piece of rubber tubing over the end of the cell and allowing the water to flow through the cell and out the vent holes.

   For extremely dirty cell, see step 4 on the following page.

4. If the conductivity cell electrodes have become extremely dirty or fouled, chemical cleaning may become necessary. Warm 10% solutions of either hydrochloric acid or sodium hydroxide may be used depending on the soil. Do not keep cells in these solutions for longer than 15 minutes. Do not have the cell connected during this procedure. Gentle brushing with a bristle brush such as a tooth brush may also be employed.

After chemical cleaning, the cell must be thoroughly rinsed in running tap water to remove strong electrolyte which may remain on the electrodes, insulators and electrode holders. This rinsing operation should continue for approximately one half hour. The cell should then be washed in several changes of distilled or deionized water over a period of several hours before being installed.

Absolute Conductivity. As an aid in determining whether a problem exists in the conductivity section of the sensor or analyzer, or the temperature compensating circuits, the absolute conductivity (the uncorrected conductivity value, without temperature compensation) of the process can be displayed. To do so:

1. Press the **ACCESS** key twice.
2. "SEt" will be displayed briefly followed by "C1 n".
3. **SELECT** "C1 n" to read the absolute conductivity of cell 1.
4. To return to normal operation, press **PV**.

Temperature Sensor Accuracy. If the temperature sensor in the conductivity sensor is suspect, measuring the resisteance along the T.C. element and comparing the corresponding temperature reading can be used in the evaluation of the sensor. Allow enough time for the T.C. element to stabilize to the surrounding temperature. Each 1° change corresponds to a change of 3.85 ohms.

8.2.4 Subassembly Replacement Considerations.

CPU Board Replacement. If a problem exists on the CPU board, and replacement is required, specific procedures included with the new board must be followed or the microprocessor will be improperly programmed. Should this occur, it will be necessary to return the analyzer to the factory for reprogramming.

Power Board Replacement. if it becomes necessary to replace the power board, the CPU will need to be recalibrated following specific procedures included with the power board Failure to follow these procedures exactly will cause the microprocessor to be improperly programmed and require the return of the analyzer to the factory for reprogramming.

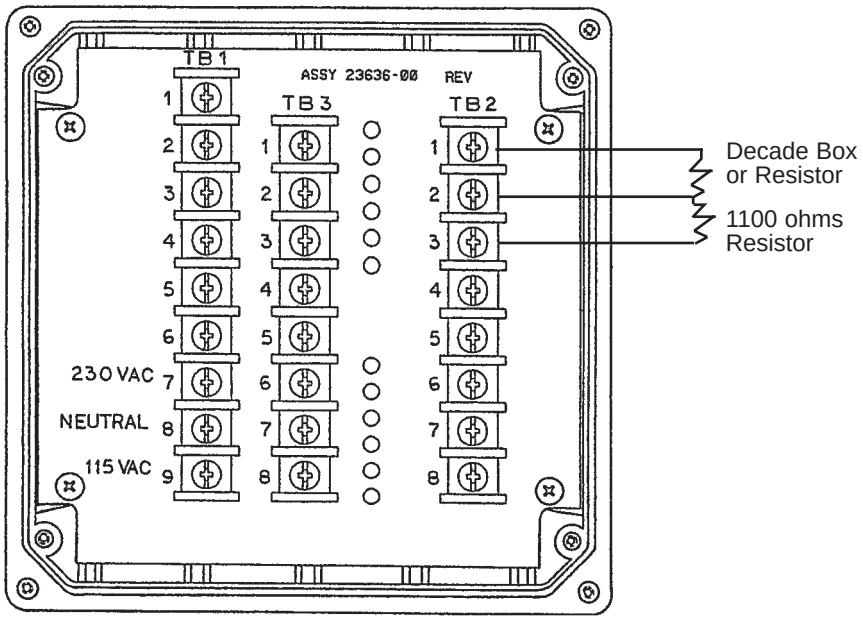
8.2.5 Instrument Electronic Check. This procedure will allow the operation of the analyzer to be evaluated by simulating a known conductivity input.

1. Disconnect the conductivity sensor input leads from TB2-1, 2, and 3. Install resistors or decade boxes to TB2 -1, 2, and 3 (see Figure 8-1). TB2-1 and TB2-2 are for conductivity input; TB2-2 and TB2-3 are temperature input.
2. Set cell constant to .01 (see Section 5.1.1).
3. Set calibration factor to 500.
4. Adjust temperature to 25°C, or put into manual temperature compensation (see Section 1.1.3)
5. To simulate a desired conductivity input, an appropriate resistance value may be calculated by Formula or selected from the conductivity (µmhos) vs resistance (ohms) table (see Figure 8-1).
6. Simulate conductivity input and evaluate the analyzer response.

8.3 INSTRUMENT MAINTENANCE. To maintain the appearance and extend the life of the enclosure, it should be cleaned on a regualar basis using a mild soap and water solution followed by a clean water rinse.

TABLE 8-3. Troubleshooting Guide

SYMPTOM	PROBLEM	ACTION
Analyzer value not the same as reference analyzer.	1. Reference analyzer incorrect. 2. Unclear what is correct 3. Analyzer out of calibration.	1. Re-calibrate reference analyzer 2. Bench test analyzer. 3. Recalibrate per Start-up and Calibration Section.
Fault code "tcH"/"tcL".	1. Miswire. 2. Open or shorted RTD.	1. Check wiring between the sensor and analyzer. 2. Replace sensor.
Fault code "CLH".	1. Process conductivity too high for sensor in use. Process contamination.	1. Check purity system.
Near zero reading.	1. Open wire between sensor and analyzer. 2. Coated/fouled sensor.	1. Repair wire/check connection. 2. Clean/replace sensor.
Fault code "EEP".	1. Defective EEPROM.	1. Replace CPU PCB.
Fault code "CHS".	1. Defective CPU.	1. Replace CPU PCB.
No alarm relay closure.	1. Defective power card. 2. Defective CPU.	1. Replace power PCB. 2. Replace CPU PCB.
No output current.	1. Defective power board. 2. Miswired.	1. Replace power PCB. 2. Check for short.
Low output current.	1. Circuit loading with excessive resistance on output.	1. Consult output loading limits Model 1054B LC specifications (600 ohms max load).
Zero conductivity reading.	1. Sensor miswired. 2. Solids coating sensor. 3. Open wire in sensor.	1. Repair wire/connection. 2. Clean sensor. 3. Replace sensor or tube.



Formula:

$$\text{Resistance (in ohms)} = \frac{.01 \times 1{,}000{,}000}{\text{desired conductivity value (in µS)}}$$

Table:

Conductivity (µS)	vs	Resistance (Megohms)
10		0.1
5		0.2
.055		18.3

FIGURE 8-1. Simulate Conductivity Input

8.4 ORDERING INFORMATION

The Model 1054B Microprocessor Analyzer: Housed in a corrosion resistant, weatherproof enclosure and operates on either 115 or 230 VAC, 50/60 Hz power. Standard features include digital display, isolated current output, dual alarms, and automatic temperature compensation.

MODEL 1054B	MICROPROCESSOR ANALYZER (3.5 lbs/1.5kg)
Code	Measurement
LC	Low Conductivity
R	Ratio Conductivity

Code	Display
01	Contacting Conductivity

1054B LC 01 EXAMPLE

TABLE 8-4. Replacement Parts

P/N	DESCRIPTION
22966-00	PCB, LCD Digital Display
23025-01	Panel Mounting Kit
23739-00	PCB, Power Supply
23655-00	PCB, CPU, Low Conductivity/Ratio
23744-00	PCB, Motherboard
23695-16	Keyboard Overlay, LCD Version
23695-17	Keyboard Overlay, LED Version
33469-00	Enclosure, Body
33470-00	Enclosure, Rear Cover
32937-00	Gasket, Rear Cover
32938-00	Gasket, Front Cover
9100157	Fuse, 0.1A, 3AB, 250V, Slo-Blow
9100160	Fuse, .250A, 125V
9100189	Fuse, .750A, 125V

TABLE 8-5. Accessories

P/N	DESCRIPTION
2001492	Tag, Stainless Steel, Specify Marking
23053-00	Mounting Bracket, 2-inch Pipe
23054-01	Mounting Bracket, Wall, with Junction Box

SECTION 9.0
RETURN OF MATERIAL

9.1 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.

9.2 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. ____

9.3 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 9.2.

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.

The right people,
the right answers,
right now.

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