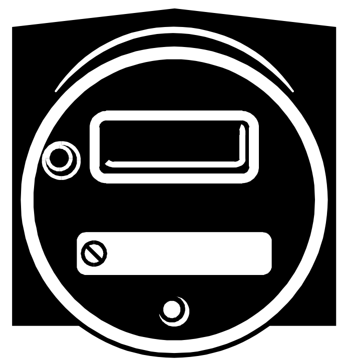
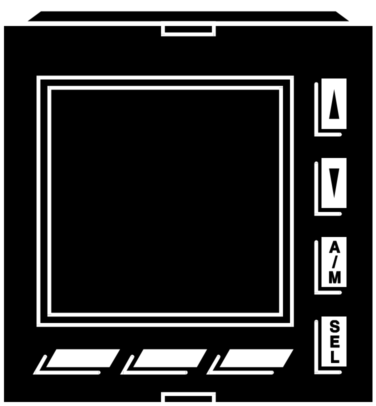
Bailey TBI! PROCESS MONITORING INSTRUMENTS

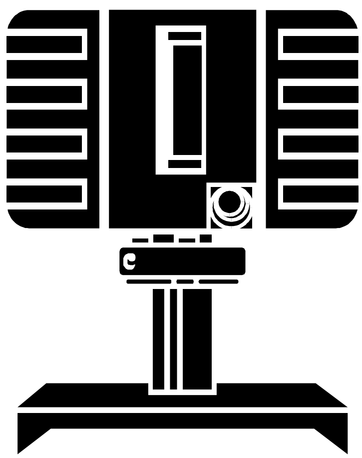
PRODUCT INSTRUCTION

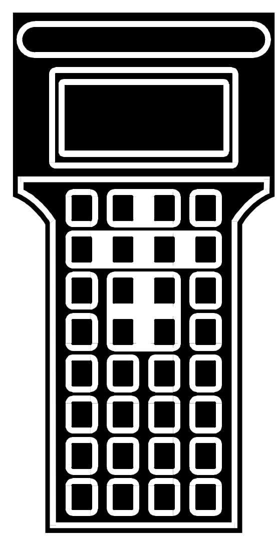
Type TB703

Analytical Controlling Transmitter
Toroidal Conductivity — μFact® Series









TBI-Bailey Controls

μFact Series Analytical Controlling Transmitter, Toroidal Conductivity
Type TB703

Sections

Appendices

Procedures

Procedures (continued)

Preface

This publication is for the use of technical personnel responsible for installation, operation, maintenance and repair of the TBI®-Bailey Type TB703 Toroidal Conductivity Analyzer.

The Type TB703 analyzer is delivered with default hardware and software configurations. These settings may need to be changed depending on the application requirements.

Some sections of this instruction have been prepared in procedure format. There is a sequence flowchart or table that follows the introduction to the section and any nonprocedural information. This flowchart directs personnel to the appropriate procedure located in the back of this instruction. By treating each task as a separate entity, the procedures provide an easy method for finding the information needed to perform each task. The procedures can be removed and placed in separate folders or notebooks, or carried to the job site.

The procedures have check boxes in the margin by each step. When performing a procedure, check each box as each step is completed.

It is important for safety and operation that this instruction be read and understood before attempting anything related to installation, operation, maintenance or repair.

List of Effective Pages

Total number of pages in this instruction is 161, consisting of the following:

Page No.	Change Date	Page No.	Change Date
Preface	Original	PR20-1	Original
List of Effective Pages	Original	PR21-1 through PR21-2	Original
iii through x	Original	PR22-1 through PR22-2	Original
1-1 through 1-9	Original	PR23-1 through PR23-3	Original
2-1 through 2-11	Original	PR24-1 through PR24-2	Original
3-1 through 3-5	Original	PR25-1 through PR25-2	Original
4-1 through 4-2	Original	PR26-1 through PR26-2	Original
5-1 through 5-2	Original	PR27-1 through PR27-2	Original
6-1 through 6-2	Original	PR28-1 through PR28-2	Original
7-1 through 7-3	Original	PR29-1 through PR29-3	Original
8-1 through 8-5	Original	PR30-1 through PR30-2	Original
9-1 through 9-2	Original	PR31-1 through PR31-2	Original
10-1 through 10-2	Original	PR32-1 through PR32-2	Original
11-1 through 11-4	Original	PR33-1 through PR33-3	Original
PR1-1	Original	PR34-1 through PR34-2	Original
PR2-1	Original	PR35-1 through PR35-2	Original
PR3-1 through PR3-2	Original	PR36-1 through PR36-3	Original
PR4-1	Original	PR37-1	Original
PR5-1	Original	PR38-1	Original
PR6-1 through PR6-3	Original	PR39-1 through PR39-2	Original
PR7-1 through PR7-2	Original	PR40-1 through PR40-2	Original
PR8-1 through PR8-2	Original	PR41-1 through PR41-3	Original
PR9-1 through PR9-2	Original	PR42-1 through PR42-2	Original
PR10-1	Original	PR43-1	Original
PR11-1 through PR11-3	Original	PR44-1	Original
PR12-1 through PR12-2	Original	PR45-1 through PR45-2	Original
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PR15-1 through PR15-3	Original	PR48-1	Original
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PR17-1 through PR17-2	Original	Worksheets 2 pages	Original
PR18-1 through PR18-3	Original	Index-1 through Index-5	Original
PR19-1	Original		

When an update is received, insert the latest changed pages and dispose of the superseded pages.

NOTE: On an update page, the changed text or table is indicated by a vertical bar in the outer margin of the page adjacent to the changed area. A changed figure is indicated by a vertical bar in the outer margin next to the figure caption. The date the update was prepared will appear beside the page number.

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Safety Summary

SPECIFIC WARNINGS

Use this equipment only in those classes of hazardous locations listed on the nameplate. Uses in other hazardous locations can lead to unsafe conditions that can injure personnel and damage equipment. (p. 3-2)

Allow only qualified personnel (refer to ***INTENDED USER***) to commission, operate, service or repair this equipment. Failure to follow the procedures described in this instruction or the instructions provided with related equipment can result in an unsafe condition that can injure personnel and damage equipment. (p. 9-1)

Do not substitute components that compromise the certifications listed on the nameplate. Invalidating the certifications can lead to unsafe conditions that can injure personnel and damage equipment. (p. 10-1)

Do not disconnect equipment unless power has been switched off at the source or the area is known to be nonhazardous. Disconnecting equipment in a hazardous location with source power on can produce an ignition capable arc that can injure personnel and damage equipment. (p. 10-1)

Remove power from the unit and allow at least one minute for the unit to discharge before performing these procedures. Failure to do so constitutes an electrical shock hazard that can injure personnel and damage equipment. (p. PR2 -1)

Disconnect the AC line cord or power lines from the operating branch circuit coming from the source before attempting electrical connections. Instruments powered by AC line voltage constitute a potential for personnel injury due to electric shock. (p. PR14 -1)

Keep the enclosure and covers in place after completing the wiring procedures and during normal operation. Do not disconnect or connect wiring or remove or insert printed circuit boards unless power has been removed and the flammable atmosphere is known NOT to be present. These procedures are not considered normal operation. The enclosure prevents operator access to energized components and to those that can cause ignition capable arcs. Failure to follow this warning can lead to unsafe conditions that can injure personnel and damage equipment. (p. PR14 -1)

SPECIFIC WARNINGS (continued)	Consider the material compatibility between cleaning fluids and process liquids. Incompatible fluids can react with each other causing injury to personnel and equipment damage. (p. PR45 -1) Acids and bases can cause severe burns. Use hand and eye protection when handling. (p. PR45 -1) Use solvents only in well ventilated areas. Avoid prolonged or repeated breathing of vapors or contact with skin. Solvents can cause nausea, dizziness and skin irritation. In some cases, overexposure to solvents has caused nerve and brain damage. Solvents are flammable - do not use near extreme heat or open flame. (p.PR45 -1)

SPECIFIC CAUTIONS	Do not over tighten screws. Doing so will cause the gasket to seat incorrectly and a water-tight seal will not be obtained. (p. PR11-1)

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Registrations and trademarks used in this document include:

® Elsag Bailey	Registered trademark of Elsag Bailey Process Automation
™ Klaxon	Trademark of the General Motors Corporation
® µFact	Registered trademark of Elsag Bailey Process Automation
® Noryl	Registered trademark of General Electric Company, GE Plastics Division
® TBI	Registered trademark of Elsag Bailey Process Automation

TOROIDAL CONDUCTIVITY

Range Jumper	Sensor Cell Constant Group A
High	0 to 100.00 mS/cm 0 to 1,000.0 mS/cm with overrange
Medium	0 to 10.000 mS/cm 0 to 100.00 mS/cm with overrange

POWER ☐ 120 VAC ☐ 240 VAC

ANALYZER RANGE
(Select from table) ____________________

RANGE JUMPER
(Select from table) ☐ Medium ☐ High

SENSOR NOMENCLATURE
(Refer to Table 1-5) ____________________

TEMPERATURE COMPENSATION ☐ Manual ☐ Standard automatic ☐ 0 to 15% NaOH
☐ 0 to 18% HCl ☐ 0 to 20% H_2SO_4 ☐ Solution coefficient

DAMPING ☐ Input ___________ sec
☐ Output ___________ sec

TEMPERATURE DISPLAY ☐ °C ☐ °F

Analog Outputs

ANALOG OUTPUT 1 (AO1)

Sourced to ☐ Conductivity ☐ Temperature ☐ Raw conductivity
Mode ☐ 1 to 5 V/4 to 20 mA ☐ 0 to 5V/4 to 20 mA
Voltage/current range ___________ Low ___________ High

ANALOG OUTPUT 2 (AO2)

Sourced to ☐ Conductivity ☐ Temperature ☐ Raw conductivity
Mode ☐ 1 to 5 V/4 to 20 mA ☐ 0 to 5V/4 to 20 mA
Voltage/current range ___________ Low ___________ High

ANALOG OUTPUT 3 (AO3)

Sourced to ☐ Conductivity ☐ Temperature ☐ Raw conductivity
Mode ☐ 1 to 5 V/4 to 20 mA ☐ 0 to 5V/4 to 20 mA
Voltage/current range ___________ Low ___________ High

TOROIDAL CONDUCTIVITY *(continued)*

Digital Outputs

DIGITAL OUTPUT 1 (DO1)

☐ High set point	___________Turn on	___________Deadband	___________Time delay
☐ Low set point	___________Turn on	___________Deadband	___________Time delay
☐ High cycle timer	___________Turn on	___________Cycle time	___________On time
☐ Low cycle timer	___________Turn on	___________Cycle time	___________On time
Sourced to	☐ Conductivity	☐ Temperature	

DIGITAL OUTPUT 2 (DO2)

☐ High set point	___________Turn on	___________Deadband	___________Time delay
☐ Low set point	___________Turn on	___________Deadband	___________Time delay
☐ High cycle timer	___________Turn on	___________Cycle time	___________On time
☐ Low cycle timer	___________Turn on	___________Cycle time	___________On time
Sourced to	☐ Conductivity	☐ Temperature	

DIGITAL OUTPUT 3 (DO3)

☐ High set point	___________Turn on	___________Deadband	___________Time delay
☐ Low set point	___________Turn on	___________Deadband	___________Time delay
☐ High cycle timer	___________Turn on	___________Cycle time	___________On time
☐ Low cycle timer	___________Turn on	___________Cycle time	___________On time
Sourced to	☐ Conductivity	☐ Temperature	

DIGITAL OUTPUT 4 (DO4)

☐ High set point	___________Turn on	___________Deadband	___________Time delay
☐ Low set point	___________Turn on	___________Deadband	___________Time delay
☐ High cycle timer	___________Turn on	___________Cycle time	___________On time
☐ Low cycle timer	___________Turn on	___________Cycle time	___________On time
Sourced to	☐ Conductivity	☐ Temperature	

BAR GRAPHS (Full scale) ___________ Set point 1 range ___________ Set point 2 range

ALARMS

___________ Temp. high (default 300°C (512°F))

___________ Temp. low (default -20°C (-4°F))

DO1	☐ Yes	☐ No
DO2	☐ Yes	☐ No
DO3	☐ Yes	☐ No
DO4	☐ Yes	☐ No

SECURITY ___________ Calibrate ___________ Tune

(M = Master, T = Technician, N = None)___________ Configure ___________ Security

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T

W

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Elsag Bailey
Process Automation

SECTION 1 - INTRODUCTION

OVERVIEW

The TBI-Bailey µFACT Series of instrumentation displays and controls the conductivity of process fluid streams. The Type TB703 Toroidal Conductivity Analyzer contains programming and electronic hardware that allows real time measurements of process streams. Since the Type TB703 analyzer is only compatible with the Type TB404 Toroidal Conductivity Sensor Series, and these sensors are designed for aggressive and harsh process streams, the Type TB703 analyzer rangeability is limited to moderate and high conductivity streams. The analyzer provides rangeability from zero to 10.000 milliSiemens per centimeter to 1,000.0 milliSiemens per centimeter. The sensor is directly connected to a terminal block at the rear of the analyzer. The conductivity analyzer automatically autoranges between any two decades of measurement for which it is configured.

All Type TB703 analyzer configurations contain conductivity functionality. Basic configuration includes setting the range of the instrument, choosing one of the two operational modes, selecting a temperature compensation mode, setting the temperature display units and input damping, and configuring the alarm reporting functions. All these functions are menu-selectable.

Temperature compensation is accomplished through a resistive, 3.0-kilohm Balco resistance temperature detector (RTD) that is integral to the sensor. Menu-selectable choices provide a wide range of easily configurable selections for temperature compensation.

Tactile soft keys and the backlit 80 by 80 pixel graphic display provide the operator interface. Multiple screens guide operators, technicians and process management personnel through menu-driven configuration and calibration procedures. Both the process variable and temperature are measured and displayed.

Two standard and one optional isolated analog outputs are configurable to all measurement parameters with adjustability across the full measurement range.

Digital outputs can be configured to a number of parameters: i.e., as high or low set points for the measured process variable, or temperature with adjustable hysteresis and time delay functions, or as a timer for relay activation. Digital outputs can also be used in a cycle timer application operating as a high or low set point. As the set point is exceeded, the timer begins timing for a fixed duty cycle. As long as the process exceeds the set point, the relay activates at the beginning of each cycle for a fixed percentage of duty cycle. The set point, duty cycle, time and percent on time are all tunable.

For processes where electrical noise is a problem, the analog outputs and, if desired, the conductivity input signal can be damped from 0.00 to 99.99 seconds.

User-entered security codes limit access to main menu functions. Two alphanumeric codes are programmable with the master level overriding the tech level. Each main menu item can be programmed for its own security level.

INTENDED USER

Installation Personnel

Electrician or person familiar with the National Electrical Code (NEC) and local wiring regulations. Should have a strong background in installation of analytical equipment.

Application Technician

Person with a solid background in conductivity measurement, electronics instrumentation and process control. Should be familiar with proper grounding and safety procedures for electronics instrumentation.

Operator

Person with knowledge of the process who should read and understand this instruction before attempting any procedure pertaining to operation.

Maintenance Personnel

Person with a background in electricity who is able to recognize shock hazards. Must also be familiar with electronic process control instrumentation and have a good understanding of troubleshooting procedures.

EQUIPMENT DESCRIPTION

The analyzer conforms to DIN sizing standards. The basic assembly contains three printed circuit boards: Flexible main board, conductivity board and front panel assembly (Fig. 1-1). The main board connects to the front panel assembly via a 22-pin connector. The conductivity board plugs into the main board assembly. Two bezel clips secure the front panel assembly in the housing.

The housing is injection molded Noryl.® It contains card guides to ease installation of the circuit boards. Multiple knockouts at the rear of the housing provide two ½-inch and two ¾-inch conduit entrance facilities for electrical connections.

The display portion on the front panel assembly contains those operator controls necessary for manual and automatic operation. Operator interface is provided through tactile soft keys and the 80 by 80 pixel LCD graphic display. Three keys at the

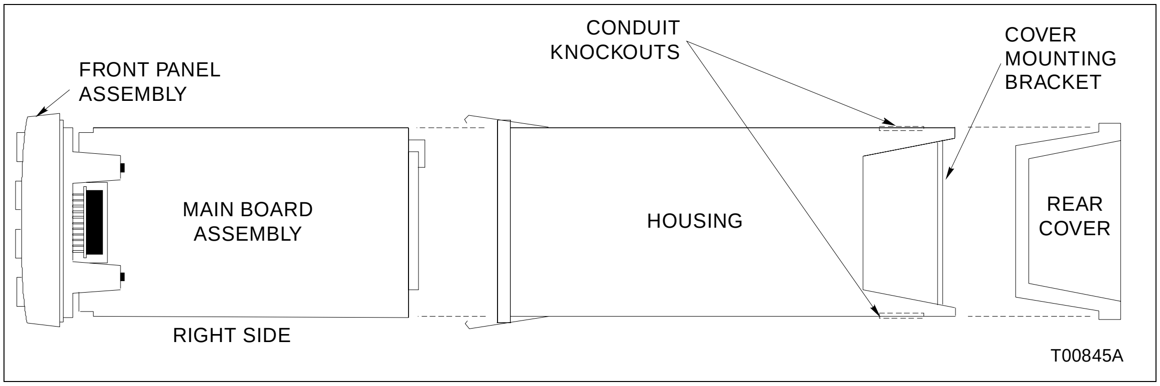


Figure 1-1. Analyzer Components

bottom of the display are multifunction soft keys. The specific function of these soft keys is defined by the graphics and varies depending on the screen displayed. The soft keys to the right of the display include single-function keys for scroll up, scroll down, automatic/manual and select (Fig. 1-2). These soft keys allow the operator to adjust set points, control outputs, transfer levels of control and select display information. The soft key functions are described in Section 2.

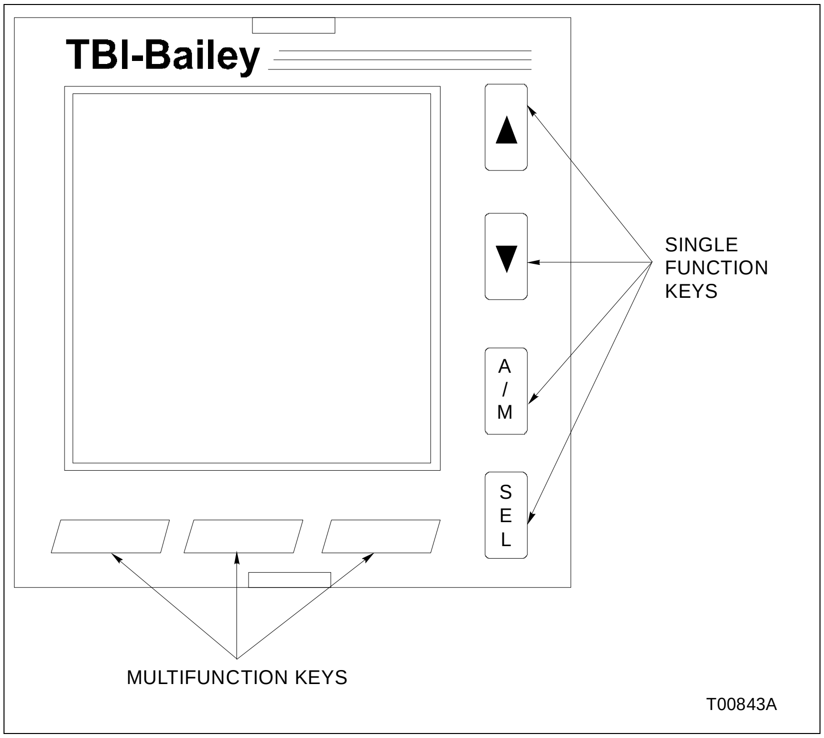


Figure 1-2. Faceplate

The rear cover has a terminal wiring diagram for reference while installing the unit. The cover must be in place for proper safety and for the best environmental performance.

FEATURES

- ***Toroidal Sensor Capability.*** Offers the necessary hardware and software for full compatibility with the Type TB404 Toroidal Conductivity Sensor Series. These sensors, with their rugged, encapsulated design, are well suited for harsh process streams. The Type TB703 analyzer offers one mode of operation: General conductivity analyzer.

- ***Wide Rangeability with Autoranging.*** Provides rangeability from zero to 10.000 milliSiemens per centimeter to 1,000.0 milliSiemens per centimeter. The instrument automatically autoranges between any two decades of measurement for which it is configured.

- ***Automatic Temperature Compensation.*** Wide range of configurable selections for temperature compensation via menu-selectable choices.

  Standard automatic (0.1N KCl based).
  Manual (0.1N KCl based).
  0 to 15% NaOH.
  0 to 18% HCl.
  0 to 20% H_2SO_4.
  Solution coefficient (0.00 to 9.99% per degree Celsius).

- ***Programmable Relay Outputs.*** Two standard and two optional SPDT relay outputs allow virtually unlimited flexibility for control, alarm and diagnostic purposes.

- ***Isolated and Configurable Analog Outputs.*** Two standard and one optional isolated analog outputs are configurable to all measurement parameters with adjustability across the full measurement range.

- ***Direct Sensor Connection.*** Simplifies installation and reduces costs.

- ***Straightforward Calibration Routines.*** Each analyzer is calibrated at the factory to theoretical 100 percent efficiency. Intelligent one-point calibration automatically calculates slope and offset errors for individual conductivity and temperature inputs in the field.

- ***Easily Programmable.*** No other microprocessor-based instrument makes programming as easy as the µFACT Series analyzers. Programming choices are keyed to configuration types, eliminating invalid programming choices. Menu-driven displays, minimal keystrokes, and fast graphic response provide maximum information and reduce operator training time. The easily accessible screens are extremely user friendly and contain straightforward fill-in-the-blank formats for configuration and calibration procedures.

- ***Multiparameter Graphic Display.*** Conductivity readout is supplemented by temperature, set point, output and alarm status on a backlit 80 by 80 pixel LCD screen.

- ***Security Interlocks.*** Personalized codes are user-selectable to three levels of security: Master, tech or none to prevent unauthorized access and tampering.

- ***Compact Packaging.*** Industry standard ¼-DIN size reduces space requirements and increases installation flexibility. NEMA 4X rating pending.

- ***Nonvolatile Memory.*** Stores and retains the configuration data in the event of a power failure.

- ***Electronic Diagnostics.*** A diagnostic routine (watchdog timer) provides indication of internal electronic and configuration errors.

ANALYZER APPLICATION

The Type TB703 analyzer is intended for process monitoring and/or control applications.

Some typical applications include the display and control of the conductivity of process fluid streams, boilers, pulping and sugar liquor strength, concentrated chemical streams, clean-in-place control, food and pharmaceutical systems, brine and solutions with heavy solids or high ionic strength liquids.

INSTRUCTION CONTENT

This instruction is organized into eleven sections, a set of procedures and an appendix. After becoming completely familiar with it and the analyzer, it can be used as a reference.

Introduction Provides a product overview, a physical description of the product, possible applications and a description of this instruction and how to use it. This section also has a list of reference documents on related equipment and subjects, the product identification (nomenclature) and a comprehensive list of hardware performance specifications including accessories and applicable certification information.

Functionality and Operator Interface Provides a functional description of the Type TB703 analyzer. A simplified block diagram details the inputs and outputs. This section also contains a detailed description of the main menu environment and operator interface controls.

Installation Contains special handling procedures for circuit boards with semiconductor devices; unpacking and inspection instructions; and location, safety, and wiring and cabling considerations. Following this information is an installation sequence flowchart that directs installation personnel to the appropriate installation procedures.

Configuration and Security Contains information on the data needed to configure the analyzer and the security levels. Following this information is a table that directs configuration personnel to the procedures necessary to enter the configuration, security levels and passwords.

Calibration Contains calibration-related information followed by a calibration sequence flowchart that directs calibration personnel to the proper calibration procedures.

Operating Procedures Provides an overview of the operator interface and a table that directs the operator to the various operating procedures.

Diagnostics Provides a description of the diagnostics tools available to aid in service of the unit. The section also provides a listing of display and relay alarms and the corrective action to be taken.

Troubleshooting Provides an analyzer and sensor troubleshooting guide and logic flow diagram to help determine and isolate encountered problems. It also includes a table listing specific troubleshooting procedures.

Maintenance Provides a preventive maintenance table that directs personnel to the various maintenance procedures.

Repair and Replacement Procedures Contains a repair and replacement sequence flowchart that directs repair personnel to the proper repair and replacement procedures.

Support Services Contains replacement parts, drawings and recommended spare parts.

Appendix A Provides temperature compensation details for the solution coefficient options.

HOW TO USE THIS INSTRUCTION

Read this entire instruction through in sequence before attempting to install, maintain or repair the analyzer. After gaining a complete understanding of this instruction and the analyzer, it can be used as a reference.

Some sections of this instruction have been prepared in procedure format. There are flowcharts or tables that follow the introduction to the section and any nonprocedural information. These flowcharts or tables direct personnel to the appropriate procedure. By treating each task as a separate entity, the procedures provide an easy method for finding the information needed to perform each task. The procedures can be removed and placed into separate folders or notebooks, or carried to the job site.

REFERENCE DOCUMENTS

Table 1-1 lists the TBI-Bailey documents referred to in this instruction.

Table 1-1. Reference Documents

Number	Document
C-E67-23-1	Conductivity/Resistivity Sensors for Process Monitoring
C-E67-23-2	Type TB404 Toroidal Conductivity Sensor Specification
TBA	Type TB404 Toroidal Conductivity Sensor Instruction
WTPEEUS110002A0	Type TB4043 Sanitary Toroidal Conductivity Sensor Specification

NOMENCLATURE

Table 1-2 lists the nomenclature for the Type TB703 analyzer. Table 1-3 describes the ranges selectable in nomenclature position seven.

Table 1-2. Nomenclature[1]

Position	1	2	3	4	5	6	7	8	
Type	T	B	7	0	□	□	□	□	Analytical Controlling Transmitter
									Input
					3				Toroidal conductivity
									Options
						0			None
						4			Expansion board (2 additional digital outputs and 1 additional analog output)
									Ranges
							M		Toroidal conductivity (medium range)
							H		Toroidal conductivity (high range)
									Power
								1	120 VAC
								2	240 VAC

NOTE:
1. A single digit must be used in each nomenclature position.

Table 1-3. Ranges

Range	Sensor Cell Constant Group A
High	0 to 100.00 mS/cm 0 to 1,000.0 mS/cm with overrange
Medium	0 to 10.000 mS/cm 0 to 100.00 mS/cm with overrange

SPECIFICATIONS

Table 1-4 lists the specifications for the Type TB703 analyzer.

Table 1-4. Specifications

Property	Characteristic/Value
Process display range	0 to 10.000 mS/cm to 0 to 1,000.0 mS/cm with 2-decade autoranging. Refer to Table 1-3.
Temperature display range	-20°C to 300°C (-4°F to 572°F)
Display resolution	Dependent on range used. 0.01 mS/cm 1°C, 1°F
Accuracy	
Conductivity	±0.5% of full scale
Temperature	1.0°C (1.8°F)
Nonlinearity	<0.5% of full scale
Temperature compensation	Manual Automatic for: 0.1N KCl 0 to 15% NaOH 0 to 20% H_2SO_4 0 to 18% HCl Solution coefficient — adjustable from 0 to 9.99% per °C
Input types	TBI-Bailey Type TB404 Toroidal Conductivity Sensor Series
Dynamic response	3 secs for 90% step change at 0.00 secs damping
Damping	0.00 to 99.99 secs
Analog outputs	2 standard, 1 optional Isolated 4 to 20 mA, 0 to 20 mA, 1 to 5 VDC, 0 to 5 VDC
Load (current mode)	0 to 750Ω
Ambient temperature effect	±0.08% per °C of full scale
Accuracy	±0.5% of full scale
Minimum span	Equivalent to 5% of full scale
Maximum span	Maximum measurement range
Digital outputs (PV, CO, TEMP, etc.)	2 standard, 2 optional
Relays	Form C, SPDT dry contact, maximum 10 W, 0.5 A resistive, 200 VDC

Table 1-4. Specifications (continued)

Property	Characteristic/Value
Maximum cable length	
Sensor group A	15.2 m (50.0 ft)
Environmental	
Operating temperature	0°C to 50°C (32°F to 122°F)
Storage temperature	-20°C to 65°C (-4°F to 149°F)
Operating humidity	0 to 95% noncondensing
Storage humidity	0 to 95% noncondensing
Size	
Height	96 mm high by 96 mm wide (3.78 in. high by 3.78 in. wide)
Overall length	237 mm (9.33 in.)
Minimum panel depth	218 mm (8.58 in.)
Maximum panel cutout	92 mm by 92 mm (3.62 in. by 3.62 in.)
Agency approvals (pending)	
Canadian Standards Association (CSA)	Class I; Division 2; Groups A, B, C and D;T3C
Standards Association of Australia (SAA)	Ex n; Group IIC; T6
Factory Mutual (FM)	Class I, II, III; Division 2; Groups A, B, C, D, E, F and G

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

ACCESSORIES

Table 1-5 lists the accessories for the Type TB703 analyzer.

Table 1-5. Accessories

Accessory	Description
Mounting kits	
4TB9515-0012	Pipe mounting kit.
4TB9515-0013	Wall mounting kit.
4TB9515-0015	Panel mounting kit.
Sensors	
TB4042	Group A, PEEK encapsulated sensor for general purpose applications.
TB4043	Group A, polypropylene encapsulated sensor for sanitary applications.
Antistatic kit	Contains a static-dissipative work surface (mat), ground cord assembly, wrist bands and alligator clip for personnel working on devices containing semiconductor components. Kit no. 1948385?1.

SECTION 2 - FUNCTIONALITY AND OPERATOR INTERFACE

INTRODUCTION

The beginning of this section provides a description of The Type TB703 Toroidal Conductivity Analyzer functionality and capabilities. It also provides important information for configuration personnel. A simplified block diagram provides insight as to the overall operation, an explanation of the digital and analog outputs and how the analyzer connects to the process. The latter part of this section discusses the operator interface controls. It includes descriptions of the process display and the main menu as well as all of the faceplate controls. These descriptions will be extremely helpful to not only the operator but also to the personnel responsible for configuration and calibration.

Any jumper settings that are briefly discussed in this section are covered in detail in the appropriate procedures.

CONFIGURATION OVERVIEW

The general conductivity configuration is the only configuration available in the analyzer. It is designed for use with all conductivity monitoring and control applications. All TBI-Bailey toroidal conductivity sensors and range jumper positions are compatible with this configuration.

RANGING/AUTO RANGING

Entering the conductivity range is a configuration menu function. The only information to enter is the range jumper setting. Refer to Table 1-3 for a listing of the analyzer ranges.

NOTE: The nomenclature designates the range jumper position as shipped from the factory. If the range requires changing, refer to the appropriate procedure to change the jumper settings.

TEMPERATURE COMPENSATION

Temperature has a marked effect on the conductivity of any solution. The effect is generally nonlinear and is dependent on the particular ionic species and concentration. The analyzer has a number of preprogrammed correction algorithms that compensate for these temperature effects. For additional information on temperature compensation choices and techniques, refer to Appendix A.

DAMPING

Damping can be helpful in noisy process environments. Select whether damping is to be added to the input conductivity and temperature signal or only to the signals that go to the recorder output. Damping is added as a capacitive type lag where reaction to any signal change is slowed according to the entered time constant. For example, a step change reaches approximately 63 percent of its final value in five seconds for five seconds of damping.

Damping the conductivity input damps signals to the controller, digital outputs, set point alarms and the recorder output. Damping the recorder output affects only analog outputs sourced to conductivity and temperature. Both choices can be set separately; however, setting damping on both choices will cause a double damping situation on the recorder outputs. Damping time is adjustable from 0.00 to 99.99 seconds.

ANALOG OUTPUTS

The Type TB703 analyzer has one optional and two standard analog outputs. These outputs can be either a voltage (programmable to zero or one-VDC based) or current (programmable to zero or four-milliamp based).

The analog outputs are available for transmitting process information to recorders, data loggers, control systems, valves, etc. The information transmitted can represent (be sourced to) process conductivity, temperature or raw process conductivity. The outputs can be ranged across any 20 to 100-percent portion of the particular measurement range by programming the lower limit (e.g., four milliamps or one VDC) and upper limit (e.g., 20 milliamps or five VDC) during configuration. Refer to Figure 2-1.

DIGITAL OUTPUTS

The Type TB703 analyzer has two standard and two optional digital outputs (Form C, SPDT relays) that are completely programmable.

Use the programmable digital outputs DO1 through DO4 for process control by connecting them to solenoid valves, control valves or other control devices. These devices then provide alarm notification, timing, diagnostic and sensor maintenance functions.

High/Low Set Point

A digital output can be configured as a high or low set point for the measured process variable or temperature. Specify the

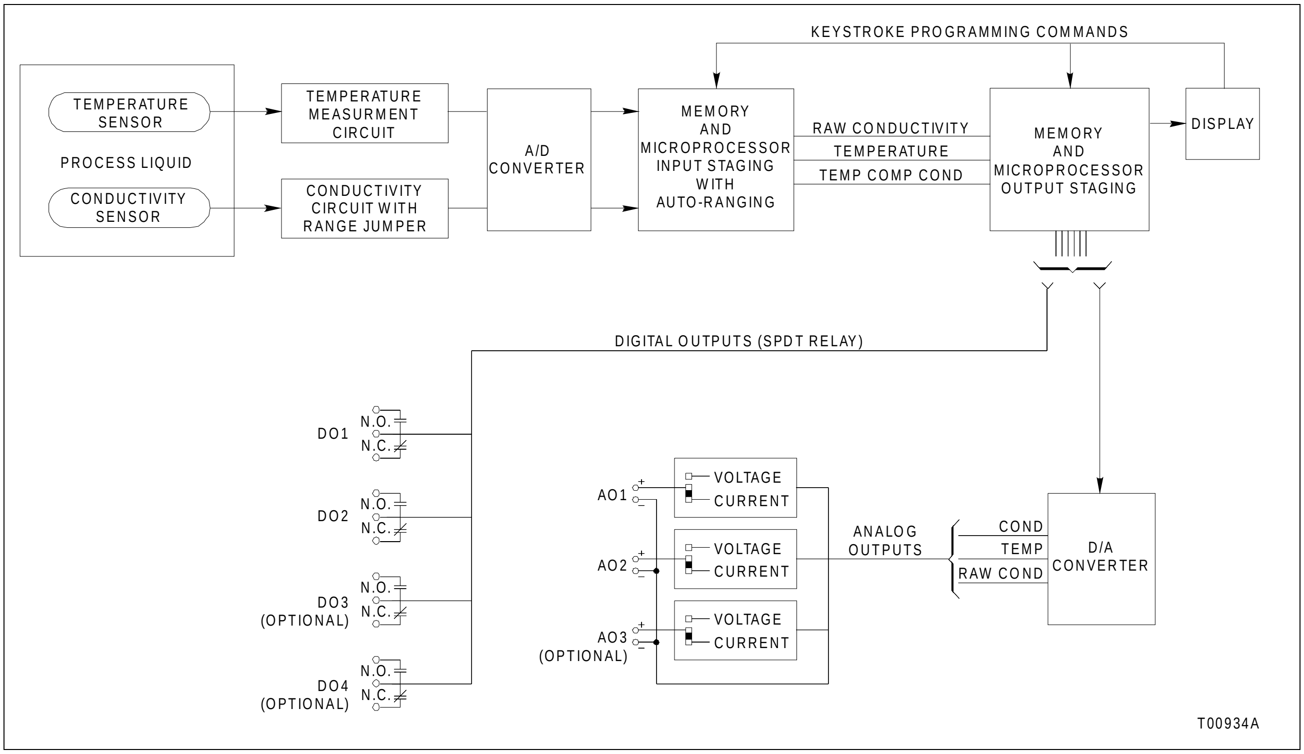


Figure 2-1. Block Diagram

turn on (activate) point and deadband value. A high set point activates as the process variable exceeds the set point and deactivates as the process variable goes below the set point by the amount entered as the deadband. A low set point activates as the process variable goes below the set point and deactivates as the process variable goes above the set point by the amount entered as the deadband. An adjustable time delay with a range of 00.00 to 99.99 minutes can also be used.

The waveforms shown in Figure 2-2 depict how DO1 responds to a varying conductivity input when selected as a high set point with conductivity as the source. The set point is ten millisiemens per centimeter and the deadband value is two millisiemens per centimeter. There is also a time delay of two minutes.

From left to right, the conductivity input increases above the turn on value of ten millisiemens per centimeter and then decreases below the turn off value of eight millisiemens per centimeter within the time period of t_1. In this example, t_1 is some period of time less than the user-selected time delay of two minutes. The output does not react to this change in conductivity input. The input then goes above the turn on value of ten millisiemens per centimeter and stays above the turn off point of eight millisiemens per centimeter for some time period greater than t_2. The t_2 value is the user-selectable time delay value of two minutes. The output reacts to this input after the time delay period of two minutes. The output stays activated (valve open) until the conductivity input falls below the turn off value of eight millisiemens per centimeter. The conductivity input then goes above the turn on value of ten millisiemens per centimeter and stays there. The output reacts to this input after the user-selectable time delay of two minutes and remains activated (valve open) until the conductivity input falls below the turn off value of eight millisiemens per centimeter.

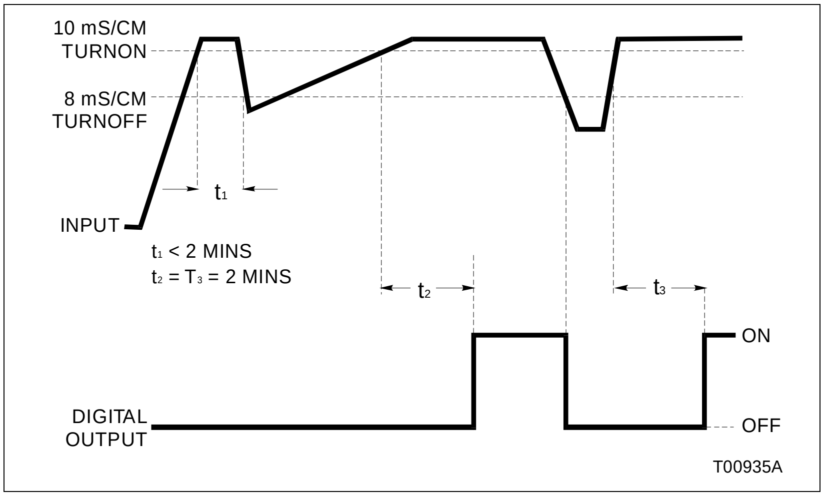


Figure 2-2. High/Low Set Point Example

High/Low Cycle Timer

A digital output can be configured as a high cycle timer or a low cycle timer. Specify the turn on (activation) point, the cycle time (range of 0.1 to 99.99 minutes) and the on time (range of 0.1 to 99.99 minutes).

In this example, DO2 is selected as a low cycle timer with conductivity as the source to control a valve that adds base to a process flow if the conductivity input falls below four millisiemens (turn on). The cycle time has been set at ten minutes and the on time is set to be six minutes. The waveforms in Figure 2-3 show how DO2 responds to a varying conductivity input.

From left to right, the conductivity input decreases below the turn on value of four millisiemens per centimeter and the output begins a 60-percent duty cycle (on time or cycle time), adding base to the process flow. This continues until the conductivity input goes above the turn on value of four millisiemens per centimeter. The conductivity input then goes low for a period of time less than the user-selected on time. The output begins the 60-percent duty cycle but deactivates as soon as the conductivity input goes above the turn on value of four millisiemens per centimeter.

NOTE: This example used DO2 as a low cycle timer where a decreasing conductivity input activates the digital output. DO2 could have been set up to be a high cycle timer that would activate the digital output on an increasing conductivity input.

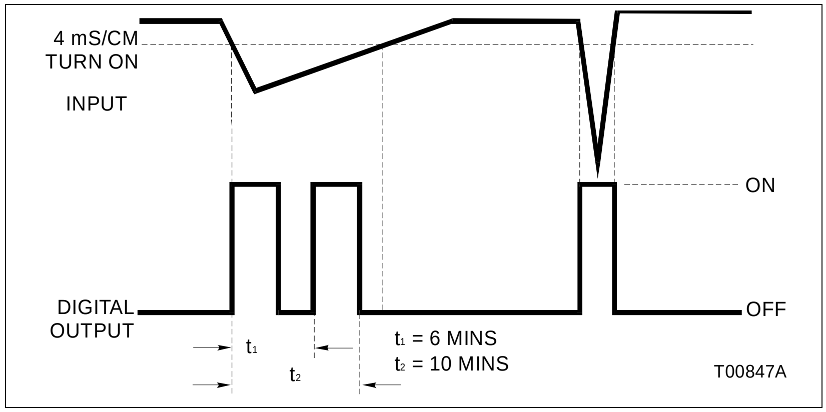


Figure 2-3. High/Low Cycle Timer Example

Timer

Digital outputs can be configured as timers for a digital output activation. The format for using a digital output as a timer is the same as using it as a high or low set point. The time delay setting is adjustable from 0.00 to 99.99 minutes. To use a digital output as a timer, choose high or low set point as the mode and the appropriate variable as the source. Figure 2-5 shows a timer example.

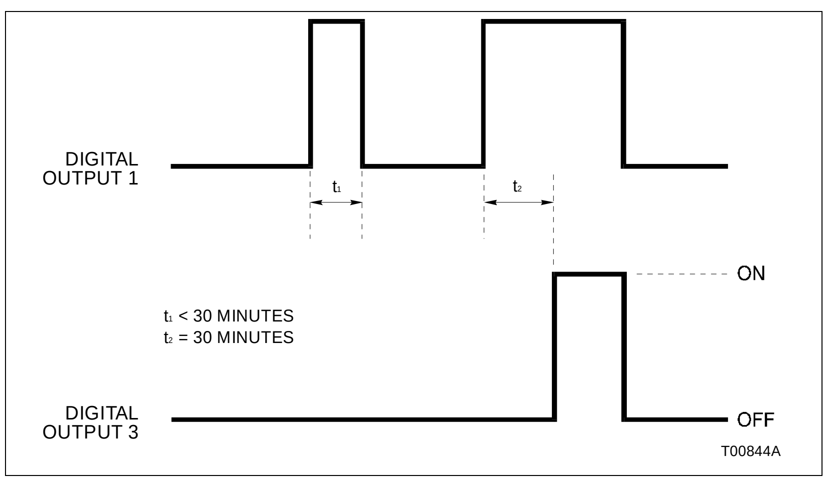


Figure 2-4. Timer Example

In this example, DO3 is selected for use as a timer by mimicking all the settings of DO1 except time delays. Thus DO3 activates if DO1 activates for a period of time greater than the user-specified time delay of 30 minutes. The waveforms in Figure 2-4 show how DO3 responds to varying activation times of DO1.

From left to right, DO1 activates for a period of time, t_1, less than the user-specified 30-minute time delay, and DO3 does not activate. DO1 then activates for a period of time, t_2, greater than the 30-minute time delay. DO3 then activates 30 minutes after DO1 becomes active and stays activated until DO1 deactivates.

DIAGNOSTICS

The Type TB703 analyzer performs a number of diagnostic checks that alert users to faults in the measurement loop. Most of these diagnostics are exhibited as alarm display messages accessible through the *ALARM SUM* multifunction soft key.

Calibration errors are noted during calibration and the values used during a bad calibration are not accepted. Existing calibration data can be viewed in the reset calibration environment. Individual digital outputs can also be programmed to indicate measurement loop errors.

Section 7 and Section 8 provide detailed information on the diagnostic capabilities of the Type TB703 analyzer.

BAR GRAPHS

The process display contains three bar graphs. Two are associated with digital outputs DO1 and DO2. The third is associated with analog output AO1. The two bar graphs indicate the logic levels of DO1 and DO2. To display the actual numerical value of the digital output set point, use **SEL** to reverse video that portion of the display. The set point can be adjusted from the faceplate once it is selected.

The output bar graph represents the AO1 level and displays as a zero to 100-percent level.

The output bar graph is preset to zero to 100 percent which represents the upper and lower limits programmed for AO1.

ALARMS

Certain process conditions cause the Type TB703 analyzer to print *ALARM* on the process display and designate the lower left multifunction soft key for alarm acknowledgment. The *ALARM* message remains on the process display until the condition clears. The alarm acknowledge message disappears after pressing the alarm acknowledge multifunction soft key. An alarm summary to describe what condition caused the alarm is accessible through the multifunction soft keys when an alarm condition exists. Overrange conductivity and high or low temperature are examples of alarm conditions. Additionally, a digital output activation that is set to indicate an abnormal condition can be programmed to cause alarm reporting.

WATCHDOG TIMER/FAILURE DETECTION

The analyzer continually runs a set of self-diagnostics to ensure proper operation. Jumper J10 on the main board allows the choosing of the response of the analyzer if an on-board failure is detected. The choices are:

- Analyzer enters into a fail-safe condition by de-energizing the digital outputs and setting the analog outputs to zero volts or zero milliamps depending on the hardware jumper configuration.
- Analyzer automatically resets itself in an attempt to resolve the failure and come up running.

OPERATOR INTERFACE

The operator interface consists of the faceplate controls, including the single-function keys and the multifunction soft keys. These keys interact with the displays that appear on the 80 by 80 pixel LCD.

Faceplate Controls

Refer to Figure 2-5. Examine the faceplate and the callouts for the keys. The following paragraphs describe the function of each key and the effect of that key when pressed.

SINGLE-FUNCTION KEYS

The four keys to the right of the LCD are single-function keys. These allow the changing of the value or choice on the screen and selection of the displayed field. Table 2-1 summarizes the single-function keys and their functions.

MULTIFUNCTION SOFT KEYS

Three unmarked multifunction soft keys at the bottom of the LCD are multifunction keys. The specific function of these keys is defined by the graphics and varies depending on the screen display. Pressing any of these multifunction soft keys displays a soft key submenu (three selection boxes at the bottom on the display area). Once these three boxes appear, pressing the multifunction soft key directly below the desired box initiates that action. The data located inside of these three boxes (soft

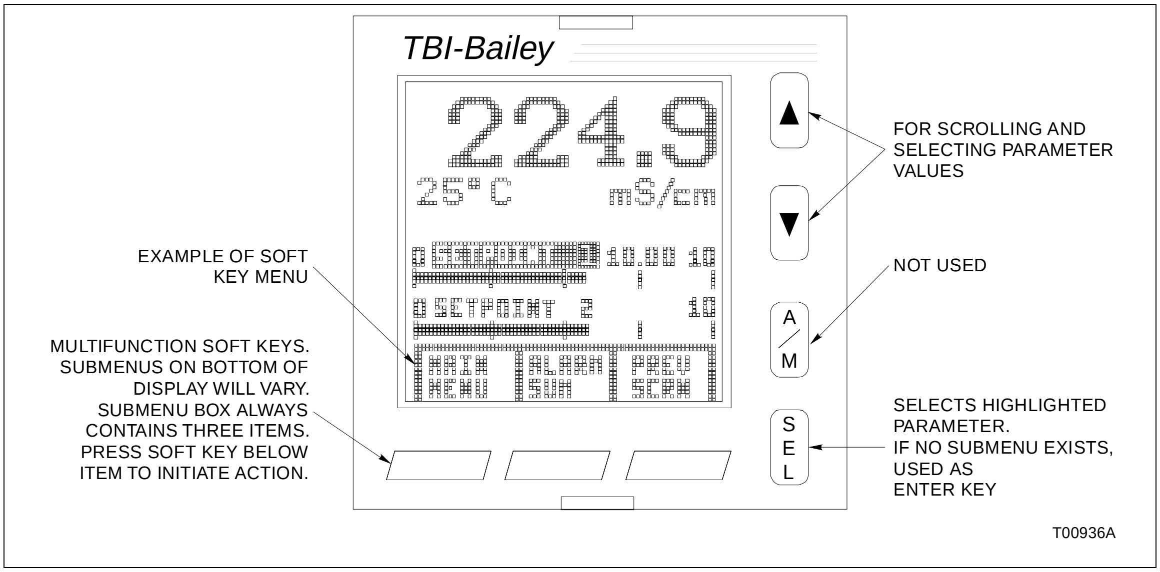


Figure 2-5. Faceplate Controls

Table 2-1. Single-Function Keys

Keys	Function
▲ ▼	Used to scroll through parameters on menu screens and to change selected parameter values.
SEL	Allows the operator to select a highlighted parameter in a submenu and on the process display. On screens where no submenu exists, it enters the displayed selection.
A/M	Not used.

key submenu) varies depending on the procedure. Table 2-2 summarizes the items that appear on the soft key submenu and their functions.

Table 2-2. Multifunction Soft Keys[1]

Soft Key	Function
Main menu	Return to the main menu.
Alarm sum	Provide a summary of current alarms.
Prev scrn	Return to the previous screen.
Next scrn	Go to the next screen of the procedure. Also allows a review of the data entered once completed with a procedure.
Proc dsply[2]	Return to the process display.
Enter	Confirm choices or selections made.
Esc	Escape procedure. This causes a return to the beginning menu of the current function or task.

NOTES:

1. If pressing any of the multifunction soft keys while at a screen does not bring up the soft key submenu, the task at the present screen has not been completed. Make a selection. Once the selection is made, the display returns to the beginning submenu of the current function.

2. The process display can always be accessed from any other environment by pressing the middle multifunction soft key.

Process Display

This screen (Fig. 2-6) is the default screen on power up and displays during normal operation. The process display shows information related to the process such as the process variable, set points, analog output level, temperature and alarm conditions.

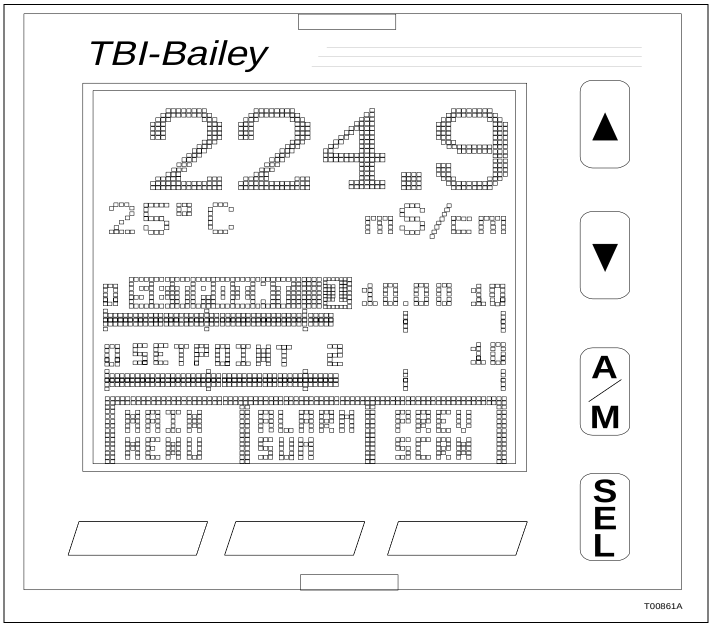


Figure 2-6. Process Display

GO TO MAIN MENU

To reach the main menu from the process display:

1. Press any of the three unmarked multifunction soft keys on the bottom of the faceplate. A selection box appears (soft key submenu) above each of the three multifunction soft keys.

2. Press the left multifunction soft key directly below the *MAIN MENU* box to go to the main menu.

GO TO PROCESS DISPLAY

To reach the process display from any screen environment:

1. Press any of the three unmarked multifunction soft keys on the bottom of the faceplate. A selection box appears above each of the three keys.

2. The *PROC DSPLY* box is above the middle multifunction soft key. Press that multifunction soft key and the process display appears.

NOTES:
1. The process display is reached from any other environment by pressing the middle multifunction soft key.

2. No security level can be placed on the process display environment.

Main Menu

The main menu is the screen through which all functionality of the Type TB703 analyzer is accessed. It is divided into five environments: monitor, calibrate, tune, configure and security. The configuration and calibration of the analyzer must be completed before beginning operation. Configuration and calibration are covered in Section 4, Section 5 and their related procedures. The daily monitor and tune functions are normally completed by the operator and are explained in Section 6 and its related procedures. For information on security functions, refer to the appropriate procedures.

Enter the main menu from other screens via the unmarked multifunction soft keys at the bottom of the faceplate. The main menu is the gateway to all of the other environments with the exception of the process display.

To get to the main menu from any other screen environment:

1. Press any of the three unmarked multifunction soft keys on the bottom of the faceplate. A selection box appears above each of the three keys.

2. In some environments, the *MAIN MENU* box appears now. If the *MAIN MENU* selection box does not appear, press the *PROC DSPLY* key (center multifunction soft key). Once the process display appears, press any multifunction soft key again.

3. The *MAIN MENU* box is above the left multifunction soft key. Press that multifunction soft key and the main menu appears (Fig. 2-7).

The security levels of the different environments are displayed on the main menu and represented by a *T* (technician) or *M* (master). Refer to the appropriate procedures for details on entering security codes.

To choose one of the five environments from the main menu:

1. Press ▼ or ▲ until the environment is highlighted.

2. Press SEL to enter the environment.

224.9 mS/

MAIN MENU

MONITOR	
CALIBRATE	M
TUNE	T
CONFIGURE	M
SECURITY	M

Figure 2-7. Main Menu

SECTION 3 - INSTALLATION

INTRODUCTION

This section contains special handling procedures for circuit boards with semiconductor devices, inspection instructions, and special location and safety considerations.

Following these topics is an installation sequence flowchart that guides personnel, seeking to perform a specific installation task, to the proper procedure or procedures needed to perform that task.

SPECIAL HANDLING

In addition to the normal precautions for storage and handling of electronic equipment, the Type TB703 Toroidal Conductivity Analyzer has special semiconductor handling requirements. This equipment contains electronic components that can be damaged from discharges of static electricity. If at all possible, do not touch the components on the circuit board. Ordinarily, the circuit will not be damaged if the circuit board is handled by the edges.

Semiconductor devices are subject to damage by static electricity. Therefore, observe the following techniques during servicing, troubleshooting and repair.

1. Remove assemblies containing semiconductor devices from their protective containers only under the following conditions:

   a. When at a designated static-free work station.

   b. Only after firm contact with an antistatic mat and/or firmly gripped by a grounded individual.

2. Personnel handling assemblies with semiconductor devices should be neutralized to a static-free work station by a grounding wrist strap that is connected to the station or to a good ground point at the field site.

3. Do not allow clothing to make contact with semiconductor devices. Most clothing generates static electricity.

4. Avoid touching edge connectors and components.

5. Avoid partial connection of semiconductor devices. Semiconductor devices can be damaged by floating leads, especially the power supply connector. If an assembly must be inserted in a live system, it should be done quickly. Do not cut leads or lift circuit paths when troubleshooting.

6. Ground the test equipment.

7. Avoid static charges during maintenance. Make sure the circuit board is thoroughly clean around its leads but do not rub or clean with an insulating cloth.

NOTE: An antistatic kit (refer to Table 1-5) is available for personnel working on devices containing semiconductor components.

UNPACKING AND INSPECTION

Examine the equipment upon receipt for possible damage in transit. File a damage claim with the responsible transportation company if necessary and notify the nearest TBI-Bailey sales office.

Carefully inspect the packing material before discarding it to make certain that all mounting equipment and any special instructions or paperwork have been removed. Careful handling and installation ensures satisfactory performance of the analyzer.

Use the original packing material and container for storage. The storage environment should be protected and free from extremes of temperature and humidity and fall within the environmental constraints listed in Table 1-4.

LOCATION CONSIDERATIONS

The Type TB703 analyzer is designed for panel mounting, pipe mounting or wall mounting. The installation site should be vibration free and conform to the environmental constraints listed in Table 1-4. Careful placement of the analyzer ensures proper operation as well as overall safety.

NOTE: Temperature is an important consideration. Allow for adequate air flow, especially if installing the analyzer in an enclosed area.

Hazardous Locations

WARNING	**Use this equipment only in those classes of hazardous locations listed on the nameplate. Uses in other hazardous locations can lead to unsafe conditions that can injure personnel and damage equipment.**

Table 1-4 lists the agencies and types of hazardous location certifications for the analyzer.

Radio Frequency Interference

Most electronic equipment is influenced by radio frequency interference (RFI). Exercise caution with regard to the use of portable communications equipment in the area. Post appropriate signs in the plant.

SAFETY CONSIDERATIONS

Upon power up without a configuration, or should a failure condition occur, the analog outputs go to a zero-volt or zero-milliamp state. The digital outputs go to a de-energized state. The installation must be designed such that these default states put the process in a safe condition.

In noisy environments or when operators may not be close to the analyzer, use the digital outputs to control Klaxons™ or other signaling devices to notify the operator of alarm conditions.

WIRING AND CABLING CONSIDERATIONS

There are ½-inch and ¾-inch conduit knockouts located at the top and bottom rear of the analyzer housing. Under ideal conditions, there is no need for conduit and shielded wire. However, to avoid noise problems, separate power, signal and output wiring and enclose them in conduit. Just prior to entering the housing, terminate rigid conduit and install a short length of flexible conduit to reduce any stress to the housing.

NOTE: Install weatherproof connectors in the wiring entry openings. Examples of weatherproof connectors would be Hubbel SHC/NHC series, Daniel Woodhead F2 series, etc.

The analyzer has the capacity for eleven 14-AWG wires. If additional wires are required, reduce the size of some or all of the others. If using more than four two-wire inputs plus outputs, reduce some or all of the wires in size. The wiring compartment has an internal volume of approximately 279 cubic centimeters (17 cubic inches). The volume required for each conductor is:

- 26 to 22 AWG — 8.19 cubic centimeters (0.50 cubic inches).
- 20 AWG — 12.29 cubic centimeters (0.75 cubic inches).
- 18 AWG — 16.39 cubic centimeters (1.00 cubic inches).
- 16 AWG — 20.48 cubic centimeters (1.25 cubic inches).
- 14 AWG — 24.58 cubic centimeters (1.50 cubic inches).

The total number of conductors multiplied by the volume requirement for each conductor should not exceed 279 cubic centimeters (17 cubic inches).

A wiring label with a nonpermanent adhesive is on the rear cover of the housing. If required, remove it and place it wherever is convenient.

INSTALLATION SEQUENCE

Refer to Figure 3-1 for the installation sequence for the analyzer. Each block of the flow represents a single task that must be completed before continuing with the sequence.

In some cases, more than one path can be taken during installation. For paths that are in parallel, either complete all of the tasks in all of the paths before continuing or complete all of the tasks in only those paths that apply before continuing. At least one path must be completed.

Some blocks contain alphanumeric codes. These codes identify the procedure that describes the steps to complete an indicated task. Complete all of the steps given in a procedure before continuing to the next procedure.

The procedures have check boxes in the margin by each procedural step. When performing a procedure, check each box as each step is completed.

By treating each task as a separate entity, the procedures provide an easy method for finding the information needed to perform each task in the installation sequence.

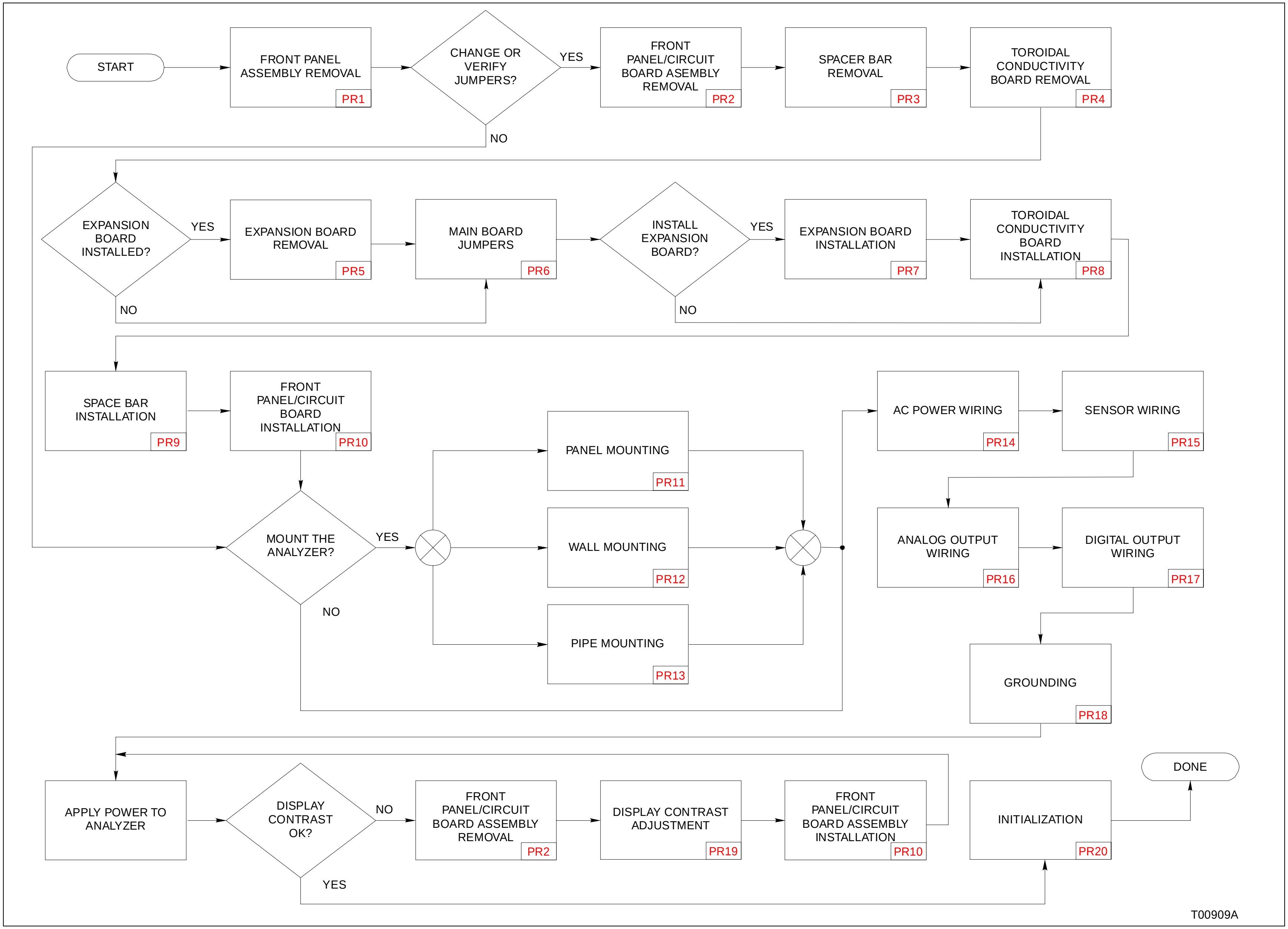


Figure 3-1. Installation Sequence Flowchart

SECTION 4 - CONFIGURATION AND SECURITY

INTRODUCTION

This section provides the required actions to establish and define the configuration of the Type TB703 Toroidal Conductivity Analyzer. This section describes the one configuration mode available with the analyzer: General conductivity. It also discusses the security levels associated with each environment.

CONFIGURATION DATA

There are several analyzer requirements to define before entering a configuration.

- Analyzer range.
- Analyzer parameters (includes temperature display units, temperature compensation type, process temperature (if manual is chosen for temperature compensation type), damping types and damping times).
- Analog outputs.
- Digital outputs.
- Bar graphs.
- Alarms.

Fill out the worksheet in the back of this instruction before entering the configuration. The worksheet helps in the configuration entry procedure and provides an historical record for future reference.

SECURITY LEVELS

Assigning security levels is optional. It is not required for operation of the analyzer. Table 4-1 provides a summary of the security levels available to apply to each environment.

Table 4-1. Security Level Summary

Environment	Security Level		
	Master	Technician	None
Monitor	N/A	N/A	N/A
Calibrate	•	•	•
Tune	•	•	•
Configure	•	•	•
Security[1]	•	N/A	•

NOTE:

1. A security level of none for the security environment is only possible if no security levels were assigned to any other environments.

CONFIGURATION AND SECURITY SEQUENCE

The configuration procedure follows the sequence in which the configuration screens appear, except for NVRAM initialization. Table 4-2 lists the procedures involved in configuring and setting security levels of the analyzer, and the corresponding procedure numbers.

Table 4-2. Configuration Sequence

Procedure	Procedure No.
NVRAM initialization[1]	PR21
Range configuration	PR22
Analyzer parameters configuration	PR23
Analog outputs configuration	PR24
Digital outputs configuration	PR25
Bar graphs configuration	PR26
Alarms configuration	PR27
Save and exit configuration	PR28
Security levels	PR29

NOTE:

1. This procedure is only used to completely erase any existing configuration data. It is not part of a normal configuration sequence.

SECTION 5 - CALIBRATION

INTRODUCTION

This section describes the steps used to calibrate the input and outputs of the Type TB703 Toroidal Conductivity Analyzer. The analyzer has built-in smart calibration routines allowing for single-point calibration with a sensor. These routines are also designed to adapt to multiple calibrations using the most recent data set. This feature allows automatic adjustment of the zero and span points of the analyzer. In addition, a miscalibrated analyzer can be quickly returned to its factory-calibrated state using the reset calibration functions found in the calibration environment.

Calibration frequency is dependent upon the application and is to be determined by the user.

NOTE: To escape any operation without saving, press a multifunction soft key and back through the *PREV SCRN*, use the *PROC DSPLY* soft key to get to the process display, or use the *ESC* soft key (when available).

RECOMMENDED SENSOR CALIBRATION

After the analyzer installation is complete and wiring to the sensor is made, the loop must be calibrated to the process liquid. The configuration of the sensor installation must be taken into consideration before performing a calibration. For example, if an insulating material such as glass or plastic is within 38.1 millimeters (1.5 inches) of the sensing area of the toroidal conductivity sensor, the bulk conductance of the process liquid will be lower (i.e., lower conductivity indication) due to the electrically insulating nature of glass and plastic. Conversely, a sensor placed within 38.1 millimeters (1.5 inches) of a metallic surface indicates a higher conductivity. To combat these effects, employ one of two types of calibration techniques:

- Grab sample method.
- Known solution method.

The grab sample method is the most reliable and is the preferred method; however, it is not practical for all applications. When the grab sample method is not possible, the known solution method is often used.

CALIBRATION SEQUENCE

Refer to Figure 5-1 for the calibration sequence for the analyzer. Each block of the flow represents a single task that must be completed before continuing with the sequence.

In some cases, more than one path can be taken during calibration. For paths that are in parallel, either complete all of the tasks in all of the paths before continuing or complete all of the tasks in only those paths that apply before continuing. At least one path must be completed.

Some blocks contain alphanumeric codes. These codes identify the procedure that describes the steps to complete an indicated task. Complete all of the steps given in a procedure before continuing to the next procedure.

The procedures have check boxes in the margin by each procedural step. When performing a procedure, check each box as each step is completed.

By treating each task as a separate entity, the procedures provide an easy method for finding the information needed to perform each task in the calibration sequence.

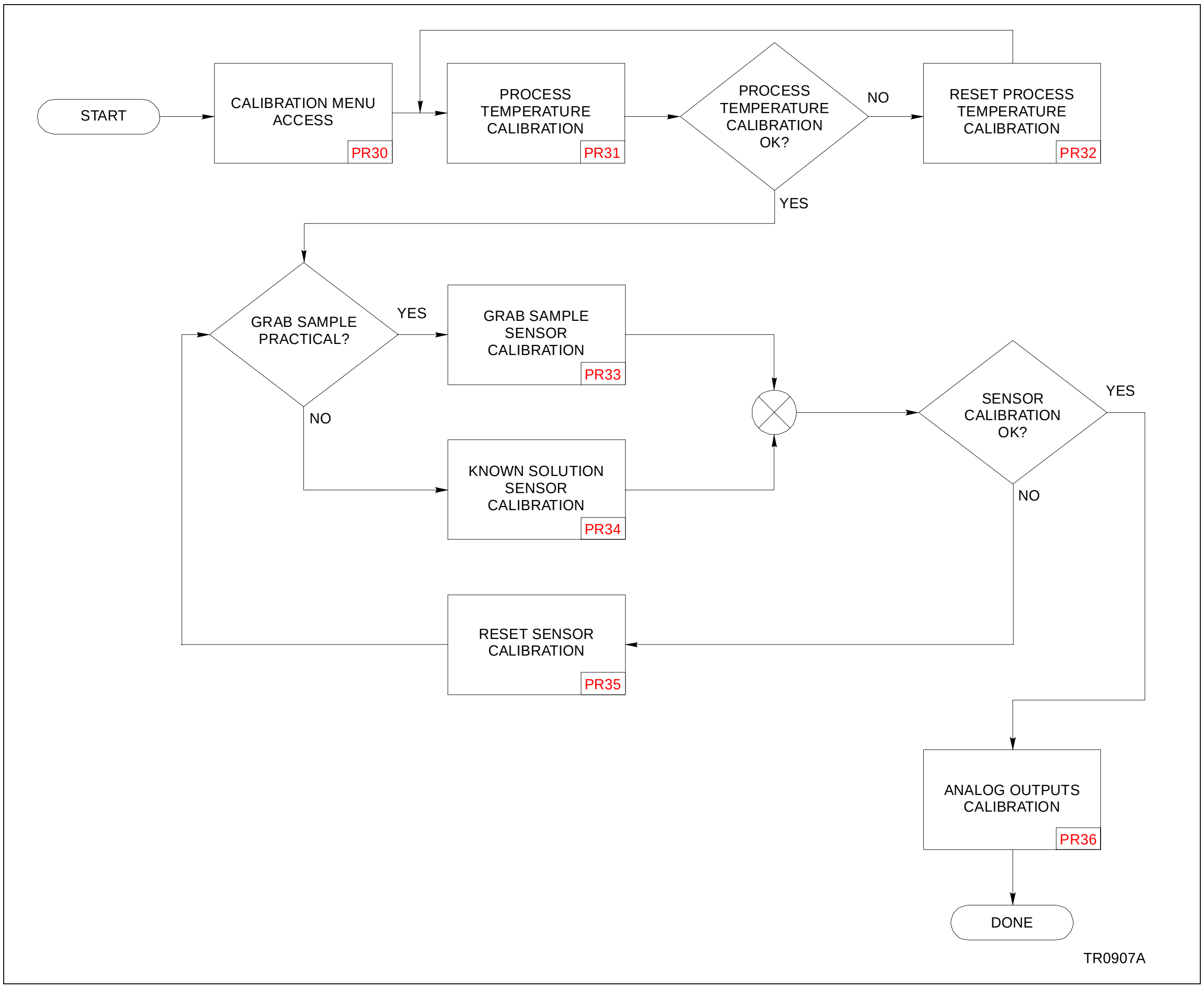


Figure 5-1. Calibration Sequence Flowchart

SECTION 6 - OPERATING PROCEDURES

INTRODUCTION

This section provides an overview of the process display and the main menu for the Type TB703 Toroidal Conductivity Analyzer. It includes instructions on how to get to the main menu and associated submenus. There are descriptions of the faceplate keys and how to use them. For more detailed descriptions, refer to ***OPERATOR INTERFACE*** in Section 2. It also includes procedures for acknowledging alarms and the monitor and tune functions. Refer to Figure 6-1 for an illustration of the operator interface.

NOTE: Before operating the analyzer it must be configured and calibrated.

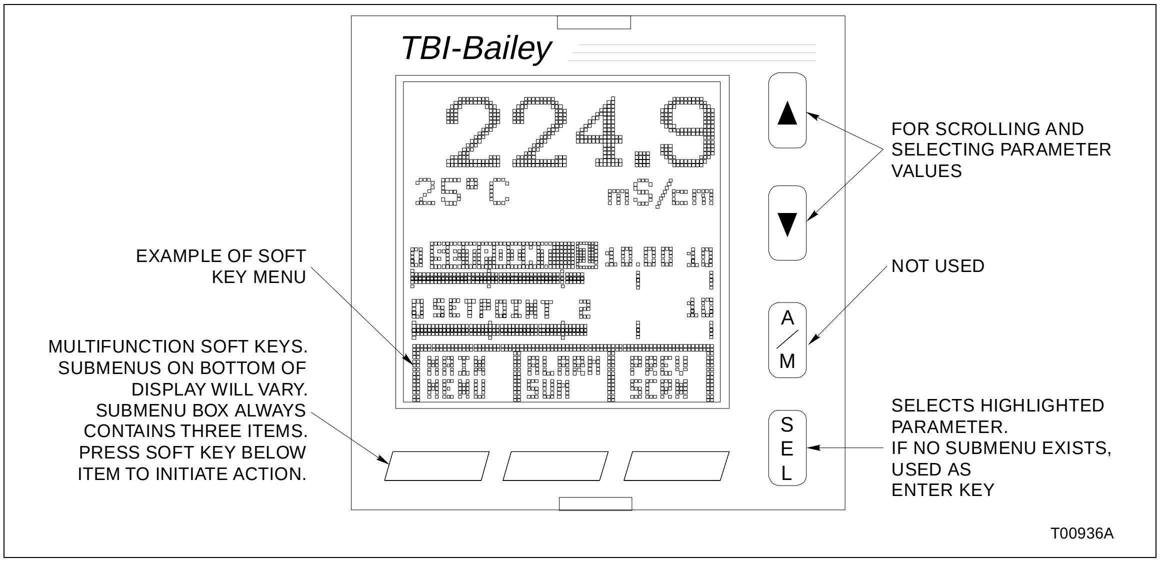


Figure 6-1. Operator Interface

OPERATOR INTERFACE

The operator interface consists of single-function keys and multifunction soft keys.

Single-Function Keys

The four keys to the right of the screen are the single-function keys. These allow the operator to change the value or choice on the screen and to select a field that is displayed on the screen. Table 6-1 is an overview of the single-function keys and their functions.

Table 6-1. Single-Function Keys

Keys	Function
▲ ▼	Used to scroll through parameters on menu screens and to change selected parameter values.
SEL	Allows the operator to select a highlighted parameter in a submenu and on the process display. On screens where no submenu exists, it enters the displayed selection.
A/M	Not used.

Multifunction Soft Keys

Three soft keys at the bottom of the screen are multifunction soft keys. The specific function of these keys is defined by the graphics and varies depending on the screen displayed. Pressing any of these soft keys first displays a soft key menu (three selection boxes) that appears directly above the soft keys. Once this soft key menu appears, pressing the soft key below the menu item initiates the action defined by that key.

OPERATING PROCEDURES

Table 6-2 lists the procedures related to operation. There is no particular sequence for these tasks.

Table 6-2. Operating Procedures

Description	Procedure
Process display access	PR37
Main menu access	PR38
Alarm acknowledging and viewing	PR39
Monitoring	PR40
Tuning	PR41

SECTION 7 - DIAGNOSTICS

INTRODUCTION

The Type TB703 Toroidal Conductivity Analyzer performs a number of diagnostic checks that alert users to faults in the measurement loop. Most of these diagnostics show up as alarm display messages. To access these messages, use the *ALARM SUM* soft key. Refer to PR39 to acknowledge and view alarms.

GENERAL DIAGNOSTICS

Errors in calibration are noted and not accepted. Existing calibration data is accessible during the reset calibration routines. Additionally, individual digital outputs are programmable to indicate measurement loop errors particular to the application. Refer to Table 7-1 for a list of display alarms.

Table 7-1. Display Alarms

Alarm Type	Probable Cause	Corrective Action
Overrange conductivity	Process conductivity too high for measurement range.	Change range.
	Temperature compensator resistance too low or connections are shorted.	Refer to Section 8.
	Faulty sensor or cabling.	Refer to Section 8.
	Incorrect calibration.	Refer to Section 5 and ***CALIBRATION DIAGNOSTICS*** in this section.
	Sensor cabling shorted to earth ground.	Examine cable for shorts and repair.
	Sensor coated with conductive substance.	Refer to Section 9 for sensor cleaning procedures.
Underrange (negative) conductivity	Sensor not in process liquid.	Reposition sensor in process piping.
	Incorrect wiring.	Refer to Section 3.
	Temperature compensator resistance too high or connections are open.	Refer to Section 8.
	Incorrect calibration.	Refer to Section 5 and ***CALIBRATION DIAGNOSTICS*** in this section.
	Sensor cable cut or not correctly connected.	Check sensor cable connections or replace cable at cut.
	Faulty sensor.	Refer to Section 8.
	Sensor sensing area is completely plugged.	Refer to Section 9 for sensor cleaning procedures.
	Sensor cable shorted to earth ground.	Locate short and repair.

Table 7-1. Display Alarms (continued)

Alarm Type	Probable Cause	Corrective Action
Temperature too high or too low	Process temperature too high.	Exceeded rated sensor temperature and will damage the sensor. Move sensor to a new location having a lower temperature. Contact TBI-Bailey to discuss correct sensor for this application.
	Process temperature too low.	Exceeded rated sensor temperature and will damage the sensor. Move sensor to a new location having a higher temperature. Contact TBI-Bailey to discuss correct sensor for this application.
	Incorrect temperature calibration.	Refer to Section 5.
	Faulty temperature compensator.	Refer to Section 8.
	Temperature compensator incorrectly installed.	Refer to Section 8.
	Faulty sensor.	Refer to Section 8.
Activation of DO1 through DO4	—	Refer to ***ADDITIONAL PROGRAMMABLE DIAGNOSTICS (VIA DIGITAL OUTPUTS)*** in this section.

CALIBRATION DIAGNOSTICS

The Type TB703 analyzer performs automatic slope and zero adjustments to a theoretically perfect conductivity or temperature measurement during each sensor calibration. Previous process calibration points are retained to make the correct smart calibration decision. If an incorrect process calibration point is entered, the Type TB703 analyzer smart calibration deletes this point after two successive calibrations. If the existence of a bad calibration point is suspected, it can be checked by accessing the reset sensor calibration routine described in PR35.

During the reset sensor calibration routine, the calculated constants referenced against the theoretically perfect conductivity and/or temperature are displayed as slope and offset. A slope of less than 0.4 or greater than 2.5 indicates a potentially bad process calibration point. An offset value greater or less than 5.0 percent of the maximum measurement range (full scale) also indicates a potentially bad calibration point. If displayed slope and offset values are outside these guidelines and the conductivity display is erroneous, perform a reset sensor calibration. If the values are within the acceptable ranges, perform future sensor calibrations as needed. Choose low conductivity values for a sensor calibration if the offset is out of the acceptable limits. Conversely, choose high conductivity values if the slope is out of the acceptable limits.

Additionally, the analyzer will not allow sensor calibration points to be entered that cause the slope to go below 0.2 or above 5.0. Sensor calibration points that cause the offset to go above or below ten percent of the high measurement range value (full scale) are also rejected.

ADDITIONAL PROGRAMMABLE DIAGNOSTICS (VIA DIGITAL OUTPUTS)

Depending on the application, the relays can be programmed to indicate a variety of fault conditions (Table 7-2).

Table 7-2. Additional Diagnostics

Diagnostic	Fault Indication
High conductivity (including overrange)	Process conductivity above expected process conditions.
	Sensor and/or cable fault (leakage or short or shorted temperature compensator).
	Analyzer is set in the wrong range.
	Incorrect configured temperature compensation type.
	Incorrect calibration.
Low conductivity (not negative)	Process conductivity below expected process conditions.
	Sensor not in liquid.
	Sensor and/or cable fault (not connected, cut or an open temperature compensator).
	Analyzer is set in the wrong range.
	Incorrect configured temperature compensation type.
	Sensor fouled.
	Incorrect calibration.
Temperature high or low	Process conditions too extreme for measurement.
	Faulty sensor and/or cabling.
	Incorrect calibration.

SECTION 8 - TROUBLESHOOTING

INTRODUCTION

This section provides troubleshooting information for the Type TB703 Toroidal Conductivity Analyzer and the associated toroidal conductivity sensor. Refer to Table 8-1 for the analyzer troubleshooting guide. In addition to describing possible error conditions that could occur with the analyzer and the corrective actions to take to remedy the situation, this section also contains procedures for checking possible sensor problems and ground loops. Refer also to Section 7 for a listing of analyzer alarm messages.

ANALYZER TROUBLESHOOTING

Table 8-1 is a list of symptoms of problems that can be encountered when using the analyzer. There are probable causes for each symptom and associated corrective actions to take to correct the problem. Following Table 8-1 is an electronic troubleshooting flowchart (Figure 8-1).

Table 8-1. Analyzer Troubleshooting Guide

Symptom	Probable Cause	Corrective Action
Display loosing pixels.	Display assembly malfunctioning.	Refer to Section 10 and replace front panel assembly.
Display will not change or respond to commands.	Electromagnetic interference (EMI).	Initialize and relocate analyzer. Install EMI protective devices as required. If problem still exists, contact TBI-Bailey.
	Ambient temperature too high or too low.	Relocate analyzer. If problem still exists contact TBI-Bailey.
	Display assembly malfunctioning.	Refer to Section 10 and replace front panel assembly.
	Main board malfunction.	Contact TBI-Bailey for assistance.

Table 8-1. Analyzer Troubleshooting Guide (continued)

Symptom	Probable Cause	Corrective Action
Display and output are erratic.	Sensor is in 2-phase flow (air bubbles).	Correct piping or relocate sensor.
	Incorrect cable type spliced between sensor and analyzer.	Move sensor closer to analyzer and remove incorrect cable. Contact TBI-Bailey for compatible cable or new sensor with longer integral cable.
	Temperature compensator is intermittent.	Replace sensor. Contact TBI-Bailey for new sensor.
	Wires connecting sensor to analyzer are improperly connected.	Refer to PR15 and check sensor connections.
	Cable shielding is faulty.	Refer to PR14, PR15, PR16, PR17 and PR18 and check all cables and shield connections.
	Intermittent cable short.	Replace sensor. Contact TBI-Bailey for new sensor.
	Process piping or vessels are carrying high common mode AC or DC voltage.	Refer to PR14, PR15, PR16, PR17 and PR18 and check all cable, shielding and grounding connections.
Display is blank, sluggish or will not change. Output is correct. Actual output is correct.	Ambient temperature below 0°C (32°F).	Locate instrument where the ambient temperature does not go below 0°C (32°F).
	Front panel assembly malfunctioning.	Refer to Section 10 and replace front panel assembly.
Display and output are incorrect.	Check for bad calibration.	Refer to PR35 and check values for slope and offset. Reset calibration to factory defaults if the values are beyond the guidelines identified in ***CALIBRATION DIAGNOSTICS*** in Section 7.
	Fault in shielding of cables.	Refer to PR14, PR15, PR16, PR17 and PR18 and check all cable, shielding and grounding connections.
	Excessive cable length between sensor and analyzer.	Remove excess cable to maintain a maximum sensor cable length of 15.2 m (50.0 ft). Relocate sensor if necessary.
	Electrical leakage path between sensor cable and earth ground.	Replace sensor (contact TBI-Bailey) or remove leakage path by repairing cable.
	Sensor is dirty.	Refer to Section 9 and clean the sensor.
	Sensor is faulty.	Replace sensor. Contact TBI-Bailey for replacement sensor.
	Temperature compensator is faulty.	Replace sensor. Contact TBI-Bailey for replacement sensor.
	Incorrect cable type spliced between sensor and analyzer.	Move sensor closer to analyzer and remove incorrect cable. Contact TBI-Bailey for compatible cable or new sensor with longer integral cable.
	High common mode AC or DC voltage.	Refer to PR14, PR15, PR16, PR17 and PR18 and check all cable, shielding and grounding connections.
	Sensor is improperly connected to the analyzer.	Refer to PR14, PR15, PR16, PR17 and PR18 and check all cable, shielding and grounding connections.
	Front panel assembly or one of the analyzer circuit boards malfunctioning.	Contact TBI-Bailey for parts and assistance.

Table 8-1. Analyzer Troubleshooting Guide (continued)

Symptom	Probable Cause	Corrective Action
Display conductivity and output are over-ranged.	Analyzer is in the wrong range.	Change to higher range and calibrate the instrument. Refer to Table 1-3 for ranges and Section 5 for calibration sequence.
	Check for bad calibration.	Refer to PR35 and check values for slope and offset. Reset calibration to factory defaults if the values are beyond the guidelines identified in ***CALIBRATION DIAGNOSTICS*** in Section 7.
	Resistance of temperature compensator is too low.	Refer to PR43.
	Configured temperature compensation type is incorrect.	Refer to Table 4-2 for configuration sequence to properly configure temperature compensation type after reading the temperature compensation descriptions detailed in Appendix A.
	Sensor is shorted.	Refer to PR43.
	Sensor is faulty.	Replace sensor. Contact TBI-Bailey for new sensor.
	Temperature compensator is not properly connected.	Refer to PR15 and check temperature compensator connections.
	Sensor or extension cable is shorted.	Replace sensor or extension cable. Contact TBI-Bailey service.
	Sensor cable is shorted.	Correct shorting condition or replace sensor (Contact TBI-Bailey) if necessary.
	Front panel assembly or one of the analyzer circuit boards malfunctioning.	Contact TBI-Bailey for parts and assistance.
Display conductivity and output are low.	Analyzer is in the wrong range.	Change to higher range and calibrate the instrument. Refer to Table 1-3 for ranges and Section 5 for calibration sequence.
	Check for bad calibration.	Refer to PR35 and check values for slope and offset. Reset calibration to factory defaults if the values are beyond the guidelines identified in ***CALIBRATION DIAGNOSTICS*** in Section 7.
	Resistance of temperature compensator is too high.	Refer to PR43.
	Configured temperature compensation type is incorrect.	Refer to Table 4-2 for configuration sequence to properly configure temperature compensation type after reading the temperature compensation descriptions detailed in Appendix A.
	Sensor is dirty.	Refer to Section 9 and clean the sensor.
	Sensor is faulty.	Replace sensor. Contact TBI-Bailey for new sensor.
	Front panel assembly or one of the analyzer circuit boards malfunctioning.	Contact TBI-Bailey for parts and assistance.

Table 8-1. Analyzer Troubleshooting Guide (continued)

Symptom	Probable Cause	Corrective Action
Display conductivity reads 0 or negative and output is 4 mA.	Temperature compensator is open.	Refer to PR15 and check sensor and temperature compensator connections. Refer to PR43 and replace sensor (contact TBI-Bailey) if necessary.
	Sensor is not connected.	Refer to PR15 and check sensor connections.
	Check for bad calibration.	Refer to PR35 and check values for slope and offset. Reset calibration to factory defaults if the values are beyond the guidelines identified in ***CALIBRATION DIAGNOSTICS*** in Section 7.
	Analyzer is in the wrong range.	Change to higher range and calibrate the instrument. Refer to Table 1-3 for ranges and Section 5 for calibration sequence.
	Sensor is dirty.	Refer to Section 9 and clean the sensor.
	Sensor is faulty.	Replace sensor. Contact TBI-Bailey for new sensor.
	Front panel assembly or one of the analyzer circuit boards malfunctioning.	Contact TBI-Bailey for parts and assistance.
Display conductivity is correct. Output is incorrect.	Analog output loop resistance too high.	Lower loop resistance to maximum load capacity as specified in Table 1-4.
	Front panel assembly or one of the analyzer circuit boards malfunctioning.	Contact TBI-Bailey for parts and assistance.
Temperature indication incorrect.	Temperature compensator is not properly connected.	Refer to PR15 and check sensor and temperature compensator connections. Refer to PR43 and replace sensor (contact TBI-Bailey) if necessary.
	Configured temperature compensation type is incorrect.	Refer to Table 4-2 for configuration sequence to properly configure temperature compensation type after reading the temperature compensation descriptions detailed in Appendix A.
	Temperature calibration incorrect.	Refer to PR32 and check values for slope and offset. Reset calibration to factory defaults if the values are abnormal.
	Temperature compensator shorted, open or otherwise incorrect.	Refer to PR15 and check sensor and temperature compensator connections. Refer to PR43 and replace sensor (contact TBI-Bailey) if necessary.

TROUBLESHOOTING PROCEDURES

Table 8-2 lists the troubleshooting procedures. There is no particular sequence for these tasks.

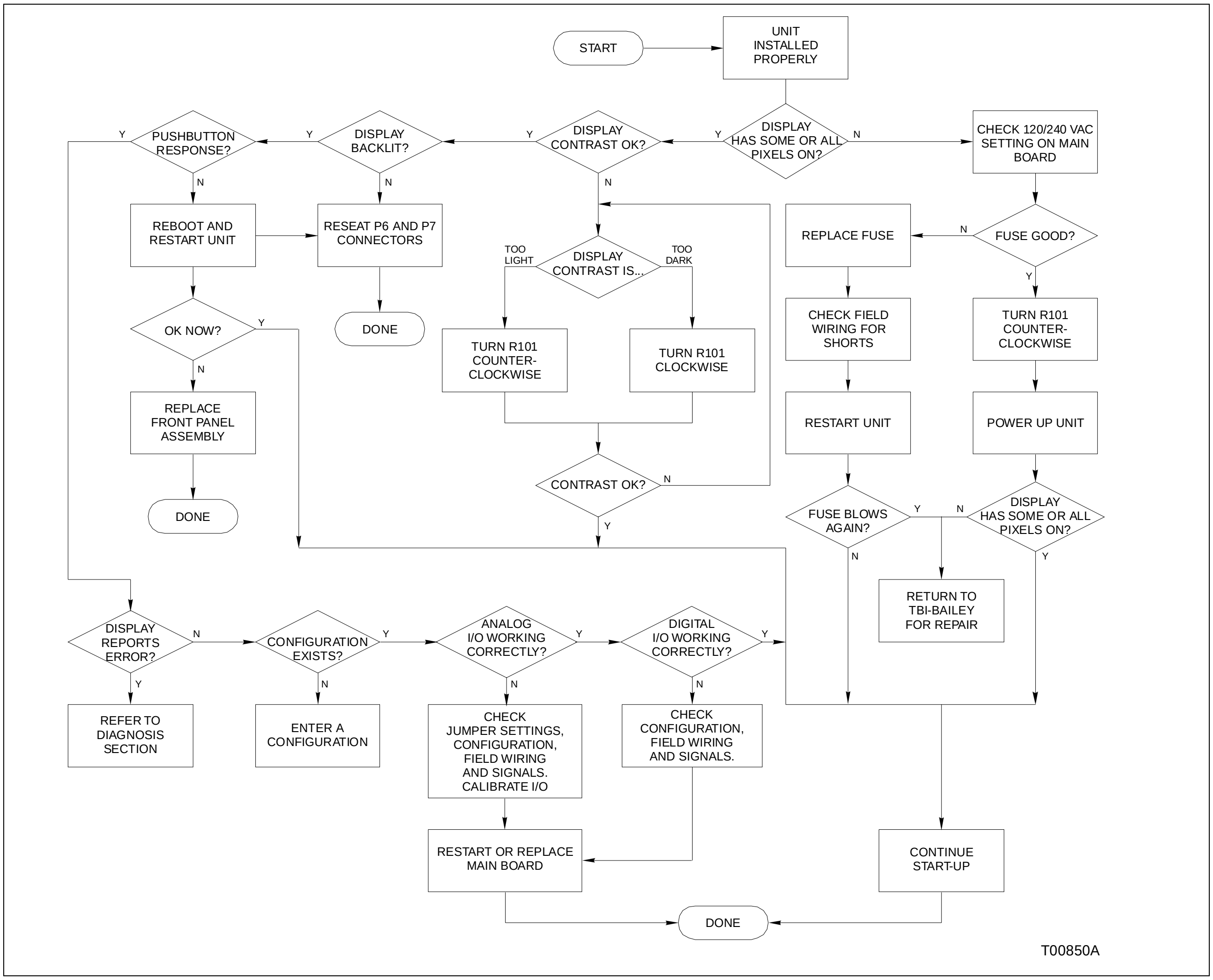


Figure 8-1. Electronic Troubleshooting Flowchart

Table 8-2. Troubleshooting Procedures

Description	Procedure
Analyzer Troubleshooting	PR42
Sensor troubleshooting	PR43
Ground loops	PR44

SECTION 9 - MAINTENANCE

INTRODUCTION

This section contains a preventive maintenance schedule for the Type TB703 Toroidal Conductivity Analyzer (Table 9-1). This table has a procedure reference next to the task when applicable. The reference indicates the procedure number where the procedure for that task can be found.

WARNING	**Allow only qualified personnel (refer to *INTENDED USER*) to commission, operate, service or repair this equipment. Failure to follow the procedures described in this instruction or the instructions provided with related equipment can result in an unsafe condition that can injure personnel and damage equipment.**

Be sure to follow all warnings, cautions and notes. Put boards containing semiconductors into antistatic bags when stored or shipped back to the factory. Do not repair printed circuit boards in the field. All repairs and adjustments should be performed by qualified personnel.

The maintenance of any stand-alone product or control system affects the reliability of that product. TBI-Bailey recommends that all equipment users practice a preventive maintenance program that will keep the equipment operating at an optimum level.

The procedures referred to in this section contain instructions that the customer should be able to perform on site. These preventive maintenance procedures should be used as a guideline to assist in establishing good preventive maintenance practices. Select the minimum steps required to meet the cleaning needs of your system.

Personnel performing preventive maintenance should meet the following qualifications:

- Maintenance personnel should be qualified electrical technicians or engineers that know the proper use of test equipment.
- Maintenance personnel should be familiar with the analyzer, have experience working with process control systems, and know what precautions to take when working with live AC power.

PREVENTIVE MAINTENANCE SCHEDULE

Table 9-1 is the preventive maintenance schedule for the Type TB703 analyzer. The table lists the preventive maintenance tasks in groups according to their specified maintenance interval. Some tasks in Table 9-1 are self explanatory. Instructions for tasks that require further explanation are found in the procedures or in the documentation supplied with any associated equipment.

Table 9-1. Preventive Maintenance Schedule

Task	Procedure	Frequency
General cleaning, including, but not limited to: Faceplate	N/A	As required
Clean and lubricate all gaskets and O-rings.	N/A	Each time seals are broken
Clean and inspect sensor	PR45	3 to 12 months (or as required)
Calibrate sensor	PR33, PR34	
Calibrate analyzer output	PR36	12 months
Check all signal, power and ground connections and verify that they are secure.	N/A	
Complete all appropriate tasks in this table.	N/A	Shutdown

SECTION 10 - REPAIR AND REPLACEMENT PROCEDURES

INTRODUCTION

This section provides disassembly and assembly procedures for replacement of the main board assembly and fuse, the front panel (display) assembly, the conductivity board and the expansion board.

This section does not contain repair instructions for the toroidal conductivity sensor. Due to the nature of its design, complete sensor replacement is required when it has been damaged or does not properly function.

WARNING	**Do not substitute components that compromise the certifications listed on the nameplate. Invalidating the certifications can lead to unsafe conditions that can injure personnel and damage equipment.** **Do not disconnect equipment unless power has been switched off at the source or the area is known to be nonhazardous. Disconnecting equipment in a hazardous location with source power on can produce an ignition capable arc that can injure personnel and damage equipment.**

REPAIR AND REPLACEMENT SEQUENCE

Refer to Figure 10-1 for the repair sequence for the analyzer. Each block of the flow represents a single task that must be completed before continuing with the sequence.

In some cases, more than one path can be taken during repair. For paths that are in parallel, either complete all of the tasks in all of the paths before continuing or complete all of the tasks in only those paths that apply before continuing. At least one path must be completed.

Some blocks contain alphanumeric codes. These codes identify the procedure that describes the steps to complete an indicated task. Complete all of the steps given in a procedure before continuing to the next procedure.

The procedures have check boxes in the margin by each procedural step. When performing a procedure, check each box as each step is completed.

By treating each task as a separate entity, the procedures provide an easy method for finding the information needed to perform each task in the repair sequence.

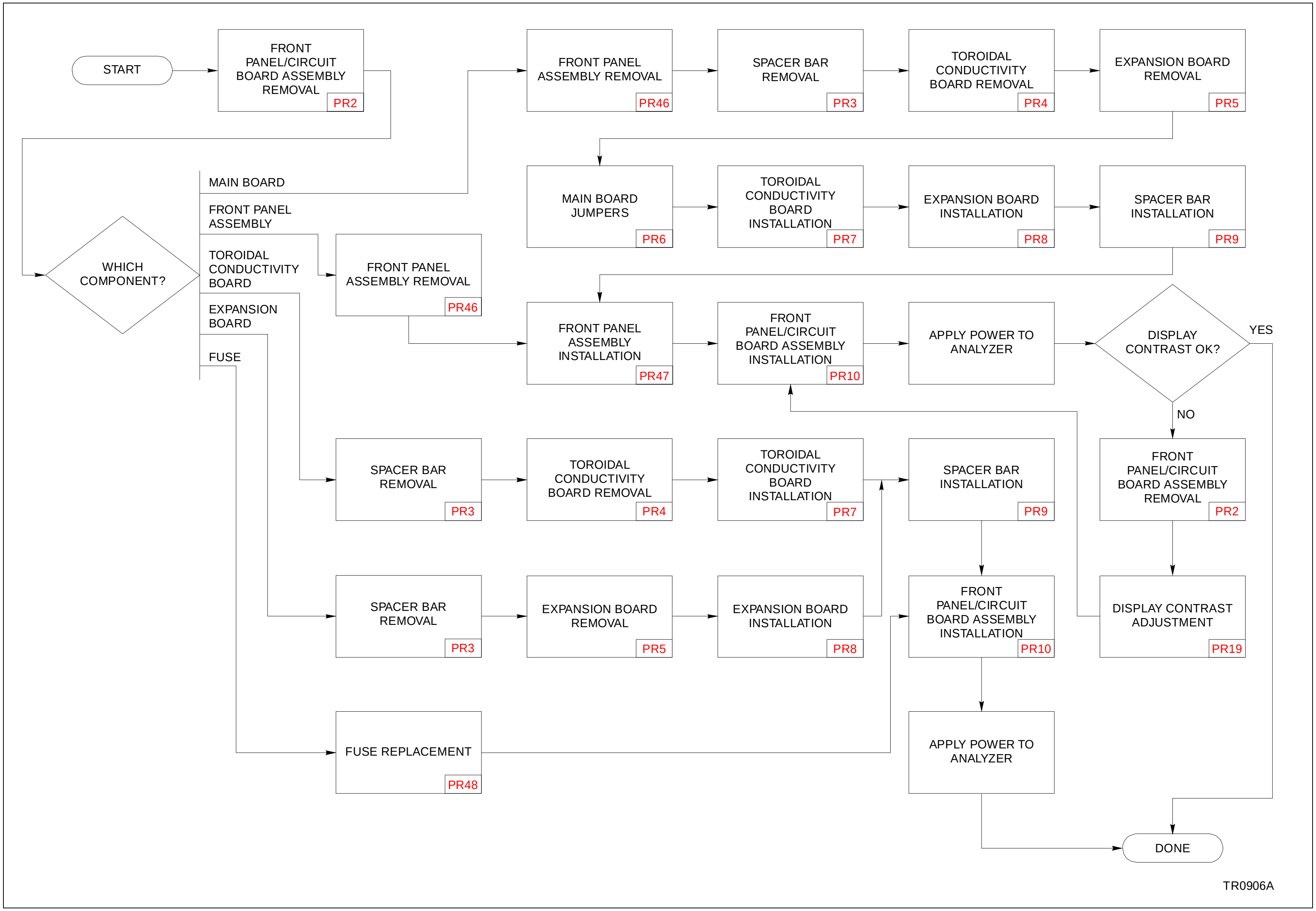


Figure 10-1. Repair and Replacement Sequence Flowchart

SECTION 11 - SUPPORT SERVICES

INTRODUCTION

Figure 11-1 is an assembly drawing of the Type TB703 Toroidal Conductivity Analyzer. When ordering replacement parts, specify nomenclature type, part name and part number of spare parts kits.

TBI-Bailey Controls Company is ready to assist in the use and repair of its products at any time. Requests for sales and/or application service should be made to the nearest sales or service office.

Factory support in the use and repair of the Type TB703 analyzer can be obtained by contacting:

TBI-Bailey Controls Co.
2175 Lockheed Way
Carson City, NV 89706
Phone: (702) 883-4366
FAX: (702) 883-4373

REPLACEMENT PARTS

When making repairs at your facility, order spare parts kits from a TBI-Bailey sales office. Provide this information.

1. Spare parts kit description, part number and quantity.

2. Model and serial number (if applicable).

3. TBI-Bailey instruction manual number, page number and reference figure that identifies the spare parts kit.

When ordering standard parts from TBI-Bailey Controls, use the part numbers and descriptions from the ***RECOMMENDED SPARE PARTS*** and ***SPARE PARTS KITS*** sections. Order parts without commercial descriptions from the nearest TBI-Bailey Controls sales office.

NOTE: Contact TBI-Bailey for replacement toroidal conductivity sensors and ROMs. Due to the special nature of these items, factory consultation is required.

RECOMMENDED SPARE PARTS

Table 11-1 lists general recommended spare parts. Table 11-2 is the Type TB703 analyzer parts list for use with Figure 11-1.

Table 11-1. Spare Parts

Part Number	Description
1948182?32500	Fuse, ¼-amp, slow blow, 5 by 20 mm
4TB9515-0022	Housing with bezel clips (does not include rear cover or front panel assembly)

Table 11-2. Parts List (Fig. 11-1)

Item	Qty	Part Number	Description
1	1	6638367?2	Front panel assembly
4	3[1]	1948593?8	Connector, terminal block, 8-position
5	6[1]	4TB4704-0099	Screw, terminal block
6	1	6640384?1	Rear cover
7	1	1951740?2	Gasket, rear cover
8	6	NBZHA13005	Screw, pan head
10	1	4TB5205-0268	Housing assembly
11	1	Consult TBI-Bailey	Main board
13	1	6640106?1	Mounting bracket
14	1	1948593?12	Connector, terminal block, 12-position
15	1	6638364?1	Spacer bar
16	1	1963318?8	Label, part number
18	2	4TB4704-0012	Screw, thread cutting
19	1[2]	6638104?1	Expansion board assembly
20	1	Consult TBI-Bailey	Toroidal conductivity board assembly
21	2	NDRAC09004	Screw, machine
22	1	4TB5001-0103	Label, wiring
24	4	4TB4710-0026	Washer, nylon
26	1	Consult TBI-Bailey	ROM, U14 (not shown — located on main board)
27	1	Consult TBI-Bailey	ROM, U15 (not shown — located on main board)
30	1	6640633?1	Spacer plate
31	4	4TB4904-0095	O-ring
32	1	197676?1	Screw, ground
33	1	197675?1	Washer, cup
34	1	NTLAC16000	Lockwasher
35	1	1951738?1	Gasket

NOTES:
1. Maximum quantity if all circuit boards are installed.
2. Type TB7034 only.

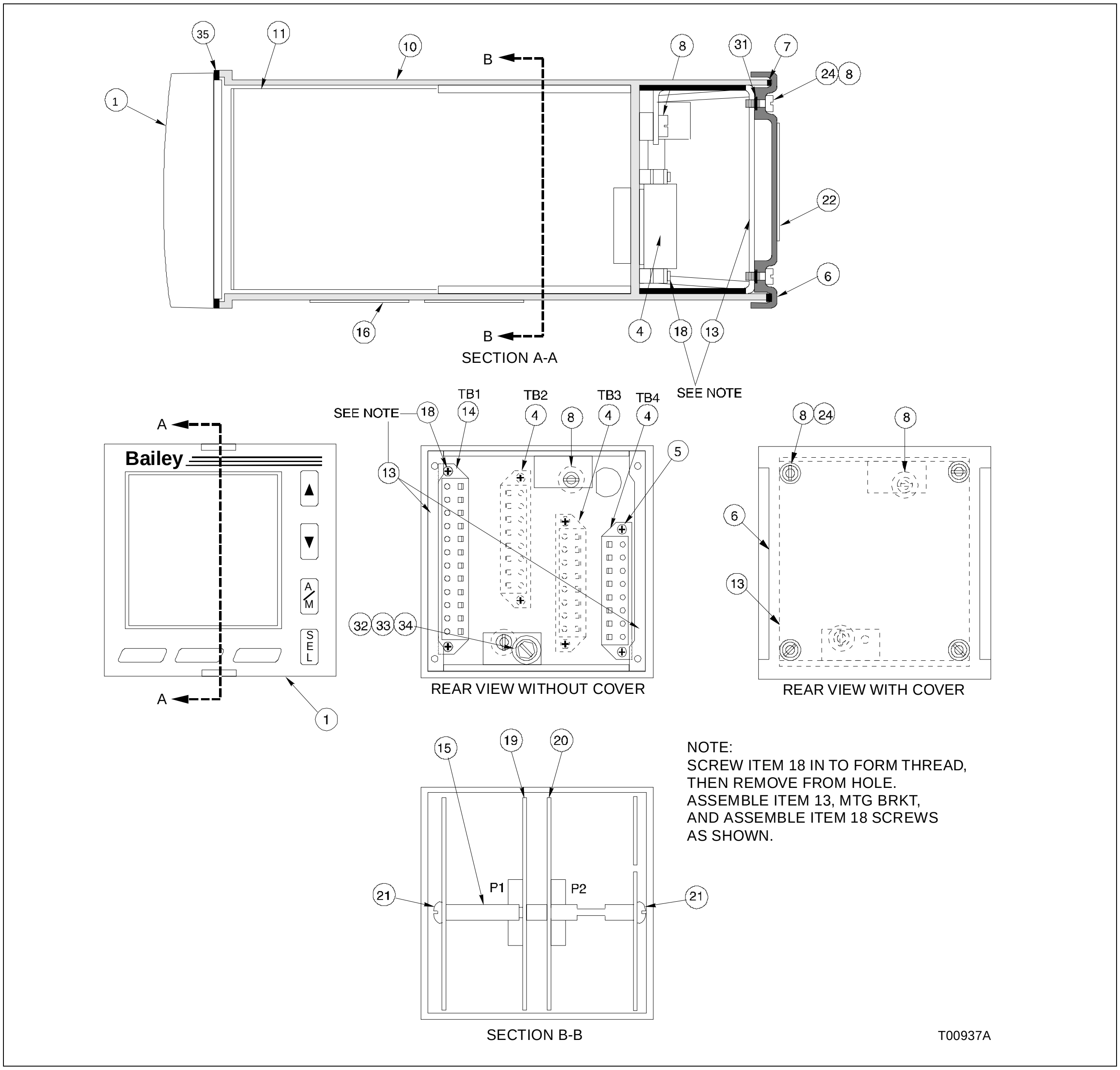


Figure 11-1. Assembly Drawing

SPARE PARTS KITS

Tables 11-3, 11-4, 11-5 and 11-6 are spare parts kits for use with the analyzer. Item numbers reference Figure 11-1.

Table 11-3. Front Panel Assembly (Kit No. 4TB9515-0025)

Item	Qty	Part Number.	Description
1	1	6638367?1	Front panel assembly
35	1	1951738?1	Gasket

Table 11-4. Termination Hardware (Kit No. 4TB9515-0028)

Item	Qty	Part Number	Description
4	3	1948593?8	Connector, terminal block, 8-position
5	6	4TB4704-0099	Screw, terminal block
14	1	1948593?12	Connector, terminal block, 12-position
18	2	4TB4704-0012	Screw, thread cutting

Table 11-5. Rear Cover Assembly (Kit No. 258482?2)

Item	Qty	Part Number	Description
6	1	6640384?1	Rear cover
7	1	1951740?2	Gasket, rear cover
8	6	NBZHA13005	Screw, pan head
13	1	6640106?1	Mounting bracket
18	2	4TB4704-0012	Screw, thread cutting
22	1	4TB5001-0103	Label, wiring
24	4	4TB4710-0026	Washer, nylon
31	4	4TB4904-0095	O-ring
32	1	197676?1	Screw, ground
33	1	197675?1	Washer, cup
34	1	NTLAC16000	Lockwasher

Table 11-6. Expansion Board Assembly (Kit No. 4TB9515-0023)

Item	Qty	Part Number	Description
4	1	1948593?8	Connector, terminal block, 8-position
5	2	4TB4704-0099	Screw, terminal block
15	1	6638364?1	Spacer bar
18	2	4TB4702-0012	Screw, thread cutting
19	1	6638104?1	Expansion board

APPENDIX A - TEMPERATURE COMPENSATION

INTRODUCTION

The Type TB703 Toroidal Conductivity Analyzer contains a variety of temperature compensation options. These include: Manual, standard automatic, zero to 15-percent Sodium Hydroxide (NaOH), zero to 20-percent Sulfuric Acid (H_2SO_4), zero to 18-percent Hydrochloric Acid (HCl) and solution coefficient.

MANUAL

Manual temperature compensation is based on 0.1-Normal Potassium Chloride (KCl). It uses a reference temperature of 25 degrees Celsius.

STANDARD AUTOMATIC

Standard automatic temperature compensation is also based on 0.1-Normal KCl. When using this type of temperature compensation, the analyzer measures the process temperature via the resistive temperature device located in the sensor. Using this measurement, the analyzer automatically adjusts the raw conductivity to a conductivity referenced to 25 degrees Celsius. Table A-1 shows the data for 0.1-Normal KCl.

Table A-1. K_{STD}/K Values for 0.1N KCl

Temperature (°C)	Raw Conductivity (µS/cm)	K_{STD}/K
0	7,150	1.8014
5	8,220	1.5669
10	9,330	1.3805
15	10,480	1.2290
20	11,670	1.1037
25	12,880	1.0000
30	14,120	0.9122
50	18,748	0.6870
75	25,890	0.4975
100	33,600	0.3833
128	42,771	0.3011
156	51,526	0.2500
306	70,840	0.1818

NaOH (0 to 15%)

The zero to 15-percent NaOH compensation characterizes an average temperature correction required to cover a zero to 15-percent NaOH concentration range. Since NaOH has a relatively constant set of temperature coefficients over a large range of concentrations, this compensation can be accurately used for weak and concentrated solutions of NaOH. Table A-2 shows the data for zero to 15-percent NaOH.

Table A-2. K_{STD}/K Values for 0 to 15% NaOH

Temperature (°C)	K_{STD}/K
0	1.79
25	1.00
50	0.69
75	0.53
150	0.43
156	0.30

H_2SO_4 (0 to 20%)

The zero to 20-percent H_2SO_4 compensation characterizes an average temperature correction required to cover a zero to 20-percent H_2SO_4 concentration range. Table A-3 shows the data for zero to 20-percent H_2SO_4.

Table A-3. K_{STD}/K Values for 0 to 20% H_2SO_4

Temperature (°C)	K_{STD}/K
0	1.37
25	1.00
50	0.84
75	0.73
150	0.67
156	0.61

HCl (0 to 18%)

The zero to 18-percent HCl compensation characterizes an average temperature correction required to cover a zero to 18-percent HCl concentration range. Since HCl also has a relatively constant set of temperature coefficients over a large range of concentrations, this compensation can be accurately used for weak and concentrated solutions of HCl. Table A-4 shows the data for zero to 18-percent HCl.

Table A-4. K_{STD}/K Values for 0 to 18% HCl

Temperature (°C)	K_{STD}/K
0	1.55
25	1.00
50	0.75
75	0.61
150	0.52
156	0.43

SOLUTION COEFFICIENT

The solution coefficient temperature compensation compensates the raw conductivity value (i.e. actual solution conductivity at the process temperature) by a percent change in conductivity per degree Celsius. The temperature compensation factor is derived from the equation:

$$\alpha = COEF \times \Delta\%/\mathrm{C} = \frac{\left(\frac{K_T}{K_{STD}} - 1.0\right) \times 100.0}{T - 25.0}$$

where:

COEF = percentage change in conductivity per degree Celsius.

K_T = conductivity at temperature T (°C).

K_{STD} = conductivity at the standard temperature (25°C).

T = temperature of the solution in degrees Celsius.

Typical ranges for temperature compensation coefficients are:

- Acids = 1.0 to 1.6%/°C.
- Bases = 1.8 to 2.0%/°C.
- Salts = 2.2 to 3.0%/°C.
- Neutral water = 2.0%/°C.

PROCEDURE PR1 - CONDUIT KNOCKOUT REMOVAL

PURPOSE/SCOPE

5 min.

This procedure explains how to remove the conduit knockouts from the analyzer housing for wiring purposes.

Parts None.

Tools

- Standard pliers with serrated ends.
- Bladed screwdriver or pen knife.

PROCEDURE

Conduit knockouts (½-inch and ¾-inch) are located at the top and bottom rear of the housing. Before mounting the analyzer, determine and remove only the required conduit knockouts to be used later during wiring procedures.

NOTE: Use only approved conduit connections.

☐ 1. Open the pliers and position them so that the serrated ends are centered on the top and bottom of the desired conduit knockout.

☐ 2. Close the pliers.

☐ 3. Rock the pliers back and forth until the conduit knockout becomes loose.

☐ 4. Release the pliers and the conduit knockout should fall free. If not, gently twist and pull until the conduit knockout is free.

☐ 5. If any plastic flashing or rough edges remain on the housing, carefully use the bladed screwdriver or pen knife to remove the remaining material.

PROCEDURE PR2 - FRONT PANEL/CIRCUIT BOARD ASSEMBLY REMOVAL

PURPOSE/SCOPE

1 min.

This procedure explains how to remove the front panel/circuit board assembly to allow access to the printed circuit boards.

Parts None.

Tools

- Bladed screwdriver.
- Antistatic kit.

SAFETY CONSIDERATIONS

WARNING	**1. Remove power from the unit and allow at least one minute for the unit to discharge before performing these procedures. Failure to do so constitutes an electrical shock hazard that can injure personnel and damage equipment.**

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ W1 1. Be sure no power is applied to the analyzer.

☐ 2. At the top and bottom of the front panel assembly are two bezel clips that hold the front panel assembly to the housing. Push the front panel in the direction of the housing.

☐ 3. Gently release the bezel clips using the bladed screwdriver.

☐ 4. Grasp the front panel assembly by the sides and pull the assembly with the circuit boards out of the housing.

☐ 5. Once unplugged, allow at least 15 seconds before handling the main board assembly.

NOTE: The main board and front panel assemblies are attached. Do not disassemble them from one another.

PROCEDURE PR3 - SPACER BAR REMOVAL

PURPOSE/SCOPE

1 min.

This procedure explains how to remove the spacer bar in order to access and remove the toroidal conductivity and/or expansion boards.

Parts None.

Tools

- Bladed screwdriver.
- Antistatic kit.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Use the bladed screwdriver to remove the two screws shown in Figure PR3-1.

☐ 2. Remove the spacer plate.

☐ 3. Remove the spacer bar.

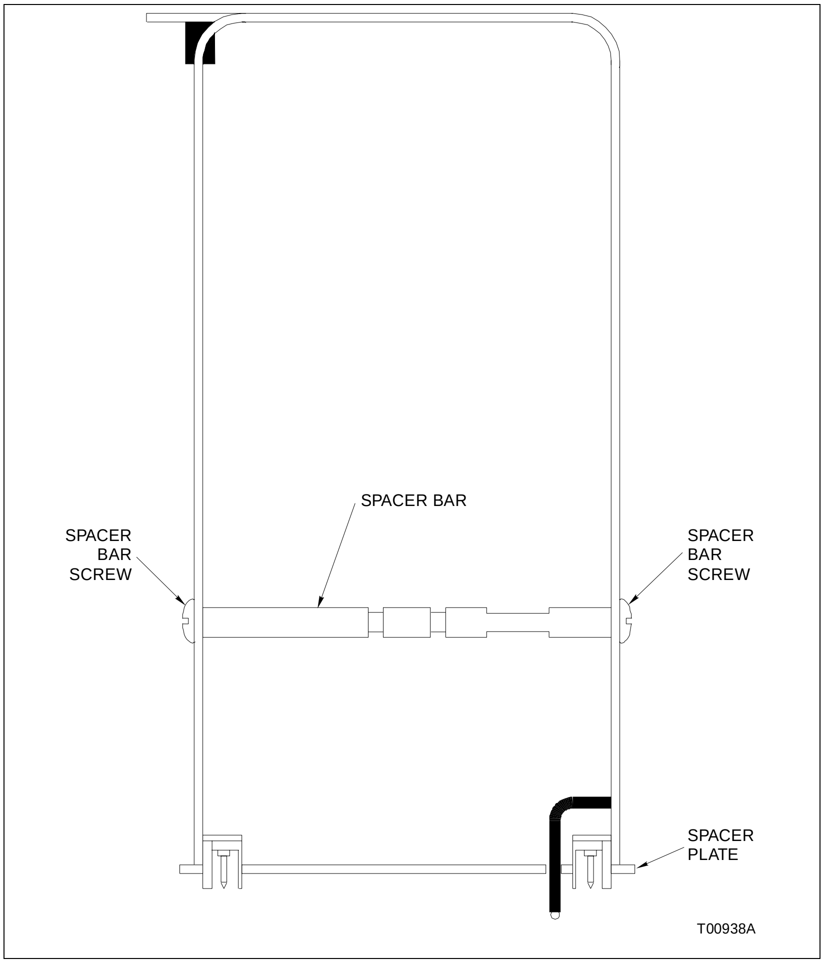


Figure PR3-1. Spacer Bar Removal

PROCEDURE PR4 - TOROIDAL CONDUCTIVITY BOARD REMOVAL

PURPOSE/SCOPE

1 min.

This procedure explains how to remove the toroidal conductivity board either for replacement, to set range jumper J1, or both.

Parts None.

Tools None.

PROCEDURE

NOTES:

1. The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

2. If both the toroidal conductivity board and the expansion board are installed, the toroidal conductivity board is the one on the right side when viewed from the top rear.

☐ 1. From the rear of the front panel/circuit board assembly, grasp the toroidal conductivity board by the top and bottom edges.

☐ 2. Remove the toroidal conductivity board from the main board.

PROCEDURE PR5 - EXPANSION BOARD REMOVAL

PURPOSE/SCOPE

1 min.

This procedure explains how to remove the expansion board either for replacement, to set analog output jumper J3, or both.

Parts None.

Tools None.

PROCEDURE

NOTES:

1. The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

2. If both the toroidal conductivity board and the expansion board are installed, the expansion board is the one on the left side when viewed from the top rear.

☐ 1. From the rear of the front panel/circuit board assembly, grasp the expansion board by the top and bottom edges.

☐ 2. Remove the expansion board from the main board.

PROCEDURE PR6 - MAIN BOARD JUMPERS

PURPOSE/SCOPE

5 min.

This procedure explains how to set the main board jumpers before installing the analyzer or when replacing the main board. The jumpers allow variations in the performance of the analyzer for a particular application.

Parts None.

Tools

- Needle nose pliers.
- Antistatic kit.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

The main board has a total of nine jumpers that affect the operation of the analyzer. This procedure is broken down according to the function that each jumper, or set of jumpers controls.

Power

Jumper J1 selects either 120VAC or 240VAC operation.

☐ 1. Locate J1 on the main board (Fig. PR6-1).

NOTE: Figure PR6-1 shows the main board as it would appear flat. It is secured in a U-shape. Use the components in the figure to help locate the proper jumper positions.

☐ 2. Refer to the following table and use the needle nose pliers to set the jumper position accordingly.

NOTE: Factory default setting is determined by nomenclature.

Analog Outputs

Jumpers J5 and J6 determine the configuration of analog outputs AO1 and AO2 that are available from the main board. They are individually selectable to provide either a current or voltage output.

☐ 1. Locate J5 and J6 on the main board.

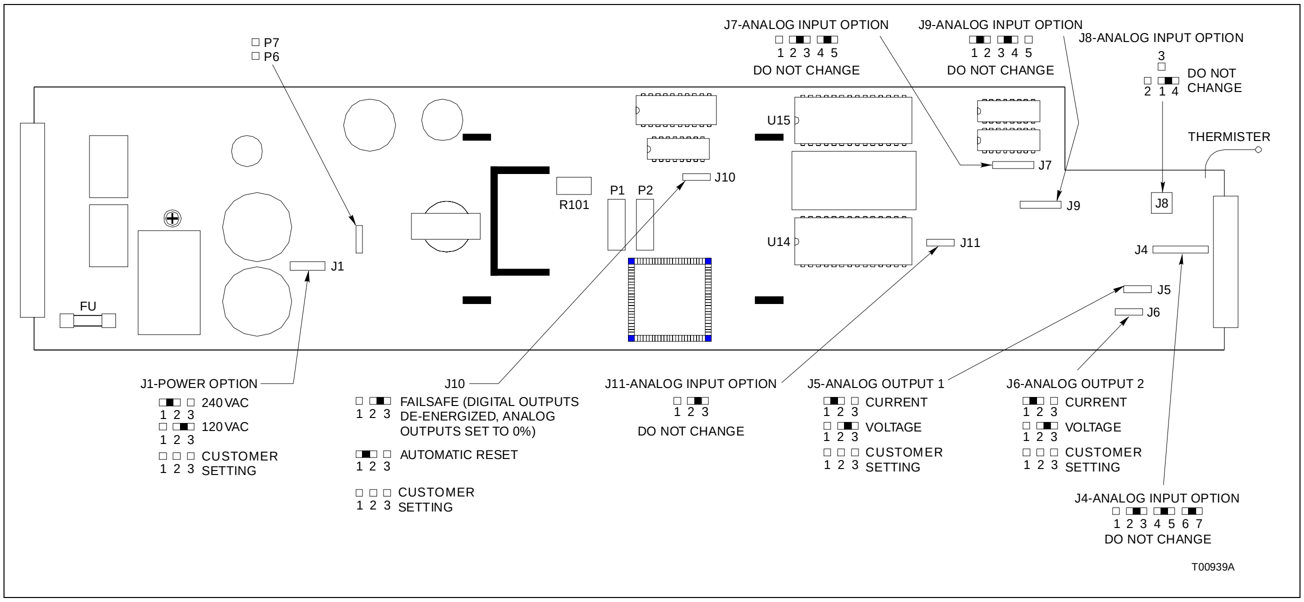


Figure PR6-1. Main Board

Voltage (VAC)	Jumper	Setting	Customer Setting
120	J1	2-3	
240		1-2	

☐ 2. Refer to the following table and use the needle nose pliers to set the jumper positions accordingly.

NOTE: Bold data indicates factory default settings.

Analog Output	Jumper	Setting	Output	Customer Setting
AO1	J5	**1-2**	**Current**	
		2-3	Voltage	
AO2	J6	**1-2**	**Current**	
		2-3	Voltage	

Conductivity Input

The main board is preset at the factory for a conductivity input. Use the following table to verify that jumpers J4, J7, J8, J9 and J11 are properly set. Jumpers J4, J7 and J9 show multiple settings because there is more than one connector block for those jumpers.

J4	J7	J8	J9	J11
2-3	2-3	1-4	1-2	2-3
4-5	4-5	—	3-4	—

J4	J7	J8	J9	J11
6-7	—	—	—	—

Failure Detection

The Type TB703 analyzer continually runs a set of self-diagnostics to ensure proper operation. Jumper J10 selects the response of the analyzer if it detects an on-board failure. The fail-safe setting causes the analyzer to de-energize its digital outputs and send the analog outputs to zero volts or zero milliamps. The auto reset setting causes the analyzer to automatically reset itself in an attempt to resolve the failure and come up running if the diagnostic tests pass.

☐ 1. Locate J10 on the main board.

☐ 2. Refer to the following table and use the needle nose pliers to set the jumper position accordingly.

NOTE: Bold data indicates the factory default setting.

Mode	Jumper	Setting	Customer Setting
Fail safe (low)	J10	2-3	
Auto reset		**1-2**	

PROCEDURE PR7 - TOROIDAL CONDUCTIVITY BOARD INSTALLATION

PURPOSE/SCOPE

1 min.

This procedure explains how to install the toroidal conductivity board either for replacement, to set range jumper J1, or both.

Parts

Number	Qty	Description
Consult factory[1]	1[2]	Toroidal conductivity board

NOTE:

1. Contact TBI-Bailey for replacement toroidal conductivity board assemblies. Due to the special nature of this assembly, factory consultation is required.
2. This part is not required if removing and replacing to set the range jumper (J1) only.

Tools

- Needle nose pliers.
- Antistatic kit.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Locate J1 on the toroidal conductivity board (Fig. PR7-1).

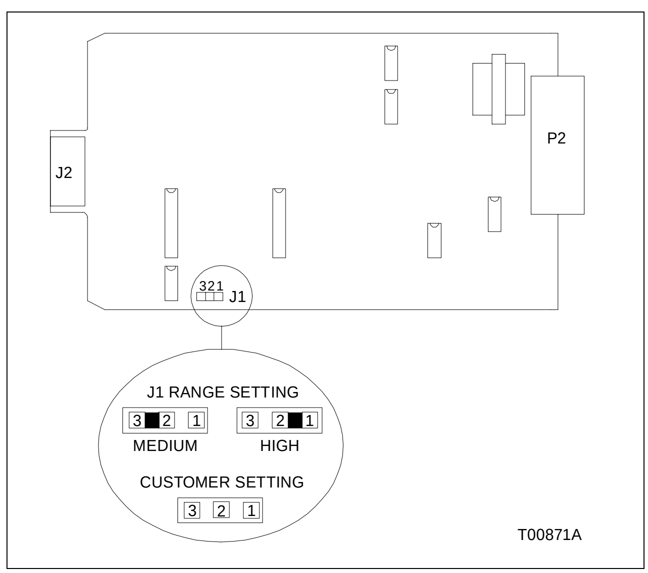


Figure PR7-1. Toroidal Conductivity Board

☐ 2. Refer to the following table and set J1 to the desired range.

Range	Position	Customer Setting
High	1-2	
Medium	2-3	

☐ 3. Grasp the toroidal conductivity board by the edges and insert it into connector P2 on the main board (Fig. PR7-2). Be sure it is properly seated.

NOTE: Figure PR7-2 shows the main board as it would appear flat. It is secured in a U-shape. Use the components in the figure to help locate P2.

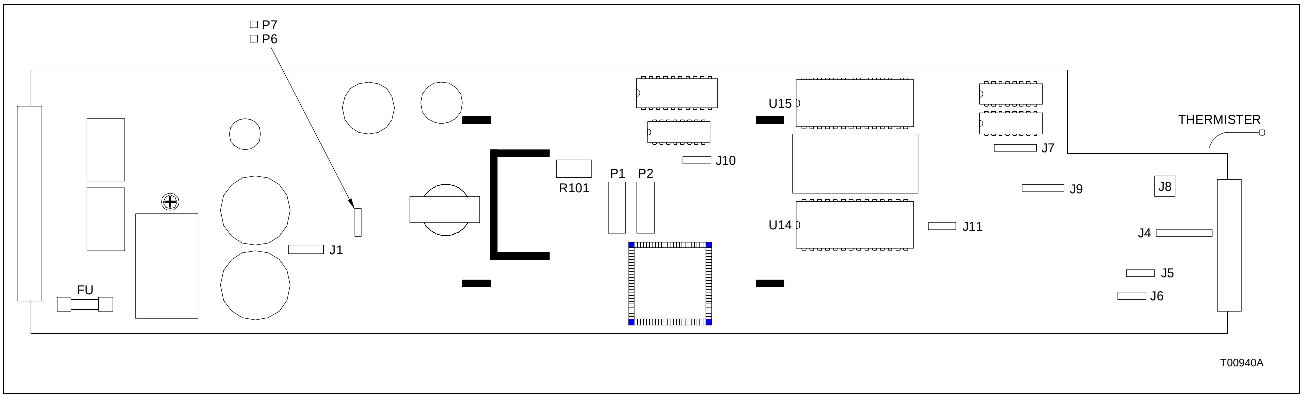


Figure PR7-2. Main Board

PROCEDURE PR8 - EXPANSION BOARD INSTALLATION

PURPOSE/SCOPE

1 min.

This procedure explains how to install the expansion board either for replacement, to set analog output jumper J3, or both.

Parts

Number	Qty	Description
6638104?1	1[1]	Expansion board

NOTE:

1. This part is not required if removing and replacing to set the output jumper (J3) only.

Tools

- Needle nose pliers.
- Antistatic kit.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Locate J3 on the expansion board (Fig. PR8-1). This jumper determines whether the analog output available on the expansion board is a voltage or current output.

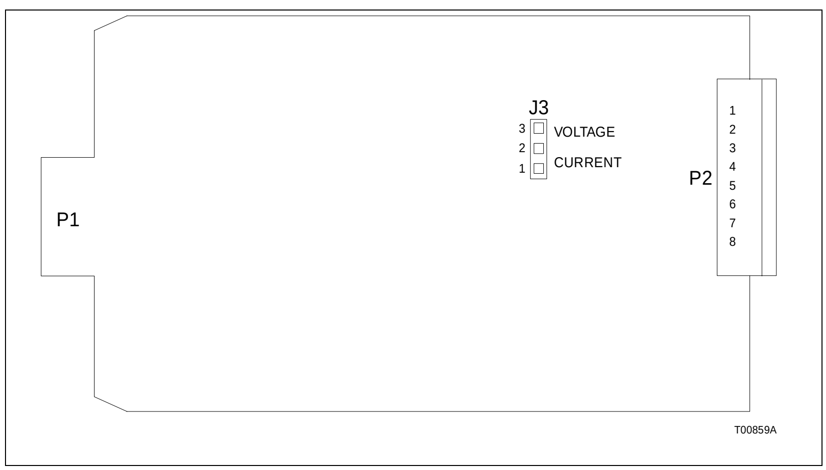


Figure PR8-1. Expansion Board

☐ 2. Refer to the following table and use the needle nose pliers to set J3 to the desired output.

Output	Setting	Customer Setting
Current	1-2	

Output	Setting	Customer Setting
Voltage	2-3	

☐ 3. Grasp the expansion board by the edges and insert it into connector P1 on the main board (Fig. PR8-2). Be sure it is properly seated.

NOTE: Figure PR8-2 shows the main board as it would appear flat. It is secured in a U-shape. Use the components in the figure to help locate the proper jumper positions.

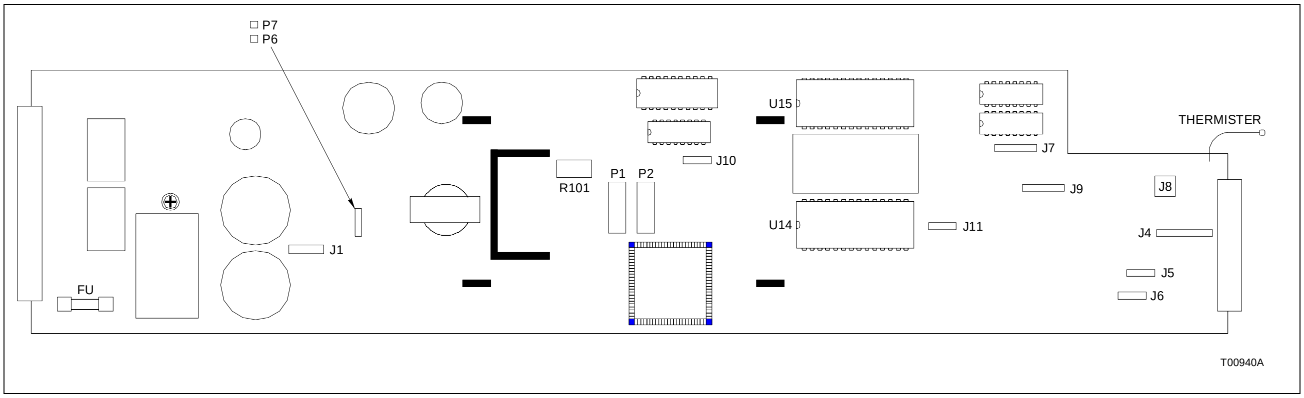


Figure PR8-2. Main Board

PROCEDURE PR9 - SPACER BAR INSTALLATION

PURPOSE/SCOPE

1 min.

This procedure explains how to install the spacer bar.

Parts

Number	Qty	Description
6638364?2	1	Spacer bar
6640633?1	1	Spacer plate
NDRAC09004	2	Screw, machine

Tools

- Bladed screwdriver.
- Antistatic kit.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Install the spacer bar as shown in Figure PR9-1. Make sure the flats on the spacer bar are oriented as shown in the figure.

☐ 2. Install the two screws and tighten.

☐ 3. Snap on the spacer plate.

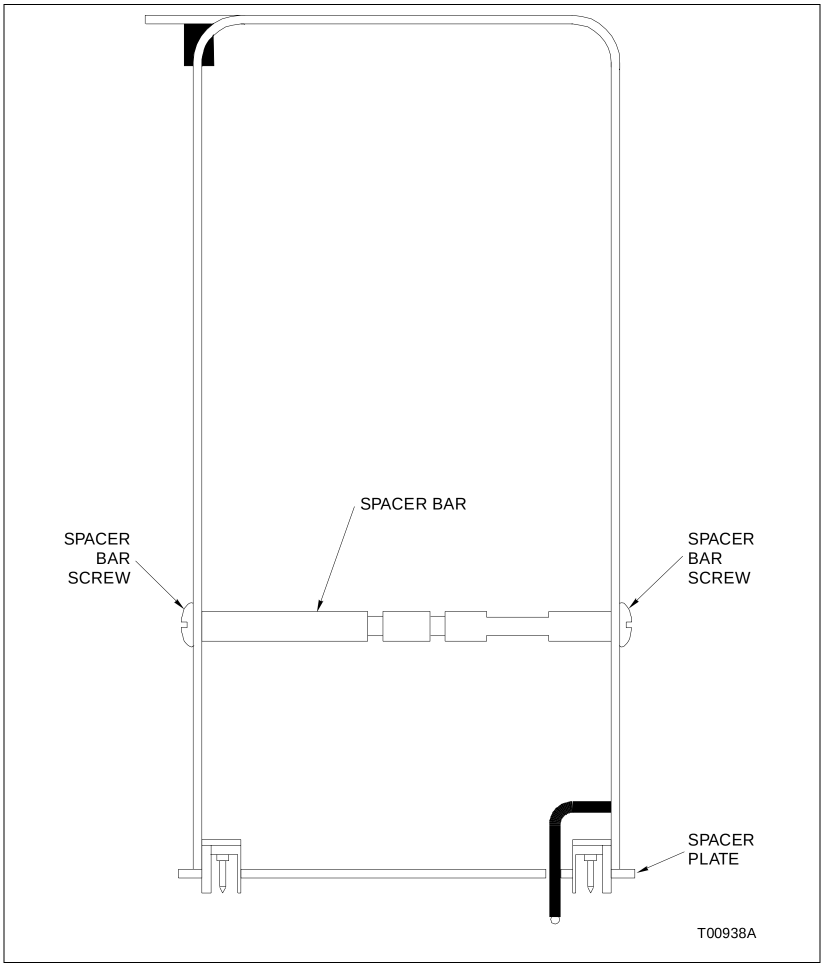


Figure PR9-1. Spacer Bar Installation

PROCEDURE PR10 - FRONT PANEL/CIRCUIT BOARD ASSEMBLY INSTALLATION

PURPOSE/SCOPE

1 min.

This procedure explains how to install the front panel/circuit board assembly.

Parts None.

Tools
- Bladed screwdriver.
- Antistatic kit.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Insert the front panel/circuit board assembly into the housing, making sure to guide the thermister (Fig. PR10-1) through the hole in the back of the housing.

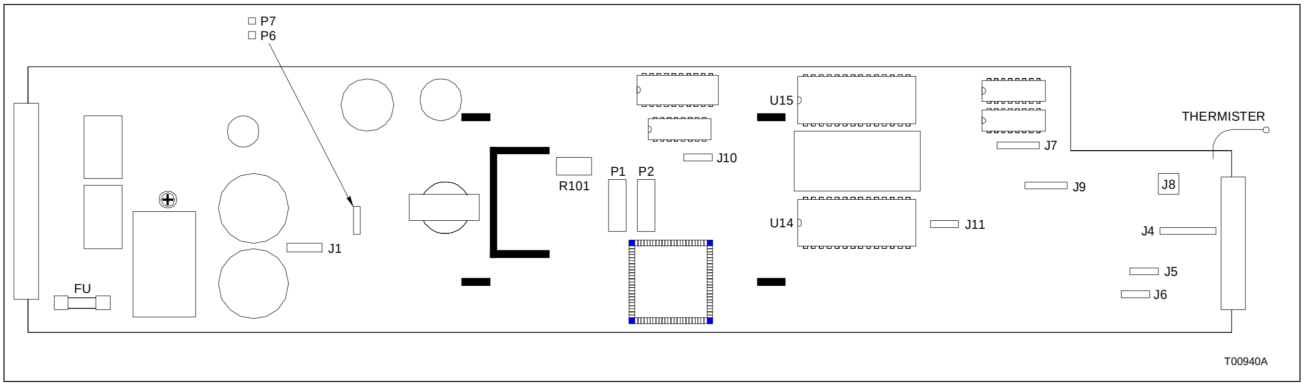


Figure PR10-1. Main Board

☐ 2. Secure the assembly by engaging the two bezel clips on the housing.

☐ 3. If this procedure is part of a repair or adjustment operation, and the analyzer is ready to be put back on line, apply power at this time. If this procedure is part of an installation operation, do not apply power at this time.

PROCEDURE PR11 - PANEL MOUNTING

PURPOSE/SCOPE

20 min.

This procedure explains how to panel mount the analyzer using kit number 4TB9515-0015.

Parts

Number	Qty	Description
1951738?1	1	Front plate gasket
1951767?1	1	Panel gasket
6638659?1	2	Mounting bracket assembly
6640182?1	1	Mounting collar

Tools

- Bladed screwdriver.
- Tools for making panel cutout (dependent on installation).
- Standard petroleum jelly or similar lubricant.
- Torque screwdriver with a setting of 0.4 Newton meters (3.5 inch-pounds).

SAFETY CONSIDERATIONS

CAUTION	**1. Do not over tighten screws. Doing so will cause the gasket to seat incorrectly and a watertight seal will not be obtained.**

PROCEDURE

☐ 1. Refer to Figure PR11-1 for the minimum panel depth and maximum panel cutout dimensions. ***These dimensions are critical***.

☐ 2. Use suitable tools (dependent on installation) to make the panel cutout.

☐ 3. Use the bladed screwdriver to remove the four screws and nylon washers that secure the rear cover to the analyzer and remove the rear cover.

☐ 4. Apply a small amount of standard petroleum jelly or similar lubricant on the panel and front plate gaskets.

☐ 5. Install the front plate gasket over the housing.

☐ 6. Slide the analyzer through the panel cutout.

☐ 7. Install the panel gasket over the rear of the housing.

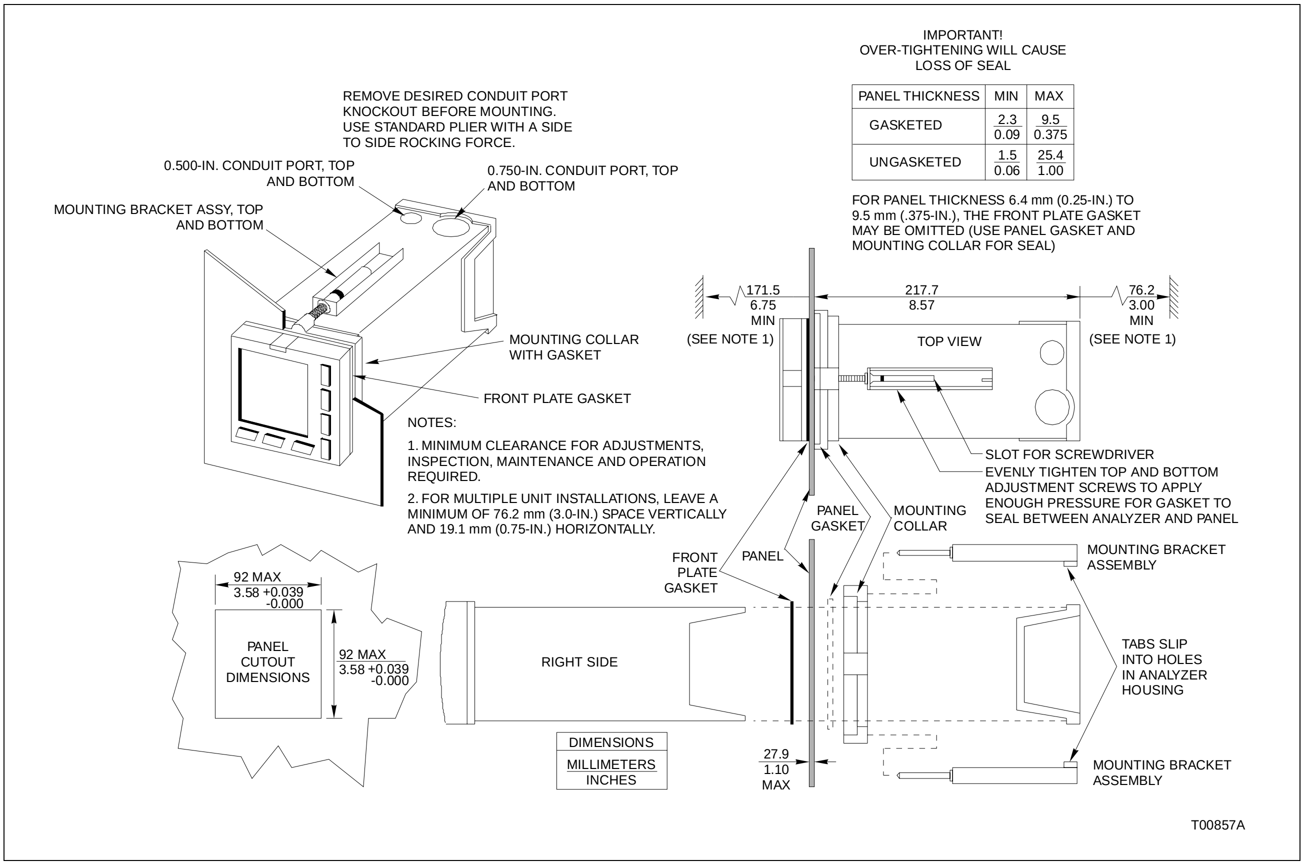


Figure PR11-1. Panel Mounting

☐ 8. Install the mounting collar over the rear of the housing, making sure that the holes in the mounting collar are directly in line with the screw bracket tab slots in the housing.

☐ 9. Slide the panel gasket and mounting collar down the case until they are completely flush against the panel.

☐ 10. Support the weight of the housing and install the two mounting bracket assemblies.

☐ C1 11. Use the bladed screwdriver to turn each bracket screw only enough to snugly seat the gaskets.

NOTE: Carefully center the housing in the panel prior to tightening the bracket screws.

☐ 12. Back off each bracket screw until it begins to turn freely.

☐ 13. If a torque screwdriver is available, perform this step and stop; if not, go to Step 14. Tighten each bracket screw using the torque screwdriver set at 0.4 Nm (3.5 in.-lbs).

☐ 14. Back off each bracket screw until it begins to turn freely.

☐ 15. Tighten each bracket screw until feeling the first sign of resistance or clamp load.

☐ 16. Tighten each bracket screw one complete turn to obtain an approximate torque of 0.34 to 0.45 Nm (3.0 to 4.0 in.-lbs).

PROCEDURE PR12 - WALL MOUNTING

PURPOSE/SCOPE

20 min.

This procedure explains how to wall mount the analyzer using kit number 4TB9515-0013.

Parts

Number	Qty	Description
4TB4704-0086	2	Bolt, hex, ⅜-16 x 0.750
4TB4704-0089	2	Bolt, hex, ¼-20 x 0.750
4TB4710-0018	2	Washer, split, ¼ in.
4TB4710-0022	2	Lock washer, stainless steel, split,⅜ in.
4TB4711-0006	2	Nut, hex, ¼-20
4TB4711-0020	2	Nut, hex, ⅜-16
4TB5008-0059	1	Wall bracket
4TB5008-0060	1	Pivot bracket
4TB5205-0236	1	Clamp bracket assembly
—	4	Mounting bolt, ⅜-in., customer-supplied

Tools

- Drill and drill bit for drilling holes to accept ⅜-inch mounting bolts (customer-supplied).
- Bladed screwdriver.
- Open-end wrench (or equivalent).

PROCEDURE

☐ 1. Position the wall bracket on the wall and mark the locations of the four mounting holes (Fig. PR12-1).

☐ 2. Drill the four mounting holes.

☐ 3. Install the wall bracket using the four customer-supplied mounting bolts (Fig. PR12-1).

☐ 4. Use the bladed screwdriver to remove the four screws and nylon washers that secure the rear cover to the analyzer and remove the rear cover in preparation for wiring procedures.

☐ 5. Position the pivot bracket on the left side of the housing.

☐ 6. Position the clamp bracket assembly on the right side of the housing.

☐ 7. Position the pivot bracket and clamp bracket assembly on the analyzer so that when assembled to the wall bracket there will be ample clearance between the wall and the rear of the housing.

☐ 8. Align the bolt holes in the pivot bracket and the clamp bracket assembly.

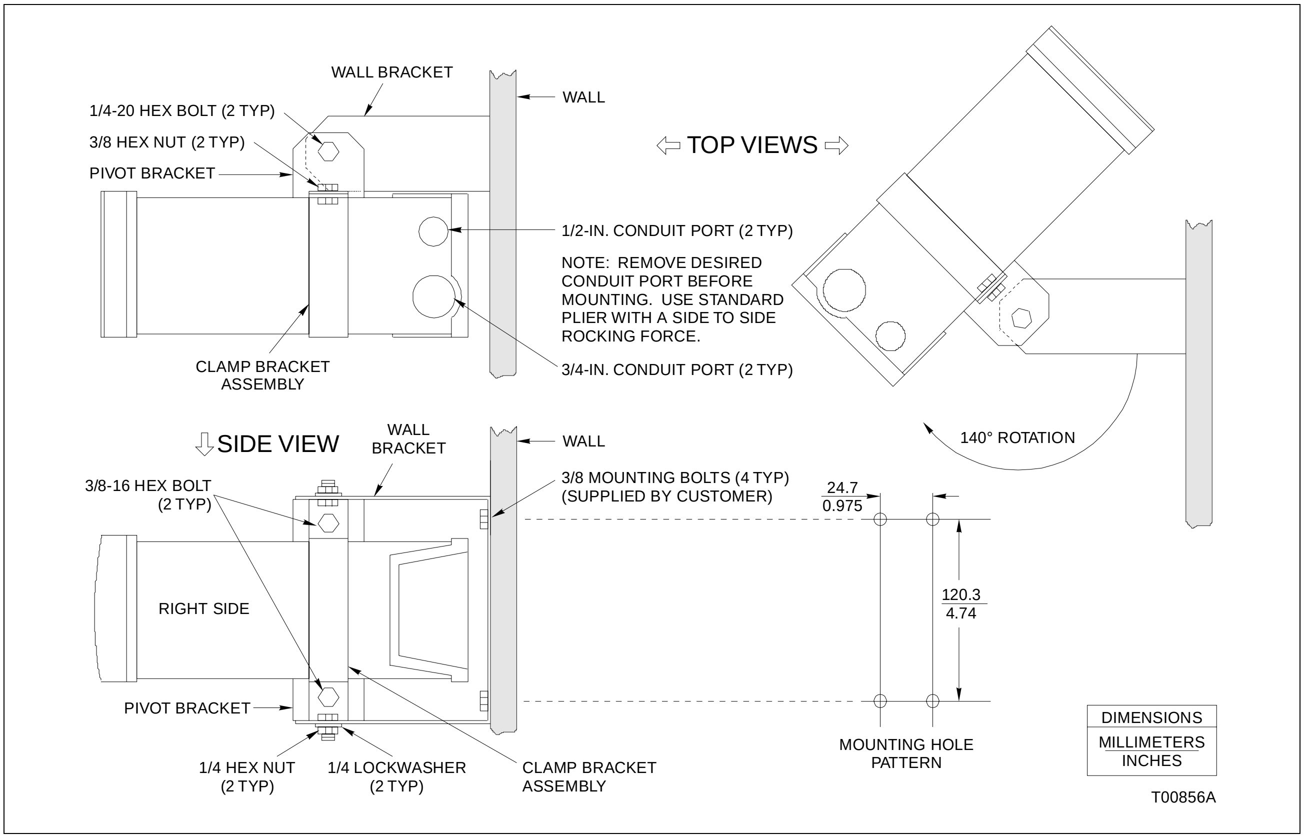


Figure PR12-1. Wall Mounting

- ☐ 9. Install the two ⅜-16 x 0.750 hex bolts through the clamp bracket assembly and into the pivot bracket.

- ☐ 10. Install the ⅜-16 hex nuts and tighten them with the open-end wrench (or equivalent).

- ☐ 11. Lift the analyzer into position and install the two ¼-20 hex bolts through the pivot bracket and into the wall bracket.

- ☐ 12. Position the analyzer to the desired angle and install the lock washers and ¼-20 hex nuts to lock the analyzer into place.

PROCEDURE PR13 - PIPE MOUNTING

PURPOSE/SCOPE

20 min.

This procedure explains how to mount the analyzer to a horizontal or vertical pipe using kit number 4TB9515-0012.

Parts

Number	Qty	Description
4TB4704-0086	2	Bolt, hex, 3/8-16 x 0.750
4TB4704-0096	2	U-Bolt, 5/16 x 2.500
4TB4710-0022	2	Lock washer, stainless steel split, 3/8 in.
4TB4710-0023	4	Lock washer, stainless steel, split, 5/16 in.
4TB4710-0025	4	Lock washer, stainless steel, flat, 5/16 in.
4TB4711-0013	4	Nut, stainless steel, hex,5/16 -18
4TB4711-0020	2	Nut, stainless steel, hex, 3/8-16
4TB5008-0022	1	Pipe mount bracket
4TB5205-0236	1	Clamp bracket assembly

Tools

- Bladed screwdriver.
- Two open-end wrenches (or equivalent).

PROCEDURE

☐ 1. Use the bladed screwdriver to remove the four screws and nylon washers that secure the rear cover to the analyzer and remove the rear cover in preparation for wiring procedures.

☐ 2. Position the clamp bracket assembly on the analyzer.

☐ 3. Align the holes in the clamp bracket assembly with the holes in the pipe mount bracket.

☐ 4. Install the two hex bolts, from the back side, on the pipe mount bracket.

☐ 5. Install one each 3/8-in. split lock washer and 3/8-16 hex nut (in that order) on the end of each hex bolt.

☐ 6. Use one open-end wrench (or equivalent) to hold a hex bolt in place while using the other open-end wrench (or equivalent) to tighten the associated hex nut. Repeat with the other pair.

☐ 7. Place the pipe mount bracket in position on the horizontal or vertical pipe (Fig. PR13-1).

☐ 8. Install the two U-bolts around the pipe and through the holes in the pipe mount bracket.

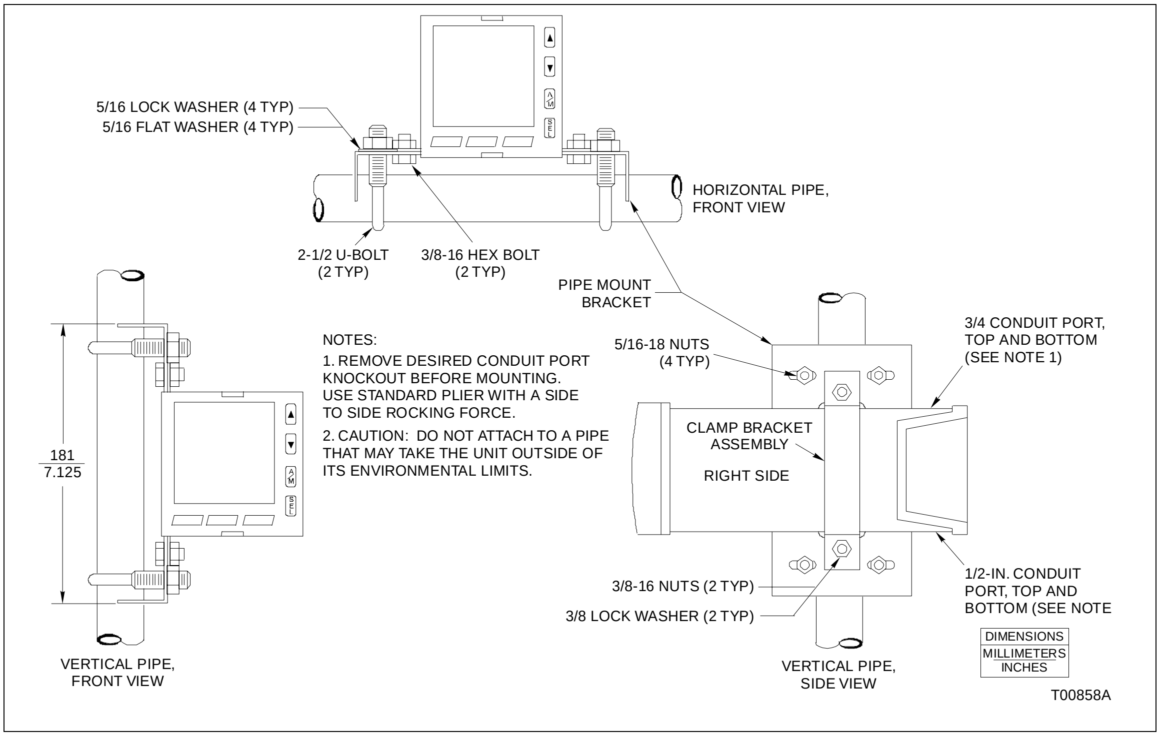


Figure PR13-1. Pipe Mounting

☐ 9. Install one each flat lock washer, $^5\!/_{16}$-in. split lock washer and $^5\!/_{16}$-18 hex nut (in that order) on each end of the U-bolts.

☐ 10. Tighten the hex nuts using the open-end wrench or equivalent.

PROCEDURE PR14 - AC POWER WIRING

PURPOSE/SCOPE

20 min.

This procedure explains how to connect the AC power wiring to the analyzer.

Parts None.

Tools

- Bladed screwdriver.
- Wire strippers.

SAFETY CONSIDERATIONS

WARNING

1. Disconnect the AC line cord or power lines from the operating branch circuit coming from the source before attempting electrical connections. Instruments powered by AC line voltage constitute a potential for personnel injury due to electric shock.

2. Keep the enclosure and covers in place after completing the wiring procedures and during normal operation. Do not disconnect or connect wiring or remove or insert printed circuit boards unless power has been removed and the flammable atmosphere is known NOT to be present. These procedures are not considered normal operation. The enclosure prevents operator access to energized components and to those that can cause ignition capable arcs. Failure to follow this warning can lead to unsafe conditions that can injure personnel and damage equipment.

PROCEDURE

The analyzer comes with the power option jumper (J1 on the main board) set for 120 VAC or 240 VAC (nominal), depending on the nomenclature ordered.

Use either a standard three-prong grounded flexible CSA certified line cord for power supply connection or hard wire the AC supply.

If hard wiring the AC power supply, use stranded, copper conductor 14-AWG wire. The wire must bear a suitable voltage rating for the highest voltage present (either signal or power), with a 75°C (167°F) minimum rating. Wiring must be in accordance with the National Electric Code (NEC), Canadian Electrical Code (CEC) and any other local or international wiring codes.

NOTES:

1. TBI-Bailey Controls recommends installing a power line switch for safety purposes and for providing power up and power down convenience when servicing the analyzer.

2. Do not power the system from a transformer that also powers large motor loads (over five horsepower) or any other type of equipment that generates line voltage surges, sags and excessive noise.

There are spring-clamp type, lugless connectors at the rear of the housing for making wiring connections.

W1

1. Strip the wire insulation back approximately seven millimeters (0.25 inches) to assure that there is enough bare wire for the jaws of the connector to contact, but not too much as to leave exposed wire beyond the connector.

2. Refer to Figure PR14-1 and connect the specified line voltage (120 VAC or 240 VAC, 50 or 60 Hz) to terminal TB1-10 (L), neutral to terminal TB1-11 (N/L2) and the ground wire to terminal TB1-12 (⏚).

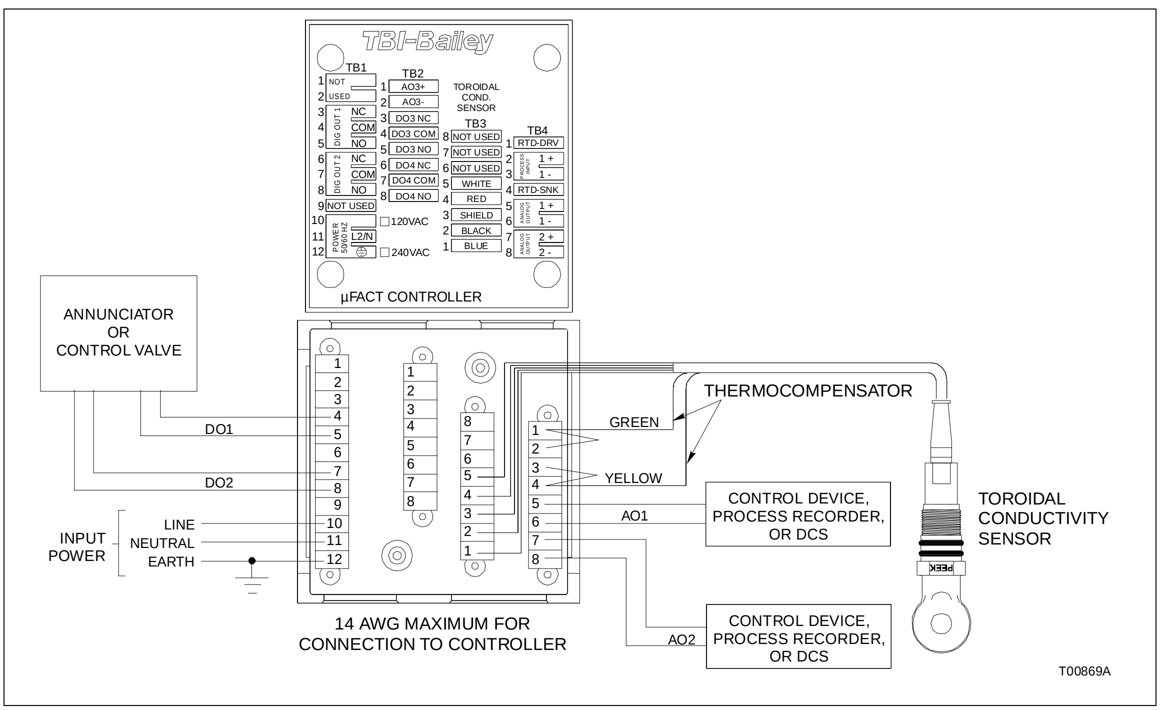


Figure PR14-1. Wiring Connections

a. Insert a bladed screwdriver into the connector and push away from the terminal. This opens the jaws of the connector for the stripped wire (Fig. PR14-2).

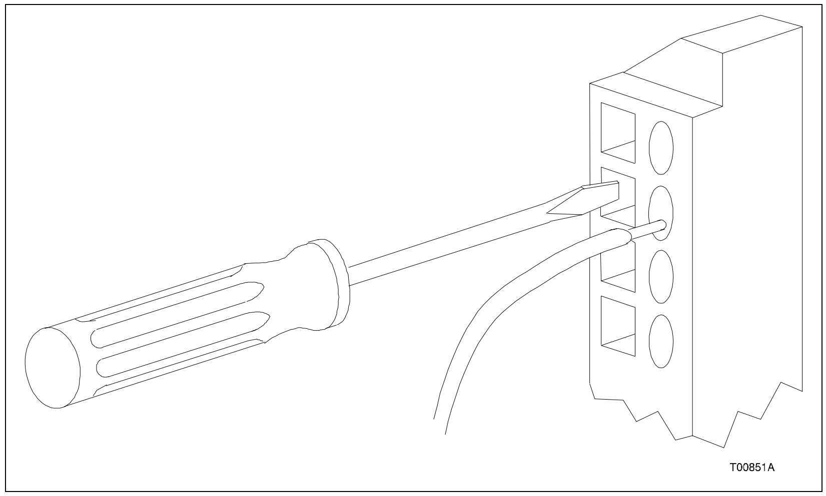


Figure PR14-2. Wire Installation

b. After the wire is in place, remove the screwdriver.

☐ W2 3. If all wiring procedures are complete, install the rear cover and use the bladed screwdriver to install the four screws and nylon washers that secure the cover to the housing.

PURPOSE/SCOPE

20 min.

This procedure explains how to connect the toroidal conductivity sensor wiring to the analyzer.

Parts None.

Tools
- Bladed screwdriver.
- Wire strippers.

PROCEDURE

The sensor cable harness has seven leads that must be connected to the rear of the analyzer. These sensor leads attach to the terminal blocks on the rear of the analyzer as shown in Figure PR15-1.

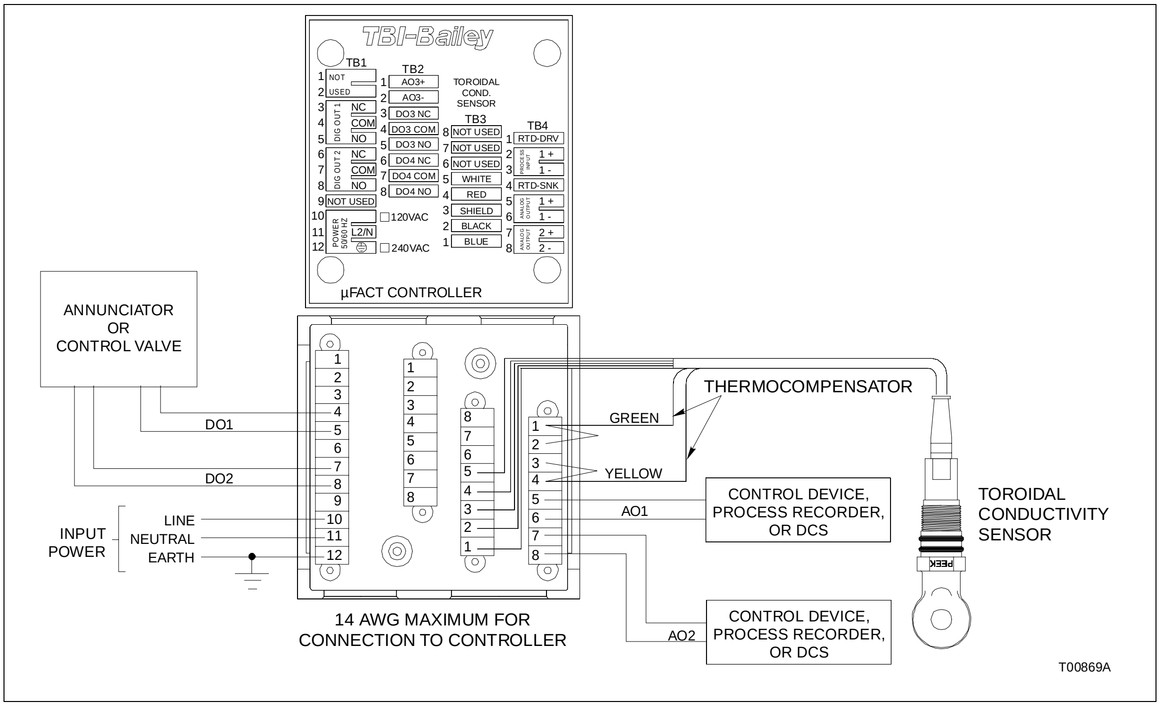


Figure PR15-1. Wiring Connections

The sensor leads are color coded and have the following relationships:

Color	Function
Black	Drive
Blue	Drive
Red	Sense
White	Sense
Green	Temperature compensator (TC)
Yellow	Temperature compensator (TC)
Heavy green	Ground

There are spring-clamp type, lugless connectors at the rear of the housing for making wiring connections.

☐ 1. Strip the wire insulation back approximately seven millimeters (0.25 inches) to assure that there is enough bare wire for the jaws of the connector to contact, but not too much as to leave exposed wire beyond the connector.

☐ 2. Connect the sensor wires to their proper terminal block positions.

a. Insert a bladed screwdriver into the connector and push away from the terminal. This opens the jaws of the connector for the stripped wire (Fig. PR15-2).

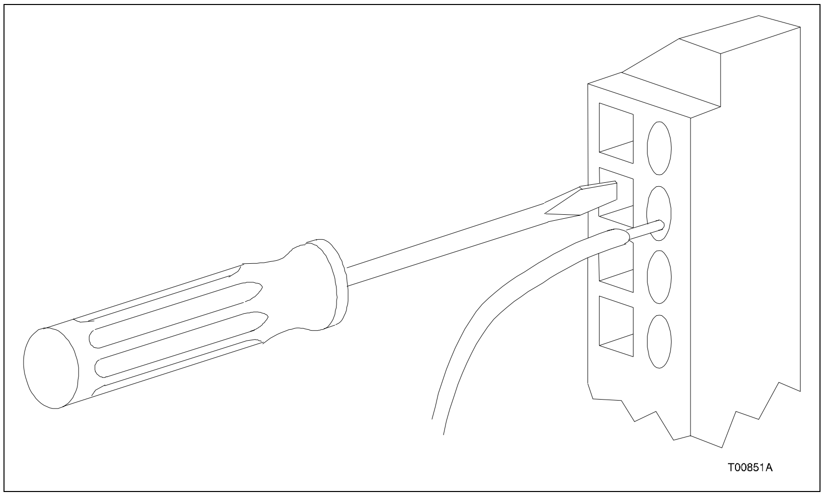


Figure PR15-2. Wire Installation

b. After the wire is in place, remove the screwdriver.

☐ 3. Connect jumper wires between TB4-1 and TB4-2, and TB4-3 and TB4-4. Use 20 to 26 AWG wire and solder them directly to the two temperature compensator leads as shown in Figure PR15-3.

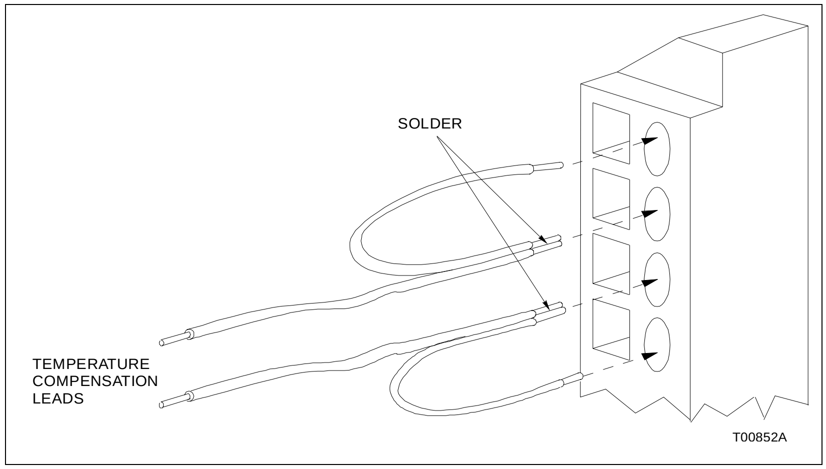


Figure PR15-3. Temperature Compensator Wiring

NOTE: Soldering the jumper wires to the temperature compensator leads is strongly recommended. Errors in temperature measurement and compensation may intermittently occur of poor wire connections exist.

☐ 4. If all wiring procedures are complete, install the rear cover and use the bladed screwdriver to install the four screws and nylon washers that secure the cover to the housing.

PROCEDURE PR16 - ANALOG OUTPUT WIRING

PURPOSE/SCOPE

20 min.

This procedure discusses analog output wiring.

Parts None.

Tools
- Bladed screwdriver.
- Wire strippers.

PROCEDURE

Wiring used for analog outputs must be carefully chosen, with consideration for environmental and electrical conditions.

Shielded (overall or individually) twisted-pair wires for low level signal conduction are recommended to reduce the effects of electromagnetic and electrostatic noise. An aluminum-mylar type with a drain wire has a very good electrostatic couple shield efficiency. All shields must be electrically insulated from other shields. Shields are to be grounded at the same earth ground potential as the AC power wiring of the analyzer. The field end of the shield should not be connected to ground.

Conduit is recommended for the field portion of the run. Wherever practical, it is recommended that trays containing analog signals be devoted exclusively to that use. Conduit containing analog signals should cross power lines, etc., at right angles and remain perpendicular for at least ten times the diameter of the crossed element on either side of the crossing joints.

The maximum wire size for the connectors on the rear of the housing is 14 AWG. The minimum is 26 AWG. The wire must bear a suitable voltage rating for the highest voltage present (either signal or power), with a 75°C (167°F) minimum rating. Wiring must be in accordance with the National Electric Code (NEC), Canadian Electrical Code (CEC) and any other local or international wiring codes.

There are spring-clamp type, lugless connectors at the rear of the housing for making wiring connections.

☐ 1. Strip the wire insulation back approximately seven millimeters (0.25 inches) to assure that there is enough bare wire for the jaws of the connector to contact, but not too much as to leave exposed wire beyond the connector.

☐ 2. Connect the analog output wires to their proper terminal block positions (Fig. PR16-1).

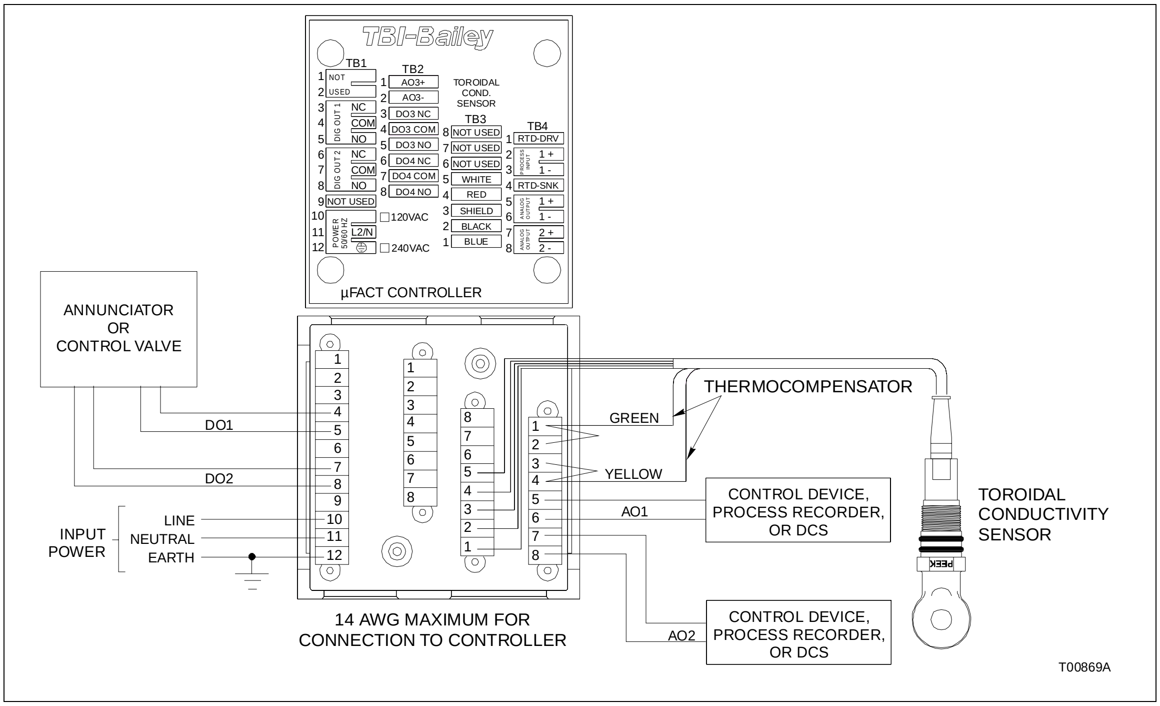


Figure PR16-1. Wiring Connections

a. Insert a bladed screwdriver into the connector and push away from the terminal. This opens the jaws of the connector for the stripped wire (Fig. PR16-2).

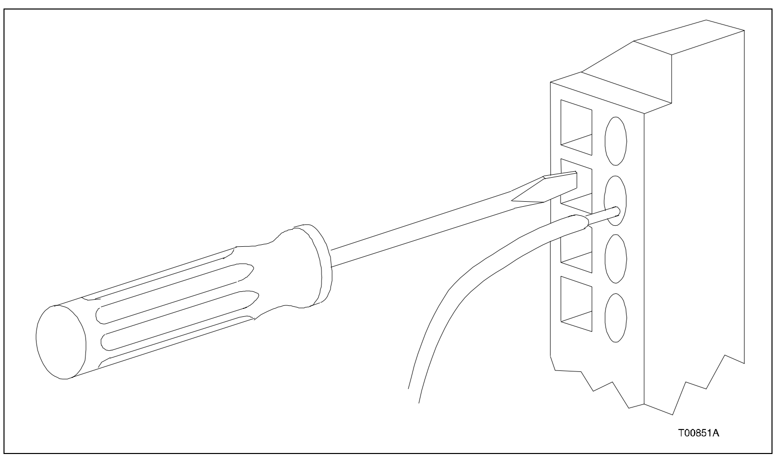


Figure PR16-2. Wire Installation

b. After the wire is in place, remove the screwdriver.

☐ 3. If all wiring procedures are complete, install the rear cover and use the bladed screwdriver to install the four screws and nylon washers that secure the cover to the housing.

PROCEDURE PR17 - DIGITAL OUTPUT WIRING

PURPOSE/SCOPE

20 min.

This procedure discusses digital output wiring.

Parts None.

Tools

- Bladed screwdriver.
- Wire strippers.

PROCEDURE

Digital output wires should be twisted-pair, stranded wires insulated with low leakage insulation materials. Individually shielded pairs provide greater protection against noise and crosstalk than consolidated shielded pairs. Ground the shields at the same earth ground potential as the AC power wiring of the analyzer. The field end of the shield should not be connected to a ground.

Digital output wiring must be separate from the low level analog input and output wiring. Use conduit for the cable run.

The maximum wire size for the connectors on the rear of the housing is 14 AWG. The minimum is 26 AWG. The wire must bear a suitable voltage rating for the highest voltage present (either signal or power), with a 75°C (167°F) minimum rating. Wiring must be in accordance with the National Electric Code (NEC), Canadian Electrical Code (CEC) and any other local or international wiring codes.

There are spring-clamp type, lugless connectors at the rear of the housing for making wiring connections.

☐ 1. Strip the wire insulation back approximately seven millimeters (0.25 inches) to assure that there is enough bare wire for the jaws of the connector to contact, but not too much as to leave exposed wire beyond the connector.

☐ 2. Connect the digital output wires to their proper terminal block positions (Fig. PR17-1).

   a. Insert a bladed screwdriver into the connector and push away from the terminal. This opens the jaws of the connector for the stripped wire (Fig. PR17-2).

   b. After the wire is in place, remove the screwdriver.

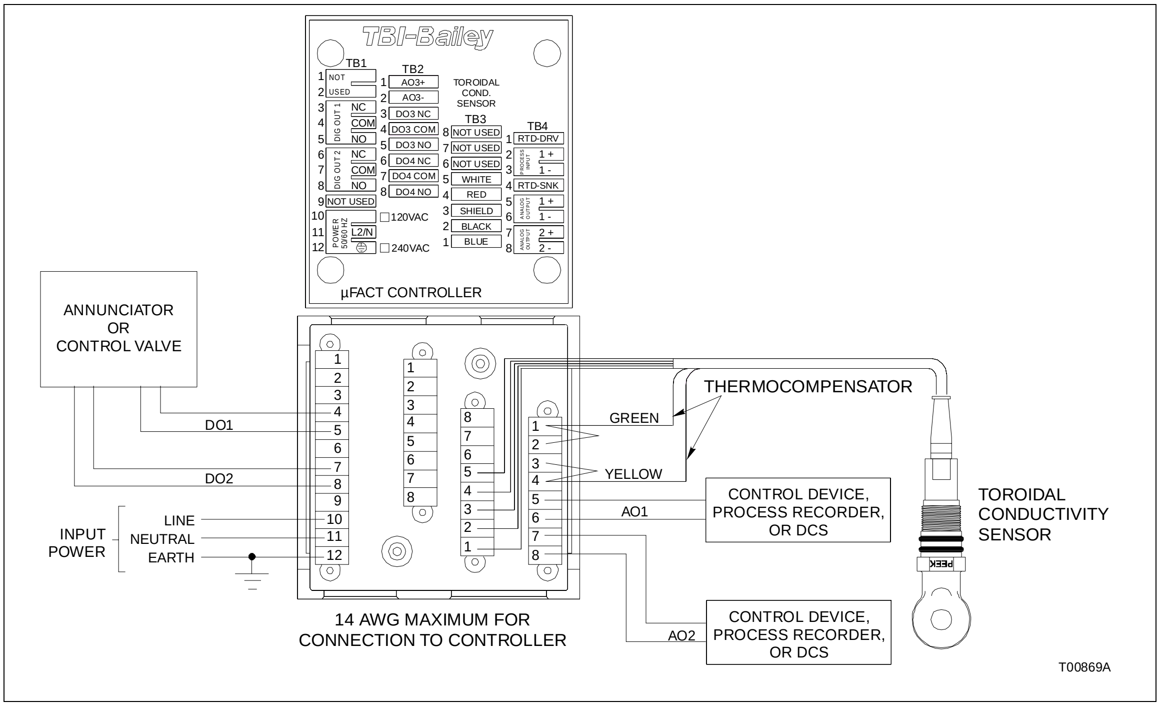


Figure PR17-1. Wiring Connections

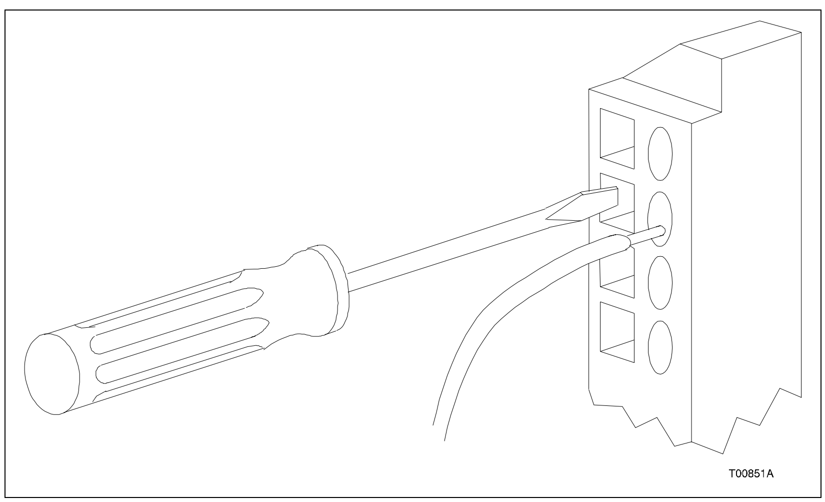


Figure PR17-2. Wire Installation

☐ 3. If all wiring procedures are complete, install the rear cover and use the bladed screwdriver to install the four screws and nylon washers that secure the cover to the housing.

PROCEDURE PR18 - GROUNDING

PURPOSE/SCOPE

20 min.

This procedure explains how to properly ground the analyzer and the sensor.

Parts None.

Tools
- Bladed screwdriver.
- Wire strippers.

PROCEDURE

The customer and wiring contractors are responsible for ensuring that the analyzer, other associated control or test equipment and all exposed conductive materials are properly grounded. Grounding procedures should be in accordance with local, National Electrical Code (NEC) or Canadian Electrical Code (CEC) regulations. These procedures and their outcome shall not be a hazard, including under fault conditions to operation and service personnel.

The maximum wire size for the connectors on the rear of the housing is 14 AWG. The minimum is 26 AWG. The wire must bear a suitable voltage rating for the highest voltage present (either signal or power), with a 75°C (167°F) minimum rating.

AC Safety Ground

There are spring-clamp type, lugless connectors at the rear of the housing for making wiring connections.

☐ 1. Strip the wire insulation back approximately seven millimeters (0.25 inches) to assure that there is enough bare wire for the jaws of the connector to contact, but not too much as to leave exposed wire beyond the connector.

☐ 2. Connect the grounding conductor to TB1-12 (Fig. PR18-1) and the ground lug found on the rear cover support.

   a. Insert a bladed screwdriver into the connector and push away from the terminal. This opens the jaws of the connector for the stripped wire (Fig. PR18-2).

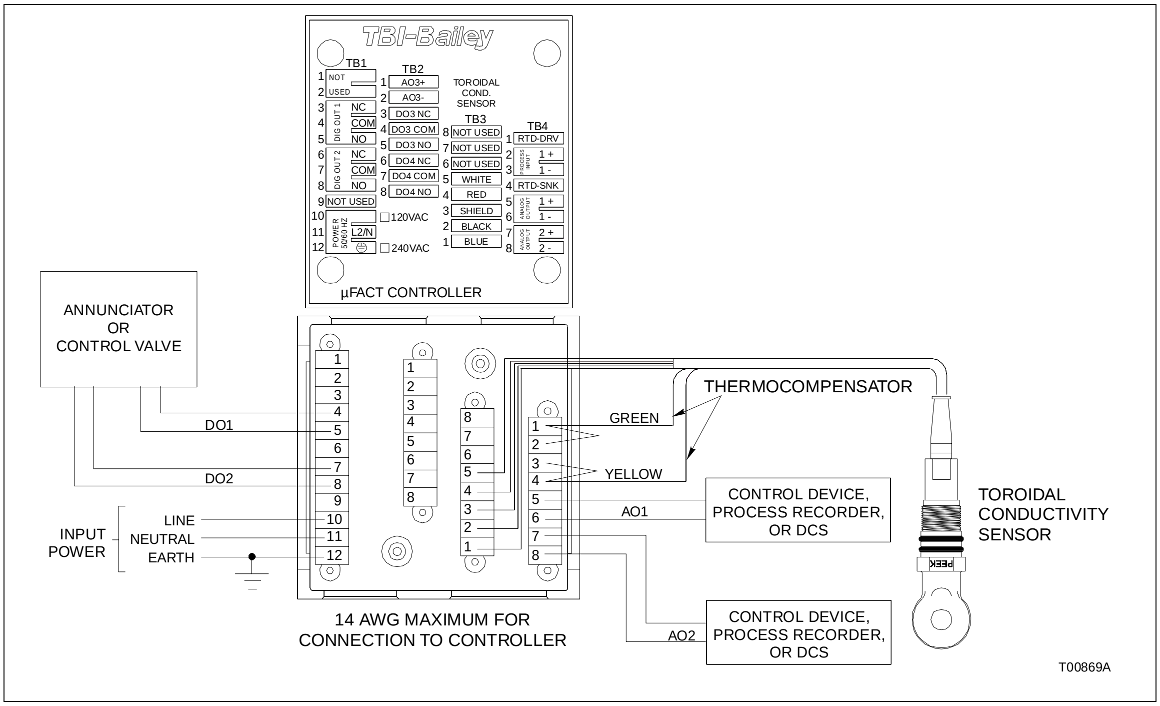


Figure PR18-1. Wiring Connections

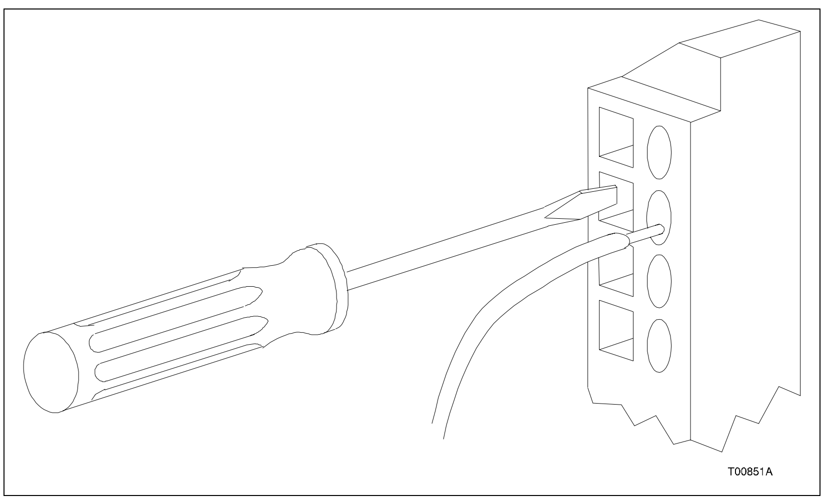


Figure PR18-2. Wire Installation

b. After the wire is in place, remove the screwdriver.

NOTES:
1. Because of prevailing differences in soil conditions throughout the world and differences in acceptable practices, it is not within the scope of this instruction to describe grounding electrode systems. It is the responsibility of the customer to ensure that a grounding electrode system that is acceptable to the local building and wiring codes exists at the facility where the Type TB703 analyzer is to be installed.

2. The NEC, Article 250, Section H, details requirements for grounding electrode systems acceptable in the United States. The CEC, Section 10, paragraphs 700 through 712, details the requirements for grounding electrode systems acceptable in Canada.

☐ 3. If all wiring procedures are complete, install the rear cover and use the bladed screwdriver to install the four screws and nylon washers that secure the cover to the housing.

Sensor Grounding

When using the Type TB703 analyzer and the Type TB404 Toroidal Conductivity Sensor, shielding is provided by the heavy green lead coming from the sensor. This lead should have already been connected to TB3-3 during the sensor wiring procedure.

NOTE: This conductor is driven by the toroidal conductivity board and must not be in electrical contact with any other conductor or earth ground.

PROCEDURE PR19 - DISPLAY CONTRAST ADJUSTMENT

PURPOSE/SCOPE

10 min.

This procedure explains how to adjust the display contrast. This procedure should be completed after the analyzer is mounted in its final position and is only necessary if the display is difficult to read.

Parts None.

Tools Bladed screwdriver.

PROCEDURE

The analyzer comes with the display contrast preset. Because of variances in lighting at the installation site, after the analyzer has been installed, wired and powered up, check the display and adjust if necessary.

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Refer to Figure PR19-1 and locate R101 on the main board.

NOTE: Figure PR19-1 shows the main board as it would appear flat. It is secured in a U-shape. Use the components in the figure to help locate R101.

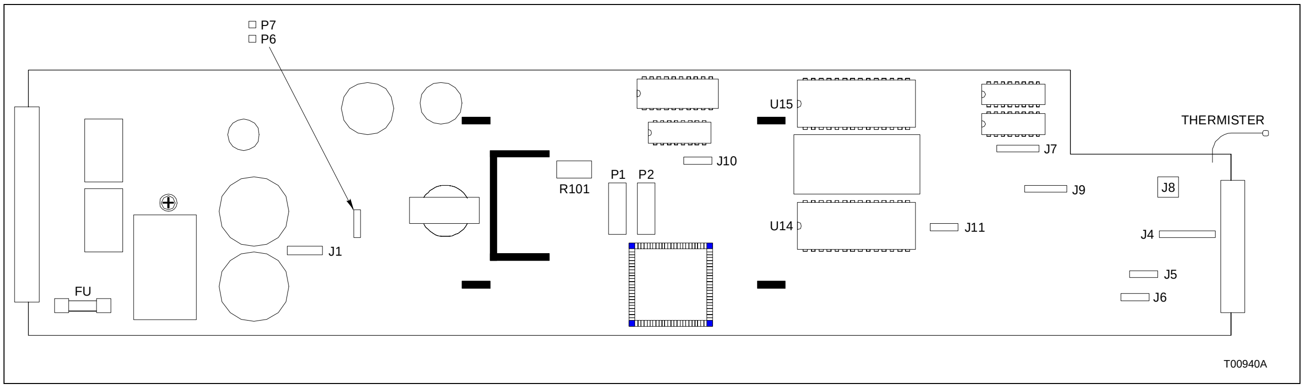


Figure PR19-1. Main Board

☐ 2. If the display is too dark, turn R101 clockwise one eighth of a turn or less. If the display is too light, turn R101 counter-clockwise one eighth of a turn or less.

PROCEDURE PR20 - INITIALIZATION

PURPOSE/SCOPE

1 min.

This procedure explains how to initialize the analyzer after completing all physical installation and wiring procedures.

Parts None.

Tools None.

PROCEDURE

☐ 1. Power up the analyzer to begin the initialization procedure. The initialization procedure takes approximately two seconds to complete.

☐ 2. During this time period, internal diagnostics are performed. The display shows:

TBI-BAILEY CONTROLS
Rev.: ___
Running
Diagnostics

☐ 3. After successfully completing the internal diagnostics, the display shows:

TBI-BAILEY CONTROLS
Rev.: ___
Diagnostics
Complete
Please Wait

☐ 4. If a configuration does not exist, the display goes to the main menu. If the configuration does exist, the display goes to the process display.

PROCEDURE PR21 - NVRAM INITIALIZATION

PURPOSE/SCOPE

1 min.

This procedure explains how to initialize (erase) the NVRAM. This procedure does not apply to first-time installations. It is used to erase existing configurations when necessary.

Parts None.

Tools None.

PROCEDURE

The configuration of the Type TB703 analyzer is stored in nonvolatile random access memory (NVRAM). This type of memory is used because it can be written to electrically, but retains data in the event of a power failure.

☐ 1. Remove the power to the analyzer.

☐ 2. Hold the lower left multifunction soft key and apply power to the analyzer. This screen appears:

TBI-BAILEY CONTROLS

Rev.: ___

Running

Diagnostics

☐ 3. If diagnostics pass, this screen appears:

TBI-BAILEY CONTROLS

Rev.: ___

Diagnostics

Complete

Please Wait

☐ 4. Continue to hold the lower left multifunction soft key until the Main Menu appears. Once the main menu appears, the NVRAM is erased.

PROCEDURE PR22 - RANGE CONFIGURATION

PURPOSE/SCOPE

2 min.

This procedure explains how to configure the analyzer range.

Parts None.

Tools None.

Prerequisites Configuration worksheet.

PROCEDURE

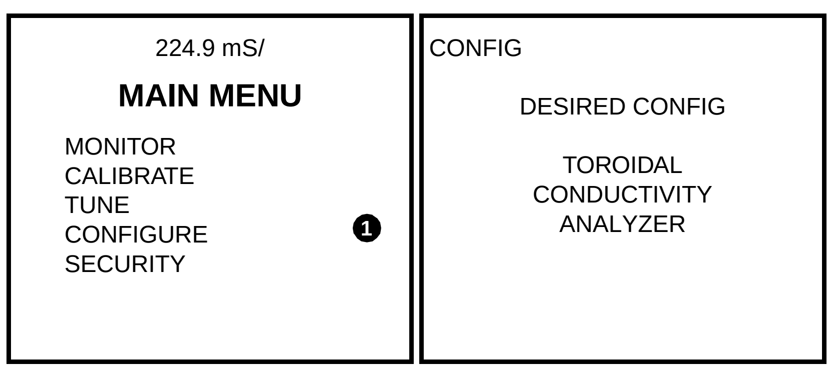
NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

This procedure assumes no configuration is present and it begins from the main menu.

Selecting the measurement range is a configuration menu function. The nomenclature designates the range jumper position of the as-shipped analyzer. The following lists the allowable measurement ranges.

Range	Sensor Cell Constant Group A
High	0 to 100.00 mS/cm
	0 to 1,000.0 mS/cm with overrange
Medium	0 to 10.000 mS/cm
	0 to 100.00 mS/cm with overrange

☐ 1. Press ▲ or ▼ until *CONFIGURE* is selected.



☐ 2. Press SEL and the desired configuration screen appears.

☐ 3. Press **SEL** again and the configuration range screen appears.

```
CONFIG                 RANGE

SENSOR GROUP   A
RANGE JUMPER   MEDIUM   ❹

MEASUREMENT RANGE
0-100.00 mS/           UPPER
0-10.000 mS/           LOWER

CHECK JUMPER J1 ON
CONDUCTIVITY BOARD
```

☐ 4. Press ▲ or ▼ until the desired range appears.

NOTE: Range jumper J1 on the toroidal conductivity board should have been physically checked during installation according to PR7. The jumper position must match the configuration choice.

☐ 5. Press one of the three soft keys to display the soft key menu.

☐ 6. Press the soft key below *NEXT SCRN* to proceed.

PROCEDURE PR23 - ANALYZER PARAMETERS CONFIGURATION

PURPOSE/SCOPE

5 min.

This procedure explains how to configure the analyzer parameters. This includes setting the temperature display units, temperature compensation mode, process temperature (if manual temperature compensation is selected), damping types and damping times.

Parts None.

Tools None.

Prerequisites Configuration worksheet.

PROCEDURE

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. The configuration menu is displayed. Press ▲ or ▼ until *ANALYZER* is selected.

```
CONFIG                 MENU

ANALYZER                 1
ANALOG OUTPUTS
DIGITAL OUTPUTS
BAR GRAPH
ALARMS
SAVE AND EXIT
EXIT
```

☐ 2. Press **SEL**. The analyzer configuration menu appears.

```
CONFIG                 ANLZR

      TEMPERATURE
      DISPLAY UNITS
           °C              3

      TEMP. COMP.
        MANUAL             5

      PROCESS TEMP.
          25.0             7
```

☐ 3. Press ▲ or ▼ to select the desired temperature display units (*°C or °F*).

☐ 4. Press SEL.

☐ 5. Press ▲ or ▼ to select the desired temperature compensation mode.

☐ 6. Press SEL.

☐ 7. If *MANUAL* was chosen for the temperature compensation type, press ▲ or ▼ to select the desired process temperature.

NOTE: If *MANUAL* was selected, wire jumpers should not be across TB4-1/TB4-2 and TB4-3/TB4-4.

☐ 8. Press one of the three soft keys to display the soft key menu.

☐ 9. Press the soft key below *NEXT SCRN*. The second page of the analyzer configuration menu appears.

CONFIG	ANLZR
DESIRED DAMPING NONE	10
INPUT DAMP TIME 0 SEC	12
RECORDER DAMP TIME 0 SEC	14

☐ 10. Press ▲ or ▼ to select the desired damping. If *NONE* is selected, go to Step 16. If damping is required, go to Step 11.

NOTE: If *NONE* is selected, the automatic default of 1.5 seconds is applied.

☐ 11. Press SEL. *INPUT DAMP TIME* and *RECORDER DAMP TIME* appear.

☐ 12. Use ▲ to set *INPUT DAMP TIME.*

☐ 13. Press SEL.

NOTE: If the *INPUT DAMP TIME* is selected, but the value is left at zero seconds, the default damping time of 1.5 seconds is not applied. A minimum value of 1.0 second is recommended.

☐ 14. Use ▲ to set *RECORDER DAMP TIME.*

☐ 15. Press SEL.

☐ 16. Press one of the three soft keys to display the soft key menu.

☐ 17. Press the soft key below *NEXT SCRN*. The configuration menu appears.

PROCEDURE PR24 - ANALOG OUTPUTS CONFIGURATION

PURPOSE/SCOPE

1 min.

This procedure explains how to configure the analog outputs.

Parts None.

Tools None.

Prerequisites Configuration worksheet.

PROCEDURE

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. The configuration menu is displayed. Press [▲] or [▼] until *ANALOG OUTPUTS* is selected.

```
CONFIG                     MENU


ANALYZER
ANALOG OUTPUTS            1
DIGITAL OUTPUTS
BAR GRAPH
ALARMS
SAVE AND EXIT
EXIT
```

☐ 2. Press [SEL]. The AO1 configuration menu appears.

```
CONFIG                   A. O. 1

SOURCE  CONDUCTIVITY      3
MODE    1-5V/4-20 mA      5

            LIMITS
            mS/cm

LOWER              UPPER
0.000    7         10.00  9
```

☐ 3. To select the value for *SOURCE*, press [▲] or [▼] until the correct selection appears.

☐ 4. Press [SEL].

- ☐ 5. To select the value for *MODE*, press ▲ or ▼ until the correct selection appears.

  NOTE: The main and expansion board analog output jumpers should have been physically checked and set during installation according to PR6 and PR8. The jumper position must match the configuration choice.

- ☐ 6. Press **SEL**.
- ☐ 7. To set the value for *LOWER LIMIT*, press ▲ or ▼ until the correct value appears.
- ☐ 8. Press **SEL**.
- ☐ 9. To set the value for *UPPER LIMIT*, press ▲ or ▼ until the correct value appears.
- ☐ 10. Press one of the three soft keys to display the soft key menu.
- ☐ 11. Press the soft key below *NEXT SCRN* to proceed.
- ☐ 12. Repeat Steps 3 through 11 for AO2 and AO3 (if available). When completed, the display returns to the configuration menu.

PROCEDURE PR25 - DIGITAL OUTPUTS CONFIGURATION

PURPOSE/SCOPE

1 min.

This procedure explains how to configure the digital outputs.

Parts None.

Tools None.

Prerequisites Configuration worksheet.

PROCEDURE

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. The configuration menu is displayed. Press ▲ or ▼ until *DIGITAL OUTPUTS* is selected.

```
CONFIG                 MENU

ANALYZER
ANALOG OUTPUTS
DIGITAL OUTPUTS          1
BAR GRAPH
ALARMS
SAVE AND EXIT
EXIT
```

☐ 2. Press **SEL**. The DO1 configuration menu appears.

```
CONFIG              D. O. 1

SOURCE   CONDUCTIVITY     3
MODE     HI SETPOINT      5

TURN ON       10.000 mS/  7

DEADBAND      0.3 mS/     9

TIME DLY      0.00 MIN   11
```

☐ 3. To select the value for *SOURCE*, press ▲ or ▼ until the correct selection appears.

☐ 4. Press **SEL**.

☐ 5. To select the value for *MODE*, press ▲ or ▼ until the correct selection appears.

☐ 6. Press SEL.

NOTE: If a different mode from the one in this example (*HIGH SETPOINT*) is selected, some of the remaining steps will vary. The other choices are listed parenthetically in the remaining steps when they vary.

☐ 7. To set value for *TURN ON* (or *CYCLE TIMER*), press ▲ or ▼ until the correct value appears.

☐ 8. Press SEL.

☐ 9. To set the value for *DEADBAND* (or *CYCLE TIMER* or *ON TIME*), press ▲ or ▼ until the correct value appears.

☐ 10. Press SEL.

☐ 11. To set the value for *TIME DLY* (or *ON TIME* or *TURN ON*), press ▲ or ▼ until the correct value appears.

☐ 12. Press one of the three soft keys to display the soft key menu.

☐ 13. Press the soft key below *NEXT SCRN* to proceed.

☐ 14. Repeat Steps 3 through 13 for DO2 and DO3/DO4 (if available). When completed, the display returns to the configuration menu.

PROCEDURE PR26 - BAR GRAPHS CONFIGURATION

PURPOSE/SCOPE

1 min.

This procedure explains how to configure the behavior of the bar graphs.

Parts None.

Tools None.

Prerequisites Configuration worksheet.

PROCEDURE

Programming the bar graphs determines the range across which the bar graphs associated with DO1 and DO2 set points are spanned to give a zero to 100 percent indication.

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. The configuration menu is displayed. Press ▲ or ▼ until *BAR GRAPH* is selected.

```
CONFIG                    MENU

ANALYZER
ANALOG OUTPUTS
DIGITAL OUTPUTS
BAR GRAPH                   1
ALARMS
SAVE AND EXIT
EXIT
```

☐ 2. Press **SEL**. The bar graph configuration menu appears.

```
CONFIG                   GRAPH
            SETPOINT 1
ZERO           0.000 mS/cm
FULL          10.000 mS/cm  3
            SETPOINT 2
ZERO           0.000 mS/cm
FULL          10.000 mS/cm  5
```

☐ 3. To set the value for *FULL* for *SETPOINT 1*, press ▲ or ▼ until the correct value appears.

> **NOTE:** The *ZERO* values are locked at *0.000 mS/cm* and cannot be changed.

☐ 4. Press **SEL**.

☐ 5. To set the value for *FULL* for *SETPOINT 2*, press ▲ or ▼ until the correct selection appears.

☐ 6. Press one of the three soft keys to display the soft key menu.

☐ 7. Press the soft key below *NEXT SCRN* to proceed. The display returns to the configuration menu.

PROCEDURE PR27 - ALARMS CONFIGURATION

PURPOSE/SCOPE

1 min.

This procedure explains how to configure the alarms.

Parts None.

Tools None.

Prerequisites Configuration worksheet.

PROCEDURE

Programming the alarms determines what conditions are reported as an alarm to the process display.

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. The configuration menu is displayed. Press ▲ or ▼ until *ALARMS* is selected.

```
CONFIG                    MENU


ANALYZER
ANALOG OUTPUTS
DIGITAL OUTPUTS
BAR GRAPH
ALARMS                     1
SAVE AND EXIT
EXIT
```

☐ 2. Press SEL. The alarm configuration menu appears.

```
CONFIG                  ALARM

OUT OF RANGE      YES       3
TEMP HIGH         300.0 C   5
TEMP LOW          -20.0 C   7
D.O.1             YES       9
D.O.2             YES       11
D.O.3             YES       11
D.O.4             NO        11
```

- ☐ 3. To select *YES* or *NO* for *OUT OF RANGE*, press ▲ or ▼ until the correct value appears.
- ☐ 4. Press SEL.
- ☐ 5. To set the value for *TEMP HIGH*, press ▲ or ▼ until the correct value appears.
- ☐ 6. Press SEL.
- ☐ 7. To set the value for *TEMP LOW*, press ▲ or ▼ until the correct value appears.
- ☐ 8. Press SEL.
- ☐ 9. To select *YES* or *NO* for *D.O.1*, press ▲ or ▼ until the correct value appears. Selecting *YES* causes *ALARM* to appear on the process display when the digital output activates.
- ☐ 10. Press SEL.
- ☐ 11. Repeat Steps 9 and 10 for DO2 and DO3/DO4 (if available).
- ☐ 12. Press one of the three soft keys to display the soft key menu.
- ☐ 13. Press the soft key below *NEXT SCRN* to proceed. The display returns to the configuration menu.

PROCEDURE PR28 - SAVE AND EXIT CONFIGURATION

PURPOSE/SCOPE

1 min.

This procedure explains how to save a new configuration and exit from the configuration menu and how to abort a configuration.

Parts None.

Tools None.

Prerequisites Configuration worksheet.

PROCEDURE

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. The configuration menu is displayed. Press ▲ or ▼ until *SAVE AND EXIT* or *EXIT* is selected.

```
CONFIG                 MENU

ANALYZER
ANALOG OUTPUTS
DIGITAL OUTPUTS
BAR GRAPH
ALARMS
SAVE AND EXIT           ❶
EXIT                    ❶
```

☐ 2. Press **SEL**. The screen on the left appears if SAVE AND EXIT is chosen and the screen on the right appears if EXIT is chosen.

CREATE A NEW CONFIGURATION **NO/YES** ❸	**ABORT THIS CONFIGURATION** **NO/YES** ❺

☐ 3. If *SAVE AND EXIT* was chosen, press ▲ or ▼ to select *YES* or *NO*. If *EXIT* was chosen, go to Step 5.

☐ 4. Press SEL. If *YES* was chosen, the process display appears. If *NO* was chosen, the configuration menu appears.

NOTE: If changes to the configuration have been made, *SAVE AND EXIT* and *YES* must be used to retain these changes.

☐ 5. Press ▲ or ▼ to select *YES* or *NO*.

☐ 6. Press SEL. If *YES* was chosen, the main menu appears. If *NO* was chosen, the configuration menu appears.

NOTE: A configuration must be saved for the analyzer is to be operational.

PROCEDURE PR29 - SECURITY LEVELS

PURPOSE/SCOPE

1 min.

This procedure explains how to set the security levels for the various environments.

Parts None.

Tools None.

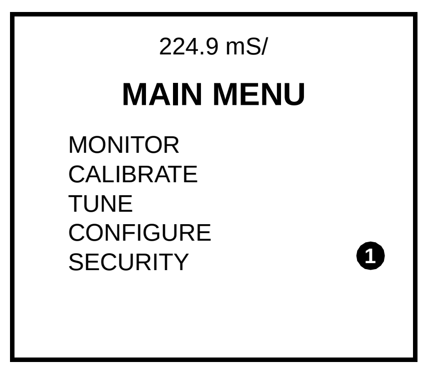
Prerequisites Configuration worksheet.

PROCEDURE

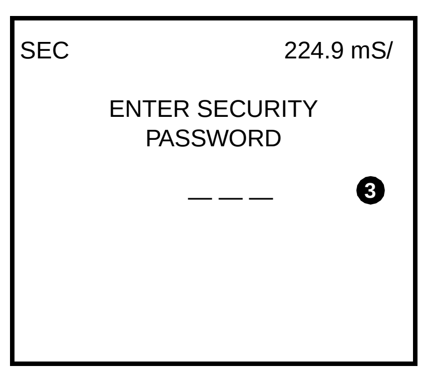
NOTES:
1. Assigning security levels is optional and is not required for operation of the analyzer.

2. Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. From the main menu, press ▲ or ▼ until *SECURITY* is selected.



☐ 2. Press SEL. The security menu appears.



☐ 3. If security levels were previously assigned, the master password is required to enter this environment. Enter the password. If there is no password, or if the correct password has been entered (if security was set), the password assignment screen appears.

```
SEC                              224.9 mS/

            ENTER PASSWORD
                MASTER

                 ___                 4

              TECHNICIAN

                 ___                 7
```

☐ 4. Enter a three-character alphanumeric password for the master level. Use ▲ or ▼ to scroll through the alphanumeric set.

☐ 5. When the desired character appears, press **SEL** to move to the next character to the right.

☐ 6. Repeat Steps 4 and 5 for the last two characters of the master password.

☐ 7. Repeat Steps 4 through 6 for the technician password.

NOTE: To remove a password, power down the analyzer and then press the three corner keys during power up. Be aware that when this is done, the configuration is lost; however, all calibration data remains.

☐ 8. When the passwords are entered, press one of the three soft keys to display the soft key menu.

☐ 9. Press the soft key below *ENTER* to proceed. The display advances to the level assignment screen with *CALIBRATE* highlighted.

```
SEC                          224.9 mS/

            ENTER LEVEL

MONITOR
CALIBRATE                    T
TUNE                         T
CONFIGURE                    M
SECURITY                     M
```

NOTE: The monitor environment has no security level associated with it.

☐ 10. Use ▲ or ▼ to scroll through the three choices: Master (*M*), technician (*T*) or none. A blank space means that none has been selected.

☐ 11. Press SEL to select *TUNE* (or the next environment).

☐ 12. Repeat Steps 10 and 11 for the remaining environments.

☐ 13. Press one of the three soft keys to display the soft key menu.

☐ 14. Press the soft key below *ENTER* to proceed. The display returns to the main menu with the security levels displayed for each environment.

NOTE: As soon as any of the other environments have security levels assigned, the master security level is automatically assigned to the security environment.

PROCEDURE PR30 - CALIBRATION MENU ACCESS

PURPOSE/SCOPE

10 min.

This procedure describes how to access the calibration menu.

Parts None.

Tools None.

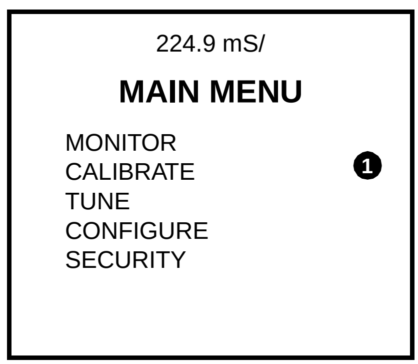
PROCEDURE

To perform a proper calibration, the configuration must have the correct sensor group selected and the jumper on the toroidal conductivity board must be in the proper position.

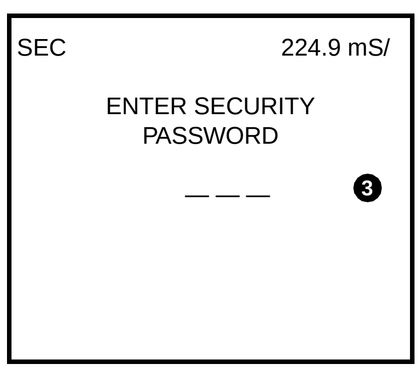
To begin calibration:

> **NOTE:** Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. With the main menu displayed, press ▲ or ▼ until *CALIBRATE* is selected.



☐ 2. Press **SEL** and the password screen appears.



☐ 3. If a security level is assigned to the calibrate environment, enter the password. The calibration menu appears.

```
CAL                         MENU

             25°C

CAL. PROCESS MEAS.
RESET CAL. MEAS.
CAL. PROCESS TEMP.
RESET CAL. TEMP.
ANALOG OUTPUTS
```

PROCEDURE PR31 - PROCESS TEMPERATURE CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to perform the process temperature calibration.

Parts None.

Tools Temperature measuring device.

PROCEDURE

The calibrate process temperature environment is for the field calibration of the analyzer temperature input. The smart calibration routine permits the use of a single-point calibration. If a two-point calibration is required to improve accuracy over a large range of temperature, perform multiple single-point calibrations at two temperatures that are at least ten degrees Celsius (18 degrees Fahrenheit) apart. The analyzer retains the most current calibration data set in memory until a reset function is performed.

> **NOTE:** Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

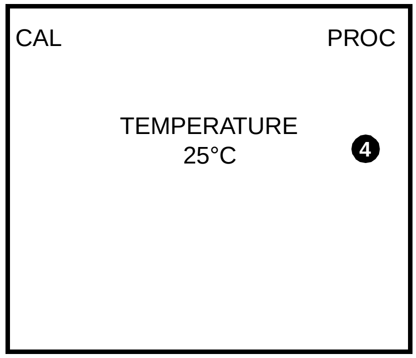
☐ 1. Use the temperature measuring device to measure the process fluid temperature.

☐ 2. Press ▲ or ▼ until *CAL. PROCESS TEMP.* is selected.

```
CAL            224.9 mS/        MENU
                 25°C

CAL. PROCESS MEAS.
RESET CAL. MEAS.
CAL. PROCESS TEMP.                2
RESET CAL. TEMP.
ANALOG OUTPUTS
```

☐ 3. Press **SEL** and the process temperature calibration screen appears.



☐ 4. Press ▲ or ▼ to adjust the process temperature to the measured value.

☐ 5. Press one of the three soft keys to display the soft key menu.

☐ 6. Press the soft key below *ENTER* to accept the change or press the soft key below *ESC* to abort the change. The display returns to the calibration menu.

PROCEDURE PR32 - RESET PROCESS TEMPERATURE CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to reset the process temperature calibration to the original factory calibration.

Parts None.

Tools None.

PROCEDURE

This procedure is for resetting the process temperature calibration to the factory calibrated values. This feature is convenient when several process temperature calibrations have been entered incorrectly and it is desired to start from a factory-calibrated input. The factory calibration emulates the response of an average temperature sensing element.

> **NOTE:** Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. Press ▲ or ▼ until *RESET CAL. TEMP.* is selected.

```
CAL          224.9 mS/     MENU
               25°C

CAL. PROCESS MEAS.
RESET CAL. MEAS.
CAL. PROCESS TEMP.
RESET CAL. TEMP.              1
ANALOG OUTPUTS
```

☐ 2. Press SEL and the process temperature calibration reset screen appears.

CAL 224.9 mS/ RESET

SLOPE 1.0000
OFFSET 0.0000

RESET TO FACTORY
CALIBRATION VALUES
NO/YES
ALL PROCESS CAL.
DATA WILL BE ERASED

☐ 3. Press ▲ or ▼ to change the response from *NO* to *YES*. A warning appears at the bottom of the screen warning that all process temperature calibration data will be erased.

☐ 4. Press SEL.

PROCEDURE PR33 - GRAB SAMPLE SENSOR CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to calibrate the sensor using the grab sample method.

Parts None.

Tools

- Type TB300 Portable Conductivity Analyzer or equivalent independent analyzer.
- Sample container.

PROCEDURE

For the highest accuracy, a grab sample method is the best technique of sensor calibration. This method is an on-line calibration check that requires a sample of the process liquid. An accurate calibration depends on proper sample handling. Use the following guidelines to ensure calibration accuracy:

- Temperature compensation compatibility between the independent analyzer and the Type TB703 analyzer must be ensured. Use an independent analyzer that has the same type of temperature compensation as the Type TB703 analyzer.
- The independent analyzer must be properly calibrated as specified by its vendor.
- Withdraw a grab sample from the process stream that is a representative sample of the liquid being measured by the sensor.
- Never neutralize, dilute or contaminate the grab sample with other substances.
- Do not cool the grab sample.
- Never leave grab samples open to the atmosphere for long periods of time. Always cap the grab sample to prevent vapor loss and contamination by ambient air.
- Measure the grab sample immediately after withdrawing it from the process stream.
- Record or memorize the Type TB703 analyzer indication at the same time the grab sample is taken.

- Minimize the time between extraction of the grab sample and the calibration of the Type TB703 analyzer.

- Use only the difference between the grab sample measurement reading on the independent analyzer and the reading on the Type TB703 analyzer to adjust the conductivity displayed on the Type TB703 analyzer.

☐ 1. Power up the analyzer and allow the conductivity indication to stabilize after connecting the sensor to the analyzer but before installing the sensor in the process.

☐ 2. While keeping the sensor dry, perform an air calibration by pressing ▲ or ▼ until *CAL. PROCESS MEAS.* is selected from the calibration menu.

```
CAL          224.9 mS/      MENU
                25°C
CAL. PROCESS MEAS.           ❷
RESET CAL. MEAS.
CAL. PROCESS TEMP.
RESET CAL. TEMP.
ANALOG OUTPUTS
```

☐ 3. Press SEL and the sensor calibration screen appears.

NOTE: A warning appears at the bottom of the screen indicating that a process temperature calibration is required. If the temperature input has not been calibrated, perform that procedure before starting this one.

```
CAL          0.0 mS/cm      PROC
                25°C
          PROCESS VARIABLE
             0.0 mS/cm     ❹
          CAL. TEMP FIRST
            IF INCORRECT
```

☐ 4. Press ▲ or ▼ until the display reads 0.0 mS/cm (i.e., an air calibration).

☐ 5. Install the sensor into the process.

☐ 6. While withdrawing a grab sample from the process, note or record the indicated conductivity value on the Type TB703 analyzer.

NOTE: Do not cool the grab sample. Measure it immediately after withdrawing it from the process stream.

☐ 7. Measure the conductivity of the grab sample with the independent analyzer.

☐ 8. Calculate the difference between the Type TB703 analyzer reading and the independent analyzer reading and retain this data for use during the process measurement calibration.

☐ 9. Use ▲ or ▼ to change the conductivity value on the Type TB703 analyzer by the difference between the reading on the independent analyzer and the value of the Type TB703 analyzer when the grab sample was taken.

Example: When the grab sample is taken, the analyzer indication is 10.00 mS/cm and the conductivity meter indication is 11.00 mS/cm. When performing the process measurement calibration on the analyzer, the analyzer indication is 15.00 mS/cm. Since the difference in grab sample reading was +1.00 mS/cm, adjust the calibration value to 16.00 mS/cm and enter it into the analyzer.

☐ 10. Press one of the three soft keys to display the soft key menu.

☐ 11. Press the soft key below *ENTER* to accept the change or press the soft key below *ESC* to abort the change. The display returns to the calibration menu.

PROCEDURE PR34 - KNOWN SOLUTION SENSOR CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to calibrate the sensor using the known solution method.

Parts None.

Tools

- Conductivity standard solutions having the same approximate conductivity range as the process liquid.
- Sample container having the approximate shape and size of the sensor receptacle/piping configuration.

PROCEDURE

The grab sample method is preferred for sensor calibration; however, sometimes it is not practical. An alternative to the grab sample method is to calibrate the sensor using known conductivity standard solutions.

Toroidal conductivity sensors are sensitive to the surrounding geometry (i.e., installation effect); however, these effects are predictable and can be anticipated.

For convenience, every toroidal conductivity sensor has an integral temperature compensator. Use of this compensating element, via automatic temperature compensation verses manual, during a known solution calibration can influence the measurement accuracy of the analyzer. For instance, a sensor in a process liquid that is at a temperature greater than the known solution requires time to equilibrate to ambient (i.e., known solution) temperature. Since conductivity is a strong function of temperature and adjustment to a reference temperature is done automatically via automatic temperature compensation, equilibration of the sensor to ambient temperature is essential. Additionally, a sensor that is hot and placed into a known solution elevates the temperature of that solution. Thus the sensor and known solution must always be kept at the same temperature.

☐ 1. Power up the analyzer and allow the conductivity indication to stabilize after connecting the sensor to the analyzer but before installing the sensor in the process.

☐ 2. While keeping the sensor dry, perform an air calibration by pressing ▲ or ▼ until *CAL. PROCESS MEAS.* is selected from the calibration menu.

CAL 224.9 mS/ MENU

25°C

CAL. PROCESS MEAS. 2
RESET CAL. MEAS.
CAL. PROCESS TEMP.
RESET CAL. TEMP.
ANALOG OUTPUTS

☐ 3. Press SEL and the sensor calibration screen appears.

NOTE: A warning appears at the bottom of the screen indicating that a process temperature calibration is required. If the temperature input has not been calibrated, perform that procedure first.

CAL 0.0 mS/cm PROC

25°C

PROCESS VARIABLE

0.0 mS/cm 4

CAL. TEMP FIRST
IF INCORRECT

☐ 4. Press ▲ or ▼ until the display reads 0.0 mS/cm (i.e., an air calibration).

☐ 5. Place enough conductivity standard into the sample container to meet the dimensional requirements of Step 6.

☐ 6. Place the sensor into the sample container.

a. If the sample does not represent the final installation, hold the sensor rigid and at least 38 mm (1.5 in.) from the bottom and the sides of the sample container. The sensor must be submerged into the solution by 38 mm (1.5 in.).

b. Orient the sensor in the expected position for samples that represent the final installation.

☐ 7. Use ▲ or ▼ to change the conductivity value on the Type TB703 analyzer to the known solution conductivity value.

☐ 8. Press a soft key to display the soft key menu.

☐ 9. Press the soft key below *ENTER* to accept the change or press the soft key below *ESC* to abort the change. The display returns to the calibration menu.

PROCEDURE PR35 - RESET SENSOR CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to reset the sensor calibration to the original factory calibration.

Parts None.

Tools None.

PROCEDURE

This procedure is for resetting the sensor calibration to the factory calibrated values. This feature is convenient when several sensor calibrations have been entered incorrectly and it is desired to start from a factory-calibrated input. The factory calibration emulates the response of an average TBI-Bailey sensor. This is a reset function only and a final sensor calibration is required before operating the analyzer.

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

☐ 1. Press ▲ or ▼ until *RESET CAL. MEAS.* is selected.

```
CAL          224.9 mS/     MENU

                25°C

CAL. PROCESS MEAS.
RESET CAL. MEAS.
CAL. PROCESS TEMP.
RESET CAL. TEMP.                1
ANALOG OUTPUTS
```

☐ 2. Press **SEL** and the sensor calibration reset screen appears.

```
CAL            224.9 mS/     RESET

SLOPE      1.0000
OFFSET     0.0000

        RESET TO FACTORY
       CALIBRATION VALUES
           NO/YES            ❸
        ALL PROCESS CAL.
       DATA WILL BE ERASED
```

☐ 3. Press ▲ or ▼ to change the response from *NO* to *YES*. A warning appears at the bottom of the screen warning that all sensor calibration data will be erased.

☐ 4. Press **SEL**.

PROCEDURE PR36 - ANALOG OUTPUTS CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to calibrate the analog outputs.

Parts None.

Tools

- Digital voltmeter (DVM) with an accuracy of ±0.5 millivolt.
- 250Ω, 0.02% resistor (only if the analog output is set for current mode and using the DVM).
- Ammeter (only if the analog output is set for current mode and not using the DVM).

PROCEDURE

NOTE: Be sure the main board jumpers are set for the correct output (current or voltage) before performing this procedure.

☐ 1. Connect the calibration setup across the analog output terminals in the proper setup for the application as shown in Figure PR36-1.

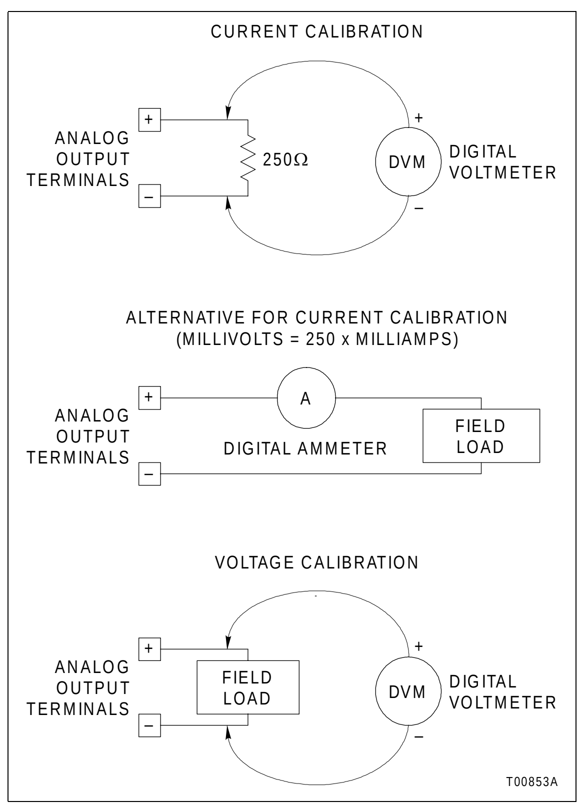


Figure PR36-1. Analog Output Calibration Setup

☐ 2. Press [▲] or [▼] until *ANALOG OUTPUTS* is selected from the calibration menu.

```
CAL          224.9 mS/        MENU

               25°C

CAL. PROCESS MEAS.
RESET CAL. MEAS.
CAL. PROCESS TEMP.
RESET CAL. TEMP.
ANALOG OUTPUTS                  2
```

☐ 3. Press [SEL] and the analog outputs calibration screen appears.

```
CAL          224.9 mS/        A.O.



               A.O. 1           4
               A.O. 2
               A.O. 3
```

☐ 4. Press [▲] or [▼] until the desired analog output is selected.

☐ 5. Press [SEL] and the low value screen appears.

```
CAL          224.9 mS/        A.O.

      MEASURE THE VOLTAGE
  ACROSS A.O. 1 AND ENTER THE
             VALUE

            LOW VAL
              1000 mV           6
```

☐ 6. At this time, the analyzer is putting out the low value that it believes is 1000 mV. The screen prompts the calibrator to measure the analog output being calibrated and enter that value in millivolts if it is different than the displayed value. Use ▲ or ▼ to enter the measured value.

> **NOTE:** If an ammeter was used instead of the 250Ω resistor and DVM, calculate the correct millivolt entry by multiplying the ammeter mA value by 250.

☐ 7. Press one of the three soft keys to display the soft key menu.

☐ 8. Press the soft key below *ENTER* to accept the change and the high value screen appears.

```
CAL            224.9 mS/          A.O.

          MEASURE THE VOLTAGE
     ACROSS A.O. 1 AND ENTER THE
                 VALUE

               HIGH VAL
                5000 mV          9
```

☐ 9. At this time, the analyzer is putting out the high value that it believes is 5000 mV. The screen prompts the calibrator to measure the analog output being calibrated and enter that value in millivolts if it is different than the displayed value. Use ▲ or ▼ to enter the measured value.

> **NOTE:** If an ammeter was used instead of the 250Ω resistor and DVM, calculate the correct millivolt entry by multiplying the ammeter mA value by 250.

☐ 10. Press one of the three soft keys to display the soft key menu.

☐ 11. Press the soft key below *ENTER* to accept the change and the analog outputs calibration screen appears.

☐ 12. Repeat Steps 4 through 11 for the remaining analog outputs.

☐ 13. When completed with all analog outputs, press one of the three soft keys to display the soft key menu.

☐ 14. Press the soft key below *MAIN MENU* to go to the main menu, *PROC DSPLY* to go to the process display or *PREV SCRN* to go back to the calibration menu.

PROCEDURE PR37 - PROCESS DISPLAY ACCESS

PURPOSE/SCOPE

0.2 min.

This procedure describes how to access the process display from any other screen.

Parts None.

Tools None.

PROCEDURE

The process display is the default screen on power up when a configuration exists and is also the screen shown while the analyzer is in actual operation. The process display shows information relative to the process: Process variable, set points, control output, temperature and the existence of alarms. To reach the process display from any screen environment:

☐ 1. Press one of the three soft keys to display the soft key menu.

☐ 2. The *PROC DSPLY* box is above the middle soft key. Press that soft key and the process display appears.

NOTE: There is no security environment associated with the process display.

PROCEDURE PR38 - MAIN MENU ACCESS

PURPOSE/SCOPE

0.2 min.

This procedure describes how to access the main menu from any other screen.

Parts None.

Tools None.

PROCEDURE

The main menu is the screen through which all functionality of the analyzer is accessed. It is divided into five environments: Monitor, calibrate, tune, configure and security.

To access the main menu from any environment, including the process display:

☐ 1. Press one of the three soft keys to display the soft key menu.

☐ 2. If the *MAIN MENU* box appears now, press the soft key below it to access the main menu and stop. If the *MAIN MENU* box does not appear now, continue with the procedure.

☐ 3. Press the center soft key below *PROC DSPLY*. The process display appears.

☐ 4. Press one of the three soft keys to display the soft key menu.

☐ 5. The main menu box is above the left soft key. Press it to access the main menu.

PROCEDURE PR39 - ALARM ACKNOWLEDGING AND VIEWING

PURPOSE/SCOPE

0.5 min.

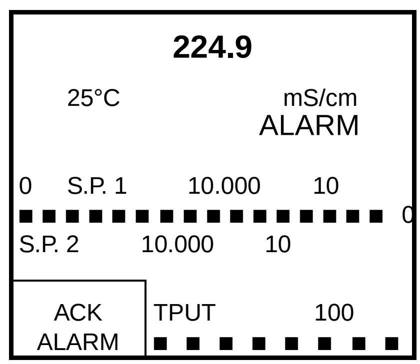
This procedure describes how to acknowledge and view alarms.

Parts None.

Tools None.

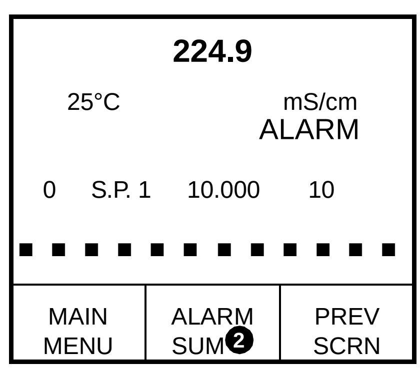
PROCEDURE

When an alarm exists, the display shows an alarm message. The alarm message remains as long as the alarm condition exists. An *ACK ALARM* box also appears on the lower left corner of the display. This box remains until the alarm has been acknowledged.

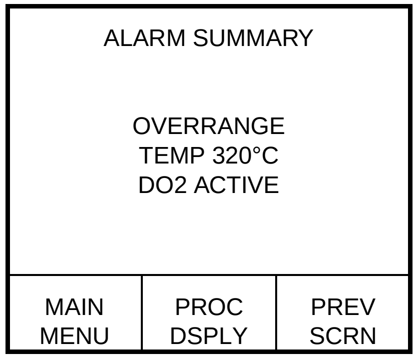


To acknowledge and read alarm conditions:

- ☐ 1. Press one of the three soft keys to display the soft key menu.
- ☐ 2. Press the soft key below the *ALARM SUM* box to display all current alarms.



☐ 3. The alarm summary screen appears. The following screen would be a typical display of an alarm summary screen.



☐ 4. To return to the process display, press any of the soft keys to display the soft key menu. Press the soft key below *PROC DSPLY* or *PREV SCRN* to return to the process display. To return to the main menu, press the soft key below *MAIN MENU*.

PROCEDURE PR40 - MONITORING

PURPOSE/SCOPE

0.1 min.

This procedure describes how to monitor the analyzer I/O in groups.

> **NOTE:** The time indicated to perform this procedure only includes the time necessary to access the monitor screen.

Parts None.

Tools None.

PROCEDURE

The monitor environment allows the observation of all analog inputs together, all analog outputs together, etc. This environment is for monitoring purposes only and can only be entered from the main menu.

> **NOTE:** Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

1. From the main menu, press ▲ or ▼ until *MONITOR* is selected.

224.9 mS/

MAIN MENU

MONITOR		1
CALIBRATE	M	
TUNE	T	
CONFIGURE	M	
SECURITY	M	

☐ 2. Press **SEL** and the monitor menu appears.

```
MON          224.9 mS/        MENU

  ANALOG INPUTS                 3
  ANALOG OUTPUTS
  DIGITAL INPUTS
  DIGITAL OUTPUTS
```

☐ 3. Press ▲ or ▼ until the desired group is selected.

☐ 4. Press **SEL** and the information about the selected group appears.

☐ 5. After observing the selected group, press one of the multifunction soft keys to display the soft key menu.

☐ 6. Press the soft key below *PREV SCRN* to go back to the monitor menu.

☐ 7. Repeat Steps 3 through 6 until all monitoring functions are complete.

☐ 8. To return to the process display, after the soft key menu appears, press the middle multifunction soft key. To return to the main menu, press the left multifunction soft key.

PROCEDURE PR41 - TUNING

PURPOSE/SCOPE

0.1 min.

This procedure describes how to tune the analyzer while it executes the configuration.

NOTE: The time indicated to perform this procedure only includes the time necessary to access the tune screen.

Parts None.

Tools None.

PROCEDURE

NOTES:
1. The analyzer must be configured and calibrated before any tuning procedures can be started.

2. The tune environment can only be accessed from the main menu.

3. The operator must enter the correct password (if any) to access the tune environment.

Tuning is the process of changing configuration constants while the analyzer executes the configuration. Tuning allows the operator to access numerical values for set point activation and adjust outputs. It also allows the changing of certain analyzer functions without changing the configuration.

When in the tune environment, the display shows the entire configuration as entered. The first tunable parameter on any particular screen is automatically selected. To use the tune environment:

NOTE: Some of the screen displays illustrated contain circled numbers. Those numbers reference the step number of the procedure.

1. From the main menu, press ▲ or ▼ until *TUNE* is selected.

```
224.9 mS/

MAIN MENU

MONITOR
CALIBRATE        M
TUNE             T     1
CONFIGURE        M
SECURITY         M
```

☐ 2. Press **SEL** and the tune menu appears.

```
TUN        224.9 mS/      MENU

  ANALYZER
  ANALOG OUTPUTS
  DIGITAL OUTPUTS              3
  BARGRAPH
  ALARM
```

☐ 3. Press ▲ or ▼ until the desired group is selected. For this example, *DIGITAL OUTPUTS* is selected.

☐ 4. Press **SEL** and the digital output screen appears.

```
TUN                      D. O. 1

SOURCE   CONDUCTIVITY
MODE     HI SETPOINT

TURN ON        10.000 mS/   5

DEADBAND       0.3 mS/      5

TIME DLY       0.00 MIN     5
```

☐ 5. In this example, the three parameters that can be tuned are: *TURN ON*, *DEADBAND* and *TIME DLY*. Press ▲ or ▼ to change the selected parameter value.

☐ 6. Press **SEL** to move from one tunable parameter to another.

NOTE: When there are no tunable parameters on a screen, or when it is desired to proceed through the configuration, use the soft keys.

☐ 7. When completed with the changes, press one of the multifunction soft keys to bring up the soft key menu.

☐ 8. If the changed parameters are correct, press the multifunction soft key below the *ENTER* box. If the changed parameters are not correct, press the multifunction soft key below the *ESC* box.

☐ 9. When *ENTER* is pressed, the soft key menu disappears. Press one of the three multifunction soft keys to recall the soft key menu.

☐ 10. Choose either *NEXT SCRN* to continue tuning parameters in the current group, *PREV SCRN* to return to the tune menu to select another group, or *PROC DSPLY* to return to the process display.

PROCEDURE PR42 - ANALYZER TROUBLESHOOTING

PURPOSE/SCOPE

10 min.

This procedure describes how to troubleshoot the analyzer when it is suspected of being the source of the problems. This procedure makes it possible to check the operation of the analyzer without removing the sensor from the analyzer.

Parts None.

Tools

- Small length of 18 to 24-AWG wire.
- Decade resistance box or equivalent resistors.
- 3,000Ω resistor (only if using automatic temperature compensation).

PROCEDURE

Process simulation with the sensor outside the process stream is possible using a small length of wire and a decade resistance box or equivalent resistors. This simulation process allows for an easy way to check the operation of the analyzer.

By using this simulation, the analyzer can be tested for proper digital output activation and analog output accuracy. Based on the information from the tests, the analyzer can be tuned to properly react under normal process conditions.

NOTE: Before evaluating the functionality of the analyzer, the sensor must be calibrated to zero percent and 100 percent of the full scale measurement range.

☐ 1. Remove the sensor from the process stream.

☐ 2. Connect the analyzer as shown in Figure PR42-1

NOTE: The three wire loops through the sensor bore are necessary to ensure the correct relationship between the decade resistance and the indicated conductivity

3. There are two possible temperature compensation configurations possible:

   a. Recommended approach — configure the analyzer for standard manual temperature compensation with a constant 25°C temperature.

   b. Place the 3,000Ω resistor across the temperature compensator input and calibrate the analyzer for a 25°C temperature display.

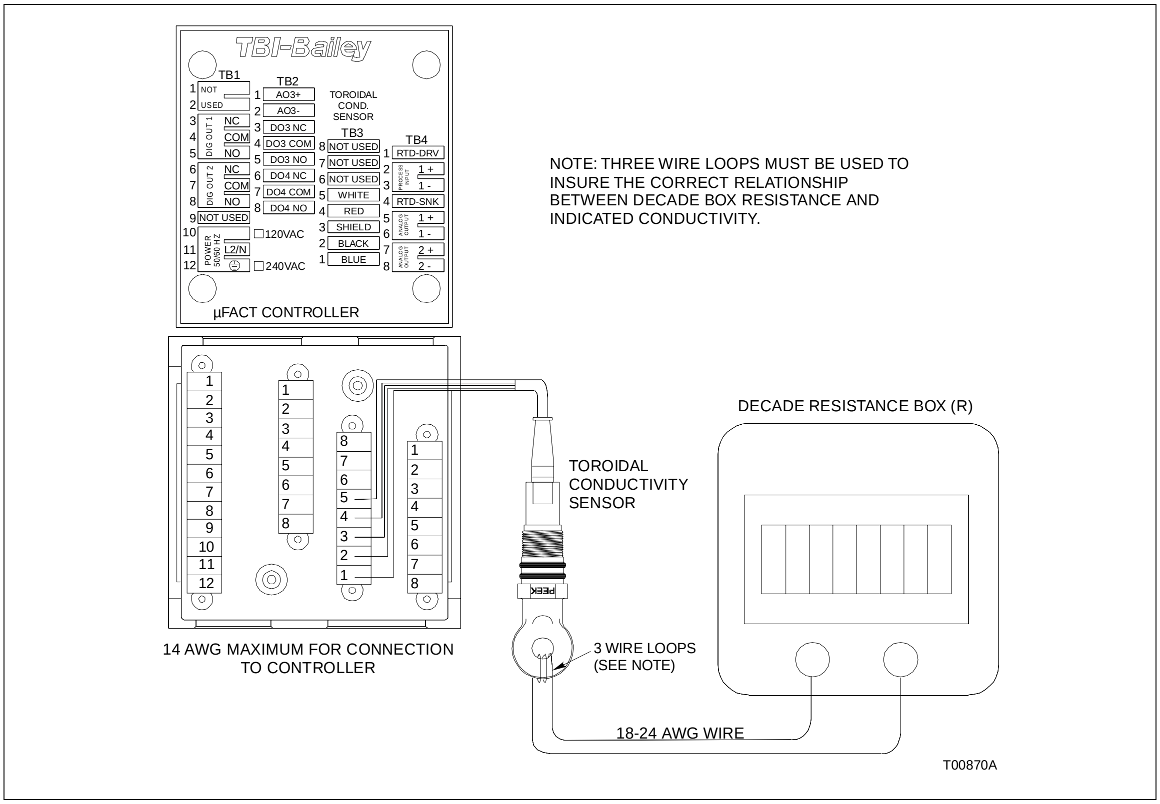


Figure PR42-1. Simulation Setup

☐ 4. Refer to the following table and check the display value versus resistance input.

Range Jumper	Resistance (Ω)	Display (mS/cm)
Medium	Open	0.000
	20,000	1.000
	4,000	5.000
	2,000	10.00
	400	50.00
	200	100.0
High	Open	0.00
	2,000	10.00
	400	50.00
	200	100.0
	40	500.0
	20	1000

PROCEDURE PR43 - SENSOR TROUBLESHOOTING

PURPOSE/SCOPE

10 min.

This procedure describes how to troubleshoot the sensor when it is suspected of being the source of the problems.

Parts None.

Tools

- Ohmmeter.
- Conductance meter (if available).

PROCEDURE

If the sensor is suspected of being the source of problems, a few quick checks with an ohmmeter can be performed to determine if the sensor is at fault. Most of these tests can be performed with the sensor in or out of the process stream.

☐ 1. Disconnect the sensor leads and temperature compensator leads from the analyzer.

☐ 2. Use the ohmmeter to check the resistance of the temperature compensator. To calculate the expected resistance, use the following equation:

$$R_{TC} = (((T - 25) \times 0.0045) + 1) \times 3,00.$$

The measured resistance value should be within ±15% of the calculated value.

☐ 3. Check the conductance between the yellow temperature compensator lead and each of the sensor leads (black, blue, red, white and heavy green). The reading must be less than 0.05 nS. If a conductance meter is not available, the resistance must be greater than 20MΩ.

☐ 4. Measure the resistance of the sensor drive by connecting the ohmmeter to the blue and black leads. The resistance must be less than 10.0Ω.

☐ 5. Measure the resistance across the sense coils by connecting the ohmmeter to the red and white leads. The resistance must be less than 10.0Ω.

☐ 6. With the sensor installed in the process piping, check the conductance between the pipe and each of the sensor leads (black, blue, red, white and heavy green). The reading must be less than 0.05 nS. If a conductance meter is not available, the resistance must be greater than 20MΩ.

PROCEDURE PR44 - GROUND LOOPS

PURPOSE/SCOPE

10 min.

This procedure describes how to check for ground loops.

Parts None.

Tools None.

PROCEDURE

A ground loop is a path between the process liquid ground and a second ground point elsewhere in the system through which unwanted current flows through the measurement circuitry. The typical symptom would be an offset or erratic measurement in the process line, but correct measurement in an isolated beaker of process liquid.

Ground loops can be caused by:

- Conductivity sensor wiring contacting water in a conduit run or in the housing, and that water making contact with a grounded fitting.
- Nicked sensor wiring insulation contacting metallic conduit. This could be an intermittent problem.
- Loss of isolation between input and output usually resulting from a wiring deficiency.

☐ 1. Remove the sensor from the process.

☐ 2. To verify a ground loop, measure the resistance from TB3-1 (black) to earth ground when the sensor is not installed in the process. The reading should quickly climb to infinity as indicated by an ohmmeter in its highest range. A reading near zero ohms indicates a direct ground connection.

☐ 3. If a ground loop exists, take the necessary action to correct the ground loop condition.

☐ 4. Return the sensor to the process.

PROCEDURE PR45 - SENSOR CLEANING

PURPOSE/SCOPE

20 min.

This procedure describes how to clean the sensor.

Parts None.

Tools

- Gloves.
- Eye protection.
- Safety shield.
- Other protective items as applicable.
- 1% to 5% Hydrochloric Acid (HCl) solution (for acid dip).
- Isopropyl alcohol or other appropriate solvent (for solvent dip).
- Clean cloth.
- Rag, acid brush or tooth brush (for physical cleaning).
- Water.

SAFETY CONSIDERATIONS

WARNING

1. Consider the material compatibility between cleaning fluids and process liquids. Incompatible fluids can react with each other causing injury to personnel and equipment damage.

2. Acids and bases can cause severe burns. Use hand and eye protection when handling.

3. Use solvents only in well ventilated areas. Avoid prolonged or repeated breathing of vapors or contact with skin. Solvents can cause nausea, dizziness and skin irritation. In some cases, overexposure to solvents has caused nerve and brain damage. Solvents are flammable - do not use near extreme heat or open flame.

PROCEDURE

TBI-Bailey toroidal conductivity sensors are cleaned using one or a combination of methods. These are recommendations and may not be suitable for all applications. When cleaning, observe all safety precautions required for handling chemicals. When handling chemicals, always use gloves, eye protection, safety shields and similar protective items and consult material data safety sheets.

Acid Dip

This method removes scales caused by hard water.

☐ W1 1. Verify that any process fluid on the sensor is not incompatible with HCl.

☐ W2 2. Put on gloves, eye protection, safety shields and other protective items as needed for protection.

☐ 3. Dip the donut portion of the sensor into a one percent to five percent solution of HCl until this region is free of the unwanted coating. Do not expose any of the metal on the sensor to this solution or corrosion may occur.

☐ 4. Rinse the sensor with water.

Solvent Dip

This method removes organic coatings.

☐ W1 1. Verify that any process fluid on the sensor is not incompatible with isopropyl alcohol or other appropriate solvent.

☐ W3 2. Put on gloves, eye protection, safety shields and other protective items as needed for protection.

☐ 3. Dip the sensor into the solvent. Do not use a solvent that is known to be incompatible with the plastic of the sensor.

☐ 4. Remove the solvent using a clean cloth.

☐ 5. Rinse the sensor with soap and water.

Physical Cleaning

This method removes especially thick scales and accumulations.

☐ 1. Use a rag, acid brush or tooth brush to clean the sensor.

PROCEDURE PR46 - FRONT PANEL ASSEMBLY REMOVAL

PURPOSE/SCOPE

2 min.

This procedure explains how to remove the front panel assembly from the main board.

Parts None.

Tools Small bladed screwdriver.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Disconnect the two display backlight wires from P6 and P7 on the main board (Fig. PR46-1).

NOTE: Figure PR46-1 shows the main board as it would appear flat. It is secured in a U-shape. Use the components in the figure to help locate the proper connections.

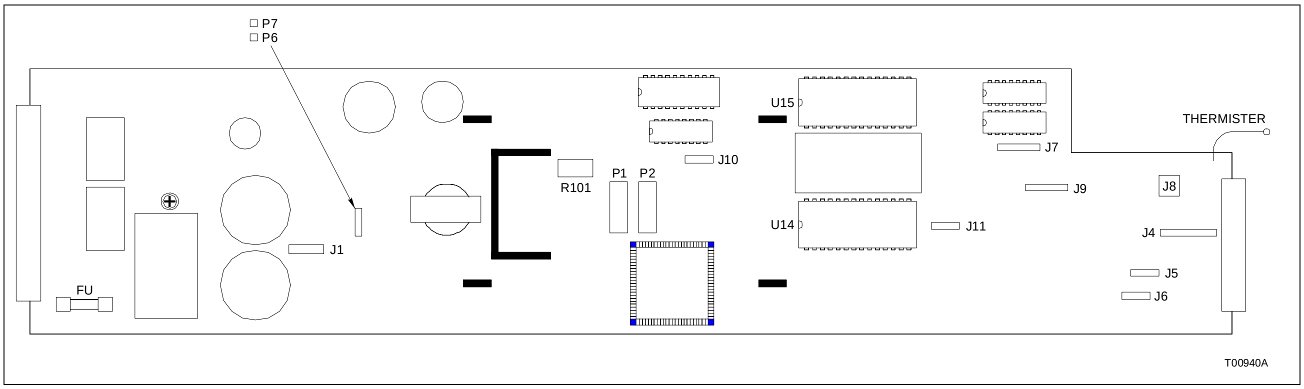


Figure PR46-1. Main Board

☐ 2. Insert the small bladed screwdriver between the main board and one of the two plastic tabs shown in Figure PR46-2.

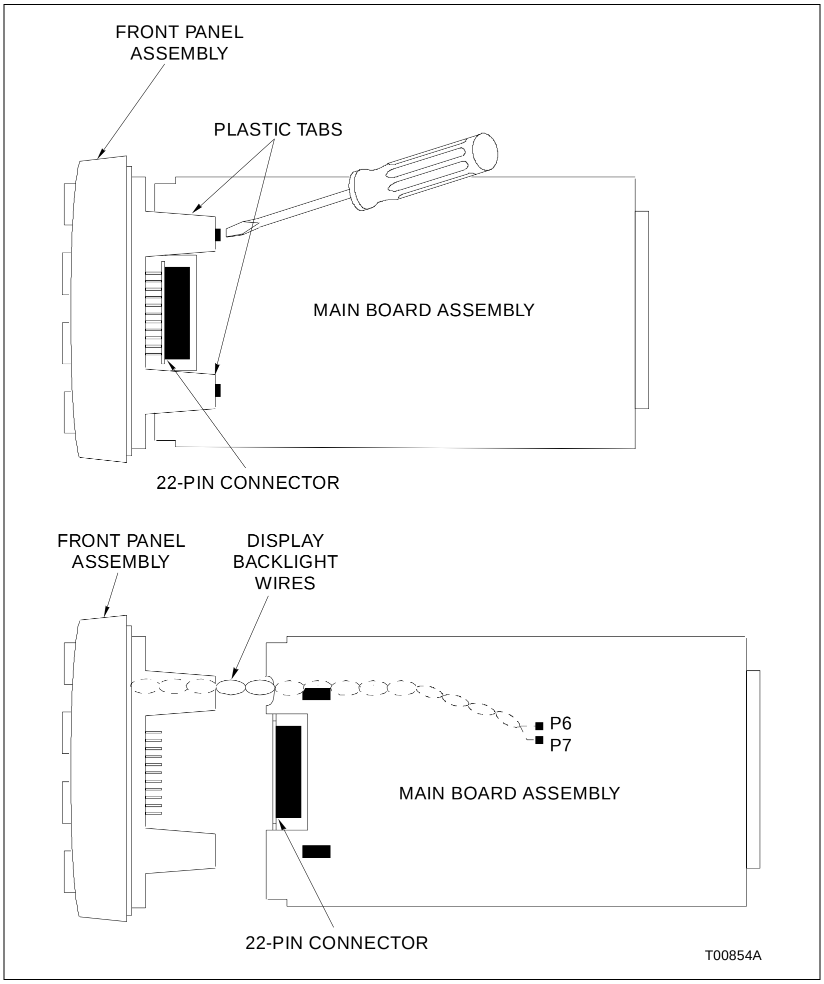


Figure PR46-2. Front Panel Assembly Removal

☐ 3. Gently pull the screwdriver handle back until the main board disengages from the plastic tab.

☐ 4. Repeat Steps 2 and 3 for the remaining plastic tabs.

☐ 5. Remove the main board from the front panel. Be careful when feeding the backlight wires through the hole in the main board and when disengaging the 22-pin display board connector from the main board.

PROCEDURE PR47 - FRONT PANEL ASSEMBLY INSTALLATION

PURPOSE/SCOPE

2 min.

This procedure explains how to install the front panel assembly onto the main board.

Parts

Number	Qty	Description
4TB9515-0025	1[1]	Front panel assembly
Consult factory[2]	1[3]	Main board

NOTES:

1. This part is not required if using this procedure as part of main board replacement only.
2. Contact TBI-Bailey for replacement main boards. Due to the special nature of this board, factory consultation is required.
3. This part is not required if using this procedure as part of front panel assembly replacement only.

Tools None.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Carefully feed the two display backlight wires attached to the display assembly through the small hole in the main board.

☐ 2. Bring the main board close to the display assembly and ***start*** the connection between the 22-pin display board header and the corresponding main board connector (Fig. PR47-1)

3. Insert the main board fully into the two plastic tabs ***opposite the display board connector***.

☐ 4. Carefully insert the main board into the two remaining plastic tabs.

☐ 5. Connect the two display backlight connectors into P6 and P7 on the main board (Fig. PR47-2 — polarity does not matter).

NOTE: Figure PR47-2 shows the main board as it would appear flat. It is secured in a U-shape. Use the components in the figure to help locate the proper connections .

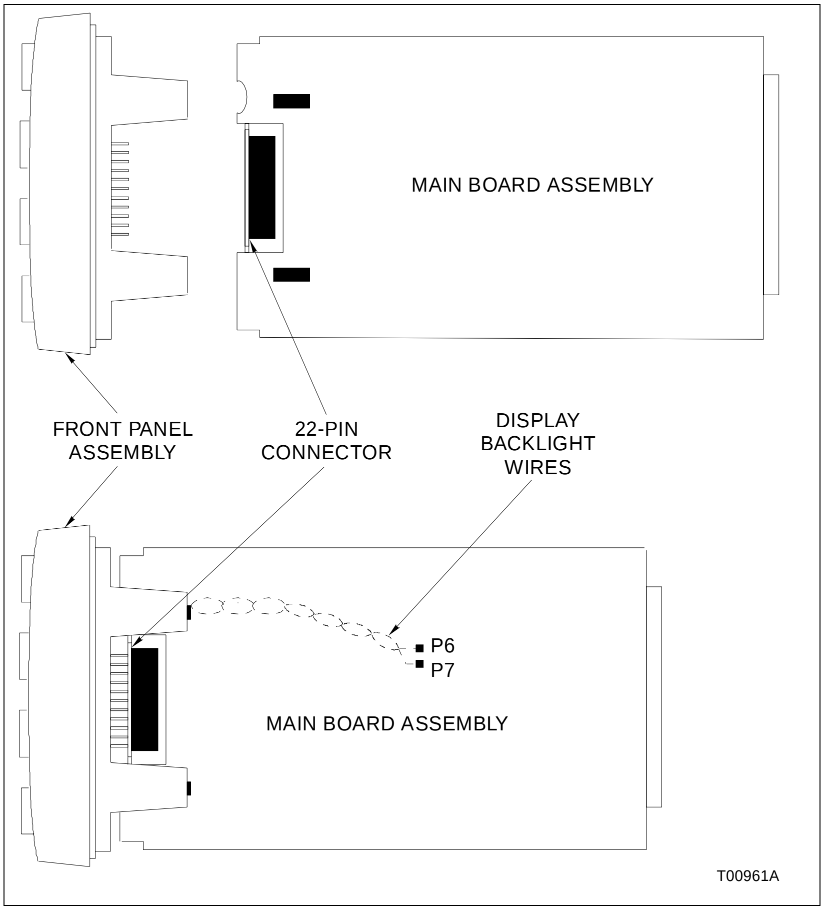


Figure PR47-1. Front Panel Assembly Installation

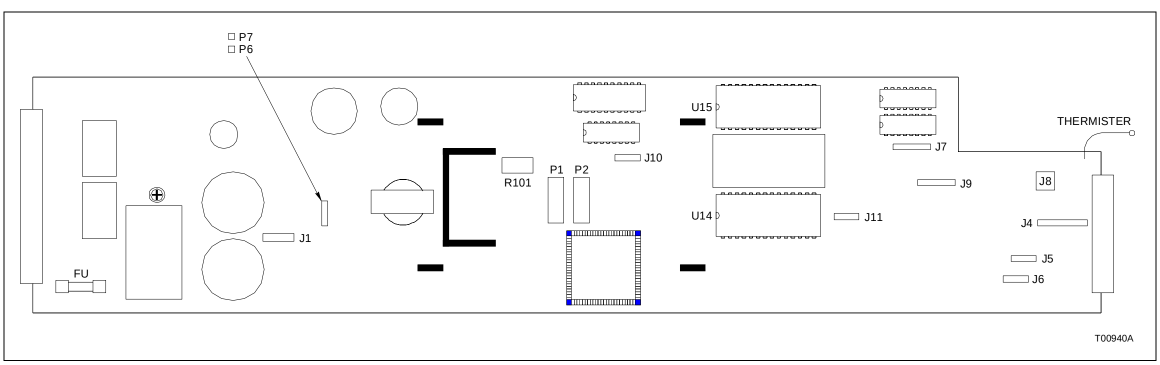


Figure PR47-2. Main Board

☐ 6. Push the 22-pin connector down into the display board header enough to ensure a good connection.

NOTE: There should be a 3.5-mm (0.14-in.) gap between the display backplate and the main board connector.

PROCEDURE PR48 - MAIN BOARD FUSE REPLACEMENT

PURPOSE/SCOPE

1 min.

This procedure describes how to replace the main board fuse.

Parts

Number	Qty	Description
1948182?32500	1	Fuse, ¼-amp, slow blow, 5 by 20 mm

Tools None.

PROCEDURE

NOTE: The printed circuit boards contain semiconductor devices and are subject to damage by static electricity. Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Remove the fuse from the main board (Fig. PR48-1).

NOTE: Figure PR48-1 shows the main board as it would appear flat. It is secured in a U-shape. Use the components in the figure to help locate the fuse holder, silkscreened FU on the main board.

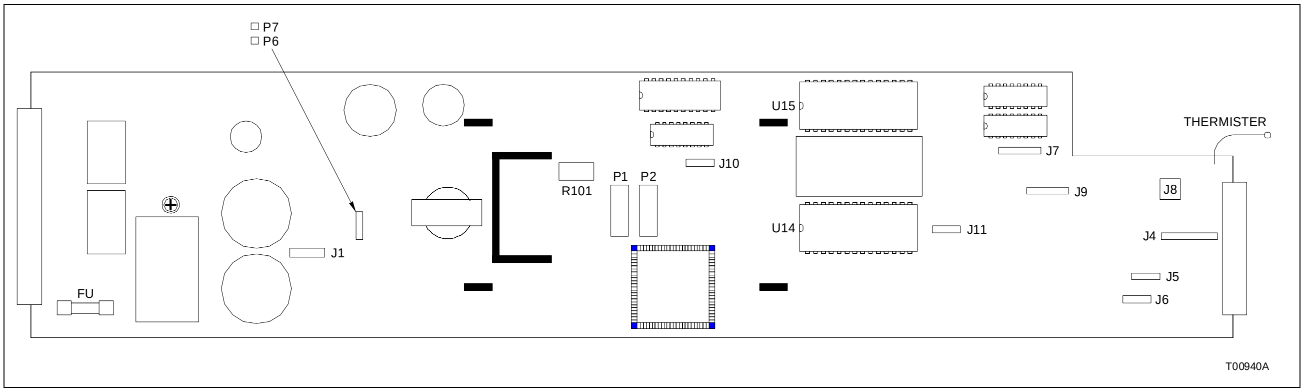


Figure PR48-1. Main Board

☐ 2. Install the new fuse in the location silkscreened FU on the main board.