User Guide OI/TB82EC–EN Rev. B

Type TB82EC Advantage Series™
2-wire, 4-electrode conductivity transmitter

Preface

This publication is for the use of technical personnel responsible for installation, operation, maintenance and repair of the ABB Type TB82EC Advantage Series™ Conductivity/Concentration Transmitter.

The Type TB82EC transmitter 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 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

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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. 3-3) All error conditions are considered catastrophic and require transmitter replacement. Replace the transmitter with a transmitter that is known to be operable. Leaving an inoperable transmitter in the process could cause process upsets. Some process upsets can lead to dangerous conditions that can harm personnel and damage equipment. (p. 12-7) Allow only qualified personnel (refer to ***INTENDED USER*** in Section 1) 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. 13-1) Consider the material compatibility between cleaning fluids and process liquids. Incompatible fluids can react with each other causing injury to personnel and equipment damage. (p. PR46-1) Acids and bases can cause severe burns. Use hand and eye protection when handling. (p. PR46-1) 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. PR46-1)

Trademarks and Registrations

Registrations and trademarks used in this document include:

™ Advantage Series	Trademark of ABB.
® HART	Registered trademark of HART Communication Foundation.
® Mylar	Registered trademark of E. I. DuPont de Nemours Company, Inc.
™ Next Step	Trademark of ABB.

SECTION 1 - INTRODUCTION

OVERVIEW

The Type TB82EC Advantage Series™ Conductivity/Concentration Transmitter is an advanced, microprocessor-based, two-wire, four to 20-milliamp compatible transmitter. It features internal and external diagnostic functionality, an innovative user interface with flexible smart key design, two user-selectable modes of operation, and DIN size packaging.

Diagnostic checks on the internal circuitry and external sensor are done continuously. This insures accuracy and immediate problem notification. Detection of sensor integrity includes: fouled or dirty sensor, ground loop detection, and shorted sensor cabling. Additional software functions monitor slope, process variable over or under range, and temperature over or under range. The transmitter can be programmed to produce, on the output current, a repetitive modulation of a given magnitude when these diagnostic conditions occur.

The transmitter packaging conforms to DIN standards. Mounting options accommodate pipe, wall, hinge, and panel installations.

Changing the transmitter sensing capability to other analytical properties such as pH/ORP/pION is quick and easy due to the modular design.

The user interface is an innovative, patent-pending technology that facilitates a smooth and problem-free link between the user and transmitter functionality. The programming structure and smart keys reduce programming difficulties by providing a toggle between basic and advanced functions.

INTENDED USER

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

Application Technician Should have a solid background in conductivity and concentration measurements, electronic instrumentation, and process control, and be familiar with proper grounding and safety procedures for electronic instrumentation.

Operator Should have knowledge of the process and should read and understand this instruction before attempting any procedure pertaining to the operation of the transmitter.

Maintenance Personnel Should have a background in electricity and be able to recognize shock hazards. Personnel must also be familiar with electronic process control instrumentation and have a good understanding of troubleshooting procedures.

FEATURES

Diagnostic sensor capability. Full compatibility with all four-electrode Model TB4 Series Conductivity Sensors and three types of RTDs (resistive temperature devices). Diagnostic capability includes ground loop detection, process and temperature variable under or over range, and dirty sensor detection.

Multiple applications. Accepts inputs from all ABB four-electrode conductivity sensors. Isolated analog output allows use in grounded or floating circuits.

Temperature compensation. Compatible with either Pt (platinum) 100, three-kilohm Balco RTD, or ABB 4.75-kilohm RTD network. Manual temperature compensation is 0.1N KCl (potassium chloride) based. Automatic temperature compensation is based on either: standard (0.1N KCl based), user-entered coefficient adjustable from zero to 9.99-percent per degree Celsius, zero to 15-percent NaOH (sodium hydroxide), zero to 20-percent NaCl (sodium chloride), zero to 18-percent HCl (hydrochloric acid), zero to 20-percent H_2SO_4 (sulfuric acid), a user-defined function generator, and pure water with trace acid, pure water with trace base, and neutral salt for pure water.

Wide rangeability. Analog output span does not affect display range of 0.000 microsiemens per centimeter to 1,999 millisiemens per centimeter for conductivity and zero to 1,999 digits, specified in the configured engineering units, for concentration. Minimum output span is 100 microsiemens per centimeter for Group A sensors, 10 microsiemens per centimeter for Group B sensors and, one microsiemen per centimeter for Group C sensors.

Innovative user interface. Four smart keys and custom LCD allow assignment of multiple functions to each smart key, displayed at appropriate time depending on programming mode. Patent-pending technology reduces number of keys and allows for larger, more visible LCD.

Easy calibration. One-point smart calibration routines for process variable and temperature automatically determine appropriate level of sensor gain (slope) and offset. Includes provisions for viewing and modifying sensor calibration data.

NEMA 4X/IP65 housing. Suitable for corrosive environment. Electronics enclosure is corrosion resistant, low copper aluminum alloy. Chemical-resistant polyurethane powder coating provides external protection.

Suitable for hazardous locations. Complies with industry standards for intrinsically safe and nonincendive installations.

Diagnostic indication. Custom LCD has dedicated icons that act as visible indications of output hold, fault, and diagnostic spike conditions.

Secure operation. Hardware lockout prevents unauthorized altering of configuration parameters while allowing access to other functions. Software security codes assignable to configure, calibrate, and output/hold modes.

Compact packaging. Industry standard ½-DIN size maintains standard panel cutouts. Increases installation flexibility by providing pipe, wall, hinge, or panel mounting.

Nonvolatile memory. Stores and retains configuration and calibration data in the event of power failure.

Diagnostics. Built-in electronic circuitry and firmware routines perform series of self-diagnostics, monitoring memory and input circuit integrity. Irregularities indicated for maintenance purposes.

EQUIPMENT APPLICATION

Use the Type TB82EC transmitter anywhere conductivity or concentration measurements are desired.

INSTRUCTION CONTENT

Introduction

Provides product overview, physical description of product, possible applications, and description of instruction and how to use it. Contains list of reference documents on related equipment and subjects, nomenclature, comprehensive list of hardware performance specifications including applicable certification information, accessories, and compatible sensors.

Description and Operation

Provides short description on transmitter functionality.

Installation

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

Operating Procedures

Addresses operator interface controls and their function. Lists mode of operation and transmitter condition icons and describes their functions.

Measure Mode Describes normal transmitter mode of operation including primary and secondary display, fault information smart key, and menu smart key functions. Contains screen flow diagram.

Calibration Provides information on sensor and transmitter calibration, and calibration data descriptions. Contains screen flow diagrams. Calibration sequence flowchart directs calibration personnel to appropriate calibration procedures.

Output/Hold Mode Lists and describes output/hold states of operation including hold, rerange, damping, and spike features. Contains screen flow diagram. Includes table that directs personnel to desired output/hold procedures.

Configuration Defines required actions to establish and program transmitter configuration. Contains screen flow diagrams. Configuration sequence flowcharts direct configuration personnel to appropriate configuration procedures.

Security Mode Provides information about transmitter security codes. Contains screen flow diagram. Directs personnel to proper security and password procedure.

Secondary Display Mode Provides information about secondary display that appears during measure mode. Contains screen flow diagram. Directs personnel to appropriate secondary display procedure.

Utility Mode Defines reset options and basic/advanced programming toggle. Contains screen flow diagram. Directs personnel to proper utility mode procedures.

Diagnostics and Troubleshooting Provides description of diagnostic tools available. Contains problem code and error code tables. Troubleshooting sequence flowchart directs personnel to appropriate troubleshooting procedures.

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

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

Support Services Provides list of replacement parts.

Appendix A Provides temperature compensation information.

Appendix B Provides information on concentration programming.

Appendix C Provides glossary of text prompts used in secondary display during transmitter programming.

Procedures PR1 through PR56 Provide procedures for each task.

HOW TO USE THIS INSTRUCTION

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

Some sections of this instruction have been prepared in procedure format. There are flowcharts that follow the introduction to the section and any nonprocedural information. These flowcharts 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.

Each procedure lists the recommended tools to perform that procedure. Specific tool sizes are listed when required, such as Allen wrench size, socket size, wrench size, etc. Screwdrivers are listed as long or short when necessary.

DOCUMENT CONVENTIONS

This document uses standard text conventions to represent keys, display items, and user data inputs:

Display item Any item displayed on a screen appears as italic text. Example:

Running

REFERENCE DOCUMENTS

Table 1-1 lists ABB documents referenced in this instruction.

Table 1-1. Reference Documents

Number	Document
P-E21-001	Installing a 4 to 20 mA transmitter in a hazardous location
WBPEEUI110502A0	Type STT smart transmitter terminal instruction

NOMENCLATURE

Table 1-2 presents the nomenclature for the Type TB82EC transmitter. Use a single digit or letter in each position.

Table 1-2. Nomenclature

Position				5	6	7	8	9	10	11	12	13	Advantage Series Transmitter
T	B	8	2	_	_	_	_	_	_	_	_	_	
													Input
				P	H	_	_	_	_	_	_	_	pH/ORP/pION
				E	C	_	_	_	_	_	_	_	Four-electrode conductivity
				T	E	_	_	_	_	_	_	_	Two-electrode conductivity
				T	C	_	_	_	_	_	_	_	Toroidal conductivity
													Programming
						1	_	_	_	_	_	_	Basic
						2	_	_	_	_	_	_	Advanced
													Digital Communications
							0	_	_	_	_	_	None
							1	_	_	_	_	_	HART[1]
													Lightning Arrestor
								0	_	_	_	_	None
								1	_	_	_	_	Included
													Housing Type
									0	_	_	_	Powder coated, alodined aluminum
													Mounting Hardware
										0	_	_	None
										1	_	_	Pipe
										2	_	_	Hinge
										3	_	_	Panel
										4	_	_	Wall
													Agency Approvals
											0	_	None
											1	_	FM
											2	_	CSA
											3	_	CENELEC
											4	_	SAA
													Label
												0	None
												1	Stainless steel
												2	Mylar®

NOTE:

1. This instruction covers the standard Type TB82EC transmitter. Consult factory for availability of HART version.

SPECIFICATIONS

Table 1-3 lists the specifications for the Type TB82EC transmitter.

Table 1-3. Specifications

Property	Characteristic/Value
Type	2-wire conductivity transmitter
Input types	
Conductivity and concentration	ABB 4-electrode conductivity sensors
Temperature	Pt 100, 3-kΩ Balco RTD, 4.75-kΩ RTD network
Process display range	
Conductivity	0.000 µS/cm to 1,999 mS/cm
Concentration	0.000 to 1,999 digits (engineering unit configurable)
Temperature display range	-20°C to +300°C (-4°F to +572°F)
Sensor full scale measurement range	
Group A	0 to 1,999 mS/cm
Group B	0 to 1,999 µS/cm
Group C	0 to 199.9 µS/cm
Display resolution	
Conductivity	
Group A	0.1 µS/cm
Group B	0.01 µS/cm
Group C	0.001 µS/cm
Concentration	0.001 digits (configuration dependent)
Temperature	1°C or 1°F
Accuracy	
Display	
Conductivity	±0.5% of measurement range per decade
Temperature	1°C or 1°F
Output	±0.02 mA for output range set to full scale values
Nonlinearity	
Display	
Conductivity	±0.5% of measurement range per decade
Temperature	1°C or 1°F
Output	±0.02 mA for output range set to full scale values
Repeatability	
Display	
Conductivity	±0.5% of measurement range per decade
Temperature	1°C or 1°F
Output	±0.02 mA for output range set to full scale values
Stability	
Display	
Conductivity	±2 LSD typical, ±5 LSD max.
Temperature	1°C or 1°F
Output	±0.01 mA for output range set to full scale values

Table 1-3. Specifications (continued)

Property	Characteristic/Value	
Temperature compensation	Manual (0.1N KCl based) and automatic. Automatic configurable as:	
	Standard (0.1N KCl based)	0 to 20% H_2SO_4
	Coefficient (0 to 9.99%/°C adjustable)	Pure water - neutral salt
	0 to 15% NaOH	Pure water - trace acid
	0 to 20% NaCl	Pure water - trace base
	0 to 18% HCl	User-defined
Dynamic response	3 secs for 90% step change at 0.00-sec damping	
Ambient temperature effect at 95% relative humidity		
Conductivity	±0.1%/°C full scale, ±0.2%/°C displayed value	
Output	±0.01 mA/°C	
Output minimum span		
Conductivity		
Group A	100.0 µS/cm	
Group B	10.00 µS/cm	
Group C	1.000 µS/cm	
Concentration	5% max. concentration range	
Output maximum span (full scale settings)		
Conductivity		
Group A	1,999 mS/cm	
Group B	1,999 µS/cm	
Group C	199.9 µS/cm	
Concentration	1,999 digits	
Damping	Continuously adjustable from 00.0 to 99.9 secs	
Supply voltage	13 to 53 VDC (13 to 42 VDC for agency certified applications)	
Load limits	Refer to Figure 1-1.	
Power supply effect	±0.005% of full scale span per volt	
Turn on time	2 secs. typical, 4 secs. max.	
Maximum sensor cable length		
Group A	30.5 m (100 ft)	
Group B	15.2 m (50 ft)	
Group C	7.6 m (25 ft)	
Sensor diagnostics	Fouled or dirty sensor, ground loop detection, shorted cabling	
Diagnostic notification	Local indication via *FAULT* or *SPIKE* icon	
Analog mode	Programmable output pulse, 0 to 16 mA for 1 sec on 6-sec cycles	
Environmental		
Temperature		
Operating	-20°C to +60°C (-4°F to +140°F)	
LCD	-20°C to +60°C (-4°F to +140°F)	
Storage	-40°C to +70°C (-40°F to +158°F)	

Table 1-3. Specifications (continued)

Property	Characteristic/Value	
Environmental (continued)		
Humidity	Will meet specifications to 95% RH (operating and storage)	
Enclosure Classification	NEMA 4X/IP65	
Mounting position effect	None	
Size	½ DIN	
h x w x d	144.0 by 144.0 by 171.0 mm (5.67 by 5.67 by 6.73 in.)	
Minimum panel depth	144.8 mm (5.70 in.)	
Maximum panel cutout	135.4 (+1.3, -0.8) by 135.4 (+1.3, -0.8) mm (5.33 (+0.05, -0.03) by 5.33 (+0.05, -0.03)) in.	
Weight	1.9 kg (4.2 lb) without mounting hardware 3.4 kg (7.5 lb) with pipe mounting hardware	
EMC requirements	Complies with all applicable European Community product requirements, specifically those required to display the CE marking on the nameplate.	
Electromagnetic emission - EN50081-2:1994	EN55011:1991 (CISPR11:1990) Class A	
Electromagnetic immunity - EN50082-2:1996	EN61000-4-2:1995 6 kV contact 6 kV indirect	EN61000-4-3:1997 10 V/m (unmodulated, rms) 80 to 1,000 MHz
	EN61000-4-4:1995 1 kV signal lines 5/50 Tr/Th nS 5 kHz	EN61000-4-8:1994 50 Hz 30 A (rms)/m
	ENV50141:1994 0.15 to 80 MHz 10 V (unmodulated, rms) 80% AM (1 kHz) 150 Ω, source impedance	ENV50204:1996 900, ±5 MHz 10 V/m (unmodulated, rms) 50% duty cycle 200 Hz
Agency certifications[1]		
Nonincendive (nonsparking)		
CSA	Class I; Division 2; Groups A, B, C, and D Class II; Division 2; Groups E, F, and G Class III; Division 2	
FM	Class I; Division 2; Groups A, B, C, and D Class II; Division 2; Groups F and G Class III; Division 2	
SAA	Ex n, Zone 2; Group IIC, T6	
Intrinsic safety	When used with appropriate barriers per application guide ***Installing a 4 to 20 mA transmitter in a hazardous location***.	
CENELEC	EEX ib, Zone 1; Group IIC, T6	
CSA	Classes I, II, III; Division 1, Applicable Groups A, B, C, D, E, F, and G; T4	
FM	Classes I, II, III; Division 1; Applicable Groups A, B, C, D, E, F, and G; T6	
SAA	Ex ia, Zone 0; Group IIC, T6	

NOTE:

1. Hazardous location approvals for use in flammable atmospheres are for ambient conditions of -25°C to +40°C (-13°F to +104°F), 86 to 108 kPa (12.5 to 15.7 psi) with a maximum oxygen concentration of 21%.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

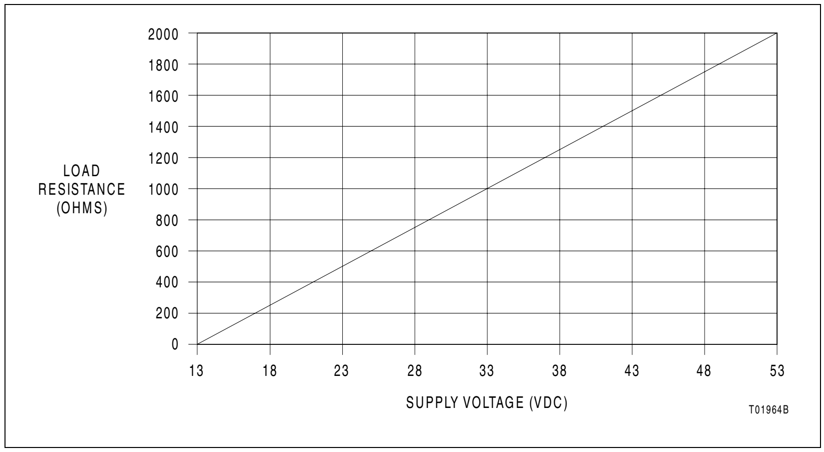

Figure 1-1. Load Limits

ACCESSORIES

Table 1-4 lists the accessory kits for the Type TB82EC transmitter and Table 1-5 lists compatible sensors.

Table 1-4. Accessory Kits

Part Number	Description
1948385?1	Contains static-dissipative work surface (mat), ground cord assembly, wrist bands, and alligator clip for personnel working on devices containing semiconductor components.
4TB9515-0123	Panel mounting
4TB9515-0124	Pipe mounting
4TB9515-0125	Hinge mounting
4TB9515-0156	Wall mounting

Table 1-5. Sensors

Model	Sensor Group	Fitting Type
TB451	A	Kynar sanitary/sterilizable
TB452	B	
TB454	A	Inline, twist lock, submersible
TB456	A	Inline, submersible
TB457	A	316 stainless steel sanitary/sterilizable
TB458	B	
TB459	C	
TB461	A	Inline threaded, submersible ball valve insertion, hot tap
TB465	B	
TB466	C	High purity, flow cell
TB467	C	Inline threaded, submersible ball valve insertion, hot tap

Table 1-5. Sensors (continued)

Model	Sensor Group	Fitting Type
TB468	A	Inline threaded, corrosion-resistant, hot tap
TB471	A	High pressure hot tap
TB475	B	
TB477	C	

SECTION 2 - DESCRIPTION AND OPERATION

INTRODUCTION

This section contains an overview of the functionality of the Type TB82EC transmitter.

FUNCTIONAL OPERATION

The Type TB82EC transmitter provides a four to 20-milliamp output signal that is proportional to solution conductivity as measured by the transmitter and the sensor. The transmitter is compatible with all ABB four-electrode conductivity sensors.

The transmitter has internal diagnostic capabilities. These detect any potential electronics or firmware operation problems. Diagnostic capabilities also include detection of sensor integrity such as:

- Ground loop detection.
- Shorted cabling.
- Process variables out of range.
- Incorrect calibration values.

USER INTERFACE

The user interface consists of a tactile keypad with four nondedicated smart keys and a custom LCD.

The LCD has a three and one-half digit numeric region that displays the process variable, a six-digit alphanumeric region that displays secondary information and programming prompts, and several status-indicating and programming icons.

Using a patent-pending novel approach, each of the four smart keys is located under a given set of icons. In each of the instrument modes and mode states, one icon over any given smart key illuminates and represents that smart key function. These smart key assignments vary as different programming modes and states are entered. In addition to the smart key assignments, text strings located in the six-character alphanumeric field (secondary display) are used as programming prompts.

MODULAR ELECTRONICS

The transmitter consists of three separate PCB (printed circuit board) assemblies that concentrate specific circuit functionality. This modular design allows for the ability to change the instrument from one of four types of instruments to another: pH/ORP/pION, four-electrode conductivity, two-electrode conductivity, and toroidal conductivity. In addition, instrument repair is made quick and easy by replacing the nonfunctioning PCB.

TEMPERATURE COMPENSATION

The process temperature is monitored using one of three types of RTD inputs: three-kilohm Balco, Pt 100, and the ABB 4.75-kilohm RTD network. It is possible to program the secondary display to show the temperature in degrees Celsius or degrees Fahrenheit when in the measure mode.

Temperature affects the activity of the disassociated ions in solution and hence the conductivity of that solution. Therefore, manual and automatic temperature compensation functions are available. Temperature compensation functions for conductivity and concentration configurations include manual (0.1N KCl based) and 10 types of automatic compensation routines. Refer to Table 1-3 for a list of the automatic types.

DAMPING

Input damping can be adjusted from 00.0 to 99.9 seconds. This feature is useful in noisy process environments. It helps minimize the displayed process variable and output current bounce.

Damping simulates a capacitive type lag where reaction to any signal change is slowed according to an entered time constant. For example, the output response to a step change in input reaches approximately 63.2 percent of its final value in five seconds for five seconds of damping.

DIAGNOSTICS

Diagnostics are provided for both the transmitter and sensor. Diagnostic detection of a serious condition that prevents the instrument from properly functioning enables a preset safe mode state. This configurable safe mode state forces the instrument output to be either high or low.

Some problems do not keep the instrument from functioning. A diagnostic spike output feature is used for these conditions. Once enabled, this feature modulates the output for one second out of every six seconds. The magnitude of these modulations can be set from zero to 100 percent of the maximum output. Detection of over 40 problem conditions can be enabled.

In both cases, diagnostic conditions cause the *FAULT* and *FAULT info* icons on the display to energize. Interrogation of each fault condition is available using a single keystroke.

Section 12 provides diagnostics information.

Transmitter Diagnostics

Five critical errors in operation are monitored and linked to the safe mode feature. These conditions include: inoperable or incorrect input circuit, bad RAM, and damaged EE memory.

Sensor Diagnostics

The transmitter continually performs diagnostics on sensor integrity. When configured to do so, the *FAULT* and *FAULT info* icons and the spike output feature notify the operator of inconsistencies in sensor performance.

Sensor faults that activate the diagnostics are: fouled or dirty sensor, shorted cable, shorted or open temperature sensor, high and low PV (process variable), high and low temperature, and many more.

Spike Output

Using the spike state in the configure mode initiates remote problem notification. The spike output option allows programming of a one to 100-percent (0.16 to 16-milliamp) pulse impressed on the four to 20-milliamp output for one second out of a six-second repeating cycle upon detection of a problem condition. Should the actual output of the transmitter be below 12 milliamps, the pulse adds current; if above 12 milliamps, it subtracts current.

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 procedures to perform that task.

SPECIAL HANDLING

In addition to the normal precautions for storage and handling of electronic equipment, the transmitter 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 workstation.

   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 1-4) 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 ABB sales office.

Carefully inspect packing material before discarding it to make sure that all mounting equipment and any special instructions or paperwork has been removed. Careful handling and installation insures satisfactory performance of the transmitter.

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 1-3.

NOTE: Remove the protective film from the transmitter lens after placing it in its final installed location.

LOCATION CONSIDERATIONS

When mounting the transmitter, leave ample clearance for removal of the front bezel and rear cover. Signal wiring should not run in conduit or open trays where power wiring or heavy electrical equipment could contact or interfere with the signal wiring. Use twisted, shielded pairs for best results.

Figure 3-1 shows the overall dimensions of the transmitter. Mounting hardware attaches to two or more of the four sets of threaded holes on the housing.

The transmitter design allows for panel mounting, pipe mounting, hinge mounting, or wall mounting. The installation site should be vibration free and conform to the environmental constraints listed in Table 1-3. Careful placement of the transmitter insures proper operation as well as overall safety.

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

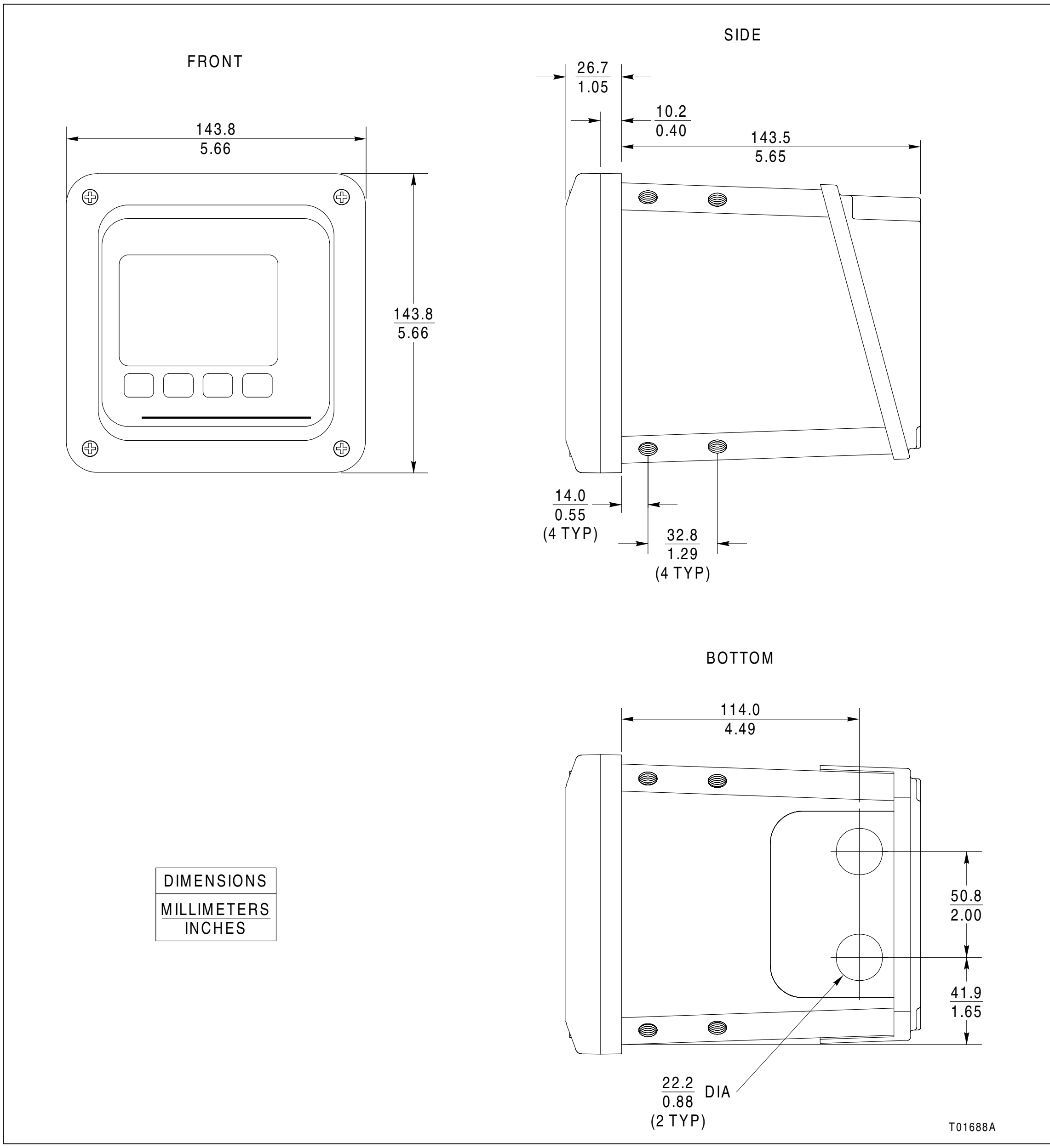

Figure 3-1. Transmitter Dimensions

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 1-3 lists the agencies and types of hazardous location certifications for the transmitter.

Refer to ***Installing a 4 to 20 mA transmitter in a hazardous location*** for additional information when using equipment in a hazardous area.

Radio Frequency Interference

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

WIRING CONSIDERATIONS

NOTE: To prevent possible signal degradation, use a separate metal conduit run for both the sensor and signal/power wiring.

Transmitter power passes through the signal leads. Under ideal conditions, the use of conduit and shielded wire may not be required. However, to avoid noise problems, enclose the sensor and signal/power wiring in separate 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.

Signal/power wiring must bear a suitable voltage rating, a temperature rating of 75-degrees Celsius (167-degrees Fahrenheit), and must be in accordance with all NEC requirements for the installation site.

OTHER EQUIPMENT INTERFACE

The transmitter has an isolated output and controls the loop current between four and 20 milliamps depending on the range and process variable values. Since the output is isolated, the instrument loop may have a maximum of one nonisolated device within its circuit. The maximum load on the current loop must not exceed that shown in Figure 1-1.

TRANSMITTER ROTATION

The transmitter has four pairs of threaded mounting holes. Since these holes are located at the corners of the transmitter, it can be mounted in any of the four positions as shown in Figure 3-2.

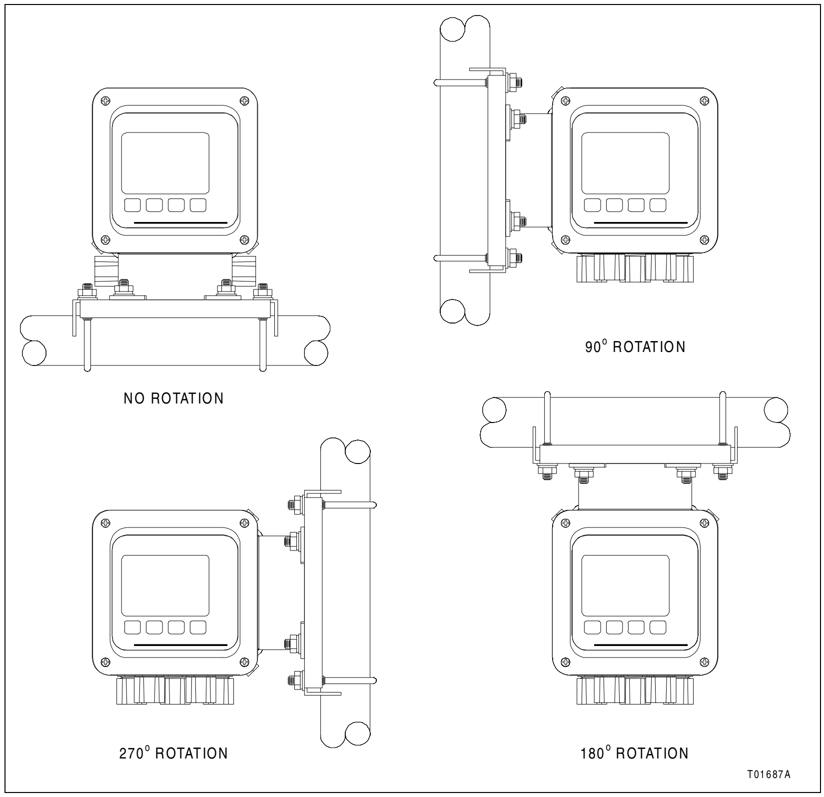

Figure 3-2. Transmitter Rotation

INSTALLATION SEQUENCE

Refer to Figure 3-3 for the transmitter installation sequence. 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.

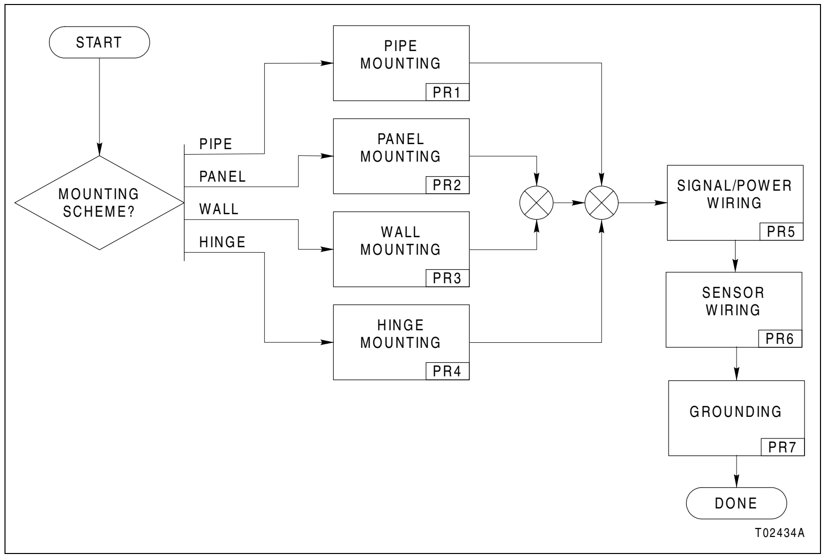

Figure 3-3. Installation Sequence

SECTION 4 - OPERATING PROCEDURES

INTRODUCTION

The Type TB82EC transmitter has six main operating modes: measure, calibrate, output/hold, configure, security, and secondary display. An operating mode has several programming states that contain functions specific to that mode.

The transmitter has a built-in user interface through which all transmitter functions are programmed or monitored. In order to maximize the viewing area and minimize the space needed for the keypad, the patent-pending interface uses a custom LCD and four-button keypad. Instrument functions and programming prompts are available through two regions on the LCD. These regions include a primary area that shows the process variable (conductivity) and a secondary area that displays text prompts for programming or auxiliary information.

In addition to the user friendly interface, the transmitter has a group of icons that alert the user of an existing fault condition, diagnostic spike output, or a held output. These icons, located at the top of the LCD, only energize under the specified condition. Pressing the *FAULT info* smart key while in the measure mode allows interrogation of any fault condition.

OPERATOR INTERFACE CONTROLS

The operator interface consists of the LCD and the smart keys.

Liquid Crystal Display

The LCD contains nine regions that provide information on the process variable, engineering units, mode of operation, output hold condition, fault indication, secondary variable, and soft key assignments. A view of the fully energized LCD with smart key and mode text included is shown in Figure 4-1.

The top set of icons indicates abnormal operating conditions such as the *Hold*, *Fault*, or *Spike* state. These icons only energize when the transmitter detects such a condition. They are active in all modes of operation.

The mode of operation indicators, shown as right arrows grouped next to the mode text, indicate the current mode of operation. Only one indicator is lit at a time. The appropriate indicator energizes when moving from one mode to the other. The mode of operation indicators are active in all modes of operation.

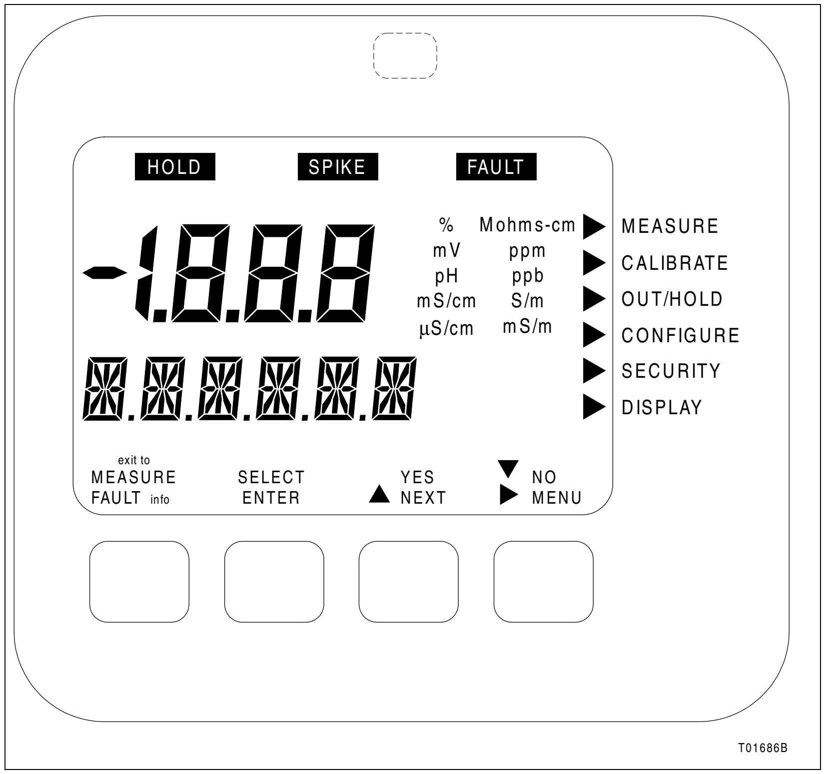

Figure 4-1. Liquid Crystal Display

The process variable appears in the three and one-half digit, seven-segment region. This display region is supported by the engineering unit region. These regions are normally active in all modes of operation; however, some programming states use these regions for data entry.

The secondary variable is displayed in the six-character, 14-segment region. This display region displays secondary information and fault information in the measure mode and textual prompting in all other modes of operation. Due to the limited number of characters for this display region, much of the prompting takes the form of text abbreviations. Refer to Appendix C for programming text abbreviations. This region is active in all modes of operation.

The smart key assignments are grouped into four sets of icons, each group directly positioned above one of the four smart keys. These icons are textual representations of the function for the associated smart key. Only one assignment will be energized per smart key at any given time.

Smart Keys

A four-button, tactile keypad is located on the front panel of the instrument. The gray buttons are embossed to easily show their location. A fifth hidden button, located at the top of the

NT in the text *ADVANTAGE*, provides access to infrequently used functions.

The four embossed keys are called smart keys since their functions are dependent on the mode and state of the instrument. Since these four keys do not have a preassigned function, icons energize over the key to indicate its function. If a smart key does not have an icon energized above it, this smart key does not have a function and initiates no action when pressed. Using this smart key method, a reduced number of keys can be used without complicating instrument functionality.

Pressing the smart key initiates the displayed function of that smart key for each operating mode and state. For example, the *NEXT* function enables the cycling through of a series of programming states. The *SELECT* function enables entering into a given mode of operation or programming state. Using this method, the transmitter guides the user through the necessary steps to program or monitor the desired functions.

A general description of each smart key function is given in Table 4-1.

Table 4-1. Smart Key Functions

Icon	Function
ENTER	Stores configured items and alphanumeric data into permanent memory.
exit to MEASURE	Escapes to measure mode from all other modes and programming states. Not available in measure mode.
FAULT info	Accesses information on diagnostic problem or error conditions. Displays information as short text string and code. Only available in measure mode.
MENU	Increments through modes of operation.
NEXT	Increments through series of programming states.
NO	Denies action about to take place.
SELECT	Selects mode of operation or programming state shown in secondary display.
YES	Affirms action about to take place.
▼	Decrements numeric values or moves through a series of parameters.
▲	Increments numeric values or moves through a series of parameters.
▶	Steps to right moving from one digit to the next.

MODES OF OPERATION

The measure mode is the normal operating mode of the transmitter and is the default mode upon power up. The measure mode is the starting point for entry into other modes. Each mode contains a unique set of transmitter functions or states. These modes and their related functions are shown in Table 4-2.

Table 4-2. Modes of Operation

Mode	Function
Calibrate	Calibration of input and output functions.
Configure	Configuration of transmitter functions such as type of conductivity sensor, temperature compensation types, temperature sensor, temperature units, etc.
Display	Selection of variable displayed in secondary display when in measure mode.
Measure	Display of process and secondary variables. Normal transmitter operating mode.
Output/hold	Online tuning of output parameters or manual setting of transmitter output. Useful during instrument maintenance, for example.
Security	Entering of password protection for calibrate, output/hold, and configure modes.

HOLD ICON

The *HOLD* icon energizes when a hold condition is active. Holding the output can only be manually enabled. Manual activation is accessible in the output/hold mode of operation. In this mode, the hold state permits the output to be held at the captured level or at a manually set level.

FAULT ICON

The *FAULT* icon energizes when the transmitter detects a fault condition. Fault conditions include all problem and error detection as outlined in Section 12.

SPIKE ICON

When enabled, the spike output function induces a step change in the level of the output current. The magnitude of the step change is configured as a percentage of the output current. When the transmitter detects a fault condition and has the spike output function enabled, the transmitter output begins to modulate and the *SPIKE* icon energizes. This provides local and remote indication of a measurement loop fault condition. Refer to Section 12 for more information on spike output and fault conditions.

SECTION 5 - MEASURE MODE

INTRODUCTION

The measure mode is the mode of operation upon transmitter power up and is the normal operating state of the transmitter. In this mode, the process variable, output state, fault condition state, spike state, and secondary display information are displayed. All other modes of operation and fault information are accessible from the measure mode.

BOREDOM SWITCH

When any operating mode or state is entered and the measure mode is not returned to after the final step, the transmitter automatically returns to the measure mode of operation after 20 minutes of unattended use. This feature insures the transmitter always ends up in its normal mode of operation.

PRIMARY DISPLAY

The primary display shows the process variable. The value of this variable is dependent on the configured analyzer, temperature compensation type, temperature value, sensor output, and damping value. The engineering units for the process variable are dependent only on the configured analyzer. Table 5-1 lists the analyzer types and corresponding engineering units.

Table 5-1. Engineering Units

Analyzer Type	Engineering Unit
Concentration	ppm, ppb, percent, or user-defined
Conductivity	mS/cm, µS/cm

SECONDARY DISPLAY

The secondary display has the ability to show a large array of information. Since the display area only has six characters, only one item can be shown at any given time. Typically, this region displays the process temperature in degrees Celsius; however, it can be changed to display the process temperature in degrees Fahrenheit, output current in milliamps, sensor type, sensor group, conductivity value, and solute name for a concentration analyzer, or firmware revision. Refer to Section 10 for more information.

Fault Information Smart Key

Fault information is only accessible from the measure mode of operation. It is interrogated through the *FAULT info* smart key. A fault condition causes the *FAULT* icon to blink and the *FAULT info* smart key to appear. These indicators continue to be present as long as the fault condition exists.

When pressing the *FAULT info* smart key, the faults appear in a FIFO (first in, first out) order and the first fault condition is shown in the secondary display. A short text string followed by the fault code is sequentially shown. Depressing the *FAULT info* smart key progressively moves from one fault to the next until all faults have been shown. Once all faults have been cycled through, the *FAULT* icon no longer blinks but remains on until removal of all fault conditions. If a new fault condition is detected, the *FAULT* icon begins to blink to indicate the newly detected condition. For more information on fault conditions and codes, refer to Section 12 and its related procedures.

Menu Smart Key

The *MENU* smart key provides access to all other modes of operation. By pressing the *MENU* smart key, the transmitter moves from one mode of operation to the next. Visual feedback is provided in two manners: the mode indication arrow moves to the next mode, such as *CALIBRATE*, and the secondary display shows the text string representative of that mode, such as *CALIBR*. Access into the displayed mode of operation is allowed by pressing the *SELECT* smart key. The *exit to MEASURE* smart key provides an escape function to the measure mode.

As seen in the screen flow diagram shown in Figure 5-1, pressing the *MENU* smart key when in the measure mode moves the transmitter into the calibrate mode. Once in the calibrate mode, pressing the *exit to MEASURE* smart key returns the transmitter back to the measure mode. Pressing the *SELECT* smart key moves the transmitter into the calibrate states of operation. Pressing the *MENU* smart key moves the transmitter to the output/hold mode. Use Figure 5-1 to identify the smart key assignments and the resulting action.

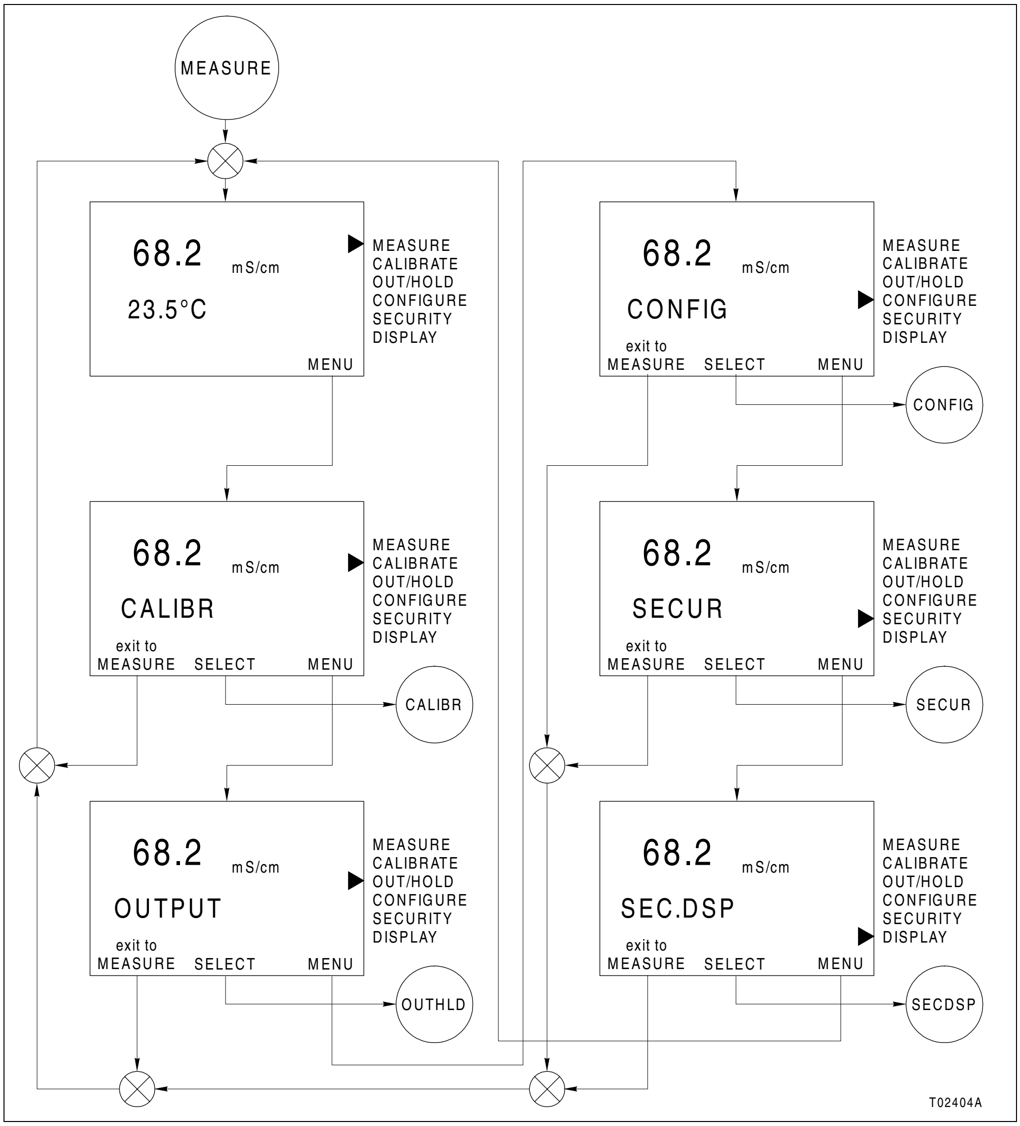

Figure 5-1. Operating Mode Screen Flow

SECTION 6 - CALIBRATION

INTRODUCTION

The calibrate mode provides the ability to calibrate the sensor input, temperature input, and transmitter output. These functions, referred to as calibrate states, include conductivity/concentration calibration, temperature calibration, edit calibration, reset calibration, and output calibration.

CALIBRATE STATES

The calibrate mode consists of five states. Table 6-1 describes the function of each state.

Table 6-1. Calibrate States

State	Display	Description
Conductivity/concentration calibration	*CON.CAL*	Calibration of process sensor input via one-point smart calibration that adjusts offset, slope, or both based on sensor calibration history.
Edit calibration	*EDT.CAL*	Manual adjustment of process sensor and temperature offset and slope values.
Output calibration	*OUT.CAL*	Calibration of transmitter output values to measured values using external validation device.
Reset calibration	*RST.CAL*	Restores calibration values for process and temperature sensors to factory settings.
Temperature calibration	*TMP.CAL*	Calibration of temperature sensor input via one-point smart calibration that adjusts offset, slope, or both based on sensor calibration history.

When in the calibrate mode, pressing the *NEXT* smart key causes the display to sequentially move through each calibrate state. This cycle repeats until either selecting a calibrate state using the *SELECT* smart key or choosing the escape function by pressing the *exit to MEASURE* smart key.

When performing the conductivity/concentration calibration, invalid new calibration values generate the text string *BAD.CAL* on the display, and the calibration value is not accepted. If the new value is valid, the slope is shown. Pressing the *NEXT* smart key displays the offset value. At this point, pressing the *NEXT* smart key returns the transmitter to the conductivity/concentration calibrate state. Pressing the *exit to MEASURE* smart key returns the transmitter to the measure mode.

NOTE: If *HOLD* appears on the display, the transmitter inquires if this condition should be released.

More information on sensor calibration diagnostics and troubleshooting techniques can be found in Section 12.

Figure 6-1 is a screen flow diagram for the calibrate mode of operation.

CALIBRATION SEQUENCE

Refer to Figure 6-2 for the calibration sequence for the transmitter. 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.

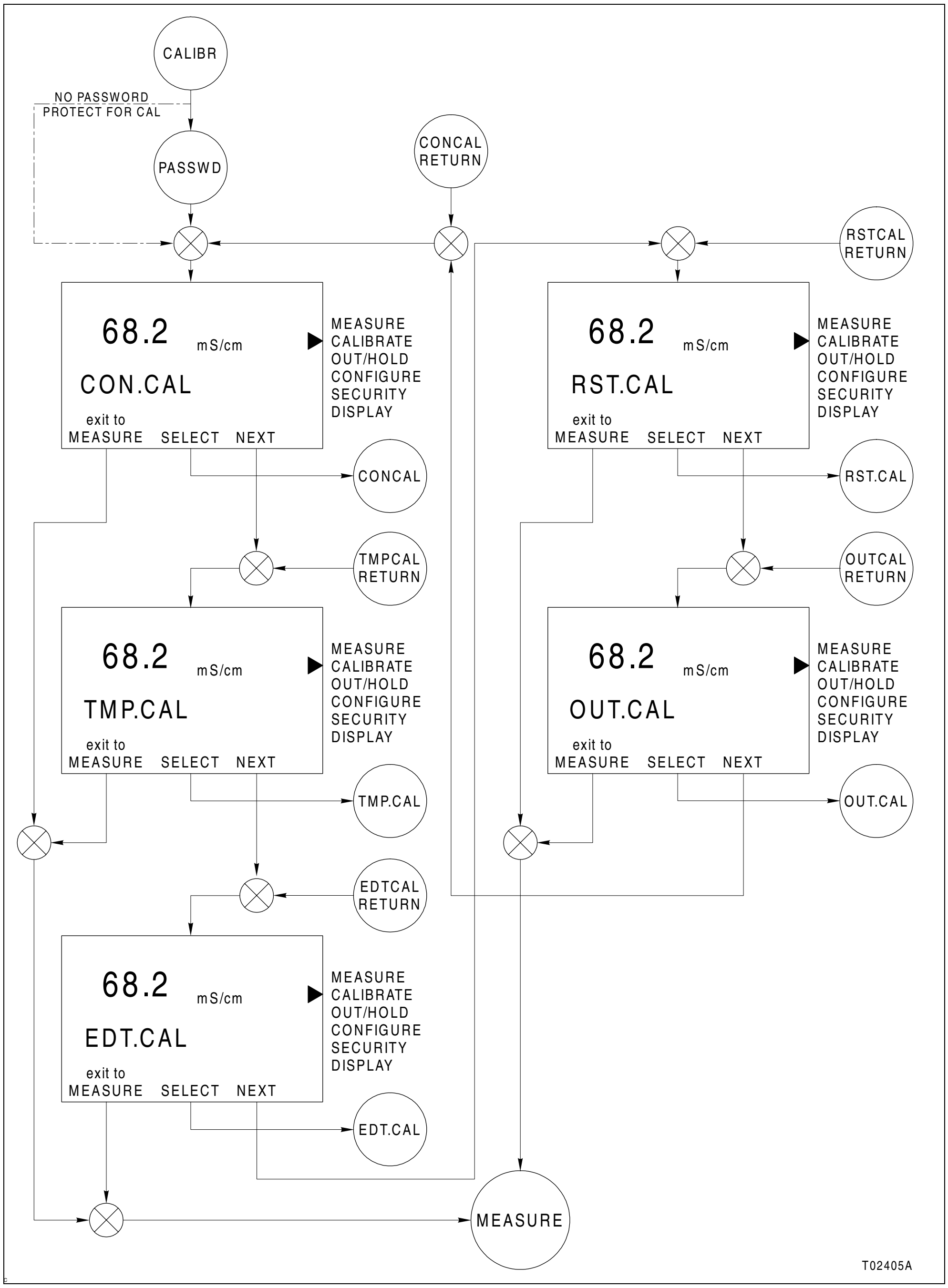

Figure 6-1. Calibrate Mode Screen Flow

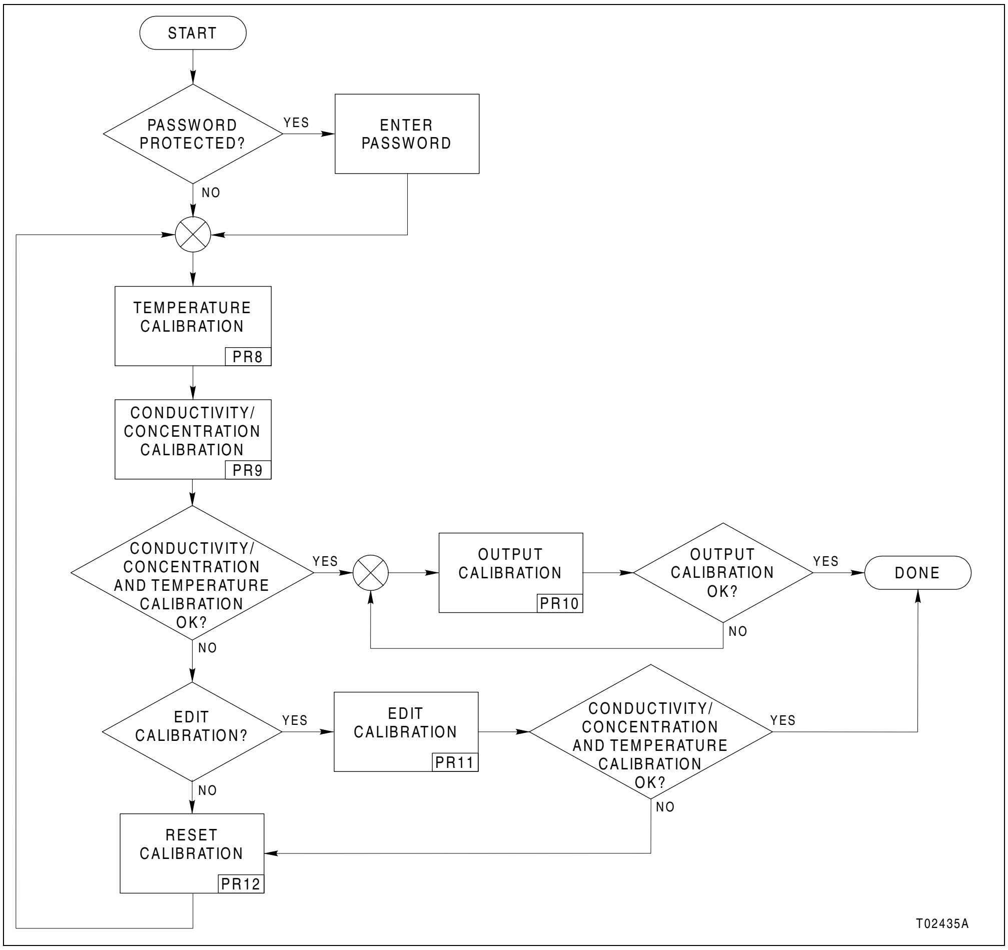

Figure 6-2. Calibration Sequence

SECTION 7 - OUTPUT/HOLD MODE

INTRODUCTION

The output/hold mode of operation provides the ability to set the output to a fixed level, change the output range, damp the output signal, or enable the diagnostic spike.

This section describes the states in the output/hold mode of operation (Table 7-1).

OUTPUT/HOLD STATES OF OPERATION

When in the output/hold mode, pressing the *NEXT* smart key causes the display to move sequentially through each output/hold state. This cycle repeats until either selection of an output/hold state using the *SELECT* smart key or choosing the escape function by pressing the *exit to MEASURE* smart key.

The output/hold mode consists of five states of operation. Table 7-1 describes the function of each state of operation and the related procedures. There is no particular sequence for these procedures. Figure 7-1 is a screen flow diagram for the output/hold mode of operation.

Table 7-1. Output/Hold States

State	Display	Function	Procedure
Damping	*DAMPNG*	Reduces fluctuation in output signal.	PR13
Hold	*HOLD*	Fixes output level at value captured upon initiation of hold or at manually entered level.	PR14
Release hold	*REL.HLD*	Releases existing output/hold state.	PR15
Rerange	*RERANG*	Changes output range.	PR16
Spike	*SPIKE*	Enables or disables spike output function if configured.	PR17

Hold/Release Hold Output State

The hold output state allows the transmitter output to be fixed at a level captured when the hold was initiated. This capture level can also be manually adjusted to any value between zero and 100 percent (four and 20 milliamps).

Rerange State

The rerange output/hold state provides the ability to change the output range. One or both endpoint values can be changed to any value or range of values that are within the specifications listed in Table 1-3.

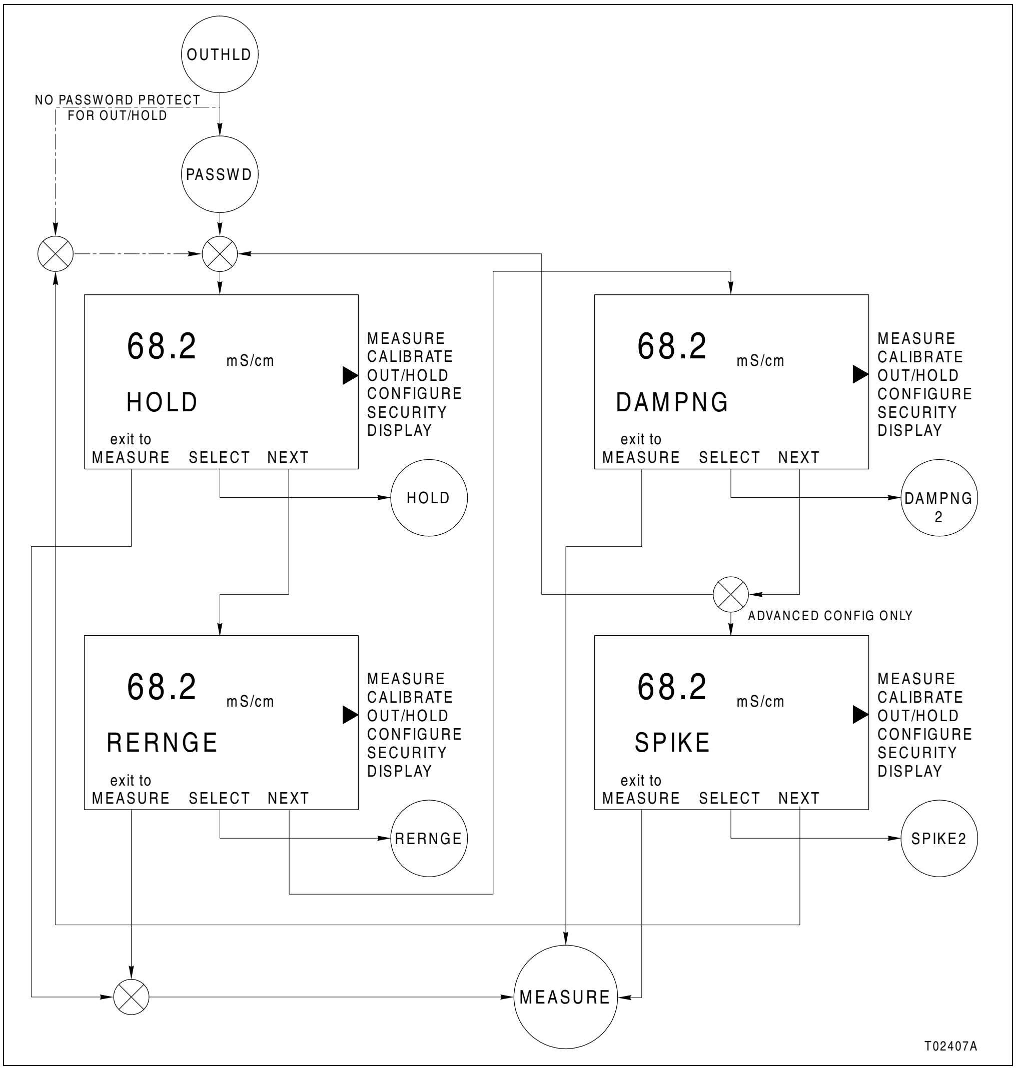

Figure 7-1. Output/Hold Mode Screen Flow

Damping State

The damping state applies a lag function on the output signal and reduces fluctuations caused by erratic process conditions. The damping value can be set from 00.0 to 99.9 seconds. This value represents the time required for the output to reach approximately 63.2 percent of its final value in response to a step change in the process variable.

Spike State

The spike state toggles the operational state of the spike output function. The spike function modulates the current output by an amount set in the transmitter configuration. This function is only available on transmitters with the advanced programming option.

SECTION 8 - CONFIGURATION

INTRODUCTION

The configure mode of operation establishes the operating parameters of the Type TB82EC transmitter. These parameters include: programming type, analyzer type, sensor type, temperature compensation type, output range, damping value, diagnostic functionality, safe mode level, and spike magnitude. Review each of the following sections and related procedures before configuring the transmitter.

This section contains screen flow diagrams and brief descriptions of the configure states of operation. Refer to ***CONFIGURATION SEQUENCE*** for procedures needed to perform the configuration tasks.

PRECONFIGURATION DATA REQUIRED

Before attempting to configure the transmitter, define the following:

- Analyzer parameters.
- Output range values.
- Security requirements.
- Sensor diagnostic functionality.

Use the worksheet at the end of these sections to help establish the proper settings for any given application. Use this worksheet during the configuration entry procedure and retain it as a historical record for future reference.

CONFIGURE VIEW/MODIFY STATE

When the configure mode is entered, a decision point is reached to determine whether to modify or view the configuration. The modify configure state enables transmitter options to be set and saved into memory. In order to provide the ability to secure the modify configure state, yet leave the ability to view configuration information, the view configure state can be entered without using a security code.

As seen in Figure 8-1, the transmitter allows the opportunity to modify the configuration. Pressing the *YES* smart key moves the transmitter into the modify configure state. Pressing the *NO* smart key moves the transmitter to the view configuration inquiry. Pressing the *exit To MEASURE* smart key escapes to the measure mode. To view a configuration, press the *YES* smart key when queried to view the configuration.

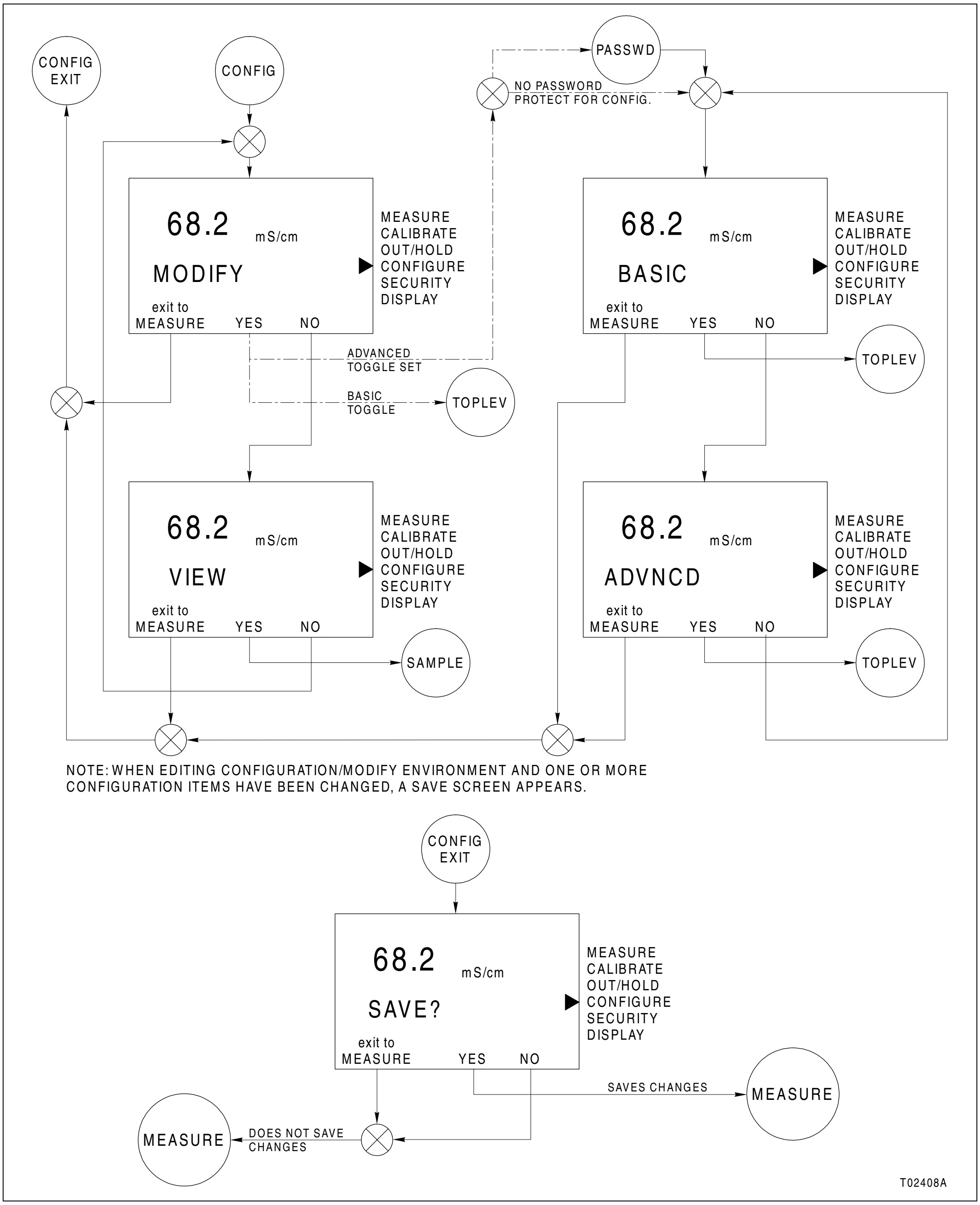

Figure 8-1. Modify/View and Basic/Advanced States Screen Flow

BASIC/ADVANCED PROGRAMMING MODE

The configure mode is split into two groups of programming: basic and advanced. These two options are specified by nomenclature and control the number of configuration options available in the modify configure mode.

The basic programming mode contains a subset of configuration options found in the advanced mode. Separation into two programming groups is advantageous when limited functionality is desired. Fewer options reduces confusion and the possibility of configuration errors.

When advanced programming is ordered, the basic/advanced programming toggle must be set in two locations:

- User state in the utility mode.
- Modify configure state in the configure mode.

In order to select either the basic or advanced programming mode in the modify configure state, the programming mode must be set to advanced in the user state.

Refer to Section 11 for more information on setting the user state programming mode to advanced.

MODIFY CONFIGURE STATES OF OPERATION

Since the view configure state only displays the configured options, the following sections focus on each modify configure state and available options for these states. Refer to ***CONFIGURATION SEQUENCE*** for the procedures necessary to perform the modifications.

The modify configure state contains all the available settings that establish the functionality of the transmitter. Upon receipt of the transmitter, the default configuration (unless otherwise specified by the customer) is used once the transmitter has been powered.

Before installing the transmitter, modify the configuration to reflect the final installed application. The modify configure states of operation define the sensor interface, output parameters, and diagnostic functionality.

The following sections contain descriptions of each modify configure state of operation. Figure 8-2 shows the screen flow for the modify configure states of operation.

Analyzer State (Basic/Advanced)

The analyzer state determines the transmitter and sensor type.

Conductivity Analyzer State (Basic/Advanced)

The conductivity analyzer state contains three choices for four-electrode sensor groups: A, B, and C.

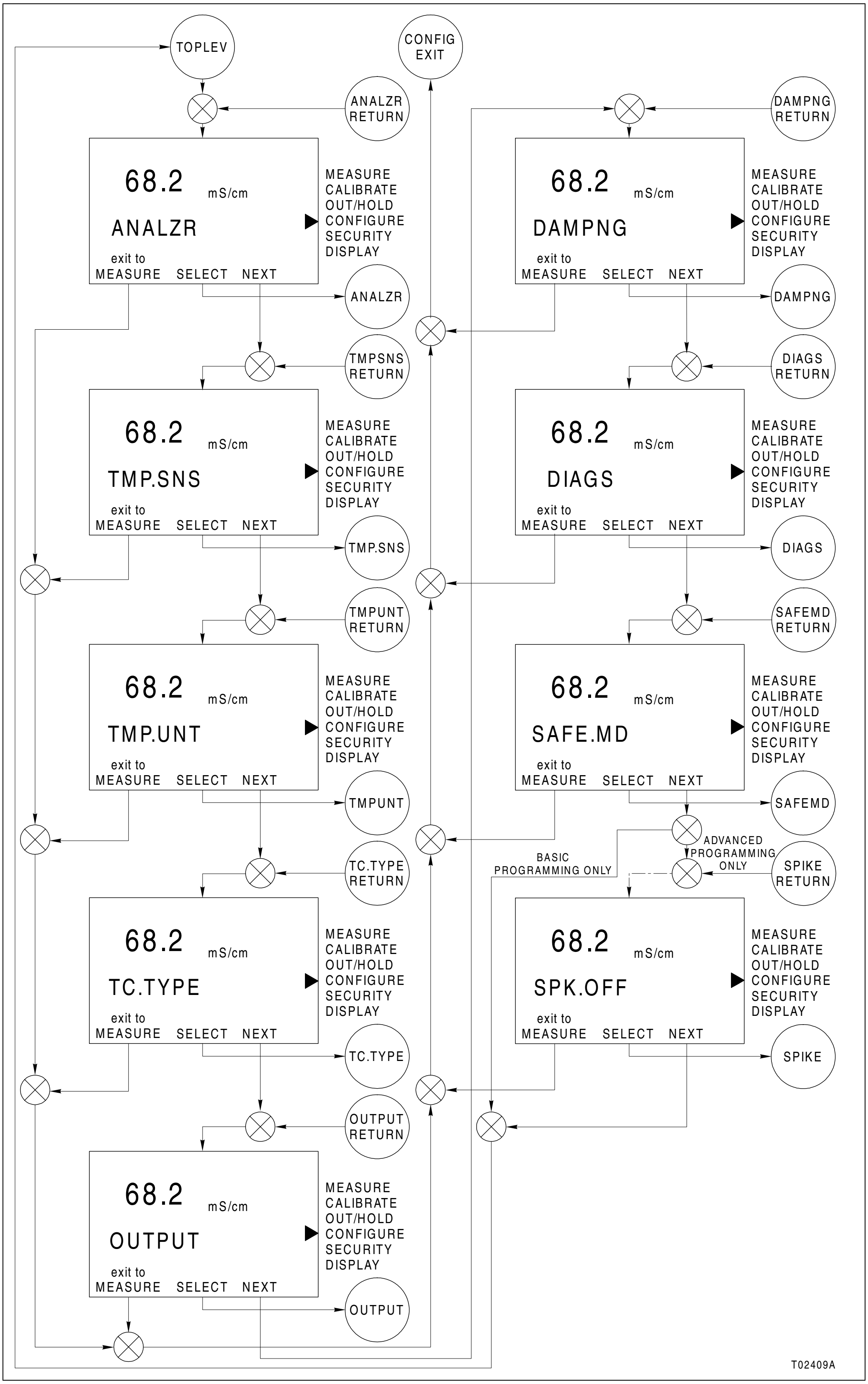

Figure 8-2. Modify Configure States Screen Flow

Concentration Analyzer State (Advanced)

The concentration analyzer state converts conductivity values to concentration units. This state applies temperature compensated conductivity measurements to a predefined or user-defined function.

Temperature Sensor State (Basic/Advanced)

The temperature sensor state configures the temperature input for no temperature sensor (none), a Pt 100 RTD, three-kilohm Balco RTD, or 4.75-kilohm RTD network.

When none is selected, the temperature is fixed at 25-degrees Celsius and the temperature compensation is fixed at manual. Changing the fixed temperature value requires a temperature calibration.

Temperature Compensation State (Basic/Advanced)

Temperature has a marked effect on the conductance of many solutions. The effect is generally nonlinear and dependent on the particular ionic species and their concentration.

The transmitter software has a number of preprogrammed correction algorithms that compensate the effect of temperature on conductivity to a reference temperature of 25-degrees Celsius. This results in accurate and stable measurements when temperature varies.

Options for temperature compensation are grouped into two sets: manual and auto. Manual temperature compensation contains no additional options. It is locked to a specific process temperature independent of the selected temperature sensor. If desiring a different process temperature, adjust it during a temperature calibration.

Auto temperature compensation options are sensor group dependent. They use temperature values measured by the transmitter temperature input. Compensation algorithms include: standard KCl (0.1N KCl based), solution coefficient, zero to 15-percent NaOH, zero to 20-percent NaCl, zero to 18-percent HCl, zero to 20-percent H_2SO_4, pure water neutral, pure water trace acid, pure water trace base, and user-defined.

The user-defined temperature compensation option requires uncompensated conductivity data from the reference temperature of 25-degrees Celsius to the maximum process temperature on a representative sample of process solution. This data is used to calculate the ratio of uncompensated conductivity to conductivity at the reference temperature of 25-degrees Celsius. These ratios are then plotted against temperature.

An example of a typical user-defined temperature compensation plot is shown in Figure 8-3 and Table 8-1.

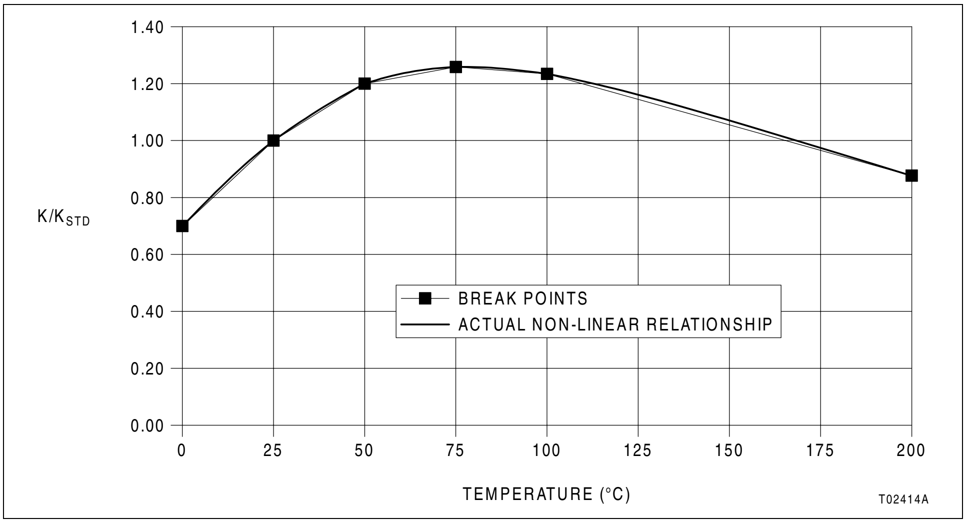

Figure 8-3. User-Defined Temperature Compensation Curve

Table 8-1. User-Defined Temperature Compensation Data

Point	Temp. (°C)	Uncompensated Conductivity (mS/cm)	Conductivity Ratio (K/K_{STD})
1	0	7.21	0.70
2	25	10.30	1.00
3	50	12.25	1.19
4	75	12.97	1.26
5	100	12.82	1.24
6	200	9.06	0.88

The curve is a nonlinear function divided into five line segments. The endpoints represent points one and six. The breakpoints represent points two through five.

Refer to Appendix A for more information on temperature compensation.

Output State (Basic/Advanced)

The output state sets the output type and range. The default output range values are 10-percent of the full scale process variable for Group A sensors, and full scale process variable for Groups B and C sensors. If desiring a reverse-acting output, reverse the four and 20-milliamp process variable values.

Damping State (Basic/Advanced)

The damping state applies a lag function on the output signal and reduces fluctuations caused by erratic process conditions. The damping value can be set from 00.0 to 99.9 seconds. This value represents the time required for the output to reach approximately 63.2 percent of its final value in response to a step change in the process variable.

Diagnostics State (Basic/Advanced)

The diagnostics state allows disabling of the built-in sensor diagnostics.

Safe Mode State (Basic/Advanced)

The safe mode state determines the output level of the transmitter if an error condition occurs that renders the transmitter inoperable. The available states are fail low and fail high. For more information on error conditions, refer to Section 12.

Spike State (Advanced)

The spike state sets the diagnostic spike level as a percent of output. This level determines the magnitude of the spike.

When the spike has been set for any level greater than zero percent and is enabled in the spike output state, the transmitter modulates the output signal by the configured level for one out of every six seconds. Using this modulation, the transmitter informs the operator of a detected diagnostic condition. For more information on error conditions, refer to Section 12.

CONFIGURATION LOCKOUT

The transmitter has a hardware lockout feature that, once engaged, prohibits access to the configure mode. This feature does not affect parameters that can be changed in other modes of operation. Refer to ***CONFIGURATION SEQUENCE*** for the configuration lockout procedure.

CONFIGURATION SEQUENCE

Refer to Figures 8-4, 8-5, and 8-6 for the transmitter configuration sequence. 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 configuration. 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 configuration sequence.

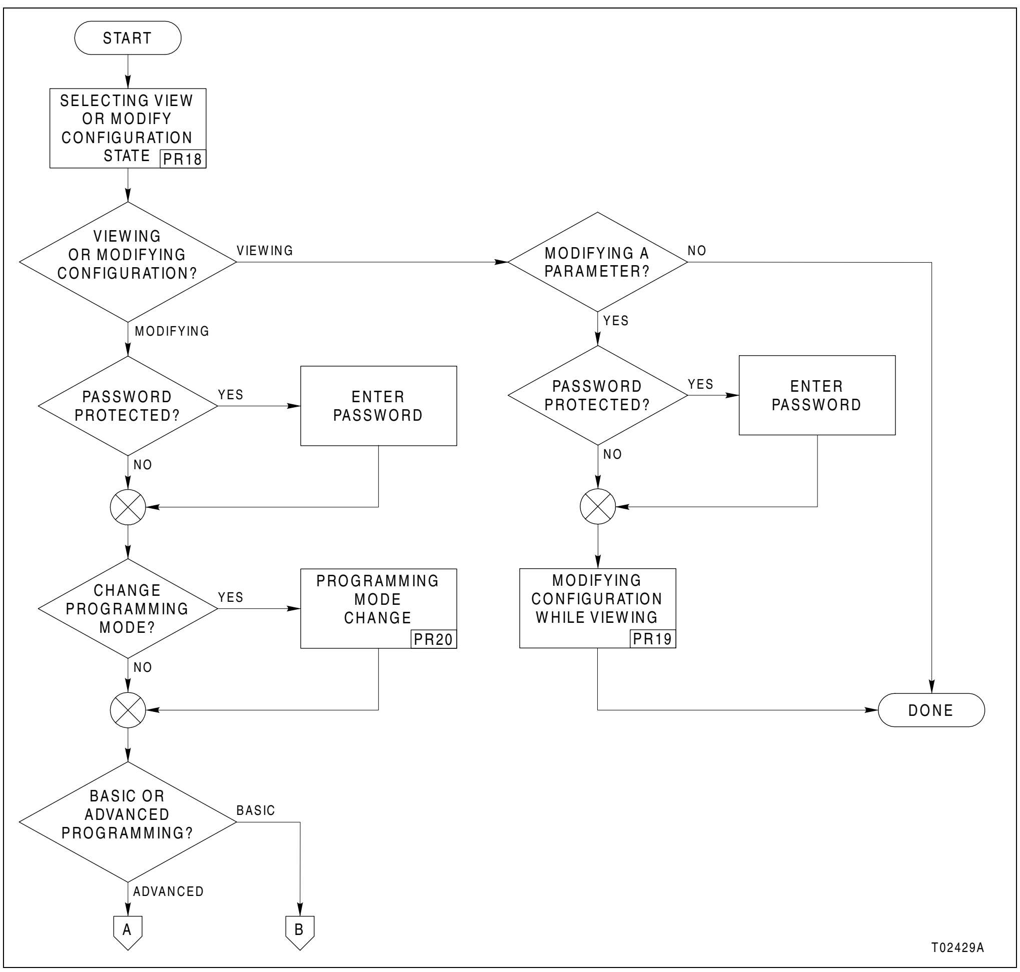

Figure 8-4. Configuration Sequence

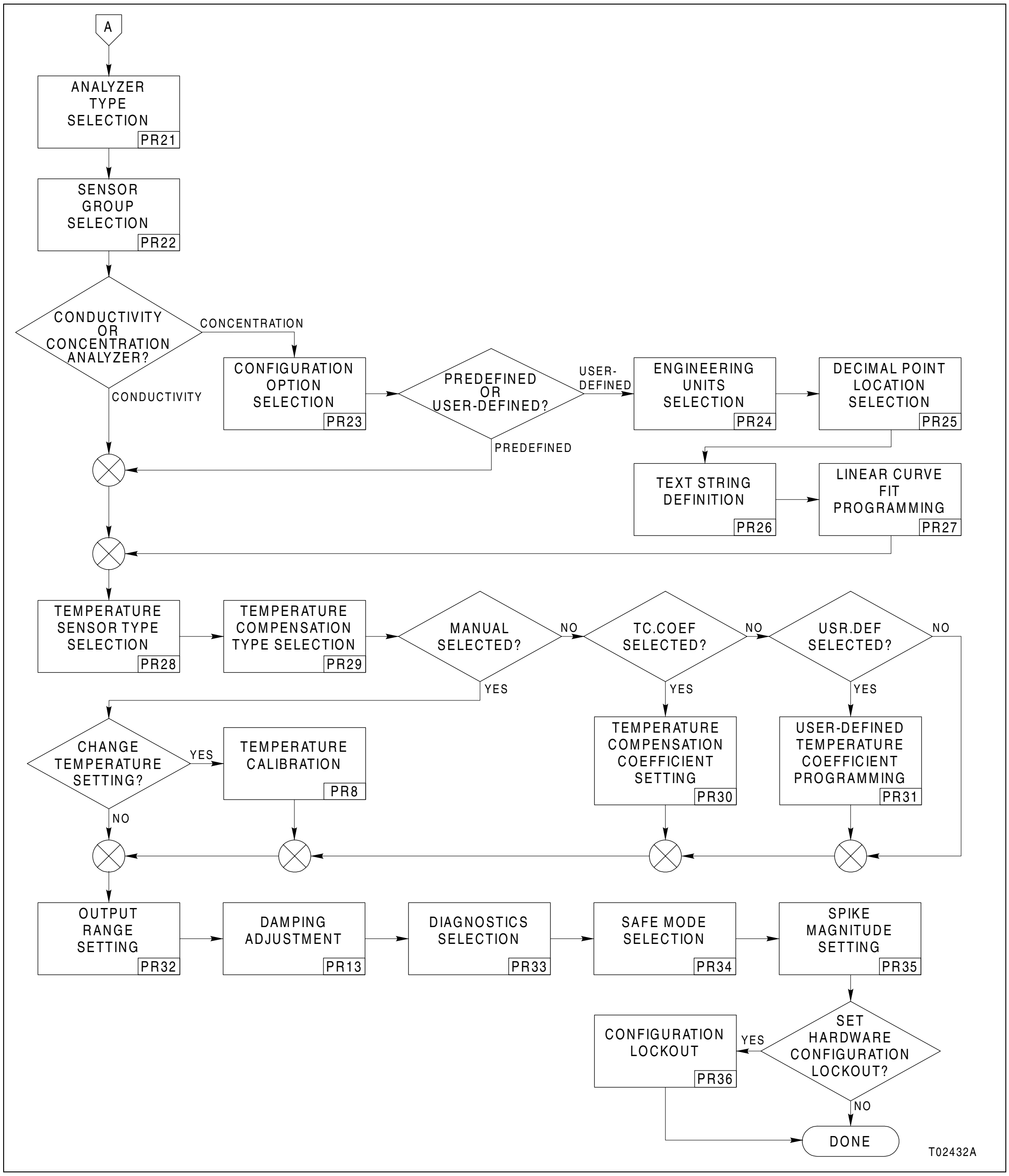

Figure 8-5. Advanced Configuration Sequence

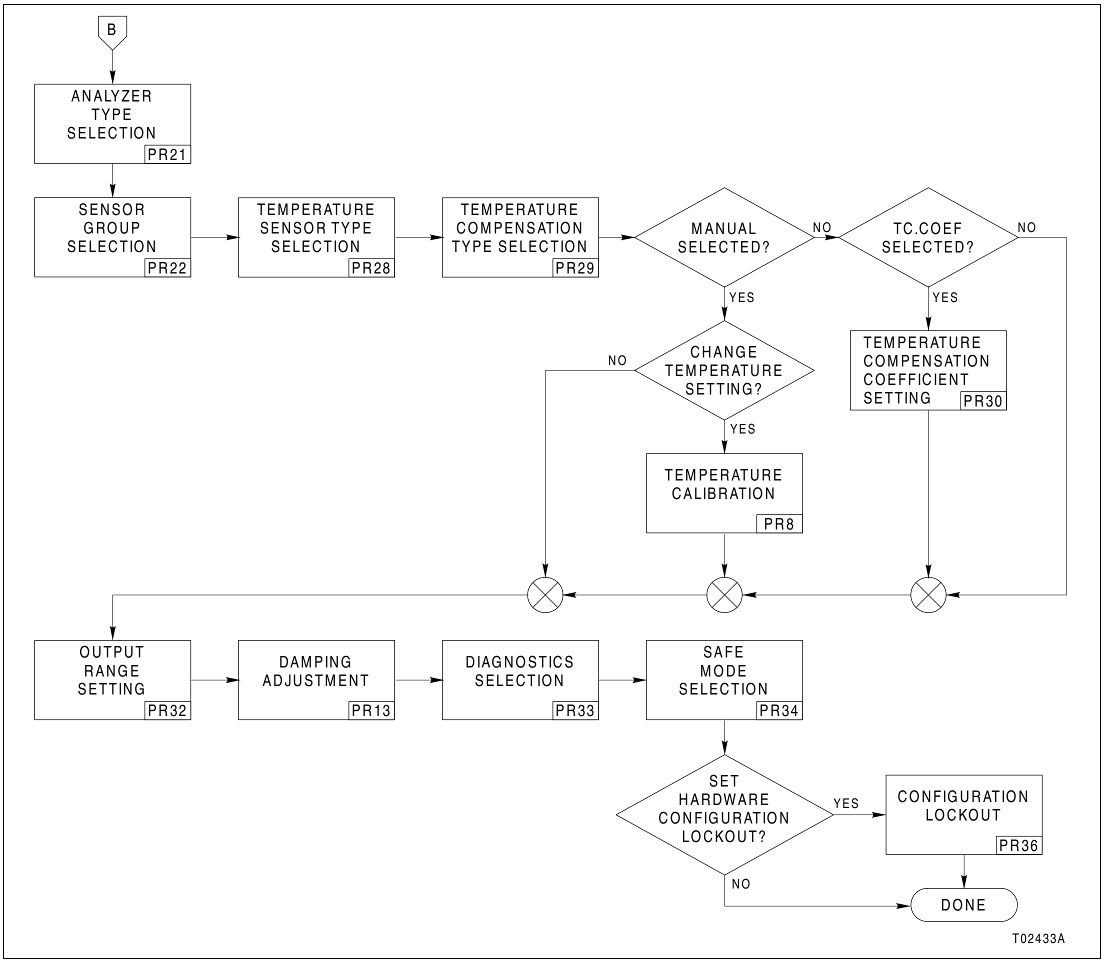

Figure 8-6. Basic Configuration Sequence

SECTION 9 - SECURITY MODE

INTRODUCTION

The security mode of operation establishes password protection against unauthorized changes to transmitter functions by unqualified personnel. Password protection can be assigned to the calibrate and output/hold modes of operation, and modify configure state of operation.

SECURITY STATE

The security mode of operation contains one state of operation. This state provides password protection of critical operating environments. Each password protected mode or state of operation can have its security state toggled on or off in the associated security screen. All security assignments must be made before assigning a password.

The security of the security state itself is automatically set to on when one or more mode or state has the security on. One password assignment applies to all secured modes and states. Figure 9-1 shows the screen flow for the security state of operation.

ENTERING PASSWORD

When the security state has been set, the password must be entered to gain access to the modes and states that have been password protected.

1. When the password inquiry screen (*PASSWD*) appears:

    a. The display reads _ _ _. Use the ▲ smart key to increment the value of the blinking digit.

    b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

    c. Repeat Steps 1a and 1b for each digit.

2. Press the *ENTER* smart key to accept the password.

SECURITY SEQUENCE

There is only one procedure associated with the security mode. Refer to PR37 to set the security states and password.

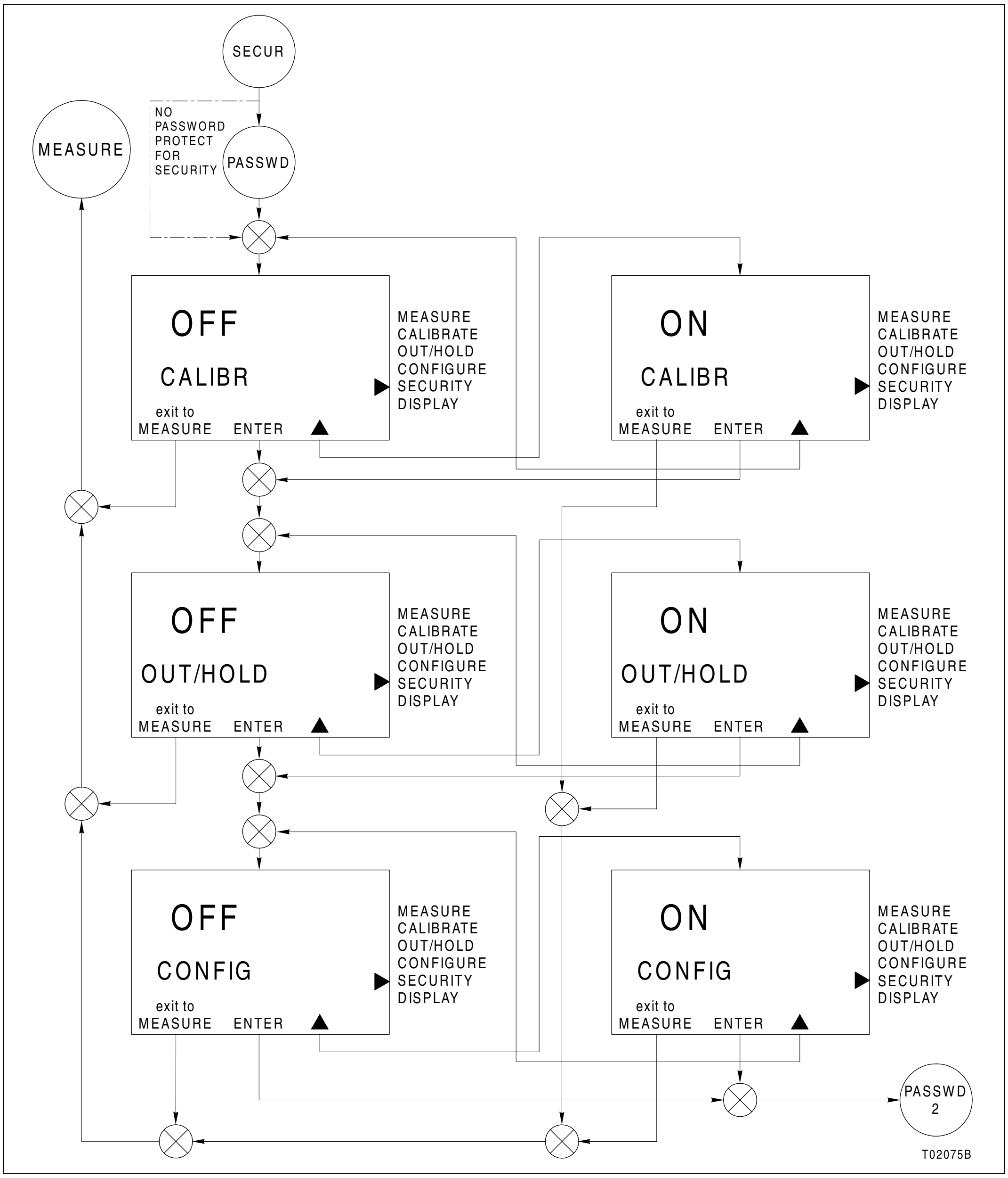

Figure 9-1. Security State Screen Flow

SECTION 10 - SECONDARY DISPLAY MODE

INTRODUCTION

The Type TB82EC transmitter has two display regions active while in the measure mode of operation. The primary display region shows the measured variable. The secondary display region can show a multitude of process, sensor, or transmitter information: process temperature, current output value, sensor type, sensor group, compensated conductivity (useful for concentration configurations), user-defined text description (concentration configuration only), spike mode status, and software revision. All of these are viewable in the secondary display region using the secondary display mode. Any of these can be set as the displayed value while in the measure mode of operation.

SECONDARY DISPLAY STATES OF OPERATION

The secondary display mode contains eight states. These provide information on the process temperature, transmitter settings, and transmitter status. As shown in Figure 10-1, each secondary state can be sequentially viewed by pressing the *NEXT* smart key. Any given secondary display state can be continually shown in the measure mode by pressing the *ENTER* smart key when the desired state is shown. The transmitter proceeds to the measure mode and displays the entered secondary display state in the secondary display region.

SECONDARY DISPLAY OPERATION

To use the secondary display mode and states of operation:

1. Press the *MENU* smart key until *DISPLAY* is highlighted on the display.

2. Press the *SELECT* smart key to enter the secondary display mode.

3. Press the *NEXT* smart key to sequentially view each secondary display state.

4. Press the *ENTER* smart key to have the desired secondary display state appear during the measure mode.

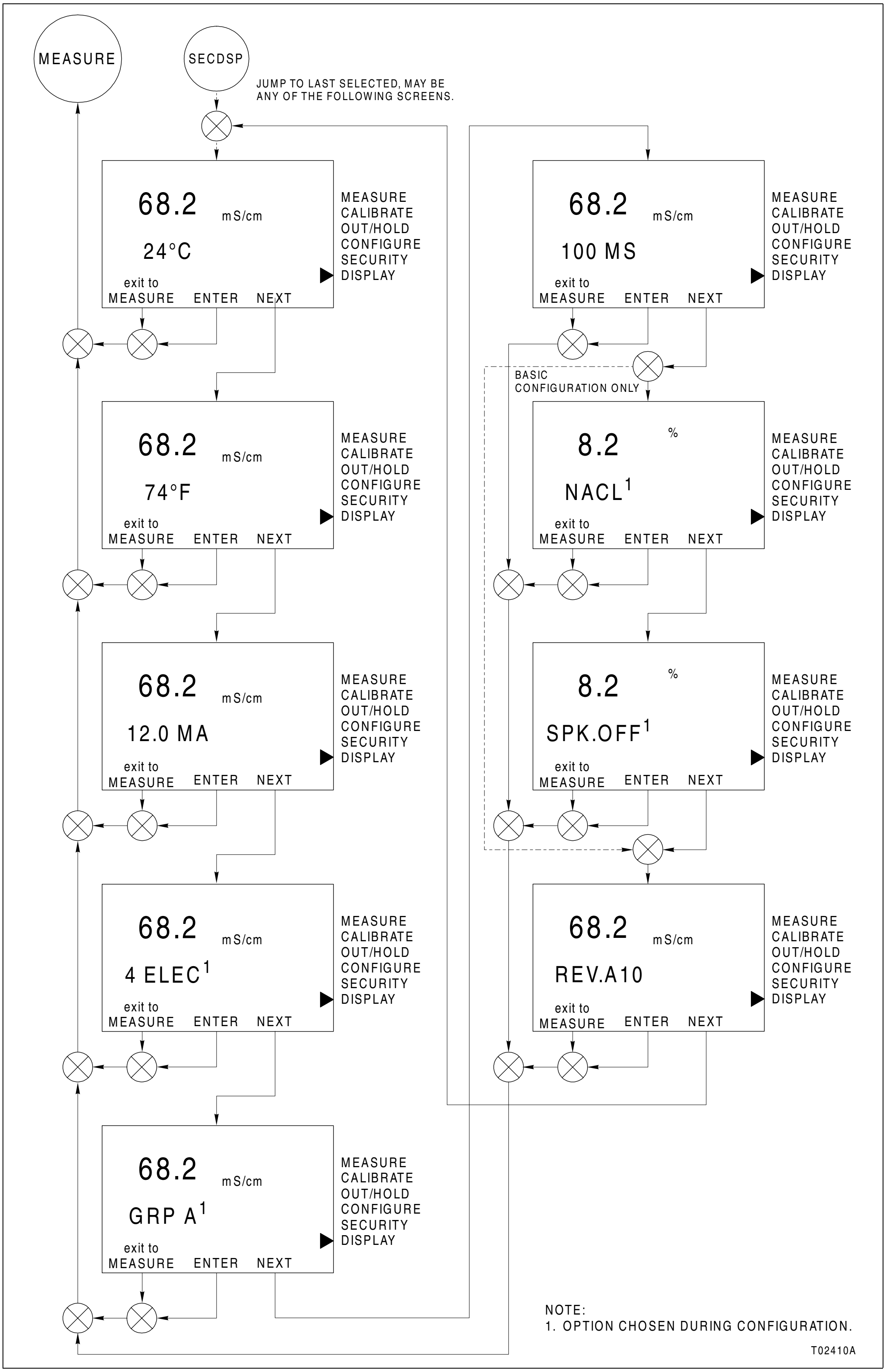

Figure 10-1. Secondary Display Mode Screen Flow

SECTION 11 - UTILITY MODE

INTRODUCTION

The Type TB82EC transmitter has a utility mode of operation that provides access to powerful functions not usually needed during normal operating conditions. These functions have been separated into two categories: factory and user. Factory functions are reserved to ABB personnel. User functions include: programming mode selection, reset configuration to default values, remove security, reset all parameters to default values, and a self-test.

This section contains descriptions of each state in the utility mode of operation. Refer to Table 11-1 for the procedures needed to perform utility mode tasks.

FACTORY AND USER STATES

Access the factory and user states of operation by using the hidden fifth key located directly above the *NT* in the *ADVANTAGE* text on the keypad. Once pressed, the hidden key causes the textual prompt *USER* to display in the secondary display region. Pressing the *SELECT* smart key moves the transmitter into the user state. Pressing the *NEXT* smart key moves the transmitter to the factory selection. Pressing the *exit to MEASURE* smart key escapes back to the measure mode.

User State

The user state consists of five states of operation. Table 11-1 describes the function of each state of operation and lists the related procedures. There is no particular sequence for these procedures.

Table 11-1. User States

State	Display	Function	Procedure
Mode	*MODE*	Sets programming mode (basic or advanced) that can be selected in the modify configure mode of operation.	PR38
Reset configuration	*RST.CON*	Resets configuration to factory defaults.	PR39
Reset security	*RST.SEC*	Resets security to *OFF* state for all applicable modes and modify configure state.	PR40
Reset all	*RST.ALL*	Resets all programming parameters such as configuration, calibration, output/hold, security, and secondary display functions to factory defaults.	PR41
Soft boot	*RST.SFT*	Initiates self-test.	PR42

The *NEXT* smart key sequentially moves through each of the five user states. This cycle repeats until a state is selected or the escape function is chosen using the *exit to MEASURE* smart key. To select a state, press the *SELECT* smart key when the desired user state is shown in the secondary display region. Figure 11-1 identifies the smart key assignments and resulting action.

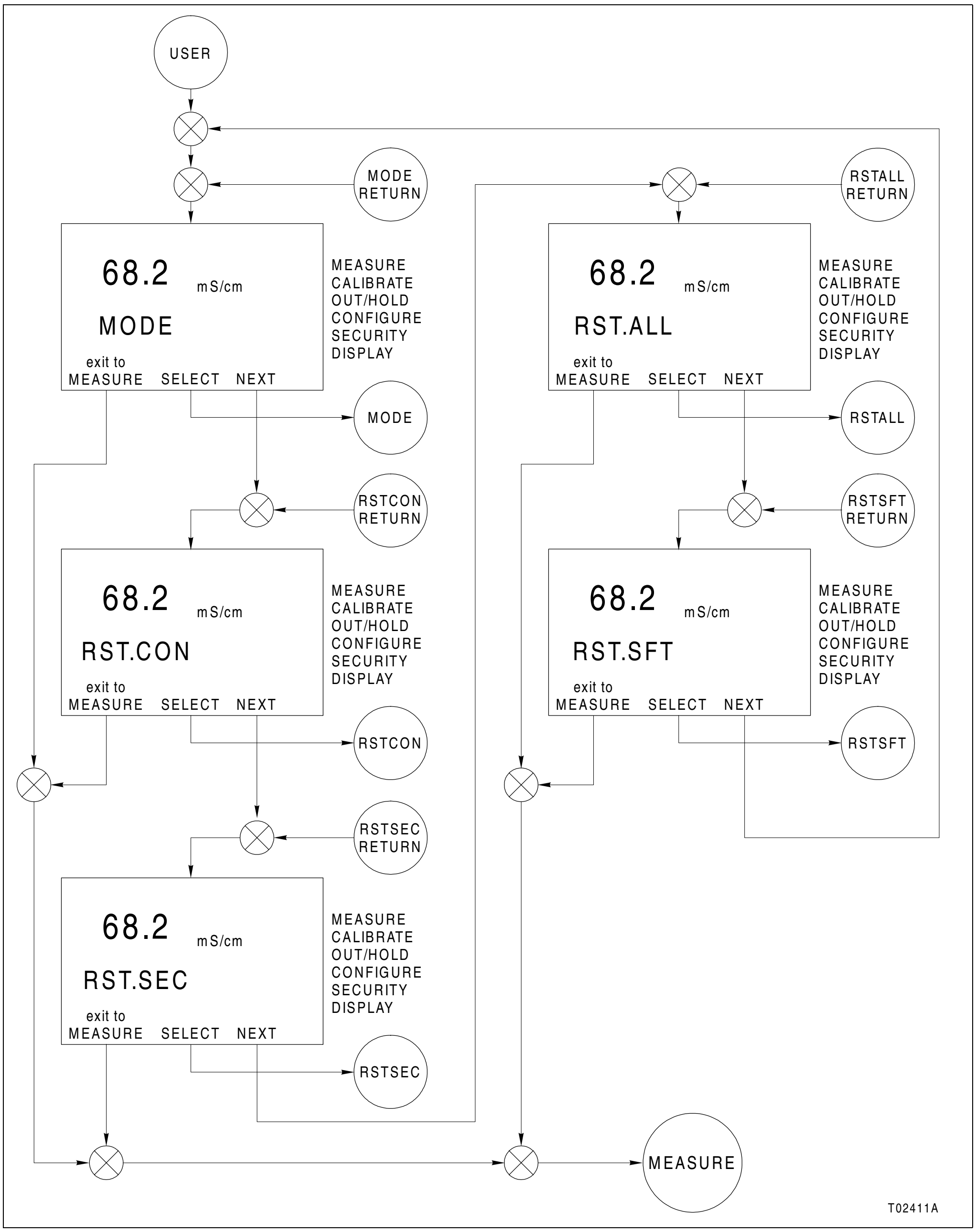

Figure 11-1. User State Screen Flow

Advanced/Basic Programming Mode User State

In order to simplify the configuration process when needing a limited amount of functionality, the transmitter contains two types of programming modes: basic and advanced. The programming mode is a nomenclature option.

The basic programming mode contains a subset of the features found in the advanced programming mode. Reducing the available features streamlines the configuration process. If the transmitter is ordered with advanced programming, the basic or advanced programming mode can be used.

Contact ABB for information on advanced programming conversion for transmitters purchased with only basic programming.

Reset Configuration User State

The reset configuration user state returns the configuration of the transmitter back to factory default settings. Table 11-2 summarizes the default software settings.

Table 11-2. Factory Software Defaults

Parameter	Default
Analyzer type	Conductivity, Sensor Group A
Damping value	00.5 secs
Instrument mode	Basic
Output range	0.00 to 199.9 mS/cm
Safe mode fail output state	Low
Sensor diagnostics state	Disable
Spike output level[1]	0%
Temperature compensation	Manual
Temperature sensor	3-kΩ Balco

NOTE:
1. This function only available in advanced programming mode.

Reset Security User State

The reset security user state returns the security of the transmitter back to factory default settings. The factory defaults are security off for all applicable modes and the modify configure state.

Reset All User State

The reset all user state returns all transmitter values back to factory defaults. This includes calibration, output/hold, configuration, security, and secondary display values.

Soft Boot User State

The soft boot user state initiates a self-test. All programmable instrument parameters will be the same as those before initiating a self-test.

SECTION 12 - DIAGNOSTICS AND TROUBLESHOOTING

INTRODUCTION

The Type TB82EC transmitter performs a number of diagnostic checks on hardware, software, and sensor functions. Upon detection of a nonconforming condition, the *FAULT* icon alerts the operator. Configurable remote indication is performed by using the spike output option to modulate the output current. Pressing the *FAULT info* smart key interrogates the transmitter as to the cause of the fault. The display of a short text string and fault code alternate on the secondary display. If multiple faults exist, the *FAULT info* smart key moves the operator to the next fault. Upon interrogation of all faults, the transmitter returns to the measure mode and the *MENU* smart key icon energizes.

This section describes the type of fault conditions and their applicability to transmitter functionality. If the evaluation of the fault codes does not resolve the problem, refer to ***TROUBLESHOOTING SEQUENCE*** to find additional troubleshooting procedures.

FAULT CODES

Fault conditions are grouped into two categories based on their severity. Conditions that result in degradation of transmitter performance are reported as problem codes (PC). Conditions that render the transmitter inoperable are reported as error codes (EC).

Fault codes are reported in the secondary display region in a FIFO (first in, first out) order. All active fault conditions can be viewed at any time while in the measure mode by using the *FAULT info* smart key. A flashing *FAULT* icon indicates a new fault condition that has not been interrogated. Upon resolution of all fault conditions, the *FAULT* icon and *FAULT info* smart key are disabled.

Problem Codes

Problem codes result from fault conditions that impact the performance of the transmitter. These conditions are usually resolved using standard practices.

The occurrence of a problem code fault condition energizes the *FAULT* icon and modulates the spike output. These diagnostic indicators provide local and remote reporting capability.

Table 12-1 lists common problem codes and Table 12-2 lists uncommon problem codes. Each entry lists the problem code number, displayed text string, a short description of the fault condition, and corrective action. Most problem codes have more than one corrective action listed. Perform the corrective actions in the order they appear until the problem is resolved.

Table 12-1. Common Problem Codes

Code	Text String	Description	Corrective Action
PC3	DRTY.SN	Dirty sensor detected.	Check cleanliness of sensor. If not clean, remove any foreign material. Clean sensor (PR46) and verify response to conductivity standards.
			Electronically test sensor (PR44). Replace if it does not meet requirements.
			Verify sensor wiring connections.
PC4	GND LP	Ground loop present or shorted sensor cable	Verify sensor wiring connections.
			Verify sensor does not have any exposed wire from nicks, etc. If it does, repair (if possible) or replace.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Verify sensor responds to conductivity standards. Replace sensor and/or sensor extension cable (if present) if sensor does not respond.
			Electronically test sensor (PR44). Replace if it does not meet requirements.
PC6	HI.LOOP	Current loop above upper range value (+0.4 mA hysteresis)	Verify process conditions are within configured output range. If PV is outside configured range, increase output range.
			Verify transmitter is configured for correct temperature compensation type.
			Verify sensor wiring connections.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Clean sensor and perform process calibration.
			Conduct temperature calibration. If not using temperature sensor, verify configuration for *TMP.SNS* is *NONE* and proper process temperature is set.
			Electronically test sensor and temperature compensator (PR44). Replace sensor if it does not meet requirements.

Table 12-1. Common Problem Codes (continued)

Code	Text String	Description	Corrective Action
PC7	LO.LOOP	Current loop below lower range value (-0.2 mA hysteresis)	Verify process conditions are within configured output range. If PV is outside configured range, increase output range.
			Verify transmitter is configured for correct temperature compensation type.
			Verify sensor wiring connections.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Clean sensor and perform process calibration.
			Conduct temperature calibration. If not using temperature sensor, verify configuration for *TMP.SNS* is *NONE* and proper process temperature is set.
			Electronically test sensor and temperature compensator (PR44). Replace sensor if it does not meet requirements.
PC8	HI.PV	PV above transmitter range	Verify process conditions are within transmitter range. PV must be within transmitter range.
			Verify sensor wiring connections.
			Verify sensor does not have any exposed wire from nicks, etc. If it does, repair (if possible) or replace.
			Remove any liquids, oils, scale, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Verify sensor responds to conductivity standards. Replace sensor and/or sensor extension cable (if present) if sensor does not respond.
			Electronically test sensor (PR44). Replace if it does not meet requirements.
PC9	LO.PV	PV below transmitter range	Verify process conditions are within transmitter range. PV must be within transmitter range.
			Verify sensor wiring connections.
			Verify sensor does not have any exposed wire from nicks, etc. If it does, repair (if possible) or replace.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Verify sensor responds to conductivity standards. Replace sensor and/or sensor extension cable (if present) if sensor does not respond.
			Electronically test sensor (PR44). Replace if it does not meet requirements.

Table 12-1. Common Problem Codes (continued)

Code	Text String	Description	Corrective Action
PC10	HI.TEMP	Temperature above transmitter range	Verify process conditions are within transmitter range. PV must be within transmitter range.
			Verify sensor wiring connections.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Clean sensor and perform process calibration.
			Conduct temperature calibration. If not using temperature sensor, verify configuration for *TMP.SNS* is *NONE* and proper process temperature is set.
			Electronically test sensor and temperature compensator (PR44). Replace sensor if it does not meet requirements.
PC11	LO.TEMP	Temperature below transmitter range	Verify process conditions are within transmitter range. PV must be within transmitter range.
			Verify sensor wiring connections.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Clean sensor and perform process calibration.
			Conduct temperature calibration. If not using temperature sensor, verify configuration for *TMP.SNS* is *NONE* and proper process temperature is set.
			Electronically test sensor and temperature compensator (PR44). Replace sensor if it does not meet requirements.
PC12	HI.T.AD	Open or missing temperature sensor	Verify process conditions are within transmitter range. PV must be within transmitter range.
			Verify sensor wiring connections.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Clean sensor and perform process calibration.
			Conduct temperature calibration. If not using temperature sensor, verify configuration for *TMP.SNS* is *NONE* and proper process temperature is set.
			Electronically test sensor and temperature compensator (PR44). Replace sensor if it does not meet requirements.
			Replace conductivity input PCB assembly.
PC13	LO.T.AD	Shorted temperature sensor	Verify process conditions are within transmitter range. PV must be within transmitter range.
			Verify sensor wiring connections.
			Remove any liquids, oils, scales, or corrosion from transmitter terminal block or extension cable junction box terminals.
			Clean sensor and perform process calibration.
			Conduct temperature calibration. If not using temperature sensor, verify configuration for *TMP.SNS* is *NONE* and proper process temperature is set.
			Electronically test sensor and temperature compensator (PR44). Replace sensor if it does not meet requirements.
			Replace conductivity input PCB assembly.

Table 12-2. Uncommon Problem Codes

Code	Text String	Description	Corrective Action
PC20	BAD.SEE	Bad SEEPROM or conductivity input PCB assembly	Input PCB assembly factory calibration constants can not be loaded. Calibrate sensor and order replacement conductivity input PCB assembly. Existing assembly should properly function until new assembly is received.
PC21	NO.F.CAL	Missing factory calibration and functional SEEPROM	Contact ABB for factory calibration procedure. Calibrate sensor for short-term usage until factory calibration is performed or a new conductivity input PCB assembly is installed.
PC22	BLNK.uP	Blank microprocessor EEPROM	Cycle transmitter power.
			Contact ABB.
PC25	ROM.SUM	Incorrect EPROM checksum	Cycle transmitter power.
			Contact ABB.
PC30	R0.F.CAL	Out of range or missing factory calibration for conductivity circuit range zero	Contact ABB for factory calibration procedure. Calibrate sensor for short-term usage until factory calibration is performed.
PC31	R1.F.CAL	Out of range or missing factory calibration for conductivity circuit range one	
PC32	R2.F.CAL	Out of range or missing factory calibration for conductivity circuit range two	
PC33	R3.F.CAL	Out of range or missing factory calibration for conductivity circuit range three	
PC34	R4.F.CAL	Out of range or missing factory calibration for conductivity circuit range four	
PC35	G0.F.CAL	Out of range or missing factory calibration for ground loop circuit range zero	Contact ABB for factory calibration procedure. If ground loop fault is continuously active and can not be tolerated, disable diagnostics (PR33) until factory calibration is performed.
PC36	G1.F.CAL	Out of range or missing factory calibration for ground loop circuit range one	
PC37	G2.F.CAL	Out of range or missing factory calibration for ground loop circuit range two	
PC38	G3.F.CAL	Out of range or missing factory calibration for ground loop circuit range three	
PC39	G4.F.CAL	Out of range or missing factory calibration for ground loop circuit range four	
PC45	BA.F.CAL	Out of range or missing factory calibration for 3-kΩ Balco temperature compensator	Contact ABB for factory calibration procedure. Calibrate temperature sensor for short-term usage until factory calibration is performed.
PC46	PT.F.CAL	Out of range or missing factory calibration for Pt 100 temperature compensator	
PC47	RT.F.CAL	Out of range or missing factory calibration for 4.75-kΩ RTD network temperature compensator	

Table 12-2. Uncommon Problem Codes (continued)

Code	Text String	Description	Corrective Action
PC50	R0.CHKS	Incorrect or missing conductivity circuit range zero checksum	Contact ABB for factory calibration procedure. Calibrate sensor for short-term usage until factory calibration is performed.
PC51	R1.CHKS	Incorrect or missing conductivity circuit range one checksum	
PC52	R2.CHKS	Incorrect or missing conductivity circuit range two checksum	
PC53	R3.CHKS	Incorrect or missing conductivity circuit range three checksum	
PC54	R4.CHKS	Incorrect or missing conductivity circuit range four checksum	
PC55	G0.CHKS	Incorrect or missing ground loop circuit range zero checksum	Contact ABB for factory calibration procedure. If ground loop fault is continuously active and can not be tolerated, disable diagnostics (PR33) until factory calibration is performed.
PC56	G1.CHKS	Incorrect or missing ground loop circuit range one checksum	
PC57	G2.CHKS	Incorrect or missing ground loop circuit range two checksum	
PC58	G3.CHKS	Incorrect or missing ground loop circuit range three checksum	
PC59	G4.CHKS	Incorrect or missing ground loop circuit range four checksum	
PC65	BA.CHKS	Incorrect or missing 3-kΩ Balco temperature compensator checksum	Contact ABB for factory calibration procedure. Calibrate temperature sensor for short-term usage until factory calibration is performed.
PC66	PT.CHKS	Incorrect or missing PT 100 temperature compensator checksum	Contact ABB for factory calibration procedure. Calibrate temperature sensor for short-term usage until factory calibration is performed.
PC67	RT.CHKS	Incorrect or missing 4.75-kΩ RTD network temperature compensator checksum	
PC70	HI.G.L.AD	Ground loop signal above transmitter A/D range	Conductivity input PCB assembly ground loop circuit failure exists. Disable diagnostics (PR33) and order replacement conductivity input PCB assembly. Existing conductivity input PCB assembly should function properly until new conductivity input PCB assembly is installed.
PC71	LO.G.L.AD	Ground loop signal below transmitter A/D range	
PC72	HI.D.S.AD	Dirty sensor above transmitter A/D range	Conductivity input PCB assembly dirty sensor diagnostic circuit failure exists. Disable diagnostics (PR33) and order replacement conductivity input PCB assembly. Existing conductivity input PCB assembly should function properly until new conductivity input PCB assembly is installed.
PC73	LO.D.S.AD	Dirty sensor below transmitter A/D range	

Error Codes

Error codes result from fault conditions that render the transmitter inoperable. These conditions can not usually be resolved using standard practices.

The occurrence of an error code fault condition energizes the *FAULT* icon and enables the safe mode output. When in the safe mode, the current output is fixed high or low based on the configuration of the safe mode. These diagnostic indicators provide local and remote reporting capability.

Table 12-3 contains all the error codes supported by the transmitter. Each entry lists the error code number, displayed text string, and a short description of the fault condition.

WARNING	**All error conditions are considered catastrophic and require transmitter replacement. Replace the transmitter with a transmitter that is known to be operable. Leaving an inoperable transmitter in the process could cause process upsets. Some process upsets can lead to dangerous conditions that can harm personnel and damage equipment.**

When an error code appears on the transmitter display, the transmitter must be replaced with one that is known to be operable. Return the nonfunctional transmitter to ABB for repair. Contact ABB for processing instructions.

Table 12-3. Error Codes

Error Code	Text String	Description
EC1	*HI.PV.AD*	Overrange PV A/D
EC2	*LO.PV.AD*	Underrange PV A/D
EC3	*PH.PCB*	pH/ORP/pION input PCB with 4-electrode conductivity firmware
EC4	*TC.PCB*	Toroidal conductivity input PCB with 4-electrode conductivity firmware
EC6	TE.PCB	2-electrode conductivity input PCB with 4-electrode conductivity firmware
EC7	EC.PCB	Electrode conductivity input PCB with 4-electrode conductivity firmware

CALIBRATION DIAGNOSTICS

The transmitter performs automatic efficiency and offset calculations. These calculations are relative to a theoretically perfect conductivity and temperature sensor during each calibration cycle. Calibration history is retained for future interrogation using the edit calibrate state. The calibration constants displayed are slope and offset for the process variable and temperature.

A slope of less than 0.2 or greater than five for the process variable indicates a potentially bad process calibration point or poorly performing sensor. In these cases, the text string *BAD.CAL* appears on the secondary display. The transmitter returns to the beginning of the calibration cycle after it reports the bad calibration.

An offset value of less than -20 or greater than +20 microsiemens per centimeter for Sensor Group A, less than -4 or greater than +4 microsiemens per centimeter for Sensor Group B, or less than -0.800 or greater than +0.800 microsiemens per centimeter for Sensor Group C also indicates a potentially bad process calibration or poorly performing sensor. In these cases, the transmitter reports the bad calibration and returns to the beginning of the calibration cycle.

The transmitter reports a bad temperature calibration and rejects calibration values for slope values less than 0.2 or greater than 1.5 and offset values less than -40-degrees Celsius or greater than +40-degrees Celsius. Temperature calibrations use smart software routines that automatically adjust the value for slope, offset, or both based on the calibration value being entered and the calibration history if it exists.

ADDITIONAL DIAGNOSTICS

Other diagnostic messages may appear during transmitter programming. These messages include *BAD.VAL* (bad value), *DENIED*, and *RAM.ERR* (RAM error).

BAD.VAL indicates the attempted numeric entry of a value out of the allowed range of the transmitter. Table 1-3 lists the transmitter range limits.

DENIED indicates incorrect entry of a security password. Section 9 contains information on security.

RAM.ERR indicates a RAM read/write error. The transmitter automatically resets when this error has been encountered. If the transmitter continues to reset, contact ABB for problem resolution.

TROUBLESHOOTING SEQUENCE

Refer to Figure 12-1 for the transmitter troubleshooting sequence. 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 troubleshooting. 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 troubleshooting sequence.

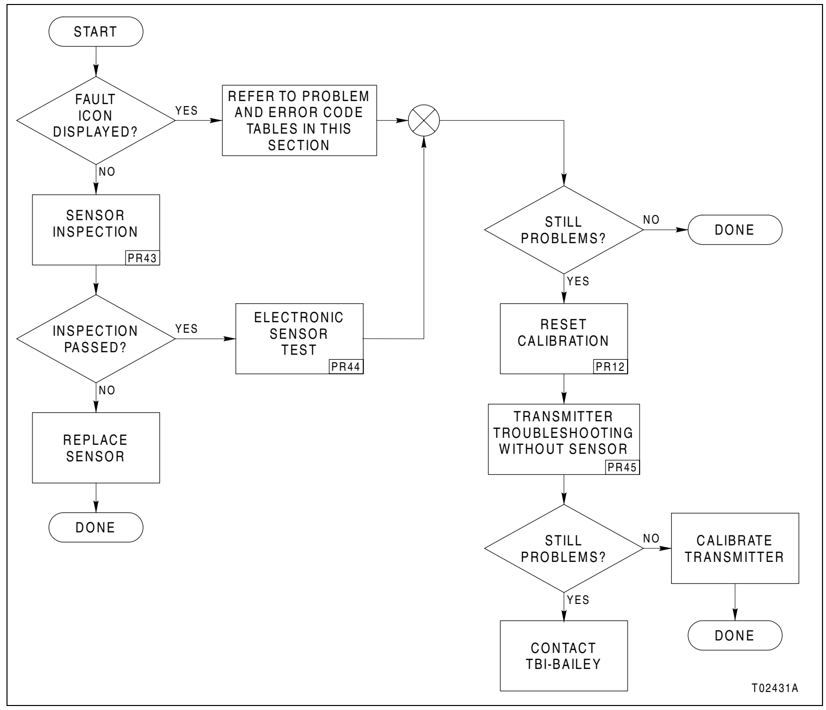

Figure 12-1. Troubleshooting Sequence

SECTION 13 - MAINTENANCE

INTRODUCTION

This section contains a preventive maintenance schedule for the Type TB82EC transmitter (Table 13-1). 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* in Section 1) 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. ABB 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 transmitter and have experience working with process control systems.

PREVENTIVE MAINTENANCE SCHEDULE

Table 13-1 is the preventive maintenance schedule for the Type TB82EC transmitter. The table lists the preventive maintenance tasks in groups according to their specified maintenance interval. Some tasks in Table 13-1 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 13-1. Preventive Maintenance Schedule

Task	Procedure	Frequency (months)
Check and clean all wiring and wiring connections.	—	12
Calibrate transmitter output.	PR10	
Inspect sensor.	PR43	As required
Clean sensor.	PR46	
Clean keypad.	PR47	
Calibrate transmitter sensor input.	Fig. 6-2	
Clean and lubricate all gaskets and O-rings.	—	Each time seals are broken
Complete all tasks in this table.	—	Shutdown

SECTION 14 - REPAIR AND REPLACEMENT

INTRODUCTION

Due to the modular design of the Type TB82EC transmitter, the replacement of an assembly can be easily completed. Replacements are available for each major assembly. These include the input PCB, microprocessor PCB, power supply PCB, front bezel, shell, and rear cover assemblies.

This section does not contain repair instructions for the sensor. Refer to Section 12 for diagnostics and troubleshooting information. Due to the nature of its design, if the troubleshooting procedures do not solve the problem, complete sensor replacement is required when it has been damaged or does not properly function.

WARNING	**Do not substitute any components other than those listed in the appropriate procedures. Doing so will compromise the certification listed on the transmitter nameplate. Invalidating these 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 14-1 for the repair sequence for the transmitter. 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.

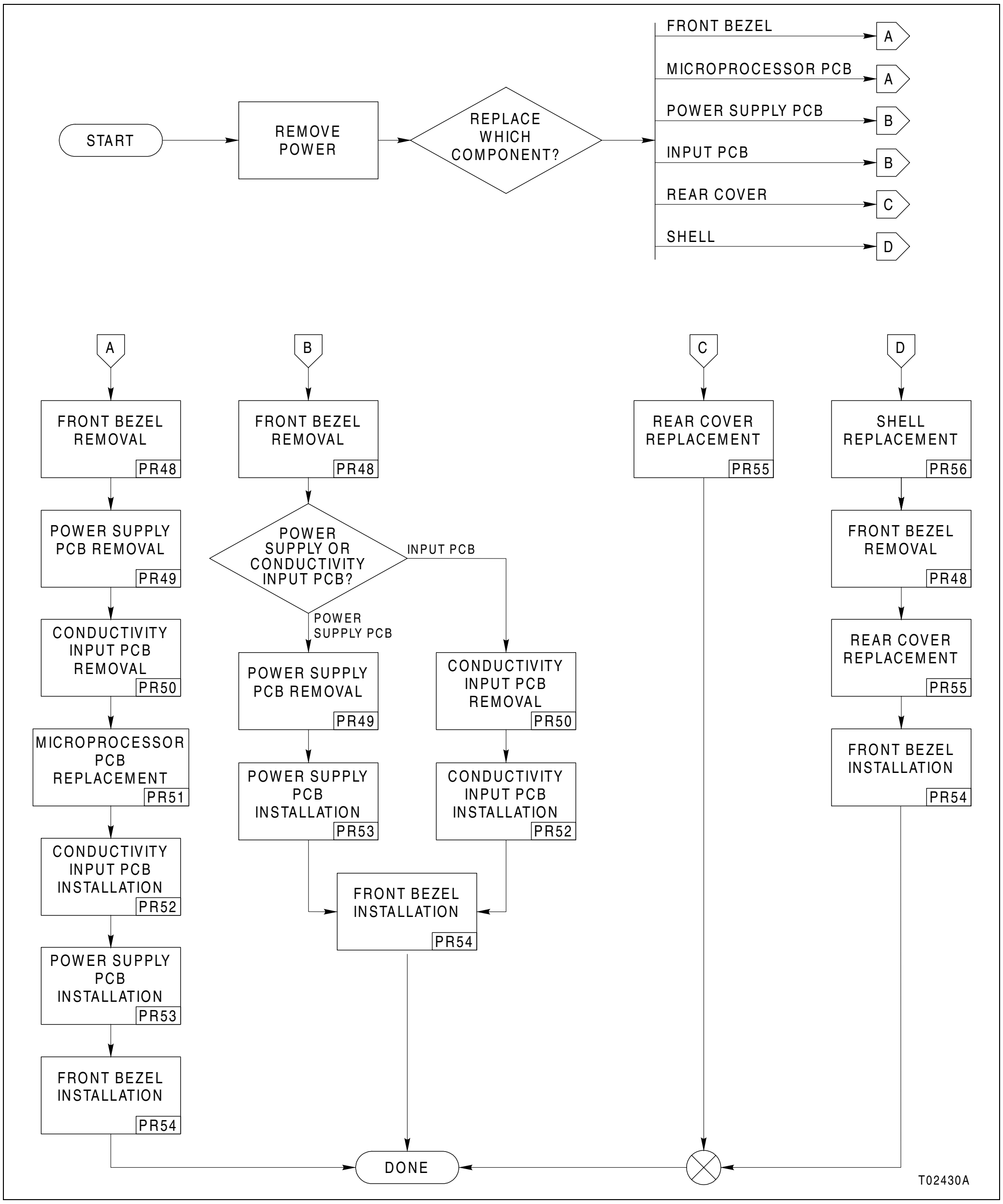

Figure 14-1. Repair and Replacement Sequence

SECTION 15 - SUPPORT SERVICES

INTRODUCTION

Figure 15-1 is an assembly drawing of the Type TB82EC transmitter. When ordering replacement parts, specify nomenclature type, part name, and part number of spare parts kits.

ABB 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 TB82EC transmitter can be obtained by contacting:

ABB Inc.
9716 S. Virginia St., Ste.E
Reno, Nevada 89511
USA
Phone: +1 (775) 850-4800
FAX: +1 (775) 850-4808
Web site: http://www.abb.com

RETURN MATERIALS PROCEDURES

If any equipment should need to be returned for repair or evaluation, please contact ABB at (775) 883-4366, or your local ABB representative for the RMA (return materials authorization) number. At the time the RMA number is given, repair costs will be provided, and a customer purchase order will be requested. The RMA and purchase order numbers must be clearly marked on all paperwork and on the outside of the return package container.

Equipment returned to ABB with incorrect or incomplete information may result in significant delays or nonacceptance of the shipment.

REPLACEMENT PARTS

When making repairs at your facility, order spare parts kits from an ABB sales office. Provide this information.

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

2. Model and serial number (if applicable).

3. ABB instruction number, page number, and reference figure that identifies the spare parts kit.

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

NOTE: Contact ABB for replacement sensors. Due to the special nature of these items, factory consultation is required.

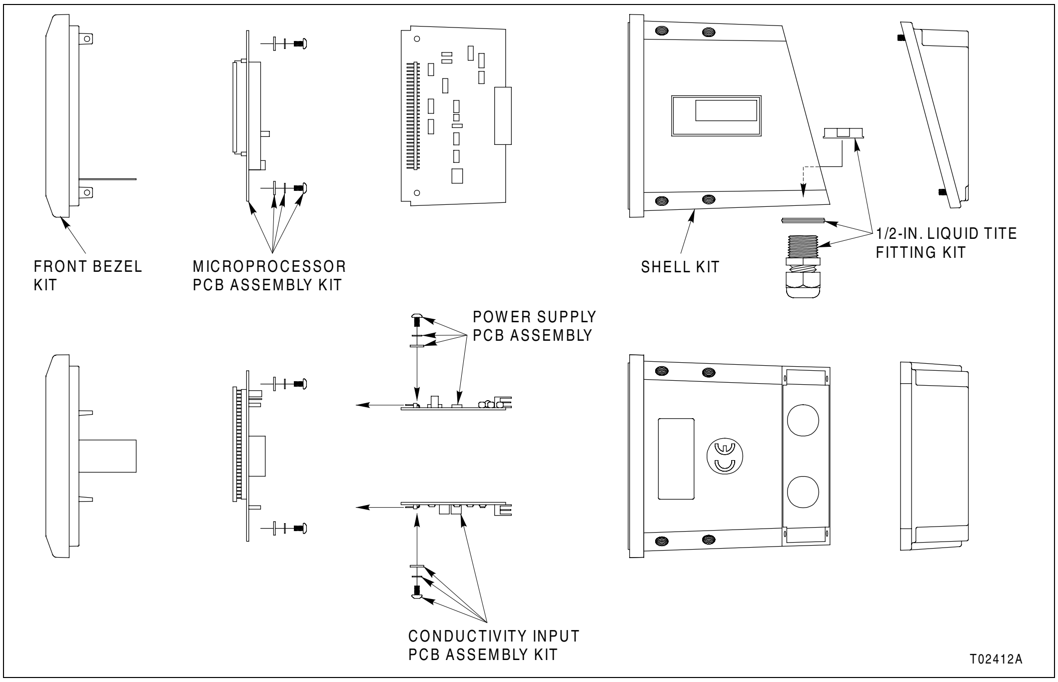

Figure 15-1. Exploded View

RECOMMENDED SPARE PARTS KITS

Table 15-1 lists the recommended spare parts kits.

Table 15-1. Spare Parts Kits

Part Number	Description
4TB5001-0150	Rear label, TB82EC
4TB9515-0123	Panel mount kit
4TB9515-0124	Pipe mount kit
4TB9515-0125	Hinge mount kit
4TB9515-0155	Power supply PCB assembly kit
4TB9515-0156	Wall mount kit
4TB9515-0157[1]	Power supply PCB assembly kit for HART compatible transmitters
4TB9515-0158	Power supply PCB assembly with lightning arrestor kit
4TB9515-0159[1]	Power supply PCB assembly with lighting arrestor kit for HART compatible transmitters
4TB9515-0160	Front bezel kit
4TB9515-0162	Rear cover kit

Table 15-1. Spare Parts Kits (continued)

Part Number	Description
4TB9515-0163	½-in. liquid-tite cable grip fitting kit
4TB9515-0175	Shell kit
4TB9515-0176	Input PCB assembly kit (4-electrode conductivity)
4TB9515-0177	ROM (read only memory) chip, TB82EC
4TB9515-0178	Microprocessor PCB/display board
4TB9515-0181	Front bezel kit, FM approved

NOTE:

1. Contact factory for availability.

APPENDIX A - TEMPERATURE COMPENSATION

INTRODUCTION

The Type TB82EC transmitter has a variety of standard conductivity temperature compensation options. These include:

- Manual (0.1N KCl based).
- Standard automatic (0.1N KCl based).
- Temperature coefficient (0.00 to 9.99%/°C).
- 0 to 15% NaOH.
- 0 to 20% NaCl.
- 0 to 18% HCl.
- 0 to 20% H_2SO_4.
- User-defined.

Additionally, three specialized types of automatic temperature compensation are available for the measurement of pure water using a Sensor Group C configuration. These types include neutral salt, trace base, and trace acid.

The concentration analyzer type configuration offers the same temperature compensation options as does the standard conductivity analyzer configuration.

TEMPERATURE COMPENSATION TYPES

Both the conductivity and concentration analyzer types offer 11 types of temperature compensation. Manual temperature compensation is based on 0.1N KCl and has a reference temperature of 25-degrees Celsius.

Automatic temperature compensation can be set to one of several types. When configured for automatic temperature compensation, the transmitter measures the process temperature via the temperature compensator located either in the sensor or external to the sensor. It automatically adjusts the raw conductivity to a conductivity referenced to 25-degrees Celsius.

Standard KCl

The standard KCl temperature compensation option characterizes the temperature effect of 0.1N KCl. The data breakpoints are listed in Table A-1. The value K_{REF} in Table A-1 is the conductivity at 25-degrees Celsius. The Value K_T in Table A-1 is the conductivity at temperature T.

Table A-1. Standard KCl Data Breakpoints

Temperature (°C)	K_{REF}/K_T
0	1.80
5	1.57
10	1.38
15	1.22
20	1.10
25	1.00
30	0.91
50	0.69
75	0.50
100	0.38
128	0.30
156	0.25
306	0.18

Temperature Coefficient

The temperature coefficient option allows for a fixed correction based on a percentage change of the reference conductivity (conductivity at 25-degrees Celsius) per degree Celsius. The temperature compensation factor is derived from the equation:

$$\alpha = TC.COEF = \frac{\left(\frac{K_T}{K_{REF}} - 1.0\right) \times 100.0}{T - 25.0}$$

where:

α and TC.COEF	Percentage change in reference conductivity per degree Celsius.
K_T	Conductivity at temperature T (°C).
K_{REF}	Conductivity at 25°C.
T	Temperature of solution (°C)

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.

NaOH

The zero to 15-percent NaOH compensation option 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, use this compensation type for weak as well as concentrated solutions of NaOH. The data break points are listed in Table A-2. The value K_{REF} is the conductivity at 25-degrees Celsius. The value K_T is the conductivity at temperature T.

Table A-2. NaOH Data Breakpoints

Temperature (°C)	K_{REF}/K_T
0	1.79
25	1.00
50	0.69
75	0.53
100	0.43
156	0.30

NaCl

The zero to 20-percent NaCl compensation option characterizes an average temperature correction required to cover a zero to 20-percent NaCl concentration range. Since NaCl has a relatively constant set of temperature coefficients over a large range of concentrations, use this compensation type for weak as well as concentrated solutions of NaCl. The data breakpoints are listed in Table A-3. The value K_{REF} is the conductivity at 25-degrees Celsius. The value K_T is the conductivity at temperature T.

Table A-3. NaCl Data Breakpoints

Temperature (°C)	K_{REF}/K_T
0	1.75
25	1.00
50	0.66
75	0.47
100	0.35
140	0.25
156	0.23

HCl

The zero to 18-percent HCl compensation option characterizes an average temperature correction required to cover a zero to 18-percent HCl concentration range. Since HCl has a relatively constant set of temperature coefficients over a large range of concentrations, use this compensation type for weak as well as concentrated solutions of HCl. The data breakpoints are listed in Table A-4. The value K_{REF} is the conductivity at 25-degrees Celsius. The value K_T is the conductivity at temperature T.

Table A-4. HCl Data Breakpoints

Temperature (°C)	K_{REF}/K_T
0	1.75
25	1.00
50	0.66
75	0.47
100	0.35
140	0.25
156	0.23

H_2SO_4

The zero to 20-percent H_2SO_4 compensation option characterizes an average temperature correction required to cover a zero to 20-percent H_2SO_4 concentration range. The data breakpoints are listed in Table A-5. The value K_{REF} is the conductivity at 25-degrees Celsius. The value K_T is the conductivity at temperature T.

Table A-5. H_2SO_4 Data Breakpoints

Temperature (°C)	K_{REF}/K_T
0	1.37
25	1.00
50	0.84
75	0.73
100	0.67
156	0.61

User-Defined

The user-defined temperature compensation option allows the entering of six break point values for K_T/K_{REF}. The value K_{REF} is the conductivity at 25-degrees Celsius. The value K_T is the conductivity at temperature T. Choose each break point value to provide the closest fit of each linear segment to the actual temperature in degrees Celsius versus the K_T/K_{REF} relationship.

Pure Water

There are three pure water temperature compensation options available when using a Sensor Group C configuration. These include neutral salt (*NEUTRL*), trace acid (*ACID*), and trace base (*BASE*). The reference temperature for these types of temperature compensation is 25-degrees Celsius.

Temperature compensation for pure water is a polynomial based on data from T.S. Light. This equation compensates for variations in conductivity due to pure water. Temperature compensation for the effect of pure water becomes insignificant compared to the effects brought about by the solute for water having a conductivity value of greater than 0.5 microsiemens per centimeter. Using pure water temperature compensation for water with a conductivity greater than 0.5 microsiemens per centimeter will not cause errors; however, the compensation on solute effects (neutral salt, trace acid, trace base) may not accurately adjust for effects caused by the process liquid.

The polynomial is:

$$Factor = K_0 + K_1 \times T + K_2 \times T^2 + K_3 \times T^3 + K_4 \times T^4 + K_5 \times T^5 + K_6 \times T^6$$

The pure water coefficient values (K_0, K_1, K_2, etc.) are listed in Table A-6.

Table A-6. Pure Water Coefficient Values

Coefficient	Pure Water	Salt	Trace Acid	Trace Base
K_0	1.170848E-02	0.532688	0.7000	0.5700
K_1	9.101055E-04	1.439182E-02	0.0120	0.0172
K_2	2.132244E-07	2.852080E-04	—	—
K_3	4.548839E-07	-6.504617E-06	—	—
K_4	-4.042016E-11	9.640603E-08	—	—
K_5	0.0	-6.982205E-10	—	—
K_6	0.0	1.887667E-12	—	—

APPENDIX B - CONCENTRATION PROGRAMMING

INTRODUCTION

The concentration analyzer configuration has four specific solute options and one user-defined option. The specific solute options are:

- 0 to 15% NaOH.
- 0 to 20% NaCl.
- 0 to 18% HCl.
- 0 to 20% H_2SO_4.

When needing a custom concentration configuration, select the user-defined option. This provides a six-point, five-segment linear approximation of a specific conductivity-to-concentration curve. When using the user-defined option, choose custom units by either selecting one of the three engineering unit icons or enter a six-character, alphanumeric string.

USER-DEFINED CONDUCTIVITY-TO-CONCENTRATION CURVES

The transmitter may be used in any range and with any ABB conductivity sensor when using the concentration analyzer option. This allows infinite programming capability.

The user-defined option allows the characterization of conductivity-to-concentration curves. These curves are determined separately in a laboratory or from published data such as that in the ***International Critical Tables***. These curves are then segmented into five straight lines and programmed into the transmitter.

During this procedure, some rules must be followed.

- Point 1 for both conductivity and concentration is always the zero-percent (four-milliamp) output point.

- Point 6 for both conductivity and concentration is always the 100-percent (20-milliamp) output point.

- All conductivity points must be ascending. Concentration points can be either ascending or descending.

- If a reverse acting output is desired, swap the output range values either in the modify configure state or the output mode.

- The output range (four and 20-milliamp output range) can not exceed the point one and point six concentration range; however, the output range is compressible using the rerange function while in the output/hold mode.

The engineering units that appear on the primary display are user-defined. Select either *PPM*, *PPB*, or *%* to appear in the primary display, or enter a six-character, alphanumeric string. This string appears permanently or temporarily on the secondary display.

PREPROGRAMMED CONDUCTIVITY-TO-CONCENTRATION CURVES

Processes with fixed solute types allow the selection of one of the four predefined solute options.

The information provided in the remainder of this appendix pertains to these four options. It was compiled and extrapolated from the ***International Critical Tables***. All data and curves are referenced at 25-degrees Celsius. The information was curve-fit to simple equations for use in the transmitter. They only approximate the actual concentration curves. If requiring improved accuracy, especially in a narrow region of concentration, ABB recommends use of the user-defined option and manual entering of the data.

NaOH

The zero to 15-percent NaOH option is characterized by the data given in Table B-1 and the curve shown in Figure B-1.

Table B-1. NaOH Conductivity-To-Concentration Data

Conductivity (mS/cm)	Concentration (Weight %)
0.0	0.0
140.0	3.0
255.0	6.0
331.0	9.0
398.0	12.0
410.0	15.0

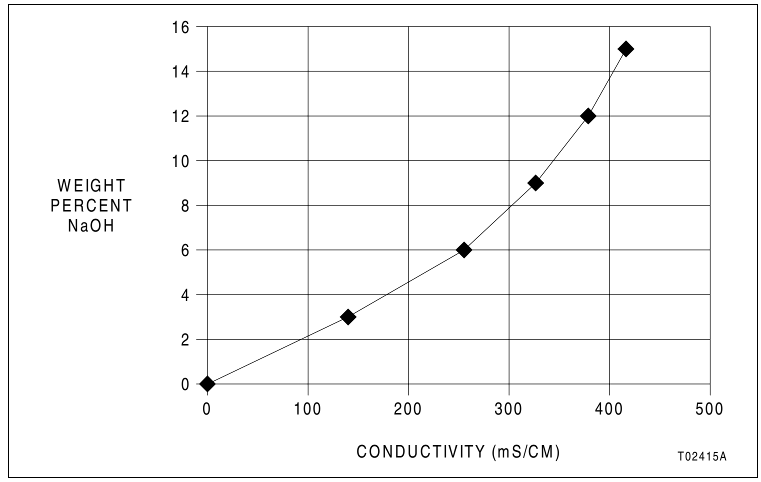

Figure B-1. NaOH Conductivity-To-Concentration Curve

NaCl

The zero to 20-percent NaCl option is characterized by the data given in Table B-2 and the curve shown in Figure B-2.

Table B-2. NaCl Conductivity-To-Concentration Data

Conductivity (mS/cm)	Concentration (Weight %)
0.0	0.0
34.3	2.0
119.7	8.0
172.6	12.0
207.6	16.0
231.9	20.0

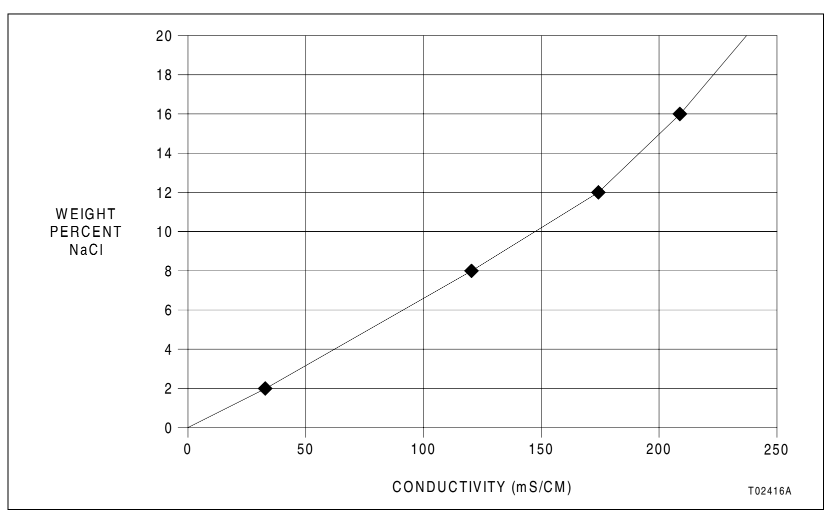

Figure B-2. NaCl Conductivity-To-Concentration Curve

HCl

The zero to 18-percent HCl option is characterized by the data given in Table B-3 and the curve shown in Figure B-3.

Table B-3. HCl Conductivity-To-Concentration Data

Conductivity (mS/cm)	Concentration (Weight %)
0.0	0.0
365.0	4.0
625.0	8.0
755.0	12.0
820.0	15.0
850.0	18.0

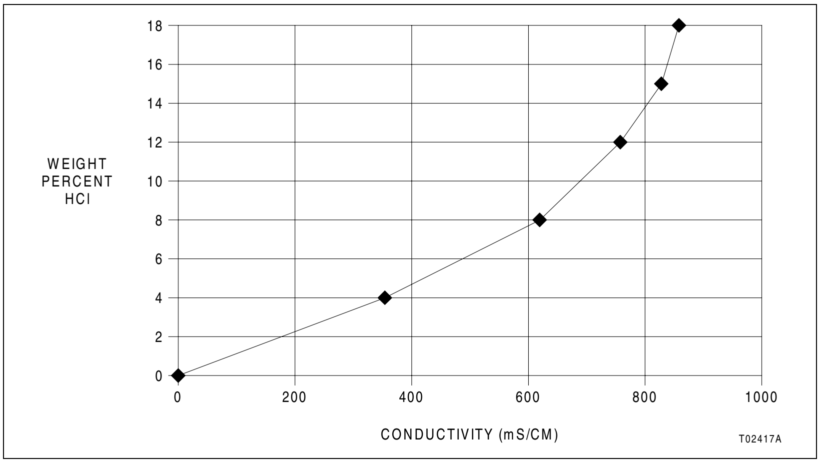

Figure B-3. HCl Conductivity-To-Concentration Curve

H_2SO_4

The zero to 20-percent H_2SO_4 option is characterized by the data given in Table B-4 and the curve shown in Figure B-4.

Table B-4. H_2SO_4 Conductivity-To-Concentration Data

Conductivity (mS/cm)	Concentration (Weight %)
0.0	0.0
190.0	4.0
355.0	8.0
499.0	12.0
618.0	16.0
710.0	20.0

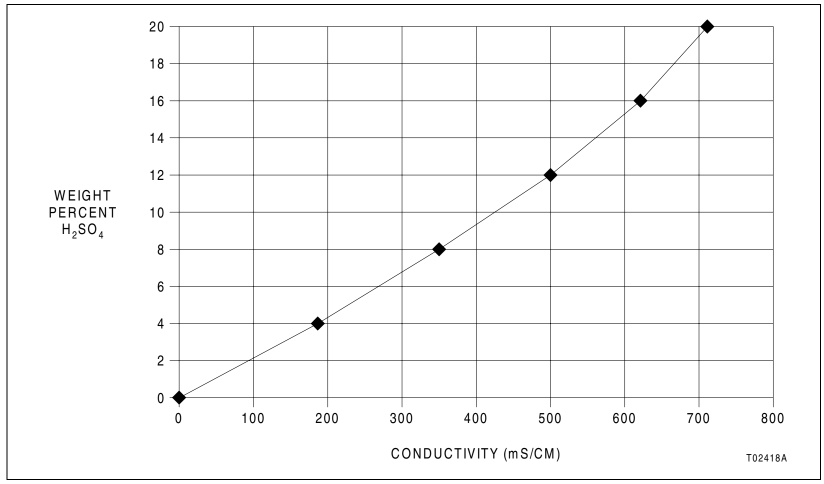

Figure B-4. H_2SO_4 Conductivity-To-Concentration Curve

APPENDIX C - PROGRAMMING TEXT STRING GLOSSARY

INTRODUCTION

When programming the transmitter, the six-character, alphanumeric region displays a wide variety of text prompts. In many cases, these prompts are abbreviations or portions of words.

TEXT PROMPTS

Table C-1 lists the text prompts and their full text equivalents.

Table C-1. Text Prompt Equivalents

Text Prompt	Equivalent
20MA.PT	20-mA point
3K.BLCO	3-kΩ Balco (temperature compensation)
4.75K.RTD	4.75-kΩ RTD network
4MA.PT	4-mA point
A GRP	Sensor Group A
AAAAAA	Alphanumeric entry
ACID	Acid
ADVNCD	Advanced programming state
ANALZR	Analyzer state
AUTO	Automatic temperature compensation (Nernstian)
B GRP	Sensor Group B
BAD.CAL	Bad calibration - entered value caused calculated values to exceed maximum values
BAD.VAL	Bad value - entered value exceeded maximum or minimum allowable value for entered parameter
BASE	Base
BASIC	Basic programming state
C GRP	Sensor Group C
CALIBR	Calibrate mode
CON.CAL	Conductivity or concentration calibration state
CONCEN	Concentration
COND	Conductivity
CONFIG	Configure mode
D.P. POS	Decimal point position
DAMPNG	Damping state
DENIED	Incorrect security password entered
DIAGS	Diagnostic state
DISABL	Disable
EDT.CAL	Edit calibration state

Table C-1. Text Prompt Equivalents (continued)

Text Prompt	Equivalent
FAIL.HI	Fail high (20 mA)
FAIL.LO	Fail low (4 mA)
H2SO4	Sulfuric acid
HCL	Hydrochloric acid
HLD.LVL	Hold level
HOLD	Hold state
K1/K25	Conductivity at temperature Point 1 to reference conductivity at 25°C. Points 2 through 6 represented in same manner.
MODIFY	Modify configure state
NACL	Sodium chloride
NAOH	Sodium hydroxide
NEUTRL	Neutral
NEW.VAL	New calibration value. The PV or temperature value expected during a PV or temperature calibration.
NEW.VL.C	New value in °C
NO D.P.	No decimal point
NO.ICON	No icon desired in primary display
NONE	None
OUT.CAL	Output calibration state
OUTPUT	Output mode
PASSWD	Security password
PT 100	Pt 100 RTD
PUR.H2O	Pure water
REL.HLD	Release hold
RERANG	Rerange state
RESET?	Conduct a reset operation?
REV.A10	Software revision A10
RST.ALL	Reset all parameters to factory settings
RST.CAL	Reset calibration constant and data to factory settings
RST.CON	Reset configurations to factory settings
RST.SEC	Reset security — remove any existing security
SAFE.MD	Safe mode state
SAVE?	Save the configuration?
SEC.DSP	Secondary display mode
SECS	Seconds
SECUR	Security mode
SLF.TST	Self test
SLOPE	Slope
SPIKE	Spike output state
SPK.MAG	Spike output magnitude
SPK.OFF	Spike output function set to off (disabled)

Table C-1. Text Prompt Equivalents (continued)

Text Prompt	Equivalent
STABL?	Is the displayed process variable stable?
T.OFF°C	Temperature offset in °C
TC.COEF	Temperature compensation coefficient
TC.TYPE	Temperature compensation type state
TMP.CAL	Temperature calibration state
TMP.SLP	Temperature slope
TMP.SNS	Temperature sensor type state
U.D.UNIT	User-defined engineering units
UNITS	Engineering units
VIEW	View configure state
X1.COND	Conductivity independent variable value for break point 1 in conductivity units. Points 2 through 6 represented in same manner.
Y1.COND	Concentration dependent variable value for break point 1 in concentration units. Points 2 through 6 represented in same manner.

FLOW TREE

Figure C-1 is a function flow tree for the Type TB82EC transmitter.

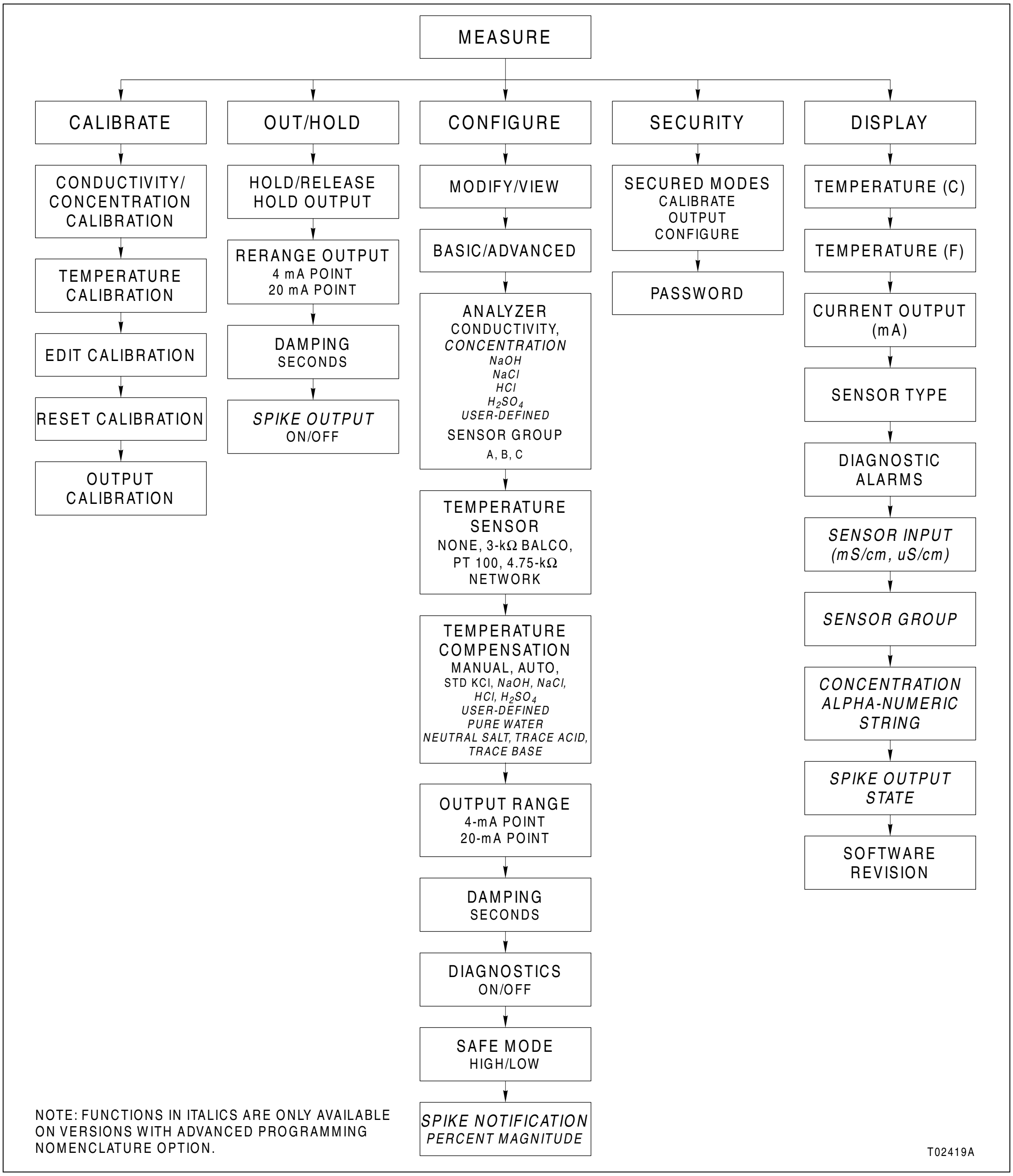

Figure C-1. Function Flow Tree

Type TB82EC Advantage Series Conductivity/Concentration Transmitter

TAG _______________ DATE _______________

PROGRAMMING MODE ☐ Basic ☐ Advanced

ANALYZER TYPE _______________________

☐ Conductivity

Sensor Group ☐ A ☐ B ☐ C

☐ Concentration

Sensor Group ☐ A ☐ B ☐ C

☐ 0 to 15% NaOH
☐ 0 to 20% NaCl
☐ 0 to 18% HCl
☐ 0 to 20% H_2SO_4
☐ User-defined

Engineering units __________________

COND1 _______	CONC1 _______
COND2 _______	CONC2 _______
COND3 _______	CONC3 _______
COND4 _______	CONC4 _______
COND5 _______	CONC5 _______
COND6 _______	CONC6 _______

TEMPERATURE SENSOR ☐ None ☐ 3-kΩ Balco ☐ Pt 100 ☐ 4.75-kΩ RTD network

TEMPERATURE COMPENSATION TYPE ☐ Manual ☐ Auto

☐ 0 to 15% NaOH
☐ 0 to 20% NaCl
☐ 0 to 18% HCl
☐ 0 to 20% H_2SO_4
☐ User-defined

T1 _______	K_{STD}/K_1 _______
T2 _______	K_{STD}/K_2 _______
T3 _______	K_{STD}/K_3 _______
T4 _______	K_{STD}/K_4 _______
T5 _______	K_{STD}/K_5 _______
T6 _______	K_{STD}/K_6 _______

OUTPUT RANGE 4 mA _______ 20 mA _______

DAMPING VALUE _______sec

SAFE MODE LEVEL ☐ Fail Low ☐ Fail High

SPIKE MAGNITUDE _______%

DIAGNOSTICS ☐ Enabled ☐ Disabled

SECURITY Password _______ ☐ Configure ☐ Calibrate ☐ Output/Hold

PROCEDURE INDEX

INTRODUCTION

This index is provided as a quick reference for those with a thorough knowledge of the Type TB82EC transmitter, related sensors, and this instruction. Procedures referenced in this index are part of an overall sequence. Going directly to a procedure without consulting the sequence flowcharts presented earlier in this instruction will not give an indication of what comes before and after in the sequence.

PROCEDURE PR1 - PIPE MOUNTING

PURPOSE/SCOPE

30 min.

This procedure describes how to mount the transmitter to a pipe using pipe mounting kit 4TB9515-0124.

Parts

Number	Qty	Description
4TB4704-0086	4	Bolt, 3/8-in. x 3/4-in.
4TB4704-0096	2	U-bolt, 5/16-in.
4TB4704-0119	4	Bolt, 3/8-in. x 5/8-in.
4TB4710-0022	8	Lockwasher, 3/8-in.
4TB4710-0023	4	Lockwasher, 5/16-in.
4TB4710-0025	4	Flatwasher, 5/16-in.
4TB4710-0028	8	Flatwasher, 3/8-in.
4TB4711-0013	4	Nut, 5/16-in.
4TB4711-0020	4	Nut, 3/8-in.
4TB5008-0022	1	Bracket, pipe mounting
4TB5008-0071	1	Bracket, instrument mounting
Customer-supplied	A/R	Fitting, liquid tight

Tools

- Crescent wrench.

PROCEDURE

The pipe mounting kit contains a pipe mounting bracket, an instrument mounting bracket, and associated hardware. The pipe mounting bracket accommodates pipe diameters as large as two inches.

☐ 1. Select the location and orientation of the transmitter.

☐ 2. Refer to Figure PR1-1 and use four 3/8-inch by 3/4-inch bolts, 3/8-inch flatwashers, 3/8-inch lockwashers, and 3/8-inch nuts to attach the instrument mounting bracket to the pipe mounting bracket.

☐ 3. Tighten the hardware using the crescent wrench.

☐ 4. Use the two U-bolts, and four each of the 5/16-inch flat washers, 5/16-inch lockwashers, and 5/16-inch nuts to attach the pipe mounting bracket to the pipe.

☐ 5. Tighten the hardware using the crescent wrench.

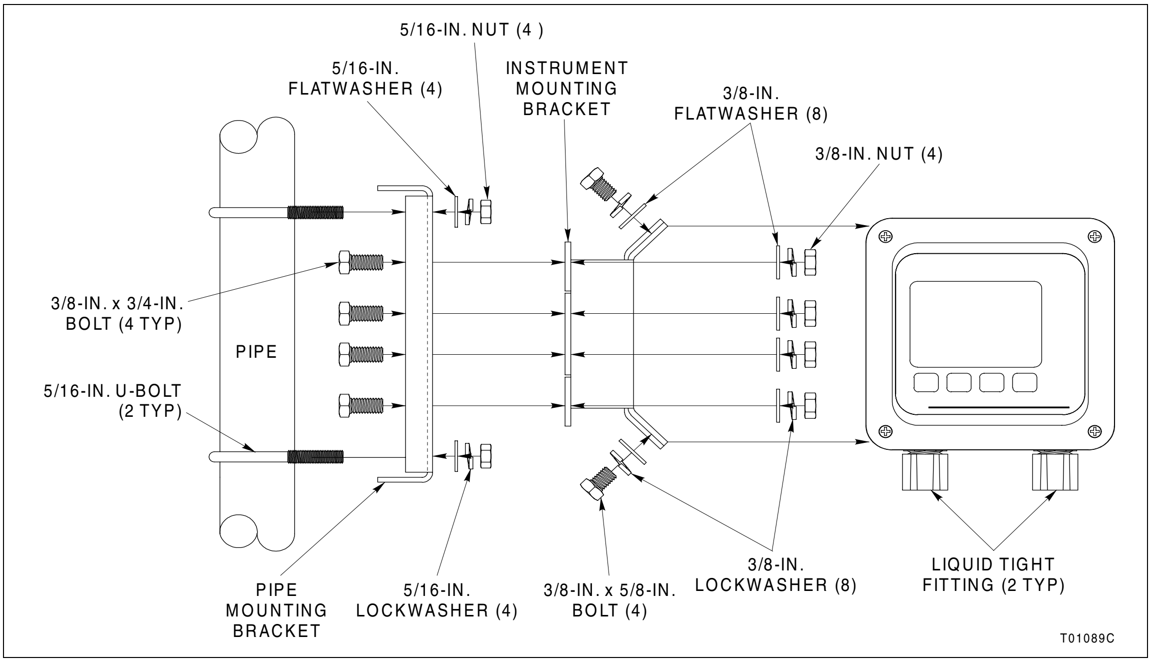

Figure PR1-1. Pipe Mounting

☐ 6. Use the four 3/8-inch x 5/8-inch bolts, 3/8-inch flatwashers, and 3/8-inch lockwashers to attach the transmitter to the instrument mounting bracket.

NOTE: The transmitter has four sets of threaded mounting holes to accommodate positioning the transmitter in any of four orientations.

☐ 7. Tighten the hardware using the crescent wrench.

PROCEDURE PR2 - PANEL MOUNTING

PURPOSE/SCOPE

30 min.

This procedure describes how to mount the transmitter into a panel using panel mounting kit 4TB9515-0123.

Parts

Number	Qty	Description
4TB4704-0048	4	Screw, hex, ⅜-16 x ½-in.
4TB4704-0118	4	Screw, panel mounting
4TB4710-0022	4	Lockwasher, split, ⅜-in.
4TB4906-0019	1	Gasket, panel
4TB5205-0292	4	Bracket, panel mounting

Tools

- Tools for making panel cutout (dependent on installation).
- Flat-blade screwdriver.
- Crescent wrench.

PROCEDURE

The panel mounting kit contains four panel mounting bracket assemblies and a panel gasket. The transmitter enclosure conforms to DIN sizing. Figure PR2-1 shows the required panel cutout, maximum panel thickness, and minimum panel depth.

☐ 1. Select the location and orientation of the transmitter.

☐ 2. Use suitable tools (dependent on installation) to make a 135.4 (+1.3, -0.8) by 135.4 (+1.3, -0.8) mm (5.33 (+0.05, -0.03) by 5.33 (+0.05, -0.03)) in. cutout with diagonal corners as shown in Figure PR2-1.

☐ 3. Install the panel gasket onto the transmitter.

☐ 4. Install the transmitter into the panel cutout.

☐ 5. Use the crescent wrench and four ⅜-16 x ½-in. hex screws and ⅜-in. lockwashers to attach the panel mounting brackets to all four corners of the transmitter.

☐ 6. Use the flat-blade screwdriver to tighten the panel mounting screws on the panel mounting bracket until the transmitter seats tightly against the panel.

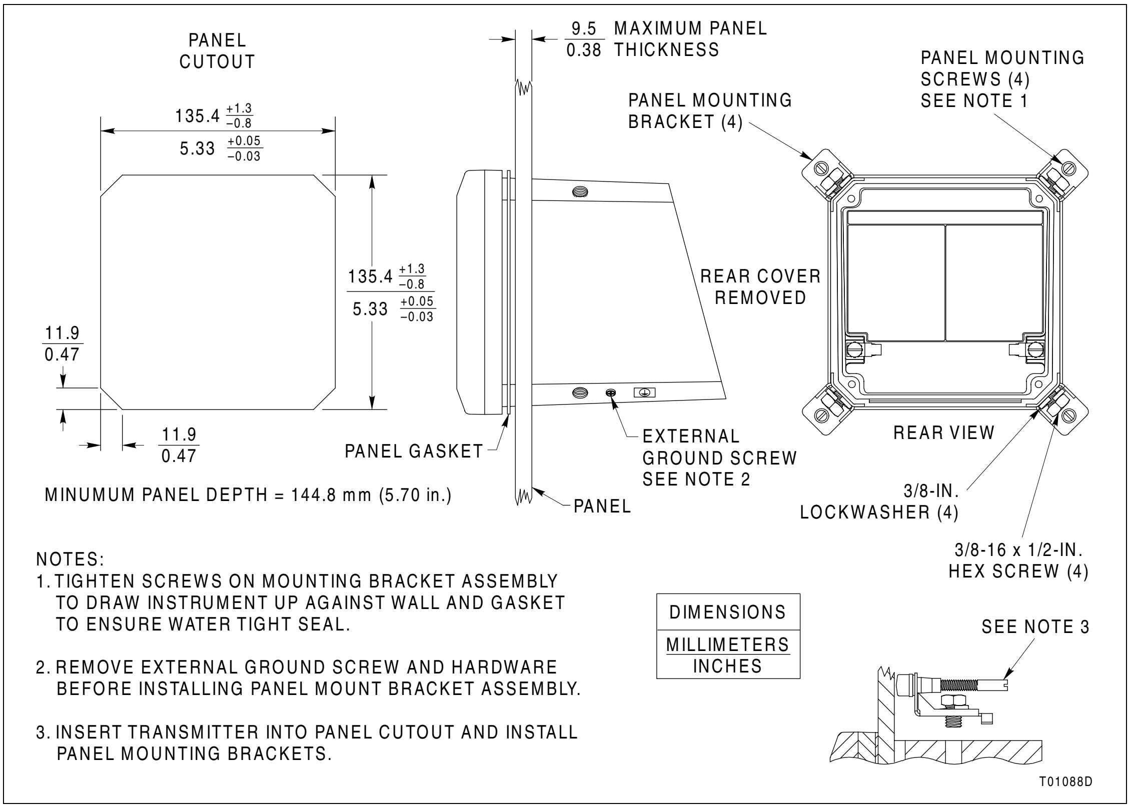

Figure PR2-1. Panel Mounting

PROCEDURE PR3 - WALL MOUNTING

PURPOSE/SCOPE

30 min.

This procedure describes how to mount the transmitter to a wall or other suitable surface using wall mounting kit 4TB9515-0123.

Parts

Number	Qty	Description
4TB4704-0119	4	Bolt, 3/8-in. x 5/8-in.
4TB4710-0022	4	Lockwasher, 3/8-in.
4TB4710-0028	4	Flatwasher, 3/8-in.
4TB5008-0071	1	Bracket, instrument mounting
Customer-supplied	A/R	Fitting, liquid tight
Customer-supplied	A/R	Fasteners for wall

Tools

- Tools for mounting instrument mounting bracket to wall (dependent on installation).
- Crescent wrench.

PROCEDURE

The wall mounting kit contains an instrument mounting bracket and associated hardware. Wall mounting accommodates installations where the transmitter can be positioned for a clear line of sight and free access to the rear terminations. These types of installations include supporting beams, flange brackets, and wall ends.

☐ 1. Select the location and orientation of the transmitter.

☐ 2. Refer to Figure PR3-1 and attach the instrument mounting bracket to the selected location using the appropriate type of fastener based on the material of the wall.

☐ 3. Use four 3/8-inch x 5/8-inch bolts, 3/8-inch flat washers, and 3/8-inch lockwashers to attach the transmitter to the instrument mounting bracket.

NOTE: The transmitter has four sets of threaded mounting holes to accommodate positioning the transmitter in any of four orientations.

☐ 4. Tighten the hardware using the crescent wrench.

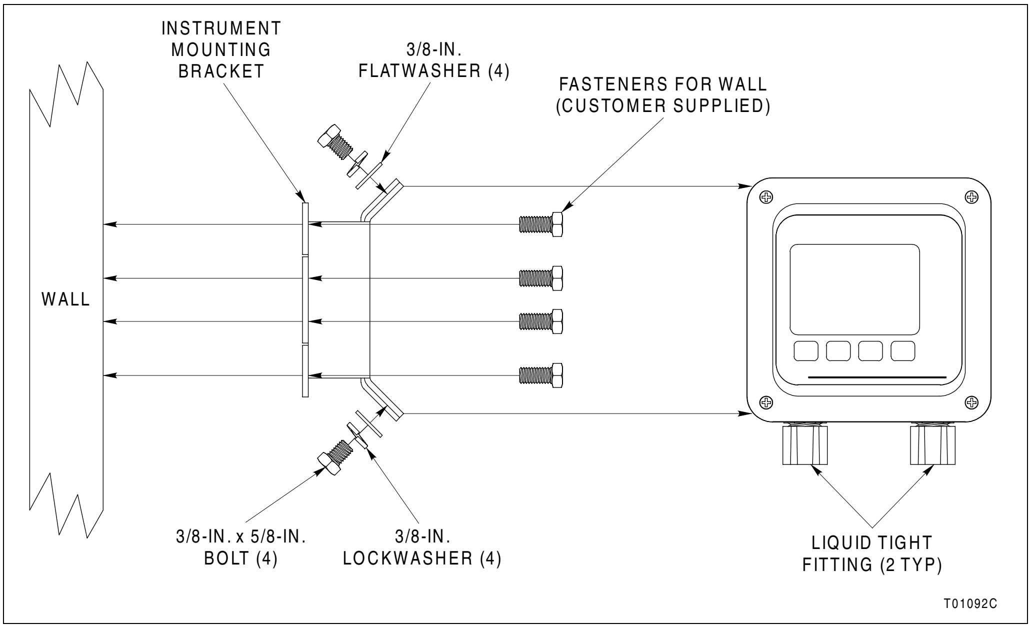

Figure PR3-1. Wall Mounting

PROCEDURE PR4 - HINGE MOUNTING

PURPOSE/SCOPE

30 min.

This procedure describes how to mount the transmitter to a wall or other suitable surface using hinge mounting kit 4TB9515-0125.

Parts

Number	Qty	Description
4TB4704-0048	4	Bolt, ⅜-in. x ⅝-in.
4TB4704-0086	8	Bolt, ⅜-in. x ¾-in.
4TB4710-0022	12	Lockwasher, ⅜-in.
4TB4710-0028	12	Flatwasher, ⅜-in.
4TB4711-0020	8	Nut, ⅜-in.
4TB5008-0071	1	Bracket, instrument mounting
4TB5008-0073	1	Bracket, L
4TB5010-0005	1	Hinge, stainless steel
Customer-supplied	A/R	Fitting, liquid tight
Customer-supplied	A/R	Fasteners for mounting surface

Tools

- Tools for mounting L-bracket to mounting surface (dependent on installation).
- Crescent wrench.

PROCEDURE

The hinge mounting kit contains an L bracket, an instrument mounting bracket, a stainless steel hinge, and associated hardware. The hinge mounting kit allows free access to the rear of the transmitter.

☐ 1. Select the location and orientation of the transmitter.

☐ 2. Refer to Figure PR4-1 and attach the L-bracket to the selected location using the appropriate type of fastener based on the material of the mounting surface.

☐ 3. Use four of the ⅜-inch x ¾-inch bolts, ⅜-inch flat washers, ⅜-inch lockwashers, and ⅜-inch nuts to attach the hinge to the L-bracket.

☐ 4. Tighten the hardware using the crescent wrench.

☐ 5. Use four ⅜-inch x ¾-inch bolts, ⅜-inch flat washers, ⅜-inch lockwashers, and ⅜-inch nuts to attach the instrument mounting bracket to the hinge.

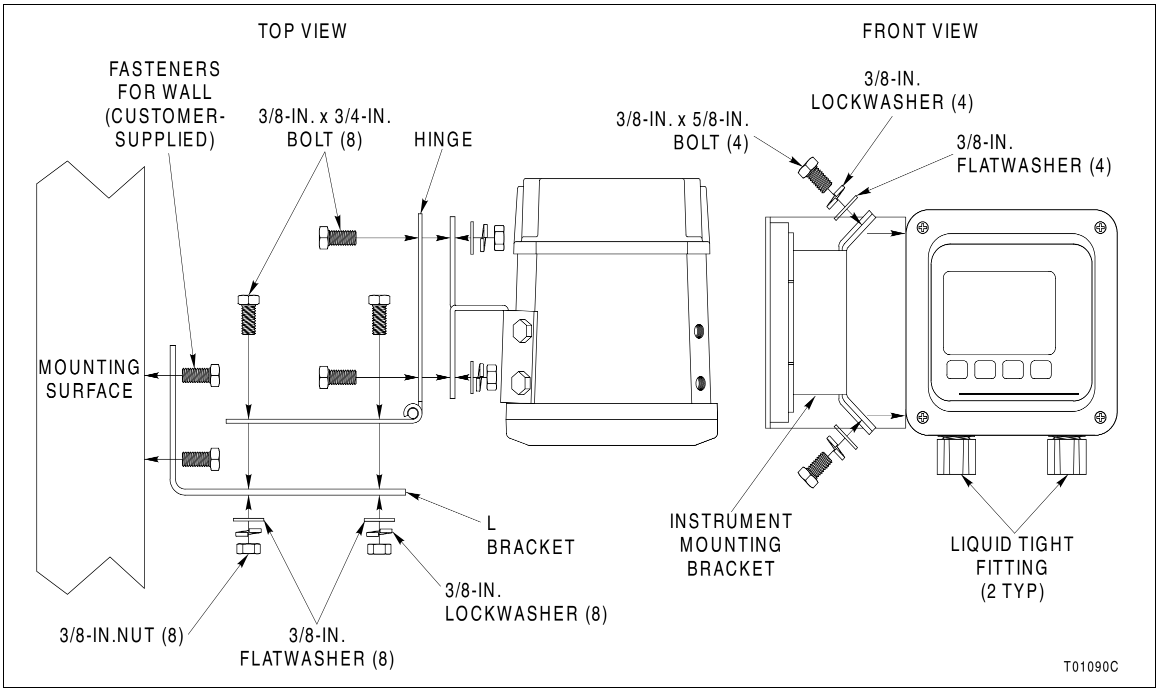

Figure PR4-1. Hinge Mounting

☐ 6. Tighten the hardware using the crescent wrench.

☐ 7. Use four 3/8-inch x 5/8-inch bolts, 3/8-inch flat washers, and 3/8-inch lockwashers to attach the transmitter to the instrument mounting bracket.

NOTE: The transmitter has four sets of threaded mounting holes to accommodate positioning the transmitter in any of four orientations.

☐ 8. Tighten the hardware using the crescent wrench.

PROCEDURE PR5 - SIGNAL/POWER WIRING

PURPOSE/SCOPE

10 min.

This procedure describes how to connect the signal/power wiring to the transmitter.

Parts None.

Tools

- Flat-blade screwdriver.
- Small flat-blade screwdriver.

PROCEDURE

Use shielded wire and separate conduit for the signal/power wiring, and the sensor wiring. Under ideal conditions, this may not be required; however, it minimizes the chance of problems from noise and signal degradation.

Just prior to entering the housing, terminate rigid conduit and install a short length of flexible conduit. This reduces stress to the housing.

The power and output signals share the same pair of wires. This wiring must bear a suitable voltage rating and be rated to at least 75-degrees Celsius (167-degrees Fahrenheit). All wiring and wiring practices must be in accordance with the National Electric Code (NEC), Canadian Electrical Code (CEC), or other applicable local or international codes for the country where the transmitter will be installed.

The signal terminals, located at the rear of the transmitter, accept wire sizes from 12 to 24 AWG. ABB recommends pin-style terminals for all connections.

A terminal block (TB1) label is marked POWER for the signal connections and shows the polarity. Wiring should not be run in conduit or open trays where power wiring or heavy electrical equipment could contact or physically and electrically interfere with the signal wiring. Twisted, shielded pairs should be used for cabling to insure the best performance. Reverse polarity protection, built into the transmitter, protects it against accidental reversal of the field wiring connections.

All power passes over the signal leads. The maximum supply voltage is 53 VDC (42 VDC for certified applications). Minimum supply voltage is determined by the loop resistance (Fig. PR5-1) as follows:

$$\text{min supply voltage (VDC)} = 13\ \text{VDC} + (0.020\ \text{A} \times \text{total R in ohms})$$

The load resistance must include any meters external to the transmitter, the wiring, and the system input.

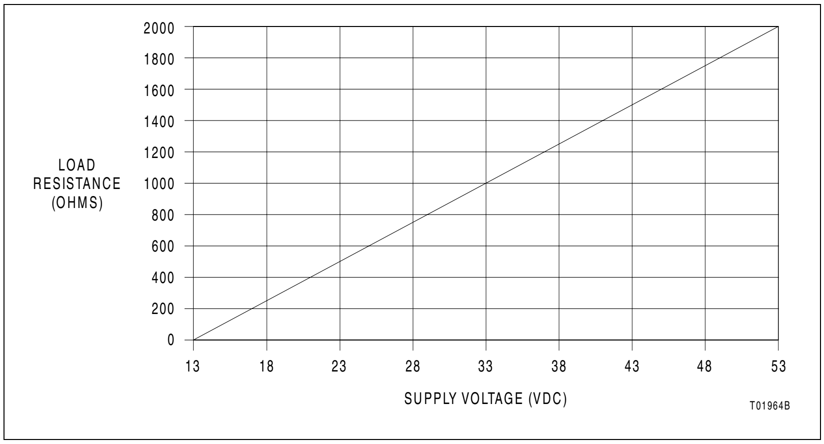

Figure PR5-1. Load Limits

☐ 1. Use the flat-blade screwdriver to loosen the four captive screws that secure the rear cover to the transmitter.

☐ 2. Use the small flat-blade screwdriver to connect the signal and power wiring to TB1-1 (+) and TB1-2 (-) as shown in Figure PR5-2.

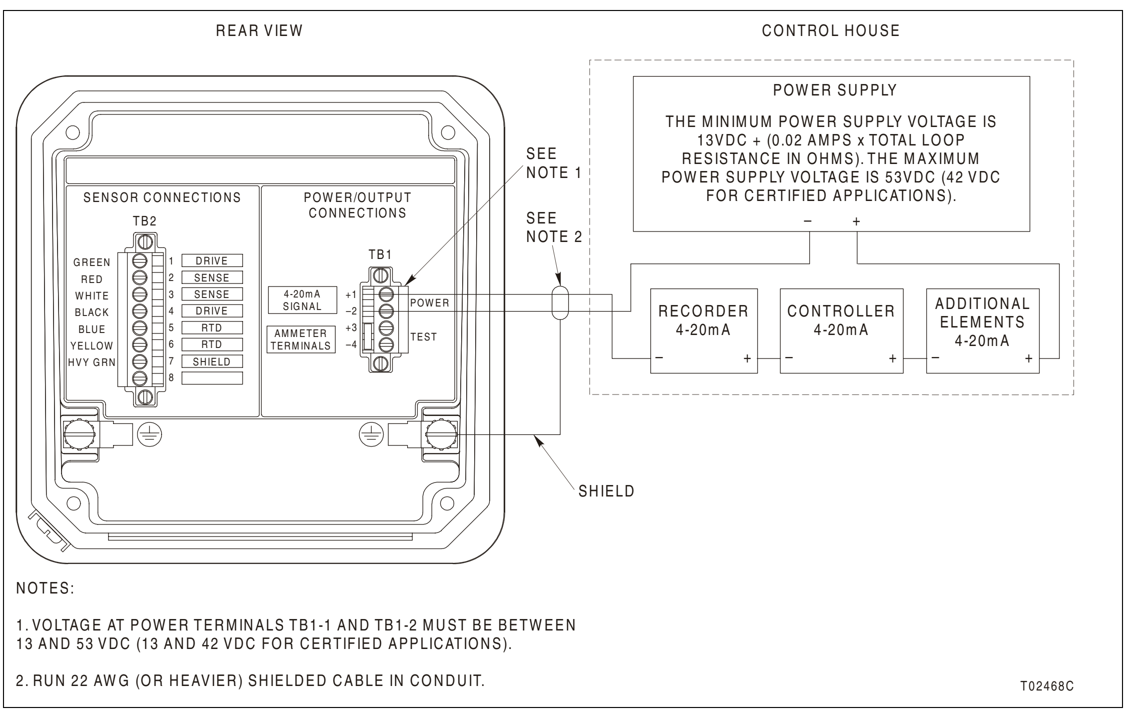

Figure PR5-2. Signal and Power Wiring

☐ 3. Install the rear cover and tighten the captive screws with the flat-blade screwdriver.

PROCEDURE PR6 - SENSOR WIRING

PURPOSE/SCOPE

10 min.

This procedure describes how to connect ABB four-electrode conductivity sensors to the transmitter.

Parts None.

Tools

- Flat-blade screwdriver.
- Small flat-blade screwdriver.

PROCEDURE

The sensor wiring connects to the rear of the transmitter. The terminals accept wire sizes from 12 to 24 AWG. ABB recommends pin-style terminals for all connections. Run sensor wiring in shielded conduit, or similar, to protect it from environmental influences. Do not allow the wires to become wet or lie on the ground or over any other equipment. Insure there is no abrading, pinching, or bending of the cables at installation.

The sensor leads are color coded and have the functions listed in Table PR6-1.

Table PR6-1. Pin Terminal Sensor Connections

Terminal	Color Code	Function
TB2-1	Green	Drive
TB2-2	Red	Sense
TB2-3	White	Sense
TB2-4	Black	Drive
TB2-5	Blue[1]	RTD
TB2-6	Yellow[1]	RTD
TB2-7	Heavy Green	Shield
TB2-8	No connection	No connection

NOTE:
1. Blue and yellow conductors are only present when using a temperature compensator.

☐ 1. Use the flat-blade screwdriver to loosen the four captive screws that secure the rear cover to the transmitter.

☐ 2. Use the small flat-blade screwdriver to connect the sensor wiring as shown in Figure PR6-1.

☐ 3. Install the rear cover and tighten the captive screws with the flat-blade screwdriver.

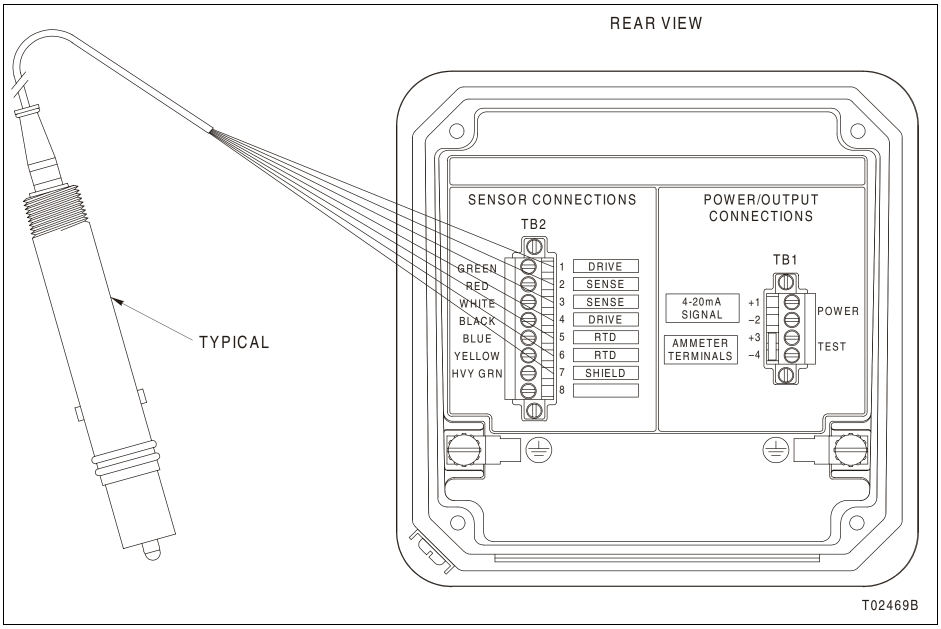

Figure PR6-1. Four-Electrode Sensor Connections

PROCEDURE PR7 - GROUNDING

PURPOSE/SCOPE

10 min.

This procedure describes how to properly ground the transmitter.

Parts None.

Tools

- Flat-blade screwdriver.

PROCEDURE

Signal wiring should be grounded at any one point in the signal loop, preferably before signal processing occurs. It may be left ungrounded (floating) if electrical noise is minimal. Ground the transmitter enclosure to an earth ground having less than 0.2 ohms of resistance. Internal and external earth ground terminals are provided and are shown in Figure PR7-1.

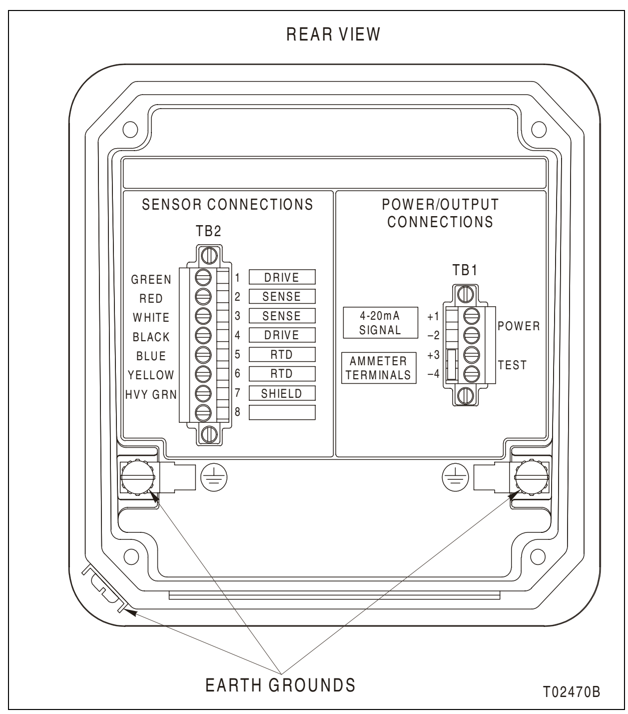

Figure PR7-1. Earth Grounds

PROCEDURE PR8 - TEMPERATURE CALIBRATION

PURPOSE/SCOPE

20 min.

This procedure describes how to perform a temperature calibration.

Parts None.

Tools

- Temperature measuring device.

PROCEDURE

The temperature calibration state is a smart calibration routine that allows for single-point and dual-point calibrations. Calibrating the temperature at two points that are at least 20-degrees Celsius apart causes the transmitter to automatically adjust the temperature sensor offset, slope, or both. Since this routine only uses the most recent calibration data, calibration can be conducted throughout the life of the sensor. This ensures consistent performance. The reset calibration state restores the calibration to factory settings in the event of bad calibration data. The reset calibration state is discussed in PR12.

NOTE: The reset calibration state resets all calibration values including the process sensor; therefore, the process sensor requires calibration after performing the reset calibration procedure.

☐ 1. If this is a new installation, allow the sensor to reach ambient temperature. If this is an existing installation, wait until the process temperature stabilizes.

☐ 2. Press the *MENU* smart key until *CALIBRATE* is highlighted on the display.

☐ 3. Press the *SELECT* smart key to enter the calibrate state.

☐ 4. Press the *NEXT* smart key until *TMP.CAL* appears on the display.

☐ 5. Press the *SELECT* smart key to start the temperature calibration procedure.

☐ 6. The transmitter displays *STABL?*. Observe the displayed reading. If it is stable, press the *YES* smart key. If it is not stable, press the *NO* smart key. If *NO* is selected, the transmitter returns to the temperature calibration state. Perform Steps 7 through 9. If *YES* is selected, go to Step 10.

☐ 7. If the ambient or process liquid temperature has become unstable, wait until the process temperature stabilizes.

☐ 8. Check to see if the transmitter has detected a fault condition by looking for the *FAULT* icon on the display. Interrogate the fault by escaping to the measure mode through the *exit to MEASURE* smart key and then pressing the *FAULT info* smart key in that order.

☐ 9. Refer to Section 12 for information on problem and error codes.

☐ 10. The transmitter asks for the *NEW VAL.* Use the temperature measuring device to measure the ambient temperature for a new installation or the process liquid for an existing installation and enter that value into the *NEW VAL.* screen.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 10a and 10b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 11. For an existing installation where a two-point calibration is desired, wait for the process liquid temperature to change to 20°C. When the process liquid temperature has stabilized, go to Step 6. For a new installation, mount the sensor in its final installed location and allow it to reach the process liquid temperature. When the sensor and process liquid have stabilized, go to Step 5.

PROCEDURE PR9 - CONDUCTIVITY/CONCENTRATION CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to perform a conductivity/concentration calibration.

Parts None.

Tools
- External instrument having the same type of temperature compensation as the transmitter.
- Grab sample of process liquid.

PROCEDURE

The conductivity/concentration calibration state is a smart one-point calibration routine. It allows for single-point and dual-point calibrations. Initiating calibrations at two different conductivity values having ample separation allows the transmitter to automatically adjust the offset, slope, or both. This insures the best sensor performance. Since this routine uses only the latest calibration data, calibration can be conducted throughout the life of the sensor. This insures consistent sensor performance.

If an incorrect calibration has been entered, the reset calibration state provides the ability to return transmitter calibration to those set at the factory.

> **NOTE:** The reset calibration state resets all calibration values, including the temperature calibration values. A temperature calibration must be performed after a calibration reset.

The transmitter is configurable as a conductivity or concentration transmitter. The smart one-point calibration routines automatically set the units of calibration to be the same as those for the measured process variable.

☐ 1. Make sure the sensor is in its final installed location and orientation.

☐ 2. Measure the process variable value, using an external instrument having the same type of temperature compensation as the transmitter, and a grab sample.

☐ 3. Record the value displayed on the transmitter at the time the grab sample was taken and the value displayed on the external instrument.

☐ 4. Press the *MENU* smart key until *CALIBRATE* is highlighted on the display.

☐ 5. Press the *SELECT* smart key to enter the calibrate state.

☐ 6. Press the *NEXT* smart key until *CON.CAL* appears on the display.

☐ 7. Press the *SELECT* smart key to start the one-point calibration procedure.

☐ 8. The transmitter displays *STABL?*. Observe the displayed reading. If it is stable, press the *YES* smart key. If it is not stable, press the *NO* smart key. If *NO* is selected, the transmitter returns to the process sensor calibration state. Perform Steps 9 through 11. If *YES* is selected, go to Step 12.

☐ 9. Wait until the process liquid composition stabilizes.

☐ 10. Check to see if the transmitter has detected a fault condition by looking for the *FAULT* icon on the display. Interrogate the fault by escaping to the measure mode through the *exit to MEASURE* smart key and then pressing the *FAULT info* smart key in that order.

☐ 11. Refer to Section 12 for information on problem and error codes.

☐ 12. The transmitter displays *NEW VAL*.

a. Calculate the new process variable value by subtracting the transmitter value recorded in Step 3 from the external instrument value recorded in Step 3 and then adding that result to the current value displayed on the transmitter.

b. Use the ▲ smart key to increment the value of the blinking digit.

c. When the first digit value is correct, use the ▶ smart key to move to the next digit.

d. Repeat Steps 12b and 12c for each digit.

e. Press the *ENTER* smart key to accept the new value.

☐ 13. If the entered calibration value is not valid, the transmitter displays *BAD.CAL*, and the calibration value is rejected. If the entered calibration value is valid, the slope (sensor efficiency) appears on the display. Press the *NEXT* smart key to display the offset.

☐ 14. Press the *NEXT* smart key to return to the conductivity/ concentration calibration state or press the *exit to MEASURE* smart key to go to the measure mode.

NOTE: If an output hold condition is present, the display inquires if this condition should be released.

PROCEDURE PR10 - OUTPUT CALIBRATION

PURPOSE/SCOPE

10 min.

This procedure describes how to calibrate the transmitter output values using an external validation device.

Parts None.

Tools

- Digital multimeter (DMM).
- Flat-blade screwdriver.
- Small flat-blade screwdriver.

PROCEDURE

The output calibrate state trims the output signal to maintain precise transmission of the process variable to the final monitoring system. The transmitter output current is factory calibrated; however, the output can be trimmed to compensate for other input and output devices.

☐ 1. Use the flat-blade screwdriver to loosen the four captive screws that secure the rear cover to the transmitter.

☐ 2. Use the small flat-blade screwdriver to remove the shorting jumper from the test terminals, TB1-3 (+) and TB1-4 (-), as shown in Figure PR10-1.

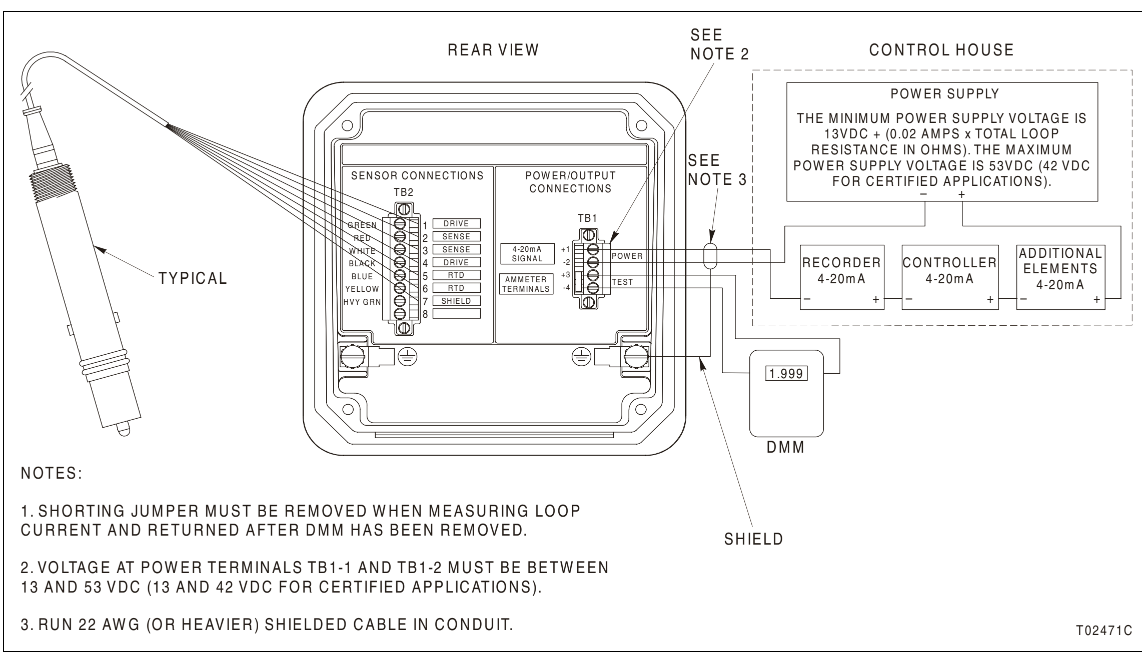

Figure PR10-1. Output Calibration Setup

☐ 3. Connect the DMM, set to measure mA, to the TEST terminals, TB1-3 (+) and TB1-4 (-).

☐ 4. Press the *MENU* smart key until *CALIBRATE* is highlighted on the display.

☐ 5. Press the *SELECT* smart key to enter the calibrate state.

☐ 6. Press the *NEXT* smart key until *OUT.CAL* appears on the display.

☐ 7. Press the *SELECT* smart key to start the output calibration procedure.

☐ 8. Use the ▼ and ▲ smart keys to adjust the output so that the DMM reads 4.0 mA.

☐ 9. Press the *ENTER* smart key to enter the new value and proceed to the 20-mA output.

☐ 10. Use the ▼ and ▲ smart keys to adjust the output so that the DMM reads 20.0 mA.

☐ 11. Press the *ENTER* smart key to enter the new value. The transmitter returns to the output calibration state.

> **NOTE:** Once the output level has been permanently stored using the *ENTER* smart key, the output calibration procedure must be repeated to rectify a bad calibration.

☐ 12. Press the *exit to MEASURE* smart key to return to the measure mode.

PROCEDURE PR11 - EDIT CALIBRATION

PURPOSE/SCOPE

5 min.

This procedure describes how to edit the process sensor and temperature sensor offset and slope values.

Parts None.

Tools None.

PROCEDURE

The edit calibration state allows manual adjustment of the process sensor and temperature sensor slope and offset values. This function may not be suitable for many applications, but it facilitates quick and easy access to these calibration values for troubleshooting purposes.

☐ 1. Press the *MENU* smart key until *CALIBRATE* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the calibrate state.

☐ 3. Press the *NEXT* smart key until *EDT.CAL* appears on the display.

☐ 4. Press the *SELECT* smart key to start the edit calibration procedure.

☐ 5. The transmitter displays the process sensor slope. Valid slope values range from 0.20 to 5.00.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 5a and 5b for each digit.

d. Press the *ENTER* smart key to accept the new value and edit the sensor offset. To continue, go to Step 6. To end the procedure, press the *exit to MEASURE* smart key.

☐ 6. The transmitter displays the process sensor offset. The valid offsets range from -20 to +20 μS/cm for Group A sensors,

-4 to +4 µS/cm for Group B sensors, and -0.8 to +0.8 µS/cm for Group C sensors.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 6a and 6b for each digit.

d. Press the *ENTER* smart key to accept the new value and edit the temperature slope. To continue, go to Step 7. To end the procedure, press the *exit to MEASURE* smart key.

☐ 7. The transmitter displays the temperature sensor slope. Valid slope values range from 0.2 to 1.5.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 7a and 7b for each digit.

d. Press the *ENTER* smart key to accept the new value and edit the temperature offset. To continue, go to Step 8. To end the procedure, press the *exit to MEASURE* smart key.

☐ 8. The transmitter displays the temperature sensor offset. Valid offset values range from -40°C to +40°C.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 8a and 8b for each digit.

d. Press the *ENTER* smart key to accept the new value and go back to the edit calibration state. To end the procedure, press the *exit to MEASURE* smart key.

PROCEDURE PR12 - RESET CALIBRATION

PURPOSE/SCOPE

1 min.

This procedure describes how to restore process sensor and temperature sensor calibration values to the factory values.

Parts None.

Tools None.

PROCEDURE

The reset calibration state sets all process sensor and temperature sensor calibration data to the values set at the factory. This state allows the purging of all calibration history and the start of a new history. The reset sets the process sensor and temperature sensor slope values to 1.000, and the process sensor and temperature sensor offset values to 0.000.

☐ 1. Press the *MENU* smart key until *CALIBRATE* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the calibrate state.

☐ 3. Press the *NEXT* smart key until *RST.CAL* appears on the display.

☐ 4. Press the *SELECT* smart key to start the reset calibration procedure.

☐ 5. The display reads *RESET?*. Press the *YES* smart key to confirm the reset or the *NO* smart key to refuse the reset.

NOTE: The reset calibration state resets all sensor and temperature calibration values; therefore, the process sensor and temperature sensor require calibration after performing the reset calibration procedure.

PROCEDURE PR13 - DAMPING ADJUSTMENT

PURPOSE/SCOPE

1 min.

This procedure describes how to change the damping on the transmitter output from the output/hold mode and the configure mode.

Parts None.

Tools None.

PROCEDURE

The damping state applies a lag function on the output signal and reduces fluctuations caused by erratic process conditions. The damping value is adjustable from 0.0 to 99.9 seconds. This value represents the time required for the output to reach approximately 63.2 percent of its final value in response to a step change in the process variable input.

Output/Hold Mode

☐ 1. Press the *MENU* smart key until *OUT/HOLD* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the output/hold mode.

☐ 3. Press the *NEXT* smart key until *DAMPNG* appears on the display.

☐ 4. Press the *SELECT* smart key to start the damping procedure.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 4a and 4b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 5. When the process is complete, the transmitter automatically goes to the measure mode.

Configure mode

☐ 1. Press the *SELECT* smart key to modify the *DAMPNG* state.

☐ 2. The transmitter displays the current damping value.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 2a and 2b for each digit.

d. Press the *ENTER* smart key to accept the new value.

PROCEDURE PR14 - HOLD OUTPUT

PURPOSE/SCOPE

1 min.

This procedure describes how to hold the transmitter output at a captured or manually adjusted value.

Parts None.

Tools None.

PROCEDURE

The hold state allows the transmitter output to be fixed at a level captured upon initiation of the hold or to be manually adjusted to any value between zero and 100 percent (four and 20 milliamps).

☐ 1. Press the *MENU* smart key until *OUT/HOLD* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the output/hold mode.

☐ 3. Press the *NEXT* smart key until *HOLD* appears on the display.

☐ 4. Press the *SELECT* smart key to start the hold output procedure.

☐ 5. To accept the current hold value, press the *ENTER* smart key and the transmitter automatically goes to the measure mode. To adjust the current hold value, do not press the *ENTER* smart key and continue with Step 6.

☐ 6. Press the ▲ smart key to increment the blinking digit to the desired value.

☐ 7. Press the ▶ smart key to move to the next digit.

☐ 8. Repeat Steps 6 and 7 for each digit.

☐ 9. Press the *ENTER* soft key to accept the new value.

☐ 10. When the process is complete, the transmitter automatically goes to the measure mode.

PROCEDURE PR15 - RELEASE HOLD OUTPUT

PURPOSE/SCOPE

1 min.

This procedure describes how to release the transmitter output from a hold condition.

Parts None.

Tools None.

PROCEDURE

The hold state is used to release a hold condition that already exists.

☐ 1. Verify that *OUTPUT HELD* appears in the upper left corner of the display.

☐ 2. Press the *MENU* smart key until *OUT/HOLD* is highlighted on the display.

☐ 3. Press the *SELECT* smart key to enter the output/hold mode.

☐ 4. Press the *NEXT* smart key until *HOLD* appears on the display.

☐ 5. Press the *SELECT* smart key to start the release hold output procedure.

☐ 6. The transmitter display reads *REL.HLD*. Press the *YES* smart key to release the hold output condition or the *NO* smart key to continue to hold the output.

☐ 7. When the process is complete, the transmitter automatically goes to the measure mode.

PROCEDURE PR16 - RERANGE OUTPUT

PURPOSE/SCOPE

2 min.

This procedure describes how to change the output range.

Parts None.

Tools None.

PROCEDURE

The rerange state provides the ability to change the output range. Change one or both endpoint values to any value or range of values that are within those listed in Table PR16-1.

Table PR16-1. Output Ranges

Input Type	Output Range
Concentration	0.000 to 1,999 digits (engineering unit configurable)
Conductivity	
Group A	0.000 to 1,999 mS/cm
Group B	0.000 to 1,999 µS/cm
Group C	0.000 to 199.9 µs/cm

☐ 1. Press the *MENU* smart key until *OUT/HOLD* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the output/hold mode.

☐ 3. Press the *NEXT* smart key until *RERNGE* appears on the display.

☐ 4. Press the *SELECT* smart key to start the rerange procedure.

☐ 5. Edit the process variable value for the four-mA point.

a. Press the ▲ smart key to increment the blinking digit to the desired value.

☐ b. Press the ▶ smart key to move to the next digit or unit of conductivity.

☐ c. Repeat Steps 5a and 5b for each digit or unit of conductivity.

☐ 6. Press the *ENTER* smart key to accept the new value and continue to the process variable value for the 20-mA point.

☐ 7. Press the *exit to MEASURE* smart key to escape to the measure mode or continue with the procedure to adjust the process variable value for the 20-mA point.

NOTE: If the four-mA value is changed and accepted using the *ENTER* smart key, the value is valid per those shown in Table PR16-1, and the transmitter is returned to the measure mode by pressing the *exit to MEASURE* smart key without adjusting the 20-mA value, the output range will reflect the new four-mA point.

☐ 8. Edit the process variable value for the 20-mA point.

☐ a. Press the ▲ smart key to increment the blinking digit to the desired value.

☐ b. Press the ▶ smart key to move to the next digit or unit of conductivity.

☐ c. Repeat Steps 8a and 8b for each digit or unit of conductivity.

☐ 9. Press the *ENTER* smart key to accept the new value.

☐ 10. When the process is complete, the transmitter automatically goes to the measure mode.

PROCEDURE PR17 - OUTPUT SPIKE TOGGLE

PURPOSE/SCOPE

1 min.

This procedure describes how to enable or disable the diagnostic spike. This setting is available in the Advanced programming mode.

Parts None.

Tools None.

PROCEDURE

The spike state toggles the operational state of the spike output function. The spike function modulates the current output by the amount set in the transmitter configuration.

☐ 1. Press the *MENU* smart key until *OUT/HOLD* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the output/hold mode.

☐ 3. Press the *NEXT* smart key until *SPIKE* appears on the display.

☐ 4. Press the *SELECT* smart key to start the spike output procedure.

☐ 5. Toggle the spike output function to the desired state (*ON* or *OFF*) by using the ▲ smart key to toggle between *ON* and *OFF*.

☐ 6. Press the *ENTER* smart key to select the desired state.

☐ 7. When the process is complete, the transmitter automatically goes to the measure mode.

NOTE: Once the spike state is *OFF*, changing the configured spike level in the configure mode will not enable the spike state. The spike state can only be turned *ON* or *OFF* in the output/hold mode.

PROCEDURE PR18 - SELECTING VIEW OR MODIFY CONFIGURATION STATE

PURPOSE/SCOPE

1 min.

This procedure describes how to select whether to view or modify the configuration.

Parts None.

Tools None.

PROCEDURE

When the configure mode is selected, a decision point is reached to determine whether to view or modify the configuration.

☐ 1. Press the *MENU* smart key until *CONFIGURE* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the configure mode.

☐ 3. The *MODIFY* screen appears. Press the *YES* smart key to modify the configuration and go to the next procedure in the flow. Press the *NO* smart key to view the configuration and go on to Step 4.

☐ 4. The *VIEW* screen appears. Press the *YES* smart key to view the configuration.

☐ 5. To view the configuration only, perform Steps 6 and 7. To modify the configuration, go to the next procedure in the flow.

☐ 6. Press the *NEXT* smart key to scroll through the configuration.

☐ 7. At any time during the viewing of the configuration, press the *exit to MEASURE* smart key to go back to the measure mode.

PROCEDURE PR19 - MODIFYING CONFIGURATION WHILE VIEWING

PURPOSE/SCOPE

1 min.

This procedure describes how to modify the configuration while in the view configure state.

Parts None.

Tools None.

PROCEDURE

☐ 1. Press the *NEXT* smart key to scroll through the configuration until the parameter that requires changing appears.

☐ 2. Press the *ENTER* smart key to modify that parameter.

☐ 3. A *MODIFY?* screen appears. Press the *YES* smart key to modify the parameter.

☐ 4. If the configure mode is password protected, perform this step and then go on to Step 5. If it is not password protected, go on to Step 5. When the password inquiry screen (*PASSWD*) appears:

a. The display reads _ _ _. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 4a and 4b for each digit.

d. Press the *ENTER* smart key to accept the password.

☐ 5. Modify the desired parameter using the proper procedure.

☐ 6. Press the *exit to MEASURE* smart key.

☐ 7. When the *SAVE?* screen comes up, press the *YES* smart key to accept the change. Press the *NO* smart key to abort the change. In either case, the transmitter goes to the measure mode.

PROCEDURE PR20 - PROGRAMMING MODE CHANGE

PURPOSE/SCOPE

1 min.

This procedure describes how to change the programming mode from advanced to basic or from basic to advanced for transmitters with the advanced programming option.

Parts None.

Tools None.

PROCEDURE

The configure mode is split into two groups of programming: basic and advanced. These two options are specified by nomenclature and control the number of configuration options available in the modify configure mode.

The basic programming mode contains a subset of configuration options found in the advanced programming mode. Separation into two programming groups is advantageous when limited functionality is desired. Fewer options reduces confusion and the possibility of configuration errors.

Transmitters ordered with the advanced programming option can be changed between basic and advanced programming. Transmitters ordered with the basic programming option require an update password to change to advanced programming. Contact ABB to obtain the password.

The programming toggle (*BASIC* or *ADVNCD*) for transmitters with the advanced programming option must be set in two locations: user state in the utility mode and modify configure state in the configure mode. In order to select either the basic or advanced programming mode in the modify configure state, the programming mode must be set to advanced in the user state.

NOTE: *ADVNCD* is the factory default setting in both modify configure state in the configure mode and user state in the utility mode for transmitters ordered with the advanced programming option.

☐ 1. The *BASIC* screen appears. Press the *ENTER* smart key to set the programming to basic and advance to the modify configure states or press the *NEXT* smart key to advance to the next screen and go on to Step 2.

☐ 2. The *ADVNCD* screen appears. Press the *ENTER* smart key to set the programming to advanced and advance to the modify configure states.

PROCEDURE PR21 - ANALYZER TYPE SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the analyzer state. This setting is available in both the basic and advanced programming modes.

Parts None.

Tools None.

PROCEDURE

The analyzer state determines the transmitter and sensor type. Table PR21-1 describes the function and programming mode of each state.

Table PR21-1. Analyzer States

State	Display	Programming Mode	Function
Concentration	*CONCEN*	Basic and Advanced	Used to measure conductivity of a solution and convert nonspecific measurement to specific solute concentration. Process variable engineering units are %, ppm, ppb, and user-defined.
Conductivity	*COND*	Basic	Used to measure conductivity of a solution. Process variable engineering units are µS/cm and mS/cm.

☐ 1. Press the *SELECT* smart key to modify the analyzer state.

☐ 2. If this is a basic configuration, the transmitter goes directly to the sensor group options. Go to the next procedure in the flow. If this is an advanced configuration, continue with Step 3.

☐ 3. The currently configured analyzer state appears. Press the *NEXT* smart key until the desired analyzer state appears.

☐ 4. Press the *ENTER* smart key to accept the new value.

PROCEDURE PR22 - SENSOR GROUP SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to select the sensor group.

Parts None.

Tools None.

PROCEDURE

There are three sensor groups: A, B, and C. The sensor group must coincide with the conductivity ranges specified in Table PR22-1. The physical orientation and surface area of the electrode, and the measured solution voltage set by the electronics of the Type TB82EC transmitter determine the cell constants of four-electrode sensors. Therefore, ABB recommends the use of only ABB conductivity sensors with the Type TB82EC transmitter.

Table PR22-1. Sensor Ranges

Group	Maximum Range
A	0 to 1,999 mS/cm
B	0 to 1,999 µS/cm
C	0 to 199.9 µS/cm

☐ 1. The currently configured sensor group appears. Press the *NEXT* smart key until the desired sensor group appears.

☐ 2. Press the *ENTER* smart key to accept the new value.

☐ 3. If this is a conductivity configuration, press the *NEXT* smart key to go to the next configuration parameter as shown in the basic configuration sequence in Figure 8-6. If this is a concentration configuration, the display advances to the configuration option selection as shown in the advanced configuration sequence flowchart in Figure 8-5.

PROCEDURE PR23 - CONFIGURATION OPTION SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to select either a predefined or user-defined concentration configuration. This setting is available in the advanced programming mode and applies to the concentration analyzer state.

Parts None.

Tools None.

PROCEDURE

The concentration state converts conductivity values to concentration units. This state applies temperature compensated conductivity measurements to a predefined or user-defined function. These functions convert conductivity measurements to concentration values having a fixed decimal point location so that decimal point ranging will not occur. The concentration state provides the following predefined configurations:

- 0 to 15% NaOH.
- 0 to 20% NaCl.
- 0 to 18% HCl.
- 0 to 20% H_2SO_4.

NOTE: The user-defined configuration option is the only one available for Sensor Groups B and C.

These predefined configurations are based on data contained in the ***International Critical Tables***. Refer to Appendix B for more information on concentration programming.

The user-defined configuration provides the capability of selecting an engineering unit icon, the decimal point position, a custom text description, and a six-point linear curve fit. These topics are discussed in subsequent procedures.

☐ 1. Press the *NEXT* smart key until the desired configuration option appears.

☐ 2. Press the *ENTER* smart key to accept the new value.

PROCEDURE PR24 - ENGINEERING UNITS SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the engineering unit icon. This setting is available in the advanced programming mode and applies to user-defined configurations in the concentration analyzer state.

Parts None.

Tools None.

PROCEDURE

The concentration state allows for conversion of conductivity inputs to concentration units such as percent, parts per million (ppm), and parts per billion (ppb). It is also possible to select no engineering unit icon.

☐ 1. Press the *NEXT* smart key until the desired engineering unit icon appears.

☐ 2. Press the *ENTER* smart key to accept the new value.

PROCEDURE PR25 - DECIMAL POINT LOCATION SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the decimal point location. This setting is available in the advanced programming mode and applies to user-defined configurations in the concentration analyzer state.

Parts None.

Tools None.

PROCEDURE

☐ 1. Press the ▲ smart key to move the decimal point to the desired location.

☐ 2. Press the *ENTER* smart key to accept the new position.

PROCEDURE PR26 - TEXT STRING DEFINITION

PURPOSE/SCOPE

2 min.

This procedure describes how to define and enter a custom text description. This setting is available in the advanced programming mode and applies to user-defined configurations in the concentration analyzer state.

Parts None.

Tools None.

PROCEDURE

The text string can be up to six characters consisting of any combination of A through Z, 1 through 9, a space, and a dash.

☐ 1. Use the ▲ smart key to increment the character.

☐ 2. When the first character is correct, use the ▶ smart key to move to the next character.

☐ 3. Repeat Steps 1 and 2 for each character.

☐ 4. Press the *ENTER* smart key to accept the text string.

PROCEDURE PR27 - LINEAR CURVE FIT PROGRAMMING

PURPOSE/SCOPE

10 min.

This procedure shows how to define the linear curve fit for a conductivity-to-concentration conversion. This setting is available in the advanced programming mode and applies to user-defined configurations in the concentration analyzer state.

Parts None.

Tools None.

PROCEDURE

The six-point linear curve fit sets the endpoint and breakpoint values for the conductivity-to-concentration conversion. The end point values define the full scale output range. The breakpoints identify the transition points between the five line segments defining the conductivity-to-concentration curve.

A plot of temperature compensated conductivity versus solute concentration is needed before beginning the procedure. An example of a linear approximation for zero to 45-percent ammonium nitrate (NH_4NO_3) is shown in Table PR27-1 and Figure PR27-1. Table PR27-1 shows the data and FIgure PR27-1 shows the linear approximation.

The curve is a nonlinear function divided into five line segments. The endpoints represent points one and six. The breakpoints represent points two through five. The transmitter output is linear relative to the NH_4NO_3 concentration.

The endpoints define the full scale output range; therefore, rerange of the output is restrained to the range between points one and six (zero and 45-percent NH_4NO_3). Refer to Appendix B for more information on concentration programming.

☐ 1. Obtain a plot of temperature compensated conductivity versus solute concentration.

☐ 2. Divide the plot into five line segments that best approximate the shape of the conductivity-to-concentration curve. The beginning of the first and end of the fifth line segment identify the endpoints of the linear approximation and output range.

☐ 3. Set the first end point conductivity value (*X1.COND*).

a. Use the ▲ smart key to increment the value of the blinking digit.

Table PR27-1. Conductivity-to-Concentration Data

Point	Conductivity (mS/cm)	Concentration (%)	Output (mA)
1	0	0	4.0
2	55	5	5.8
3	105	9	7.2
4	195	16	9.7
5	310	28	14.0
6	400	45	20.0

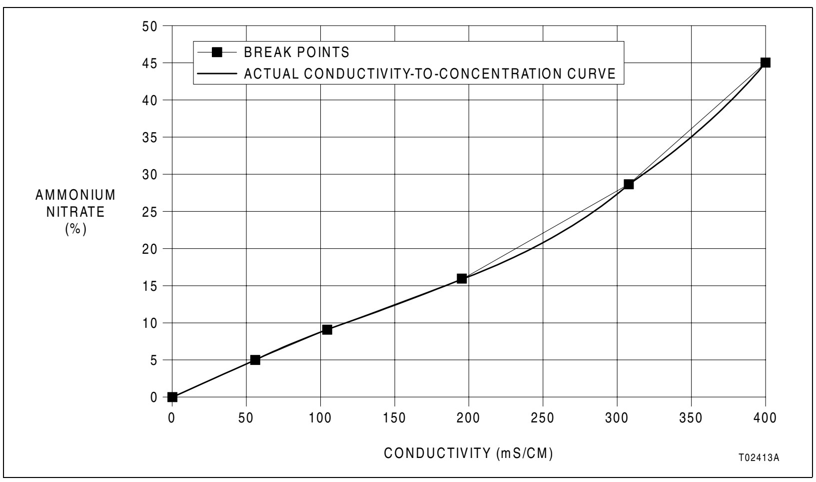

Figure PR27-1. Linear Curve Fit

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 3a and 3b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 4. Set the first end point concentration value (*Y1.CONC*) that represents the endpoint conductivity value entered in Step 3.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 4a and 4b for each digit.

d. Press the *ENTER* smart key to accept the new value.

- ☐ 5. Repeat Steps 3 and 4 for the four breakpoints and the last endpoint (*X2.COND* through *X6.COND*, and *Y2.CONC* through *Y6.CONC*).

- ☐ 6. Press the *NEXT* smart key to go on to the next configuration parameter.

PROCEDURE PR28 - TEMPERATURE SENSOR TYPE SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the temperature sensor state. This setting is available in both the basic and advanced programming modes.

Parts None.

Tools None.

PROCEDURE

The temperature sensor state configures the temperature input for a Pt 100, three-kilohm Balco RTD, 4.75-kilohm RTD network, or for no temperature input (none).

☐ 1. Press the *SELECT* smart key to modify the *TMP.SNS* state.

☐ 2. The currently configured temperature sensor state appears first. Press the *NEXT* smart key until the desired temperature sensor state appears. Choose between *NONE*, *3K.BLCO*, *PT100*, and *4.75K.RTD.*

☐ 3. Press the *ENTER* smart key to accept the new value.

PROCEDURE PR29 - TEMPERATURE COMPENSATION TYPE SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes the types of temperature compensation available and how to choose them.

Parts None.

Tools None.

PROCEDURE

Temperature has a marked effect on the conductance of many solutions. The effect is generally nonlinear and dependent on the particular ionic species and their concentration.

The transmitter software has a number of preprogrammed correction algorithms that compensate the effect of temperature on conductivity to a reference temperature of 25-degrees Celsius. This results in accurate and stable measurements when temperature varies.

Options for temperature compensation are grouped into two sets: manual and auto. Manual temperature compensation contains no additional options. It is locked to a specific process temperature independent of the selected temperature sensor. If desiring a different process temperature, adjust it during a temperature calibration.

Auto temperature compensation options are sensor group dependent. They use temperature values measured by the transmitter temperature input. Compensation algorithms include: standard KCl (0.1N KCl based), solution coefficient, zero to 15-percent NaOH, zero to 20-percent NaCl, zero to 18-percent HCl, zero to 20-percent H_2SO_4, pure water neutral salt, pure water trace acid, pure water trace base, and user-defined.

The user-defined temperature compensation option requires uncompensated conductivity data from the reference temperature of 25-degrees Celsius to the maximum process temperature on a representative sample of process solution. This data is used to calculate the ratio of uncompensated conductivity to conductivity at the reference temperature of 25-degrees Celsius. These ratios are then plotted against temperature.

Refer to Appendix A for more information on temperature compensation.

Table PR29-1 describes the function and programming mode of each state.

Table PR29-1. Temperature Compensation States

State	Display	Programming Mode	Function
Manual	*MANUAL*	Basic and Advanced	Employed when using fixed temperature value instead of measured value. Initial value is 25°C. Use temperature calibrate state to change fixed temperature value. Compensation is 0.1N KCl based.
Standard potassium chloride (automatic)	*STD.KCL*	Basic and Advanced	Used when temperature sensor provides measured temperature value. Compensation is 0.1N KCl based (standard).
Temperature compensation coefficient (automatic)	*TC.COEF*	Basic and Advanced	Used when temperature sensor provides measured temperature value. Compensation is based on percent change of conductivity at reference temperature (25°C) per °C. The value is adjustable between 0 and 9.99%/°C.
Sodium hydroxide (automatic)	*NAOH*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is 0 to 15% NaOH based.
Sodium chloride (automatic)	*NACL*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is 0 to 20% NaCl based.
Hydrochloric acid (automatic)	*HCL*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is 0 to 18% HCl based.
Sulfuric acid (automatic)	*H2SO4*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is 0 to 20% H_2SO_4 based.
Pure water neutral salt (automatic)	*NEUTRL*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is pure water with neutral salt based. Restricted to Sensor Group C.
Pure water trace acid (automatic)	*ACID*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is pure water with acid based. Restricted to Sensor Group C.
Pure water trace base (automatic)	*BASE*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is pure water with base based. Restricted to Sensor Group C.
User-defined (automatic)	*USR.DEF*	Advanced	Used when temperature sensor provides measured temperature value. Compensation is defined as ratio of uncompensated conductivity over compensated conductivity for a specific set of temperatures.

☐ 1. Press the *SELECT* smart key to modify the *TC.TYPE* state.

☐ 2. Press the *NEXT* smart key to toggle between *MANUAL* and *AUTO*.

☐ 3. Press the *ENTER* smart key to accept the desired value. If manual was selected, press the *NEXT* smart key to go on to the next configuration parameter as shown in the advanced configuration sequence in Figure 8-5 and the basic configuration sequence in Figure 8-6. If *AUTO* was selected, go on with Step 4.

☐ 4. Press the *NEXT* smart key until the desired type of automatic temperature compensation appears.

☐ 5. If *TC.COEF* or *USR.DEF* were selected, go to the next procedure in the sequence as shown in Figures 8-5 and 8-6. Otherwise, press the *ENTER* smart key to accept the desired value and go on to the next configuration parameter in the sequence.

PROCEDURE PR30 - TEMPERATURE COMPENSATION COEFFICIENT SETTING

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the temperature compensation coefficient. This setting is available in both the basic and advanced programming modes.

Parts None.

Tools None.

PROCEDURE

The temperature compensation coefficient is used when a temperature sensor provides the measured temperature value. Compensation is based on percent change of conductivity at a reference temperature (25-degrees Celsius) per degree Celsius. The value is adjustable between zero and 9.99 percent per degree Celsius. Refer to Appendix A for more information on temperature compensation.

- ☐ 1. Use the ▲ smart key to increment the digit.
- ☐ 2. When the first digit is correct, use the ▶ smart key to move to the next digit.
- ☐ 3. Repeat Steps 1 and 2 for each digit.
- ☐ 4. Press the *ENTER* smart key to accept the value.
- ☐ 5. Press the *NEXT* smart key to go on to the next configuration parameter.

PROCEDURE PR31 - USER-DEFINED TEMPERATURE COEFFICIENT PROGRAMMING

PURPOSE/SCOPE

10 min.

This procedure describes how to define the linear curve fit for a user-defined temperature compensation plot. This setting is available in the advanced programming mode.

Parts None.

Tools None.

PROCEDURE

The user-defined temperature compensation option requires uncompensated conductivity data from the reference temperature of 25-degrees Celsius to the maximum process temperature on a representative sample of process solution. This data is used to calculate the ratio of uncompensated conductivity (K) to conductivity at the reference temperature of 25-degrees Celsius (K_{STD}). These ratios are plotted against temperature.

The curve is a nonlinear function divided into five line segments. The endpoints represent points one and six. The breakpoints represent points two through five.

Refer to Appendix A for more information on temperature compensation.

☐ 1. Obtain a plot of temperature versus conductivity ratio.

☐ 2. Divide the plot into five line segments that best approximate the shape of the curve. The start of the first and end of the fifth segments are the end points of the approximation.

☐ 3. Set the first endpoint temperature value (*TMP1°C*).

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 3a and 3b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 4. Set the first endpoint ratio value (*K1/K25*) that represents the endpoint temperature value entered in Step 3.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 4a and 4b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 5. Repeat Steps 3 and 4 to enter the four breakpoints and last endpoint (*TMP2°C* through *TMP6°C*, and *K2/K25* through *K6/K25*).

☐ 6. Press the *NEXT* smart key to go on to the next configuration parameter.

PROCEDURE PR32 - OUTPUT RANGE SETTING

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the output state. This setting is available in both the basic and advanced programming modes.

Parts None.

Tools None.

PROCEDURE

The output state sets the output type and range. The default output range values are 10 percent of the full scale process variable for Group A sensors, and full scale process variable for Groups B and C sensors. If requiring a reverse acting output, reverse the four and 20-milliamp process variable values.

☐ 1. Press the *SELECT* smart key to modify the *OUTPUT* state.

☐ 2. The transmitter displays the process variable value for the four-mA point.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 2a and 2b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 3. The transmitter displays the process variable value for the 20-mA point.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 3a and 3b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 4. Press the *NEXT* smart key to go on to the next configuration parameter.

PROCEDURE PR33 - DIAGNOSTICS SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the diagnostics state. This setting is available in both the basic and advanced programming modes.

Parts None.

Tools None.

PROCEDURE

The diagnostics state allows disabling of the built-in sensor diagnostics.

☐ 1. Press the *SELECT* smart key to modify the *DIAG* state.

☐ 2. Use the ▲ smart key to toggle between *ON* and *OFF*.

☐ 3. Press the *ENTER* smart key to accept the new value.

PROCEDURE PR34 - SAFE MODE SELECTION

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the safe mode state. This setting is available in both the basic and advanced programming modes.

Parts None.

Tools None.

PROCEDURE

The safe mode state determines the output level of the transmitter if an error condition occurs that renders the transmitter inoperable. The available states are *FAIL.LO* (fail low) and *FAIL.HI* (fail high). More information about error conditions is contained in Section 12.

☐ 1. Press the *SELECT* smart key to modify the *SAF.MOD* state.

☐ 2. Use the *NEXT* smart key to toggle between *FAIL.HI* and *FAIL.LO*.

☐ 3. Press the *ENTER* smart key to accept the new value.

☐ 4. If this is an advanced configuration, go to Step 6. If this is a basic configuration press the *exit to MEASURE* smart key and go on to Step 5.

☐ 5. When the *SAVE?* screen comes up, press the *YES* smart key to accept the configuration. Press the *NO* key to abort the configuration. In either case, the transmitter goes to the measure mode. Do not perform Step 6.

☐ 6. Press the *NEXT* smart key to go on to the next configuration parameter.

PROCEDURE PR35 - SPIKE MAGNITUDE SETTING

PURPOSE/SCOPE

1 min.

This procedure describes how to configure the spike magnitude state. This setting is available in the advanced programming mode.

Parts None.

Tools None.

PROCEDURE

The spike state sets the diagnostic spike level as a percent of output. This level determines the magnitude of the spike.

When the spike magnitude has been set to any level greater than zero percent and is enabled in the spike output state, the transmitter modulates the output signal by the configured level for one second out of every six seconds. Using this modulation, the transmitter informs the operator of a detected diagnostic condition.

Enter the spike magnitude as a percentage of the 16-milliamp output range. A 10-percent spike magnitude generates a 1.6-milliamp spike, a 20-percent spike magnitude generates a 3.2-milliamp spike, etc.

NOTE: Once the spike state is *OFF*, changing the configured spike level in the configure mode will not enable the spike state. The spike state can only be turned *ON* or *OFF* in the output/hold mode.

☐ 1. Press the *SELECT* smart key to modify the *SPK.MAG* state.

☐ 2. The transmitter displays the current spike magnitude value.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 2a and 2b for each digit.

d. Press the *ENTER* smart key to accept the new value.

☐ 3. Press the *exit to MEASURE* smart key.

☐ 4. When the *SAVE?* screen comes up, press the *YES* smart key to accept the configuration. Press the *NO* key to abort the configuration. In either case, the transmitter goes to the measure mode.

PROCEDURE PR36 - CONFIGURATION LOCKOUT

PURPOSE/SCOPE

5 min.

This procedure describes how to set the hardware configuration lockout jumper.

Parts None.

Tools
- Flat blade screwdriver.
- Needle nose pliers.

PROCEDURE

The transmitter has a lockout feature that, once engaged, prohibits access to the configure mode. This feature does not affect parameters that can be changed in the other modes of operation: calibrate, output/hold, security, and secondary display.

> **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. Turn off power to the transmitter and allow at least one minute for it to discharge.

☐ 2. Use the flat-blade screwdriver to loosen the four captive screws that secure the front bezel assembly to the transmitter shell.

☐ 3. Pull gently on the front bezel assembly to remove it from the shell.

☐ 4. The microprocessor PCB assembly, which is attached to the front bezel, contains the configuration lockout jumper. Position A (jumper W1 on pins 1 and 2) is the factory default position and disables the configuration lockout. Position B (jumper W1 on pins 2 and 3) enables the configuration lockout. Refer to Figure PR36-1 and use the needle nose pliers to change the jumper to the desired position.

☐ 5. Place the front bezel assembly into the shell and press gently.

☐ 6. Use the bladed screwdriver to tighten the four captive screws.

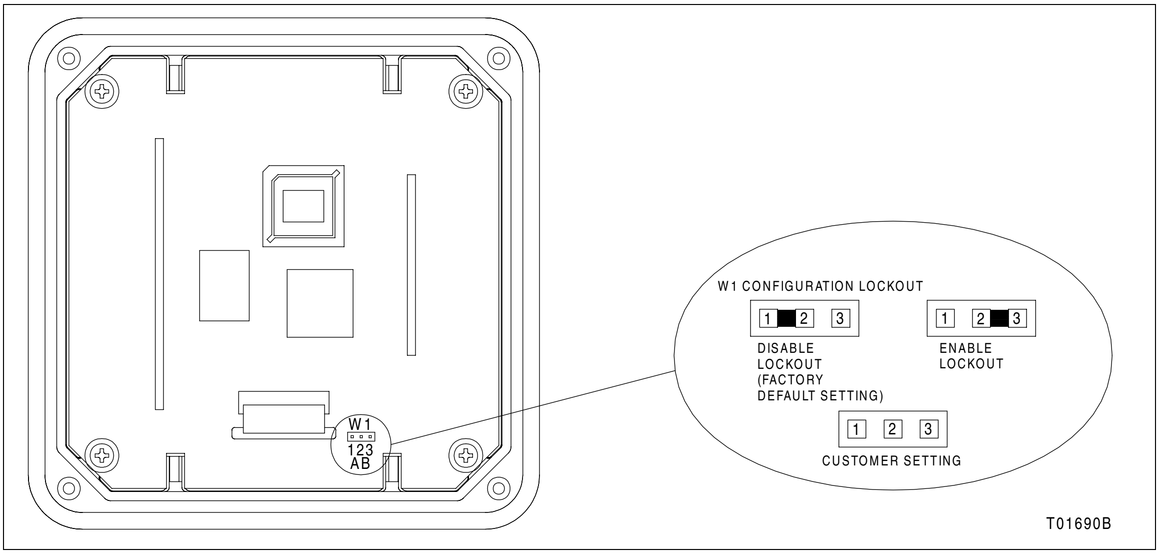

Figure PR36-1. Configuration Lockout Jumper

PROCEDURE PR37 - SECURITY AND PASSWORD ASSIGNMENT

PURPOSE/SCOPE

5 min.

This procedure describes how to define which modes and states of operation are security protected. It also describes how to set the password for the protected states and modes of operation, how to remove all security, and how to change security and the password.

Parts None.

Tools None.

PROCEDURE

This procedure contains three actions. Setting the security and password, removing all security, and changing the security and password.

> **NOTE:** In the unlikely event that the password cannot be retrieved and the secured modes and states must be accessed, a reset security state exists. Refer to PR40 for the reset security procedure.

Setting Security and Password

- ☐ 1. Press the *MENU* smart key until *SECURITY* is highlighted on the display.
- ☐ 2. Press the *SELECT* smart key to enter the security mode.
- ☐ 3. The *CALIBR* screen appears first. To set the security, press the ▲ smart key to change the security from *OFF* to *ON* and continue with Step 4. To leave the security *OFF*, press the ENTER key and go on to Step 5.
- ☐ 4. Press the *ENTER* smart key to accept the selection.
- ☐ 5. The *OUTPUT* screen appears. To set the security, press the ▲ smart key to change the security from *OFF* to *ON* and continue with Step 6. To leave the security *OFF*, press the ENTER key and go on to Step 7.
- ☐ 6. Press the *ENTER* smart key to accept the selection.
- ☐ 7. The *CONFIG* screen appears. To set the security, press the ▲ smart key to change the security from *OFF* to *ON* and continue with Step 8. To leave the security *OFF*, press the ENTER key and go on to Step 9.
- ☐ 8. Press the *ENTER* smart key to accept the selection.

☐ 9. The *PASSWD* screen appears with _ _ _ shown. Define the password for all secured modes and states.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 9a and 9b for each digit.

d. Press the *ENTER* smart key to accept the password.

☐ 10. The password must now be verified. The *PASSWD* screen appears with _ _ _ shown.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 10a and 10b for each digit.

d. Press the *ENTER* smart key to accept the password.

NOTE: The password must be defined as three digits and verified to enable security on the modes and states entered in Steps 3 through 8. If security is not *ON* for any of the modes and states, the transmitter bypasses the password screen.

Removing All Security

☐ 1. Press the *MENU* smart key until *SECURITY* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the security mode.

☐ 3. If the security mode has been secured, the transmitter requires the password and displays _ _ _. To enter the password:

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 3a and 3b for each digit.

d. When the password is correct, press the *ENTER* smart key.

☐ 4. The *CALIBR* screen appears first. Press the ▲ smart key to change the security from *ON* to *OFF*.

☐ 5. Press the *ENTER* smart key to accept the selection.

☐ 6. The *OUTPUT* screen appears. Press the ▲ smart key to change the security from *ON* to *OFF*.

☐ 7. Press the *ENTER* smart key to accept the selection.

☐ 8. The *CONFIG* screen appears. Press the ▲ smart key to change the security from *ON* to *OFF*.

☐ 9. Press the *ENTER* smart key to accept the selection.

Changing Security or Password

☐ 1. Press the *MENU* smart key until *SECURITY* is highlighted on the display.

☐ 2. Press the *SELECT* smart key to enter the security mode.

☐ 3. If the security mode has been secured, the transmitter requires the password and displays _ _ _. To enter the password:

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 3a and 3b for each digit.

d. When the password is correct, press the *ENTER* smart key.

☐ 4. The *CALIBR* screen appears first. To change the security, press the ▲ smart key to toggle the security between *OFF* and *ON* and continue with Step 5. To leave the security unchanged, press the ENTER key and go on to Step 6.

☐ 5. Press the *ENTER* smart key to accept the selection.

☐ 6. The *OUTPUT* screen appears. To change the security, press the ▲ smart key to toggle the security between *OFF* and *ON* and continue with Step 7. To leave the security unchanged, press the ENTER key and go on to Step 8.

☐ 7. Press the *ENTER* smart key to accept the selection.

☐ 8. The *CONFIG* screen appears. To change the security, press the ▲ smart key to toggle the security between *OFF* and *ON* and continue with Step 9. To leave the security unchanged, press the ENTER key and go on to Step 10.

☐ 9. Press the *ENTER* smart key to accept the selection.

☐ 10. The *PASSWD* screen appears with _ _ _ shown. Either change the password or enter the existing password to accept the changes to the security.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 10a and 10b for each digit.

d. Press the *ENTER* smart key to accept the password.

☐ 11. If the password was changed, it must now be verified. If the password was not changed, this procedure is complete. The *PASSWD* screen appears with _ _ _ shown.

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 11a and 11b for each digit.

d. Press the *ENTER* smart key to accept the password.

PROCEDURE PR38 - UTILITY MODE ADVANCED/BASIC PROGRAMMING

PURPOSE/SCOPE

1 min.

This procedure describes how to change programming modes while in the user state.

Parts None.

Tools None.

PROCEDURE

The basic programming mode contains a subset of configuration options found in the advanced programming mode. Separation into two programming groups is advantageous when limited functionality is desired. Fewer options reduces confusion and the possibility of configuration errors.

Transmitters ordered with the advanced programming option can be changed between basic and advanced programming. Transmitters ordered with the basic programming option require an upgrade password to change to advanced programming. Contact ABB to obtain the password.

The programming toggle for transmitters with the advanced programming option must be set in two locations: user state in the utility mode and modify configure state in the configure mode. In order to select either the basic or advanced programming mode in the modify configure state, the programming mode must be set to advanced in the user state.

NOTE: *ADVNCD* is the factory default setting in the modify configure state in the configure mode and the user state in the utility mode for transmitters ordered with the advanced programming option.

☐ 1. Press the hidden key located above the *NT* in the *ADVANTAGE* text on the keypad. The prompt *USER* appears in the secondary display region.

☐ 2. Press the *SELECT* smart key. The text *MODE* appears in the secondary display.

☐ 3. Press the *SELECT* smart key and the *BASIC* screen appears. Press the *ENTER* smart key to set the programming to basic, and advance to the next user state or press the *NEXT* smart key to advance to the next screen and go on to Step 4.

☐ 4. The *ADVNCD* screen appears. Press the *ENTER* smart key to set the programming to advanced and advance to the next user state.

PROCEDURE PR39 - CONFIGURATION RESET

PURPOSE/SCOPE

1 min.

This procedure describes how to reset the configuration back to the factory default settings.

Parts None.

Tools None.

PROCEDURE

Table PR39-1 lists the factory software default configuration settings.

Table PR39-1. Factory Software Defaults

Parameter	Default
Instrument mode	Basic
Analyzer type	Conductivity, Sensor Group A
Temperature sensor	3-kΩ Balco
Temperature compensation	Manual
Output range	0.00 to 199.9 mS/cm
Damping value	0.5 secs
Sensor diagnostics state	Disable
Safe mode fail output state	Low
Spike output level[1]	0%

NOTE:
1. This function only available in advanced programming mode.

☐ 1. Press the hidden key located above the *NT* in the *ADVANTAGE* text on the keypad. The prompt *USER* appears in the secondary display region.

☐ 2. Press the *SELECT* smart key. The text *MODE* appears in the secondary display.

☐ 3. Press the *NEXT* smart key until *RST.CON* appears in the secondary display.

☐ 4. Press the *SELECT* smart key to reset the configuration.

☐ 5. If the configure mode has been secured, the transmitter requires the password and displays _ _ _. To enter the password:

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value is correct, use the ▶ smart key to move to the next digit.

c. Repeat Steps 5a and 5b for each digit.

d. When the password is correct, press the *ENTER* smart key.

☐ 6. The text *RESET?* appears. Press the *YES* smart key to confirm the reset operation or the *NO* smart key to abort the procedure.

PROCEDURE PR40 - SECURITY RESET

PURPOSE/SCOPE

1 min.

This procedure describes how to reset the security back to the factory default settings. The factory defaults are security off for all applicable modes (calibrate, output/hold, and modify configure).

Parts None.

Tools None.

PROCEDURE

☐ 1. Press the hidden key located above the *NT* in the *ADVANTAGE* text on the keypad. The prompt *USER* appears in the secondary display region.

☐ 2. Press the *SELECT* smart key. The text *MODE* appears in the secondary display.

☐ 3. Press the *NEXT* smart key until *RST.SEC* appears in the secondary display.

☐ 4. Press the *SELECT* smart key to reset the security.

☐ 5. The transmitter displays _ _ _. The security reset password is 732. To enter the password:

  a. Use the ▲ smart key to increment the value of the blinking digit.

  b. When the first digit value reaches *7*, use the ▶ smart key to move to the next digit.

  c. Use the ▲ smart key to increment the value of the blinking digit.

  d. When the second digit value reaches *3*, use the ▶ smart key to move to the next digit.

  e. Use the ▲ smart key to increment the value of the blinking digit.

  f. When the third digit value reaches *2*, press the *ENTER* smart key.

☐ 6. The text *RESET?* appears. Press the *YES* smart key to confirm the reset operation or the *NO* smart key to abort the procedure.

PROCEDURE PR41 - RESETTING ALL PARAMETERS

PURPOSE/SCOPE

1 min.

This procedure describes how to reset all transmitter values back to the factory default settings. This includes calibration, output/hold, configuration, security, and secondary display values.

Parts None.

Tools None.

PROCEDURE

☐ 1. Press the hidden key located above the *NT* in the *ADVANTAGE* text on the keypad. The prompt *USER* appears in the secondary display region.

☐ 2. Press the *SELECT* smart key. The text *MODE* appears in the secondary display.

☐ 3. Press the *NEXT* smart key until *RST.ALL* appears in the secondary display.

☐ 4. Press the *SELECT* smart key to reset all transmitter parameters.

☐ 5. The transmitter displays _ _ _. The reset all password is 255. To enter the password:

a. Use the ▲ smart key to increment the value of the blinking digit.

b. When the first digit value reaches *2*, use the ▶ smart key to move to the next digit.

c. Use the ▲ smart key to increment the value of the blinking digit.

d. When the second digit value reaches *5*, use the ▶ smart key to move to the next digit.

e. Use the ▲ smart key to increment the value of the blinking digit.

f. When the third digit value reaches *5*, press the *ENTER* smart key.

- [ ] 6. The text *RESET?* appears. Press the *YES* smart key to confirm the reset operation or the *NO* smart key to abort the procedure.

PROCEDURE PR42 - TRANSMITTER SOFT BOOT

PURPOSE/SCOPE

1 min.

This procedure describes how to perform a transmitter self-test without affecting existing parameters.

Parts None.

Tools None.

PROCEDURE

The soft boot user state initiates a self-test. All programmable transmitter parameters remain unchanged after performing the soft boot.

☐ 1. Press the hidden key located above the *NT* in the *ADVANTAGE* text on the keypad. The prompt *USER* appears in the secondary display region.

☐ 2. Press the *SELECT* smart key. The text *MODE* appears in the secondary display.

☐ 3. Press the *NEXT* smart key until *RST.SFT* appears in the secondary display.

☐ 4. Press the *SELECT* smart key to initiate the self-test.

☐ 5. The text *RESET?* appears. Press the *YES* smart key to confirm the self-test or the *NO* smart key to abort the procedure.

PROCEDURE PR43 - SENSOR INSPECTION

PURPOSE/SCOPE

10 min.

This procedure describes how to visually inspect the sensor.

Parts None.

Tools None.

PROCEDURE

If the sensor is suspected of being the source of problems, a quick visual inspection can identify the problem.

Sensor Body

☐ 1. Remove the sensor from the process.

☐ 2. Inspect the sensor body for cracks and distortions.

☐ 3. If cracks or distortions exist, contact ABB for alternative sensor styles and materials.

Cable and Connectors

☐ 1. Inspect the sensor cable for cracks, cuts, or shorts.

☐ 2. If using a junction box or extension cable, check for moisture, oil, corrosion, or particulates. All connections must be dry and free of oil, corrosion, and particulates. Even slight amounts of these contaminants can short sensor signals and affect conductivity.

☐ 3. Check to see that all wiring is dry and not shorting against any metal, conduit, or earth grounds.

O-Ring Seals

☐ 1. Inspect the sealing O-rings for attack by the process liquid.

☐ 2. If the O-rings show evidence of corrosion, deterioration, or distortion, contact ABB for alternate material choices.

PROCEDURE PR44 - ELECTRONIC SENSOR TEST

PURPOSE/SCOPE

10 min.

This procedure describes how to run the electronic sensor test.

Parts None.

Tools

- Digital multimeter (DMM) with a conductance function capable of reading zero to 200 nanosiemens, and a resistance function capable of reading zero to 20 kilohms.
- Temperature measuring device.

PROCEDURE

There is an electronic sensor test to verify the integrity of conductivity sensor elements and associated cable.

☐ 1. Disconnect the sensor leads and automatic temperature compensator leads from the transmitter.

☐ 2. Use the DMM set to measure ohms to measure the resistance between the yellow and blue temperature compensator leads.

a. If using a three-kΩ Balco RTD, the expected resistance can be calculated from:

$$R_{TC} = (((T - 0°C) \times 0.0045) + 1) \times 3,000$$

where T is the temperature in degrees Celsius. The measured resistance should be within the expected value by ±15%.

b. If using a PT 100 RTD, the expected resistance can be calculated from:

$$R_{TC} = 100 + ((T - 0°C) \times 0.385)$$

where T is the temperature in degrees Celsius. The measured resistance should be within the expected value by ±5%.

c. If using a 4.75-kΩ RTD network, the expected resistance can be calculated from:

$$R_{TC} = 6,329 - 104.5 \times T + 0.774 \times T^2 - 0.0026 \times T^3 + 0.000003 \times T^4$$

where T is the temperature in degrees Celsius. The measured resistance should be within the expected value by ±20%.

☐ 3. Moisture intrusion behind the sensor electrode seal can be detected. Remove the sensor from the process and dry it thoroughly.

☐ 4. Use the DMM set to measure conductance, to measure the conductance between the yellow temperature compensator lead and each of the other sensor leads (green, red, white, black, and heavy green). The reading must be less than 0.05 nS.

☐ 5. Check the conductance between the green drive lead and each of the other sensor leads (black, white, red, and heavy green). The reading must be less than 0.05 nS.

☐ 6. Check the conductance between the heavy green shield lead and each of the other sensor leads (blue, yellow, black, green, red and white). The reading must be less than 0.05 nS.

PROCEDURE PR45 - TRANSMITTER TROUBLESHOOTING WITHOUT SENSOR

PURPOSE/SCOPE

10 min.

This procedure describes how to troubleshoot the transmitter with the sensor disconnected. Sensor simulation is an easy way to check the operation of the transmitter without the sensor.

Parts None.

Tools

- Decade resistance box.
- 3000-Ω resistor.

PROCEDURE

☐ 1. Remove the transmitter from the process and disconnect the sensor.

> **NOTE:** The transmitter calibration values must be set back to those entered at the factory in order for this procedure to be valid.

☐ 2. There are two ways to perform sensor simulation. Either connect a 3000-Ω resistor across the temperature sensor input as shown in Figure PR45-1, or configure the transmitter for manual temperature compensation with a constant 25°C temperature.

☐ 3. Connect the transmitter in the setup shown in Figure PR45-1.

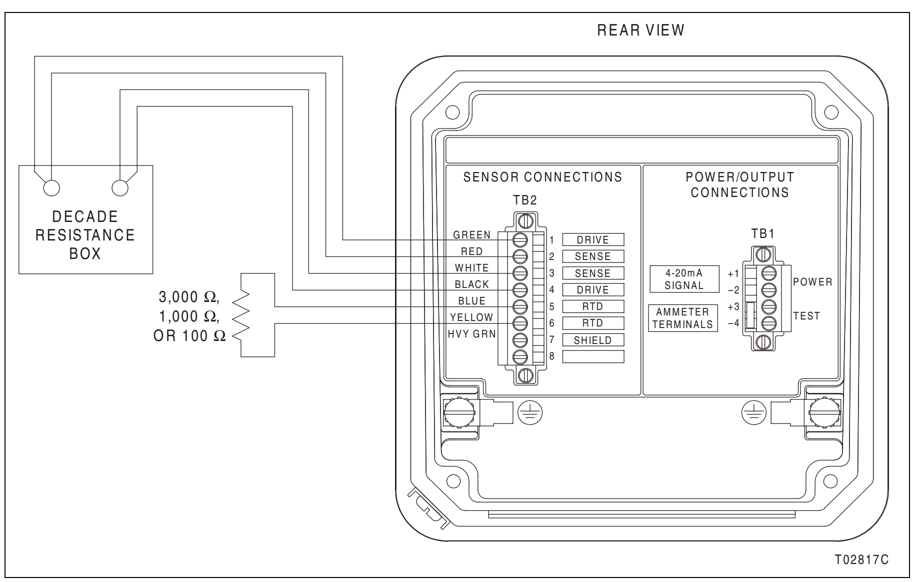

Figure PR45-1. Sensor Simulation Setup

☐ 4. Set the decade resistance box to the values indicated in Table PR45-1 and record the displayed value, comparing it to the value indicated in the desired display value column.

NOTE: The reset calibration feature resets all calibration values. Before putting the transmitter back into service, be sure to perform a temperature, process, and output calibration.

Table PR45-1. Sensor Simulation Values

Sensor Group	Variable Resistance (Ω)	Desired Display Value	Displayed Value
A	Open	0.000 µS/cm	
	5,000.0	100.0 µS/cm	
	1,000.0	500.0 µS/cm	
	500.0	1,000 µS/cm	
	100.0	5.000 mS/cm	
	50.0	10.00 mS/cm	
	10.0[1]	50.00 mS/cm	
	5.0[1]	100.0 mS/cm	
	1.0[1]	500.0 mS/cm	
	0.5[1]	1,000 mS/cm	
B	Open	0.000 µS/cm	
	50,000	1.000 µS/cm	
	5,000	10.00 µS/cm	
	1,000	50.00 µS/cm	
	500	100.0 µS/cm	
	100	500.0 µS/cm	
	50	1000 µS/cm	
C	Open	0.000 µS/cm	
	100,000	0.050 µS/cm	
	50,000	0.100 µS/cm	
	5,000	1.000 µS/cm	
	1,000	5.000 µS/cm	
	500	10.00 µS/cm	
	100	50.00 µS/cm	
	50	100.0 µS/cm	

NOTE:

1. Leadwire and contact resistance becomes significant part of simulated conductivity and must be considered in order to obtain indications close to desired display values.

PROCEDURE PR46 - 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 toothbrush (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

ABB conductivity sensors are cleaned using one or a combination of methods. These are recommendations and may not be suitable for all applications. Other cleaning methods may be developed that better suit particular 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 compatible with HCl.

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

☐ 3. Dip the tip of the sensor into a 1-percent to 5-percent solution of HCl until this region is free of the unwanted coating. Minimize exposure of any of the metal on the sensor to this solution or corrosion may occur.

☐ 4. Rinse the sensor with clean water.

Solvent Dip

This method removes organic coatings.

☐ W1 1. Verify that any process fluid on the sensor is compatible with isopropyl alcohol or other appropriate solvent.

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

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

☐ 4. Remove the solvent using a clean cloth.

Physical Cleaning

This method removes especially thick scales and accumulations.

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

PROCEDURE PR47 - KEYPAD CLEANING

PURPOSE/SCOPE

2 min.

This procedure describes how to clean the keypad.

Parts None.

Tools

- Soft, lint-free cloth.
- Mild soap.
- Warm water.

PROCEDURE

☐ 1. Mix mild soap into warm water according to the soap manufacturer's instructions.

☐ 2. Dampen the cloth with the soap and water mixture and wring out excess liquid.

☐ 3. Gently wash off the keypad with the cloth.

☐ 4. Allow to air dry.

PROCEDURE PR48 - FRONT BEZEL REMOVAL

PURPOSE/SCOPE

2 min.

This procedure describes how to remove the front bezel.

Parts None.

Tools

- Flat-blade screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Remove power from the transmitter and allow at least one minute for it to discharge.

☐ 2. Use the flat-blade screwdriver to loosen the four captive screws that secure the front bezel to the transmitter shell.

☐ 3. Pull gently on the front bezel to remove it from the shell.

PROCEDURE PR49 - POWER SUPPLY PCB REMOVAL

PURPOSE/SCOPE

2 min.

This procedure describes how to remove the power supply PCB.

Parts None.

Tools

- Phillips screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Use the Phillips screwdriver to remove the two screws that retain the power supply PCB (Fig. PR49-1).

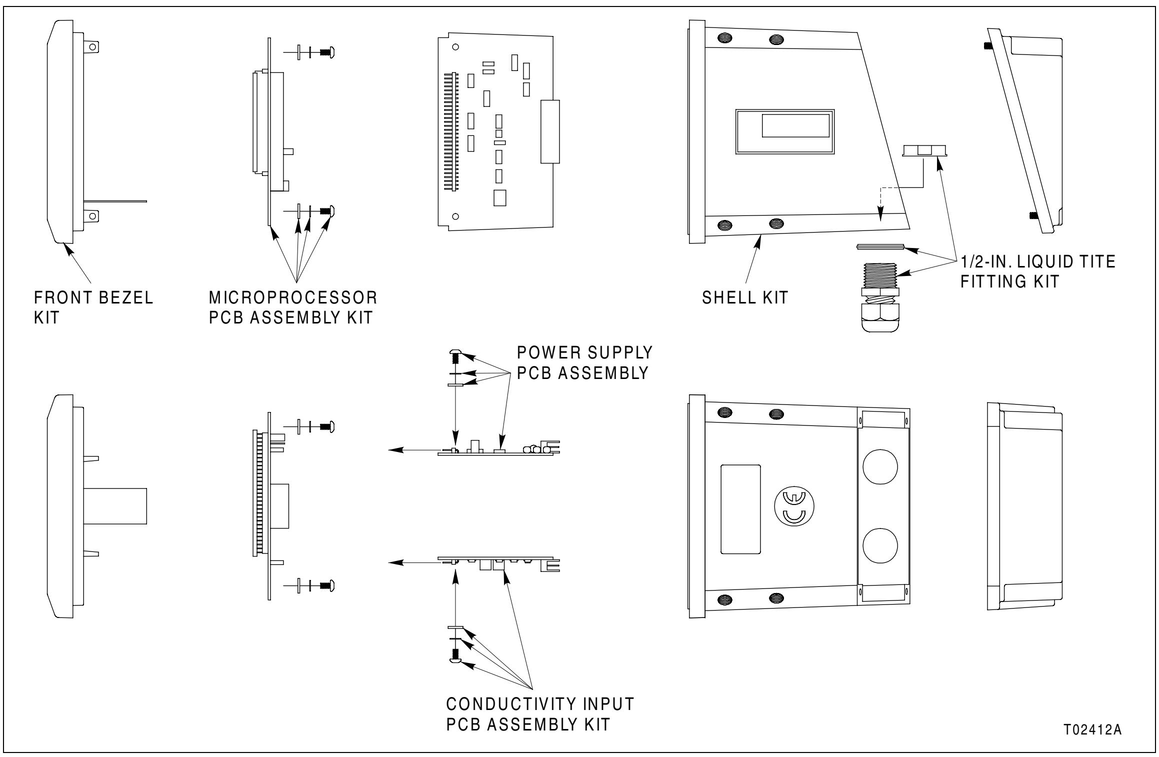

Figure PR49-1. Power Supply PCB Removal

☐ 2. Gently pull on the power supply PCB to disengage it from the microprocessor PCB.

PROCEDURE PR50 - CONDUCTIVITY INPUT PCB REMOVAL

PURPOSE/SCOPE

2 min.

This procedure describes how to remove the conductivity input PCB.

Parts None.

Tools

- Phillips screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Use the Phillips screwdriver to remove the two screws that retain the conductivity input PCB (Fig. PR50-1).

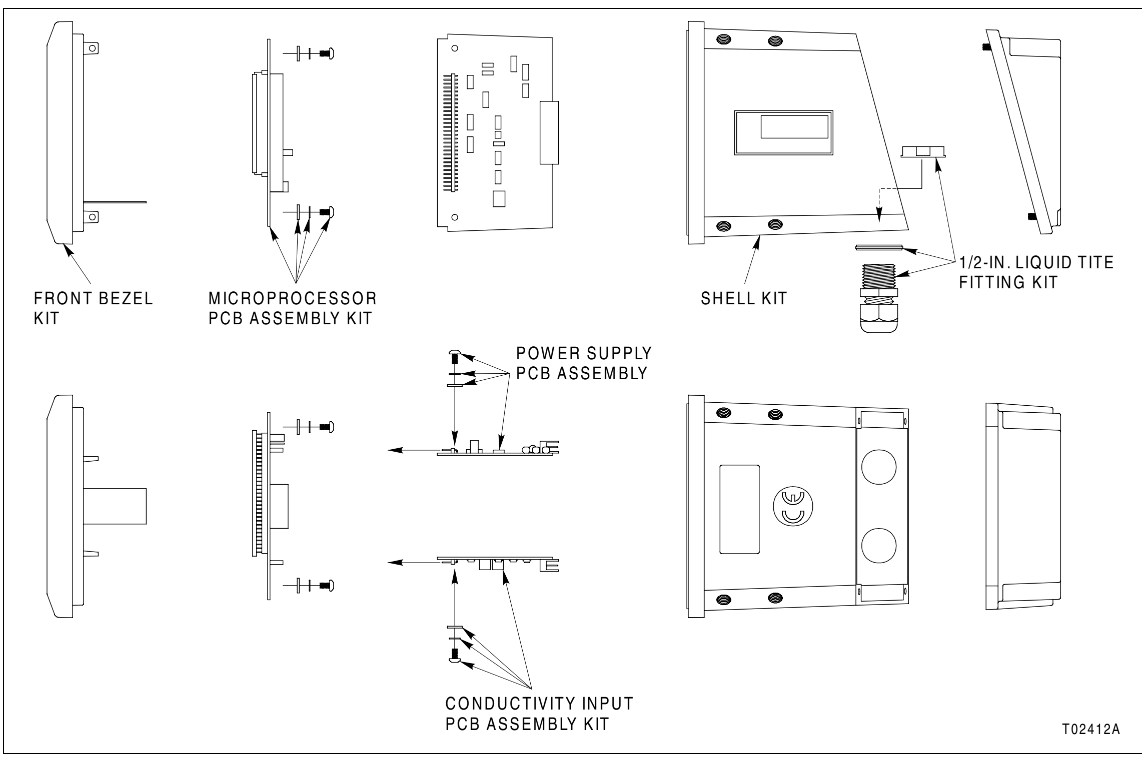

Figure PR50-1. Conductivity Input PCB Removal

☐ 2. Gently pull on the conductivity input PCB to disengage it from the microprocessor PCB.

PROCEDURE PR51 - MICROPROCESSOR PCB REPLACEMENT

PURPOSE/SCOPE

2 min.

This procedure describes how to replace the microprocessor PCB.

Parts

Number	Qty	Description
4TB9515-0178	1	Microprocessor PCB

Tools

- Phillips screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Release the keypad ribbon cable connector latch by pushing the outside of the connector and lightly pulling outwards.

☐ 2. Use the Phillips screwdriver to remove the two screws that secure the microprocessor PCB to the front bezel (Fig. PR51-1).

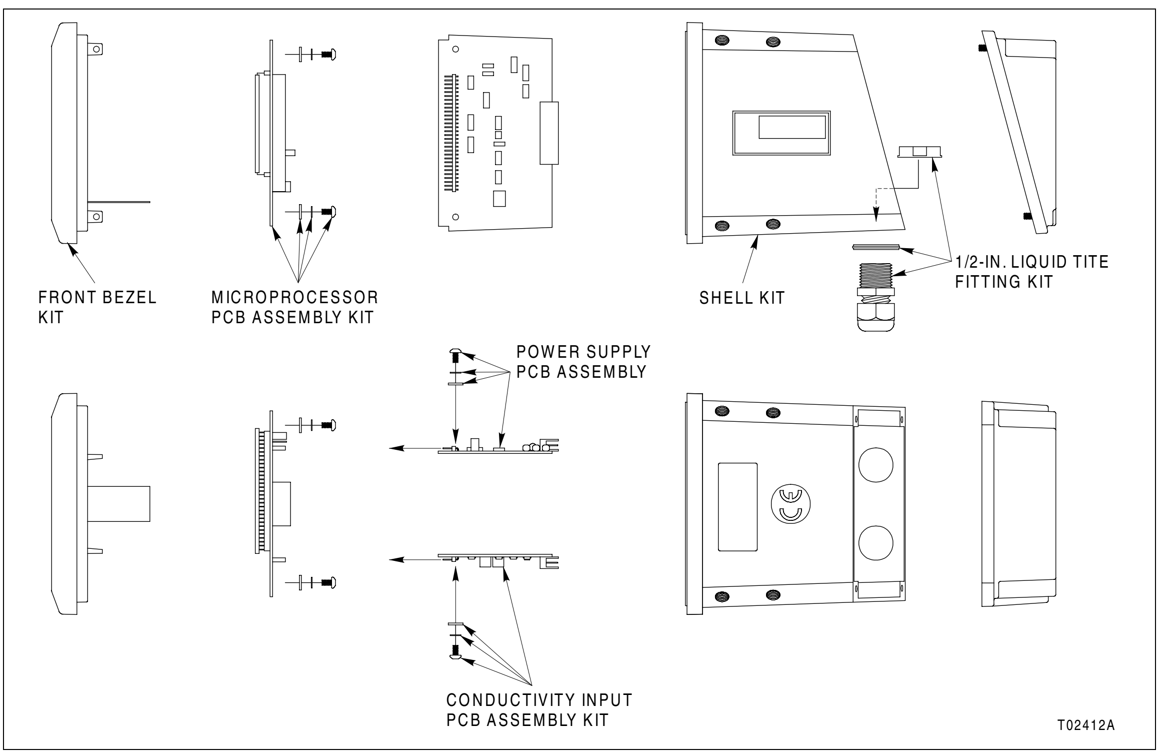

Figure PR51-1. Microprocessor PCB Replacement

☐ 3. Remove the microprocessor PCB.

☐ 4. Install the new microprocessor PCB.

☐ 5. Install the two screws to secure the microprocessor PCB to the front bezel and tighten them with the Phillips screwdriver.

☐ 6. Insert the keypad ribbon cable into the mating connector and push connector locks into place.

PROCEDURE PR52 - CONDUCTIVITY INPUT PCB INSTALLATION

PURPOSE/SCOPE

2 min.

This procedure describes how to install the conductivity input PCB.

Parts

Number	Qty	Description
4TB9515-0176	1	Conductivity input PCB

Tools

- Phillips screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Insert the header on the conductivity input PCB into the proper connector on the microprocessor PCB.

☐ 2. Install the two screws to retain the conductivity input PCB and tighten them with the Phillips screwdriver.

PROCEDURE PR53 - POWER SUPPLY PCB INSTALLATION

PURPOSE/SCOPE

2 min.

This procedure describes how to install the power supply PCB.

Parts

Number	Qty	Description
4TB9515-0155	1	Power supply PCB
4TB9515-0157		Power supply PCB for HART compatible transmitters
4TB9515-0158		Power supply PCB with lightning arrestor
4TB9515-0159		Power supply PCB with lighting arrestor for HART compatible transmitters

Tools

- Phillips screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Insert the header on the power supply PCB into the proper connector on the microprocessor PCB.

☐ 2. Install the two screws to retain the power supply PCB and tighten them with the Phillips screwdriver.

PROCEDURE PR54 - FRONT BEZEL INSTALLATION

PURPOSE/SCOPE

2 min.

This procedure describes how to install the front bezel.

Parts

Number	Qty	Description
4TB9515-0160	1	Front bezel

Tools

- Flat-blade screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Insert the front bezel with electronics assembly into the shell and press gently to engage terminal block connectors.

☐ 2. Use the flat-blade screwdriver to tighten the four captive screws.

PROCEDURE PR55 - REAR COVER REPLACEMENT

PURPOSE/SCOPE

2 min.

This procedure describes how to replace the rear cover.

Parts

Number	Qty	Description
4TB9515-0162	1	Rear cover

Tools

- Flat-blade screwdriver.

PROCEDURE

NOTE: Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Remove power from the transmitter and allow at least one minute for it to discharge.

☐ 2. Use the flat-blade screwdriver to loosen the four captive screws that secure the rear cover to the transmitter shell.

☐ 3. Pull gently on the rear cover to remove it from the shell.

☐ 4. Install the rear cover onto the shell.

☐ 5. Use the flat-blade screwdriver to tighten the four captive screws.

PROCEDURE PR56 - SHELL REPLACEMENT

PURPOSE/SCOPE

1 min.

This procedure is for part number reference only. The repair sequence flowchart (Fig. 14-1) includes the procedures necessary to replace the transmitter shell.

Parts

Number	Qty	Description
4TB9515-0175	1	Shell

Tools None.

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Index (continued)

Index (continued)

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Customer support
We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

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Fax: +1 860 298 7669

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Fax: +44 (0)1453 829671

China
ABB Engineering (Shanghai) Limited
Tel: +86 (0) 21 6105 6666
Fax: +86 (0) 21 6105 6992

Client Warranty
Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:
- A listing evidencing process operation and alarm logs at time of failure.
- Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

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