User Guide OI/TB82PH–EN Rev. B

# Type TB82pH Advantage Series™
# 2-wire pH/ORP/pION transmitter


Power and productivity
for a better world™

# The Company

We are an established world force in the design and manufacture of measurement products for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

**WARNING** notices as used in this manual apply to hazards or unsafe practices which could result in personal injury or death.

**CAUTION** notices apply to hazards or unsafe practices which could result in property damage.

**NOTES** highlight procedures and contain information which assist the operator in understanding the information contained in this manual.



**WARNING**

**POSSIBLE PROCESS UPSETS**. Maintenance must be performed only by qualified personnel and only after securing equipment controlled by this product. Adjusting or removing this product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.

# Preface

This publication is for the use of technical personnel responsible for installation, operation, maintenance and repair of the ABB Type TB82 Advantage Series™ pH/ORP/pION Transmitter.

The Type TB82 transmitter is delivered with default hardware and software configurations. These settings may need to be changed depending on the application requirements.

This instruction covers the standard version of the Type TB82 transmitter. Information regarding installation, configuration, calibration and operation of the HART® version of the transmitter can be found in the ***Type STT Smart Transmitter Terminal Instruction***.

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.

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# Safety Summary

| | |
|---|---|
| **GENERAL WARNINGS** | **Equipment Environment**<br>All components, whether in transportation, operation or storage, must be in a noncorrosive environment.<br><br>**Electrical Shock Hazard During Maintenance**<br>Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing. |

| | |
|---|---|
| **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)<br><br>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. 12-1, 13-1)<br><br>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. (p. 14-1)<br><br>Do not disconnect equipment unless power has been switched off at the source or the area is known to be nonhazardous. Disconnecting equipment in a hazardous location with source power on can produce an ignition-capable arc that can injure personnel and damage equipment. (p. 14-1)<br><br>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. PR53-1)<br><br>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. PR56-1) |

# Safety Summary (continued)

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|---|---|
| **SPECIFIC WARNINGS** | Acids and bases can cause severe burns. Use hand and eye protection when handling. (p. PR56-1)<br><br>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. PR56-1) |

| | |
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| **SPECIFIC CAUTIONS** | When mechanically cleaning the sensor, always use a soft bristle brush in order to avoid damage to the insulating coating on the solution ground (the metallic collar around the measuring electrode). Damage to this coating will cause the reference diagnostics to malfunction. (p. PR54-1) |

# Trademarks and Registrations

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| ® Mylar | Registered trademark of E. I. DuPont de Nemours Company, Inc. |
| ™ Next Step | Trademark of ABB. |

# SECTION 1 - INTRODUCTION

## OVERVIEW

The Type TB82 Advantage Series pH/ORP/pION Transmitter is an advanced, microprocessor-based, two-wire, four to 20-milliampere compatible transmitter. It features internal and external diagnostic functionality, an innovative user interface with hot key capability, two user-selectable modes of operation, and DIN size packaging.

Diagnostic checks on the internal circuitry and external sensor are done continuously. This ensures accuracy and immediate problem notification. Detection of sensor integrity includes: broken or fractured glass electrode, sensor coating, sensor out-of-liquid, ground-loop detection, and shorted or open sensor cabling. Additional software functions monitor slope, asymmetric potential, process variable over or under range, and temperature over or under range. Transmitter programming allows the production of a repetitive modulation of a given magnitude in the output current 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 solution conductivity 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 multifunction 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 National Electrical Code (NEC) and local wiring regulations. Should have a strong background in installation of analytical equipment.

**Application Technician**

Should have a solid background in pH/ORP/pION 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 TBX5 Advantage Series of pH/ORP/pION sensors having Next Step™ reference technology. Well suited for harsh process streams.

***Multiple Applications.*** Accepts inputs from standard glass pH electrodes, antimony pH electrodes, gold or platinum oxidation-reduction potential (ORP) electrodes, or any specific ion electrode. Custom electrode configuration also available that uses information regarding the asymmetric potential and isopotential point. Isolated analog output allows use in grounded or floating circuits.

***Automatic Temperature Compensation.*** Menu-selectable choices provide wide range of easily configurable selections for temperature compensation: automatic Nernstian, automatic Nernstian with solution coefficient and manual Nernstian.

***Wide Rangeability.*** Analog output span does not affect display range of -2.00 to +16.00 pH (-2,000 to +2,000 millivolts for ORP and pION). Minimum and maximum output spans are 1.0 pH (100 millivolts for ORP and pION) and 14 pH (4,000 millivolts for ORP and pION).

***Innovative User Interface.*** Four smart keys and custom LCD allow assignment of multiple functions to each key. Displayed at appropriate time depending on programming mode. Patent pending technology reduces number of keys and allows for a larger, more visible LCD.

***Easy Calibration.*** Easily accessed one and two-point calibrations guide calibrator through each step. Includes provision for viewing and modifying sensor calibration data. Temperature calibration uses smart calibration routines that determine the appropriate adjustments based on previous calibration data.

***NEMA 4X/IP65 Housing.*** Suitable for corrosive environment (pending). The electronics enclosure is a corrosion resistant, low copper Aluminum alloy. A chemical resistant polyurethane powder coating provides external protection.

***Suitable for Hazardous Locations.*** Complies with industry standards for intrinsically safe and nonincendive installations (pending).

***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 the configuration and calibration data in event of power failure.

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

## EQUIPMENT APPLICATION

Use the Type TB82 transmitter anywhere pH, ORP or specific ion measurements are desired.

## INSTRUCTION CONTENT

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

**Description and Operation** Provides a short description on the functionality of the transmitter.

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

**Operating Procedures** Addresses operator interface controls and their function. It lists the 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 a screen flow diagram.

**Calibration** Provides information on sensor and transmitter calibration and calibration data descriptions. Contains screen flow diagrams. Following this information is a calibration sequence flowchart that directs calibration personnel to the appropriate calibration procedures.

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

**Configuration** Defines the required actions to establish and program the transmitter configuration. Contains screen flow diagrams. Following this information are configuration sequence flowcharts that direct configuration personnel to the appropriate configuration procedures.

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

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

**Utility Mode** Defines the reset options and Basic/Advanced programming toggle. Contains a screen flow diagram. Directs personnel to the proper utility mode procedures.

**Diagnostics and Troubleshooting** Provides a description of the diagnostic tools available to aid with unit servicing. Includes a troubleshooting sequence flowchart that directs personnel to the appropriate troubleshooting procedures.

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

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

**Support Services** Provides a list of replacement parts unique to the Type TB82 transmitter.

**Appendix A** Provides temperature compensation information.

**Appendix B** Provides glossary of text prompts used in the secondary display during transmitter programming.

**Procedures PR1 through PR66** Provide procedures for each task.

## HOW TO USE THIS INSTRUCTION

Read this entire instruction through 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.

This instruction covers the standard Type TB82 transmitter. Refer to the ***Type STT Smart Transmitter Terminal Instruction*** for information on the HART version.

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.

## REFERENCE DOCUMENTS

Table 1-1 lists ABB documents referenced in, or used in conjunction with this instruction.

*Table 1-1. Reference Documents*

| Number | Document |
|---|---|
| WTPEEUS510001A0 | pH/ORP Sensors for Process Monitoring Specification |
| P-E21-001 | Installing a 4 to 20 mA Transmitter in a Hazardous Location |
| T-P90-2 | Calibration and Troubleshooting of pH Loops |
| T-P93-11 | Validation of Field pH Sensors |
| T-P96-1 | Temperature Another Wild Card in pH Control |
| WBPEEUI110502A0 | Type STT Smart Transmitter Terminal Instruction |
| WBPEEUS520151A0 | Type TB82 Advantage Series Two-Wire pH/ORP/pION Transmitter Specification |

## NOMENCLATURE

Table 1-2 presents the nomenclature for the Type TB82 transmitter. Use a single digit or letter in each position.

*Table 1-2. Nomenclature*

| Position: T B 8 2 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Advantage Series Transmitter |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **Input** |
| | P | H | | | | | | | | pH/ORP/pION |
| | E | C | | | | | | | | Four 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 Approval (pending)** |
| | | | | | | | | 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 TB82 transmitter. Refer to the ***Type STT Smart Transmitter Terminal Instruction*** for information on the HART version.

## SPECIFICATIONS

Table 1-3 lists the specifications for the Type TB82 transmitter.

*Table 1-3. Specifications*

| Property | Characteristic/Value |
|---|---|
| Process display range | |
| pH | -2 to +16.00 pH |
| ORP | -1,999 to +1,999 mV |
| pION | -1,999 to +1,999 mV |
| Temperature display range | -20° to +300°C (-4° to +572°F) |
| Display resolution | |
| pH | 0.01 pH |
| ORP | 1 mV |
| pION | 1 mV |
| Temperature | 1°C or 1°F |
| Accuracy | |
| Display | |
| pH | ±0.01 pH |
| ORP | ±1 mV |
| pION | ±1 mV |
| Temperature | 1°C or 1°F |
| Output | ±0.02 mA at full scale output setting |
| Nonlinearity | |
| Display | |
| pH | ±0.01 pH |
| ORP | ±1 mV |
| pION | ±1 mV |
| Temperature | 1°C or 1°F |
| Output | ±0.02 mA at full scale output setting |
| Repeatability | |
| Display | |
| pH | ±0.01 pH |
| ORP | ±1 mV |
| pION | ±1 mV |
| Temperature | 1°C or 1°F |
| Output | ±0.02 mA at full scale output setting |

*Table 1-3. Specifications (Continued)*

| Property | Characteristic/Value |
|---|---|
| Stability | |
| Display | |
| pH | ±0.01 pH |
| ORP | ±1 mV |
| pION | ±1 mV |
| Temperature | 1°C or 1°F |
| Output | ±0.02 mA at full scale output setting |
| Temperature compensation | Manual Nernstian, automatic Nernstian and automatic Nernstian with solution coefficient |
| Input types | |
| pH | Glass, Antimony (Sb), Custom isopotential and asymmetric potential |
| ORP | Platinum (Pt), Gold (Au) |
| pION | Sodium (Na), chloride, sulfide, etc. |
| Temperature | 3-kΩ Balco, Pt 100 |
| Dynamic response | 3 secs for 90% step change at 0.00 sec damping |
| Ambient temperature effect at 95% relative humidity | |
| pH | ±0.007 pH/°C |
| ORP | ±0.4 mV/°C |
| pION | ±0.4 mV/°C |
| Temperature | ±0.16°C/°C |
| Output | ±0.008 mA/°C |
| Output minimum span | |
| pH | 1.00 pH |
| ORP | 100 mV |
| pION | 100 mV |
| Output maximum span (full scale settings) | |
| pH | 0 to 14 pH |
| ORP | -1,999 to +1,999 mV |
| pION | -1,999 to +1,999 mV |
| Damping | Continuously adjustable from 0.0 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. |
| Sensor cable length (max.) | 30.5 m (100 ft) |

*Table 1-3. Specifications (Continued)*

| Property | Characteristic/Value |
|---|---|
| Sensor diagnostic | |
| pH | Glass and reference impedance, open and short cabling, efficiency and asymmetric potential check |
| ORP and pION | Reference impedance, open and short cabling, efficiency and asymmetric potential check |
| Diagnostic notification | Local indication via a *FAULT* or *SPIKE* icon |
| Analog mode | Programmable output pulse, 0 to 16 mA for 1 sec on 6-sec cycles |
| Environmental | |
| Temperature | |
| Operating | -20° to +60°C (-4° to +140°F) |
| LCD | -20° to +60°C (-4° to +140°F) |
| Storage | -40° to +70°C (-40° to +158°F) |
| Humidity | |
| Operating | Will meet specifications to 95% RH |
| Storage | Will meet specifications to 95% RH |
| Mounting position effect | None |
| Size | 144-mm high by 144-mm wide by 171-mm deep (5.67-in. high by 5.67-in. wide by 6.75-in. deep) |
| Minimum panel depth | 144.8 mm (5.70 in.) |
| Panel cutout | 135.4 (+1.3, -0.8) mm by 135.4 (+1.3, -0.8) mm<br>(5.33 (+0.05, -0.03) in. by 5.33 (+0.05, -0.03) in.) |
| Weight | 1.9 kg (4.2 lb) without mounting hardware<br>3.4 kg (7.5 lb) with pipe mounting hardware |
| EMC requirements | CE certified:<br>Electromagnetic emission - EN55011: 1991<br>CISPR11: 1990 Classes A and B<br>Electromagnetic immunity - EN50082-2: 1995<br>IEC1000-4-2: 1995<br>6 kV contact<br>8 kV air<br>6 kV indirect<br>IEC1000-4-3: 1995<br>10 V/m<br>20 to 1,000 MHz<br>IEC1000-4-4: 1995 - 1 kV signal lines |
| Enclosure classification | NEMA 4X/IP65 |
| Agency approvals[1] (pending) | |
| Factory Mutual (FM) | |
| Intrinsic safety | Classes I, II, III; Division 1; applicable Groups A, B, C, D, E, F and G; T6 when used with appropriate barriers per ***Installing a 4 to 20 mA Transmitter in a Hazardous Location***. |
| Nonincendive | Class I; Division 2, groups A, B, C and D.<br>Class II; Division 2, Groups F and G<br>Class III; Division 2 |

*Table 1-3. Specifications (Continued)*

| Property | Characteristic/Value |
|---|---|
| Agency approvals (continued) | |
| Canadian Standards Association (CSA) | |
| Intrinsic safety | Classes I, II, III; Division 1; applicable Groups A, B, C, D, E, F and G; T4 when used with appropriate barriers per ***Installing a 4 to 20 mA Transmitter in a Hazardous Location***. |
| Nonincendive | Class I; Division 2, groups A, B, C and D.<br>Class II; Division 2, Groups E, F and G<br>Class III; Division 2 |
| CENELEC | |
| Intrinsic safety | EEX ia, Zone 1; Group IIC, T6 when used with appropriate barriers per ***Installing a 4 to 20 mA Transmitter in a Hazardous Location***. |
| Standards Association of Australia (SAA) | |
| Intrinsic safety | Ex ia, Zone 0; Group IIC, T6 when used with appropriate barriers per ***Installing a 4 to 20 mA Transmitter in a Hazardous Location***. |
| Nonincendive | Ex n, Zone 2; Group IIC, T6 |

**NOTE:**

1. Hazardous location approvals for use in flammable atmospheres are for ambient conditions of -25° to +40°C (-13° 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.

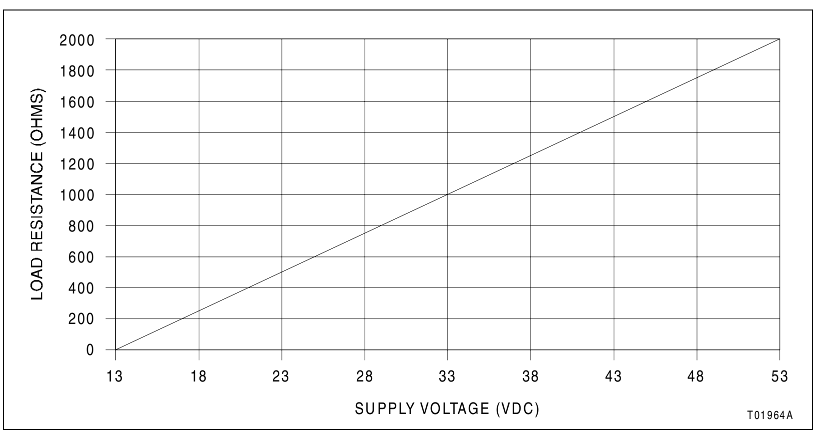


*Figure 1-1. Load Limits*

## ACCESSORIES

Table 1-4 lists the accessories for the Type TB82 transmitter.

*Table 1-4. Accessories*

| Part Number | Description |
|---|---|
| 4TB9515-0123 | Panel mounting kit |
| 4TB9515-0124 | Pipe mounting kit |
| 4TB9515-0125 | Hinge mounting kit |

*Table 1-4. Accessories (Continued)*

| Part Number | Description |
|---|---|
| 4TB9515-0156 | Wall mounting kit |
| 4TB9515-0164 | BNC adapter |
| 4TB9515-0166 | BNC adapter with fitting |
| 1948385?1 | Antistatic kit contains a static-dissipative work surface (mat), ground cord assembly, wrist bands and alligator clip for personnel working on devices containing semiconductor components. |
| TBX551[1], TB551 | Sensor, in-line, twist lock, submersible |
| TBX556[1], TB556 | Sensor, in-line, threaded, submersible |
| TBX557[1], TB557 | Sensor, ball valve insertion, hot top |
| TBX561[1], TB561 | Sensor, in-line, sterilizable |
| TBX562[1], TB562 | Sensor, sanitary/sterilizable |
| TBX564[1], TB564 | Sensor, high pressure, hot top |
| TBX566[1], TB566 | Sensor, high purity, flow cell |
| TBX567[1], TB567 | Sensor, in-line, high pressure |

**NOTE:**

1. Model TBX5 Next Step Advantage Series Sensors required for Advanced sensor diagnostics.

# SECTION 2 - DESCRIPTION AND OPERATION

## INTRODUCTION

The first part of this section contains an overview of the functionality of the Type TB82 transmitter. Also included is important information for configuration personnel. The latter part of this section discusses the transmitter modes and faceplate controls.

## FUNCTIONAL OPERATION

The Type TB82 transmitter provides a four to 20-milliampere output signal in response to the output of any electrochemical sensor having a DC voltage output between -2,000 and +2,000 millivolts. This includes sensors requiring electrometer type detectors such as pH, ORP and pION sensors.

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

- pH glass electrode impedance.
- Reference electrode impedance.
- Ground loop detection.
- Open and 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.

> **NOTE:** This instruction covers the standard Type TB82 transmitter. Refer to the ***Type STT Smart Transmitter Terminal Instruction*** for information on the HART version.

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 novel approach (patent pending), 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. The end result is an interface that provides a great deal of flexibility and functionality.

## MODULAR ELECTRONICS

The transmitter consists of three separate printed circuit board (PCB) assemblies that concentrate specific circuit functionality onto each of the three boards. This modular design allows for the ability to change the instrument from one of three types of instruments: pH/ORP/pION, four-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 two types of RTD inputs: three-kilohm Balco and Pt 100. 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 output of measuring electrodes such as those used to measure pH. Therefore, temperature compensation functions are available. Manual Nernstian, automatic Nernstian and automatic Nernstian with solution coefficient are used for pH measurements. Manual (no compensation) and solution coefficient are used for ORP and pION measurements.

## DAMPING

Input damping can be adjusted from 0.0 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. Diagnostics 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 detailed 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: high reference, shorted cable, open cable or sensor out of solution, shorted or open temperature sensor, high and low process variable (PV), 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-milliampere) pulse impressed on the four to 20-milliampere 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 milliamperes, the pulse adds current; if above 12 milliamperes, 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 procedure or procedures needed 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 workstation 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 the packing material before discarding it to make certain that all mounting equipment and any special instructions or paperwork have been removed. Careful handling and installation ensures satisfactory performance of the 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. Twisted, shielded pairs should be used for best results.

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 ensures 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.

### *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 radio frequency interference (RFI). 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, ABB recommends a separate metal conduit run for the sensor, and signal and 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, ABB recommends that sensor, and signal and power wiring be enclosed 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 and 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 milliamperes 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 positioned in any of the four positions as shown in Figure 3-1.

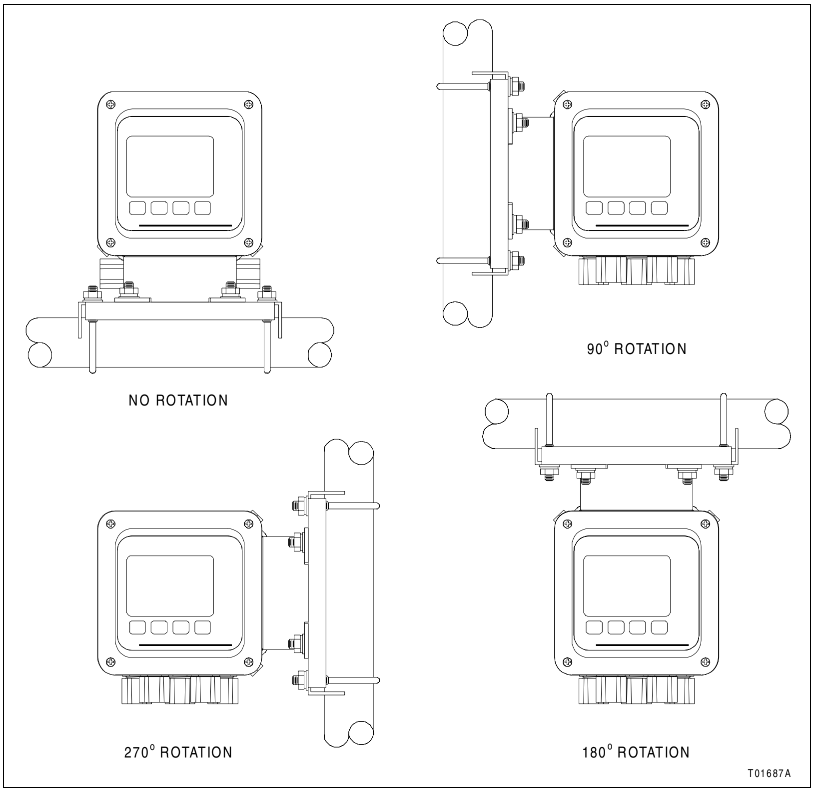


*Figure 3-1. Transmitter Rotation*

## INSTALLATION SEQUENCE

Refer to Figure 3-2 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.

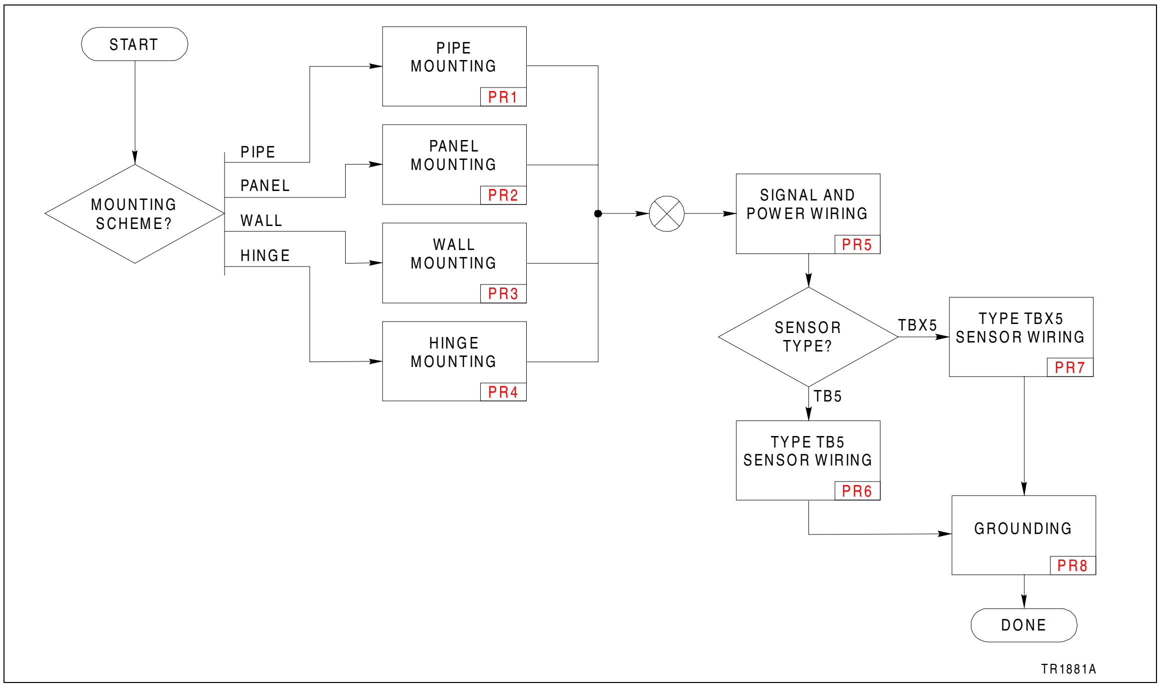


*Figure 3-2. Installation Sequence*

# SECTION 4 - OPERATING PROCEDURES

## INTRODUCTION

The Type TB82 transmitter has six main operating modes: measure, calibrate, output/hold, configure, security and secondary display. Within each mode, several programming states containing functions specific to the related mode are available.

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 interface (patent pending) uses a custom LCD and four-button keypad. Instrument functions and programming prompts are available through one of two regions on the LCD. These regions include a primary area that shows the process variable (pH) 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 are located at the top of the LCD and are only energized under the specified condition. Interrogation of any fault condition is allowed by pressing the *FAULT info* smart key in the measure mode.

**NOTE:** This instruction covers the standard Type TB82 transmitter. Refer to the ***Type STT Smart Transmitter Terminal Instruction*** for information on the HART version.

## OPERATOR INTERFACE CONTROLS

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

### Liquid Crystal Display (LCD)

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 *OUTPUT HELD*, *FAULT* or *SPIKE* states. 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.

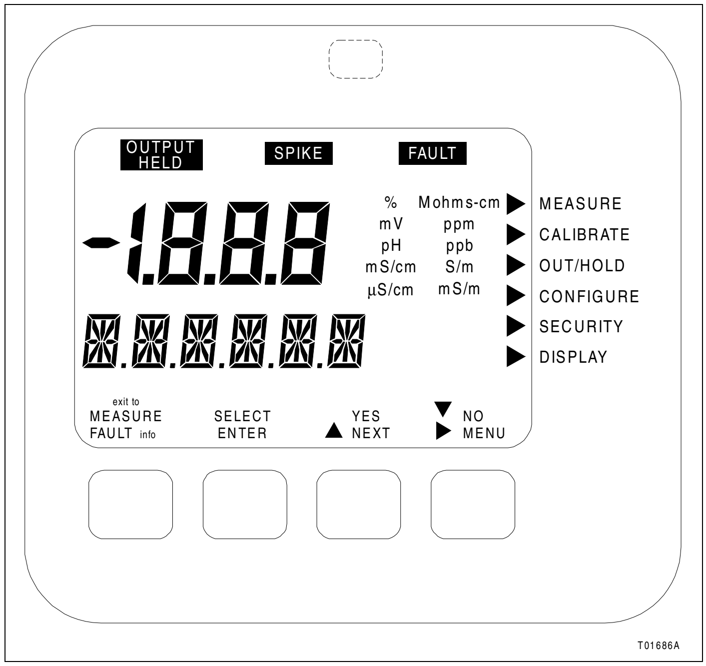


*Figure 4-1. Liquid Crystal Display*

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 active in all modes of operation; however, in some programming states, the process variable region is used for data entry and the engineering units region reflects the data units.

The secondary variable is displayed in the six-character, fourteen-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 B 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.

## *Multifunction Smart Keys*

A five-button, tactile keypad is located on the front panel of the instrument. Four of 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 are energized over the key to indicate its function. If a smart key does not have an icon energized above its location, this smart key does not have a function and will not initiate an action when pressed. Using this smart key method, a small 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 for a given mode of operation. 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 input and output functions. |
| Configure | Configuration of transmitter functions such as temperature compensation types, temperature sensor, measurement electrode type, etc. |
| Secondary 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 | On-line 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. |

## OUTPUT HELD ICON

The *OUTPUT HELD* icon energizes when a hold condition is active. Holding the output can be either manually or automatically 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 current level or at a manually set level.

Automatic activation only occurs in the two-point calibration state. In this state, the transmitter automatically holds the output at the current level. When exiting from the calibration mode, the transmitter inquires on releasing the hold condition.

## 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 and its related procedures.

## SPIKE ICON

The spike output function modulates the transmitter output from the normal level representative of the current process variable to a value configured as a set percentage of 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. For more information on spike output and fault conditions, refer to Section 12 and its related procedures.

# 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 ensures 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 for Analyzer Types*

| Analyzer Type | Engineering Unit |
|---|---|
| pH | pH |
| ORP | mV |
| pION | mV |
| pION concentration | ppm, ppb, percent or user-defined |

## 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 milliamperes, reference impedance in ohms or kilohms, sensor output in millivolts, or firmware revision. Refer to Section 10 and its related procedure 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 first in, first out (FIFO) 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 from *Measure* to *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.

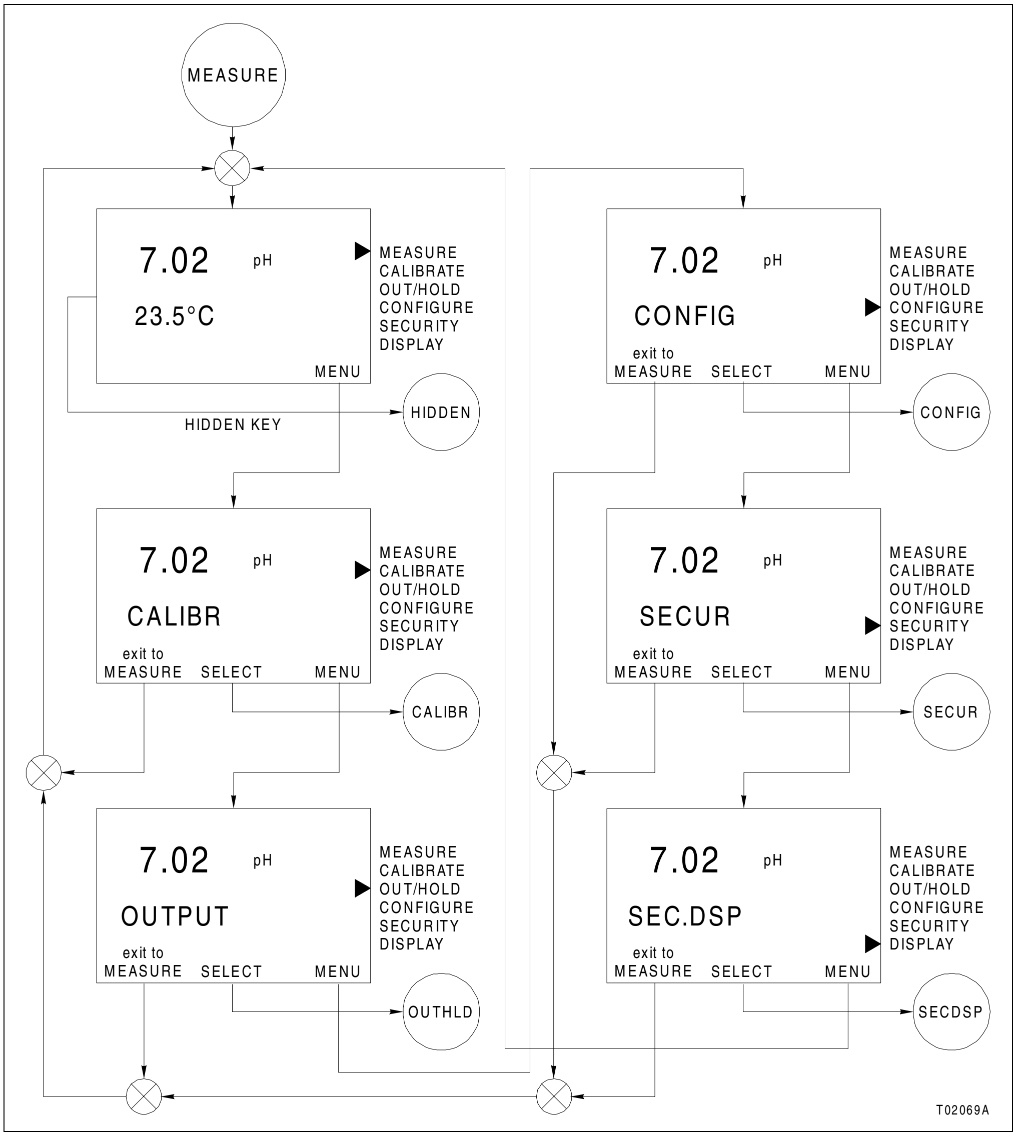


*Figure 5-1. Operating Mode Screen Flow*

# 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 process sensor 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 | Description |
|---|---|
| pH calibration | Calibration of the process sensor input via a one-point offset, or two-point offset and slope (efficiency) calibration. |
| ORP calibration | |
| pION calibration | |
| Temperature calibration | Calibration of temperature sensor input via one-point smart calibration that adjusts offset, slope or both based on sensor calibration history. |
| Edit calibration | Manual adjustment of process sensor and temperature offset and slope values. |
| Reset calibration | Restores calibration values for process sensor and temperature sensor to factory settings. |
| Output calibration | Calibration of transmitter output values to measured values using external validation device. |

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

When performing the one or two-point process sensor 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 process sensor calibrate state. Pressing the *exit to MEASURE* smart key returns the transmitter to the measure mode.

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

For more information on sensor calibration techniques and troubleshooting, refer to ***Calibration and Troubleshooting of pH Loops*** (Table 1-1).

Figures 6-1 and 6-2 are screen flow diagrams for the calibrate mode of operation.

## CALIBRATION SEQUENCE

Refer to Figure 6-3 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.

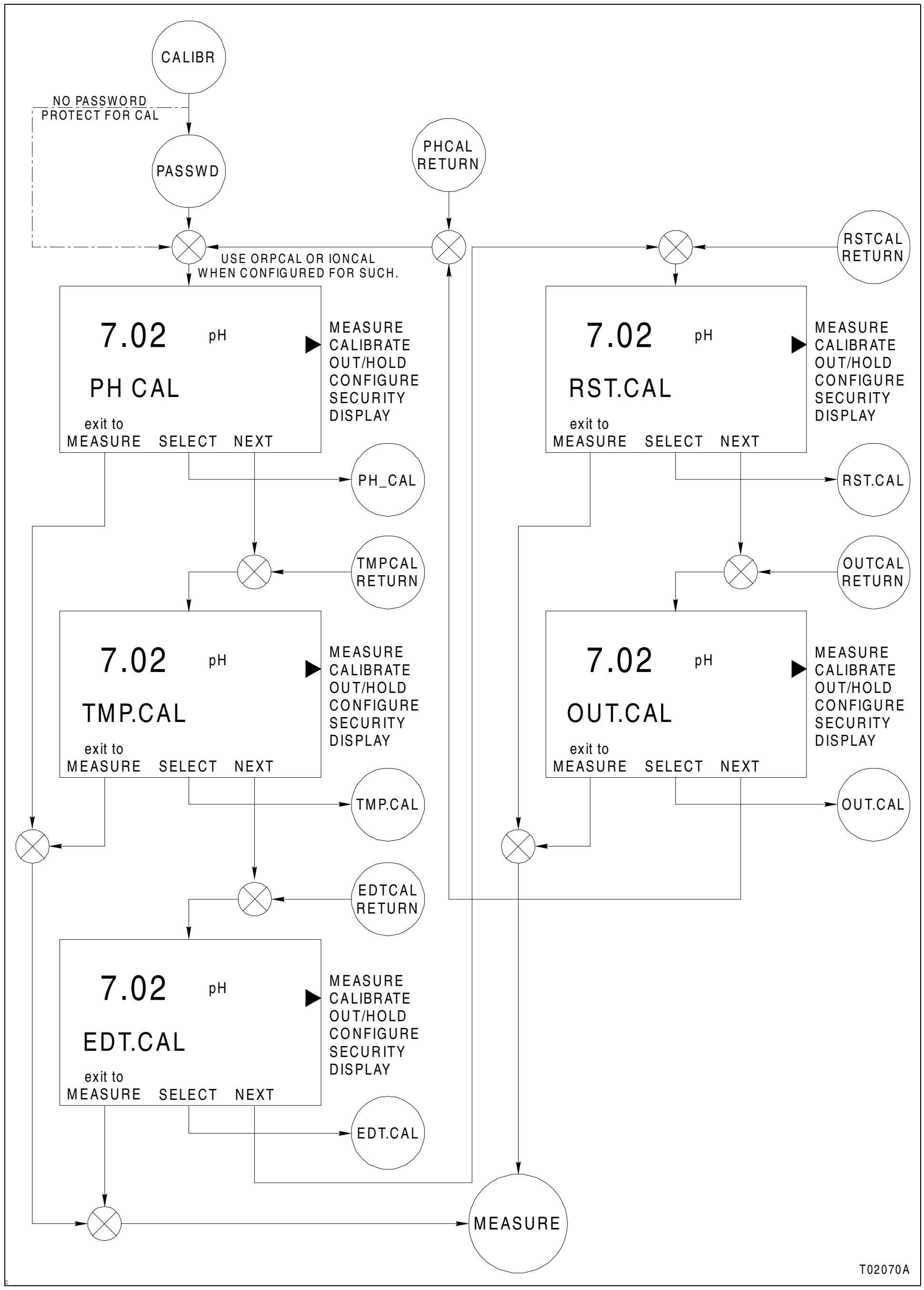


*Figure 6-1. Calibrate Mode Screen Flow*

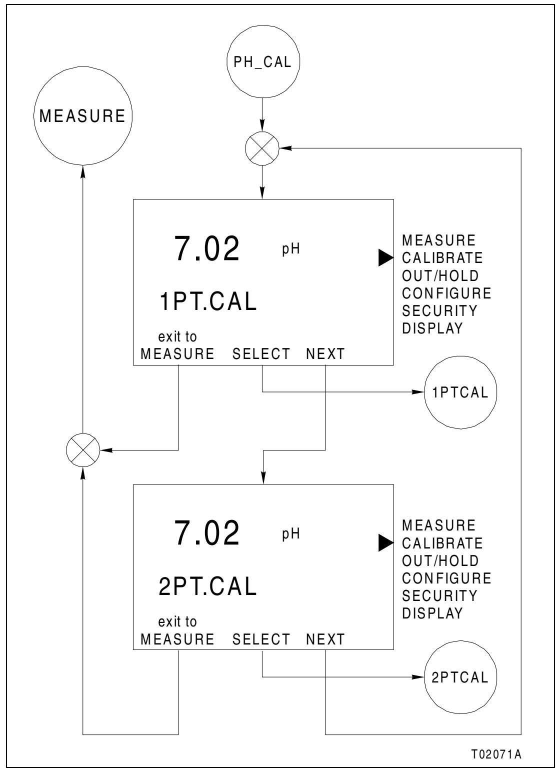


*Figure 6-2. Process Sensor Screen Flow*

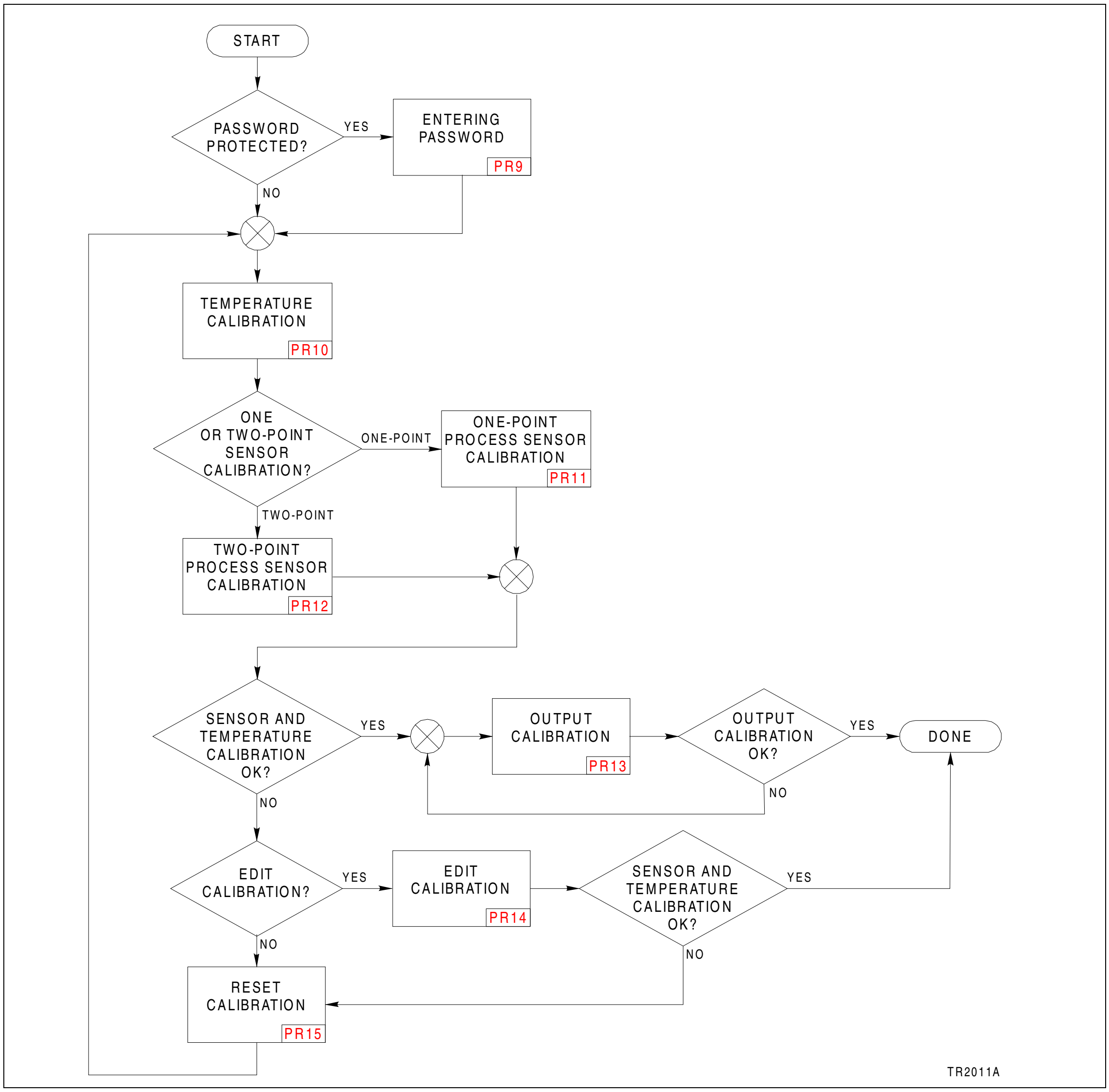


*Figure 6-3. Calibration Sequence*

# 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 lists the procedures that describe how to perform the tasks in each state.

## OUTPUT/HOLD STATES OF OPERATION

The output/hold mode consists of five states of operation. Table 7-1 describes the function of each state of operation. Table 7-1 also lists 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. | PR16 |
| Hold | *HOLD* | Fixes output level at value captured upon initiation of hold or at manually entered level. | PR17 |
| Release hold | *REL.HLD* | Releases existing output/hold state. | PR18 |
| Rerange | *RERANG* | Changes output range. | PR19 |
| Spike | *SPIKE* | Enables or disables spike output function if configured. | PR20 |

### 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 milliamperes).

### Rerange State

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

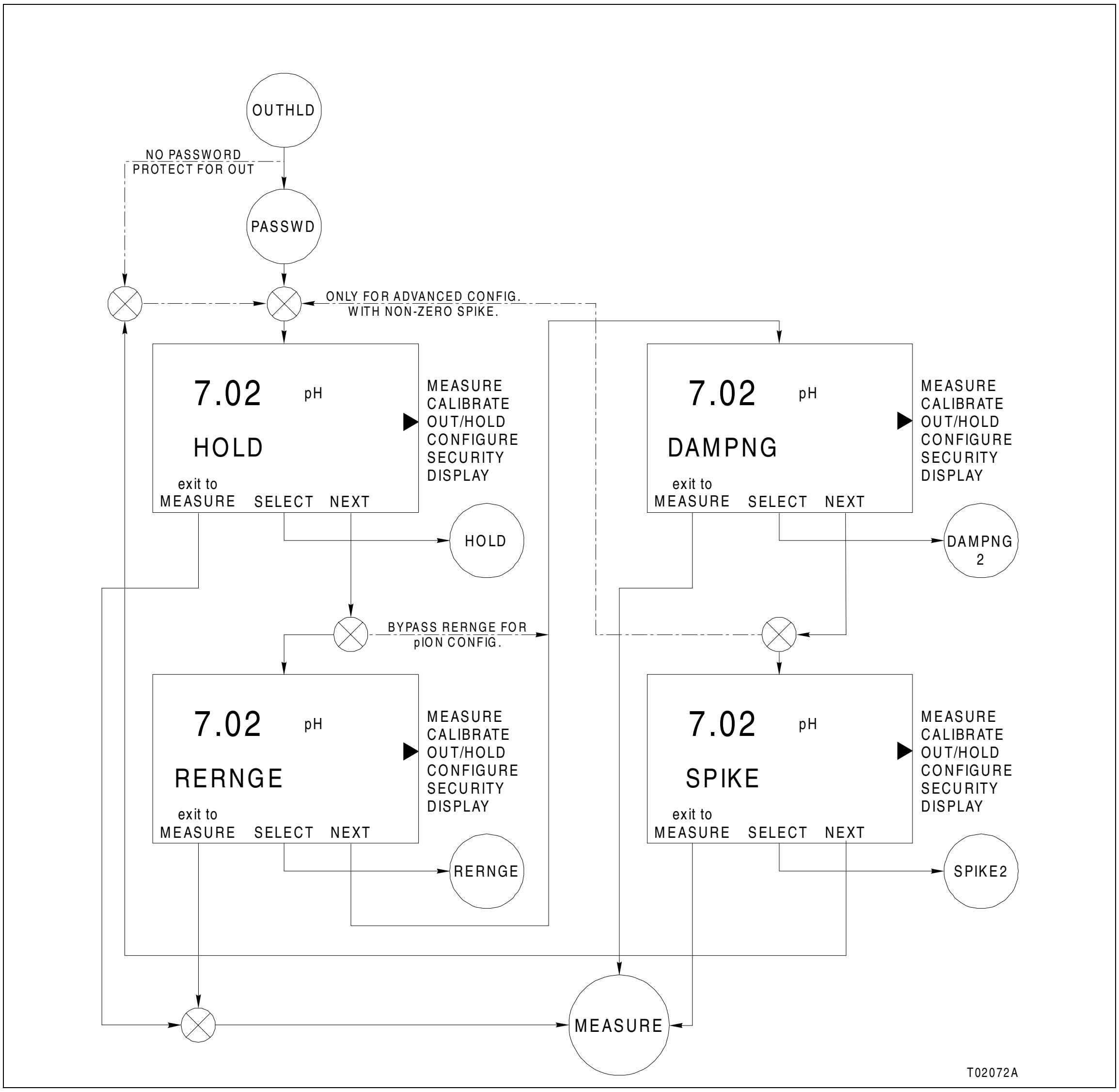


*Figure 7-1. Output/Hold Mode Screen Flow*

## *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 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.

## *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.

# SECTION 8 - CONFIGURATION

## *INTRODUCTION*

The configure mode of operation establishes the operating parameters of the Type TB82 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 an 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 asks if the user would like 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.

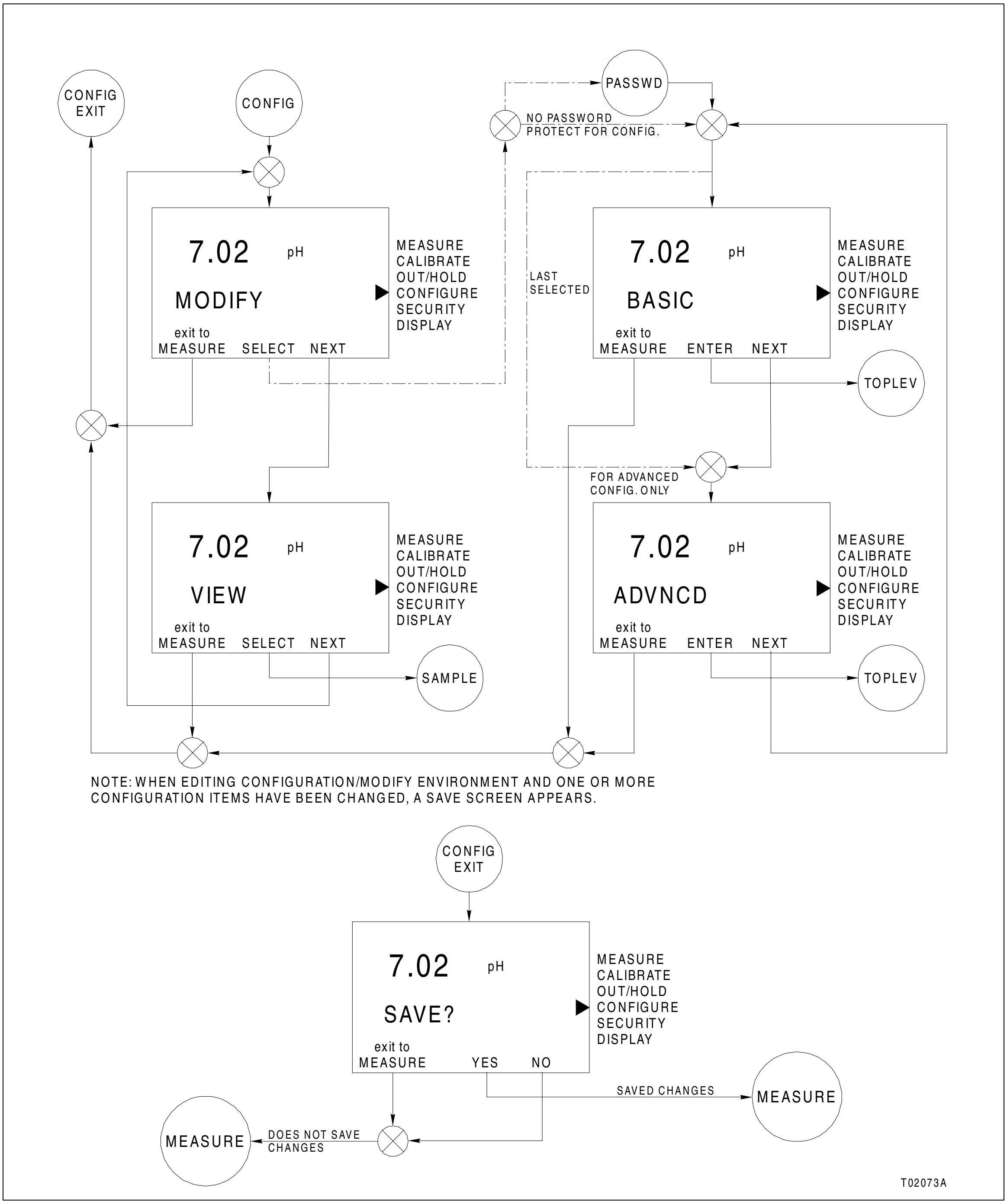


*Figure 8-1. Modify/View and Basic/Advanced States Screen Flow*

## 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 type of process variable to be measured and must coincide with the type of sensor being used.

### pH Analyzer State (Basic/Advanced)

The pH analyzer state contains three types of sensors: glass, antimony and custom.

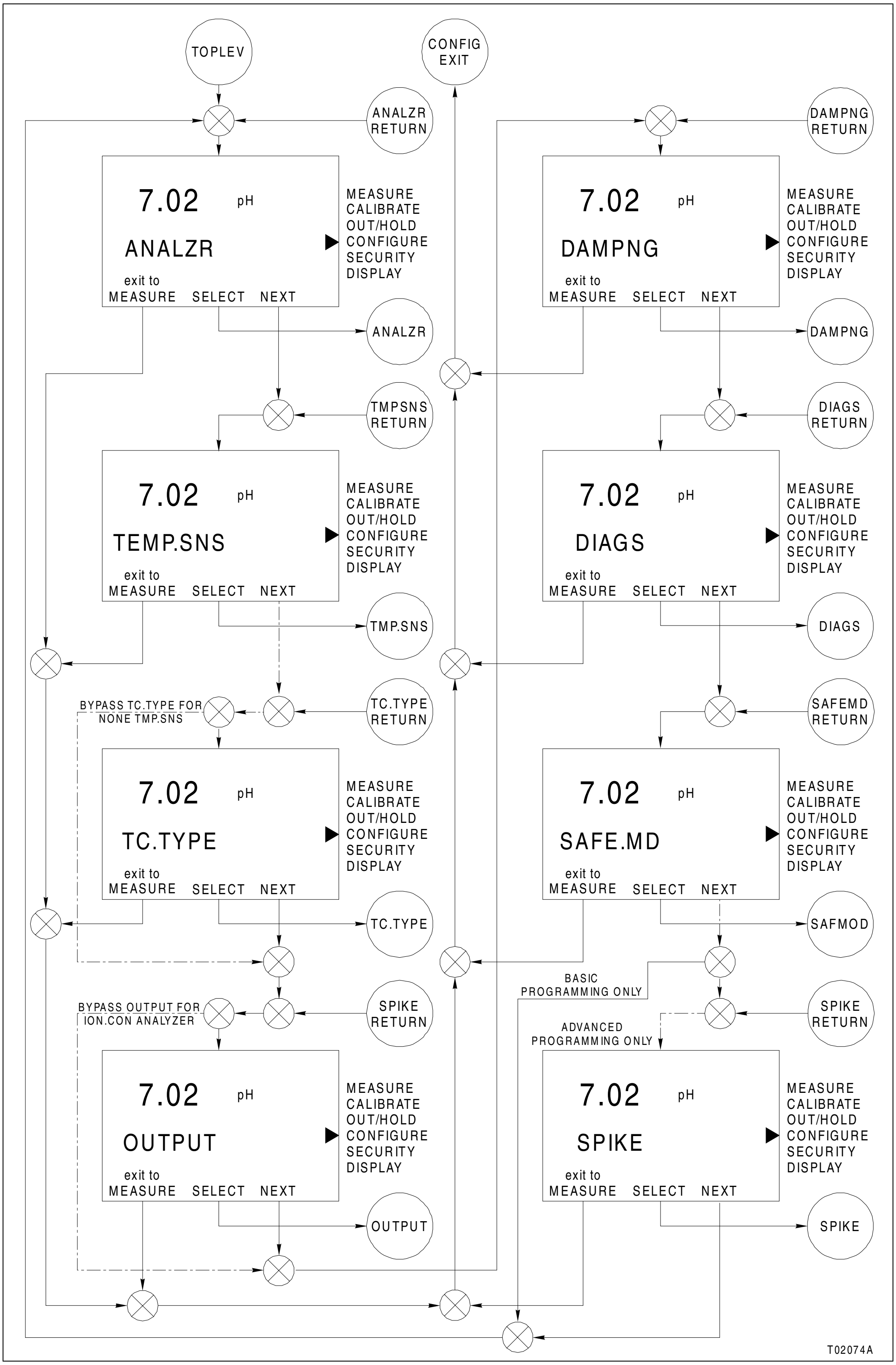


*Figure 8-2. Modify Configure States Screen Flow*

### *ORP and pION States (Basic/Advanced)*

Set the ORP or pION analyzer states by pressing the *ENTER* smart key on the desired state when displayed using the *NEXT* smart key. Advanced configurations require the entering of the reference impedance value.

### *Ion Concentration State (Advanced)*

The ion concentration state allows for pION sensor inputs to be converted to concentration units such as parts per million and parts per billion. This state uses temperature compensated millivolt values and applies a logarithmic function that has a fixed end point in millivolts, an ion valence ranging from -3 to +3, and an end point magnitude that can be set to 10, 100 or 1,000.

The ion concentration state functions by associating an end millivolt value to an end magnitude value. The valence determines the millivolt change per decade of concentration and is defined by the Nernst equation. If the valence is negative the millivolt to concentration relationship will have a negative slope. The number of magnitudes defines the transmitter output.

### *Temperature Sensor State (Basic/Advanced)*

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

### *Temperature Compensation State (Basic/Advanced)*

Temperature has two effects on electrochemical sensors. The first effect, the Nernstian effect, causes the sensor output to increase with increasing temperature. In the case of a pH sensor, the increase is roughly 0.03 pH per pH Unit from seven pH per 10-degrees Celsius. Since ABB pH sensors use a silver/silver chloride measurement and reference half cell, the isopotential point (the pH value where the sensor output is not affected by temperature) of these sensors is seven pH.

The second effect of temperature is on the actual chemistry of the solution. Since ion disassociation is a function of temperature, measured ion properties such as pH, ORP and pION are affected by changes in process temperature. This effect cannot be predicted due to differences between solution chemistries.

The temperature compensation state sets the compensation method to reflect these temperature effects. The three states of temperature compensation include manual Nernstian, automatic Nernstian and automatic Nernstian with solution coefficient.

### Manual Nernstian State (Basic/Advanced)

Manual temperature compensation compensates for the effects of temperature on the sensor at a specific temperature. A temperature sensor is not required for this compensation state. Manual Nernstian state is only applicable for pH analyzer states. The displayed process variable is standardized to 25-degrees Celsius.

### Automatic Nernstian State (Basic/Advanced)

Automatic Nernstian temperature compensation requires an input from a temperature sensing device. This input can be either from a Pt 100 or three-kilohm Balco RTD and must be set to the appropriate temperature sensor in the temperature sensor state.

Automatic Nernstian temperature compensation corrects for effects of temperature on the sensor. It is only applicable for the pH analyzer state. The displayed process variable is standardized to 25-degrees Celsius. The allowable temperature range is zero to 140-degrees Celsius.

### Automatic Nernstian With Solution Coefficient State (Advanced)

The Automatic Nernstian with solution coefficient state compensates the sensor output to standard temperature values of 25-degrees Celsius using the Nernst Equation and a solution coefficient.

This compensation method also requires an input from a temperature sensing device. This input can be either from a Pt 100 or three kilohm Balco RTD and must be set to the appropriate temperature sensor in the temperature sensor state. The allowable temperature range is zero to 140-degrees Celsius.

### Output State (Basic/Advanced)

The output state sets the output type and range. For Basic configurations, the output type is linear and requires the entering of the lower and upper process variable values. The default values set the output range to the full scale process variable range. For Advanced configurations, the output type can be linear or nonlinear. The linear output state is the same as for the Basic configuration. The nonlinear output state requires the programming of process variable lower and upper values, and five break points in terms of percentage input against percentage output.

### *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 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.

### *Diagnostics State (Basic/Advanced)*

The diagnostics state allows the built-in sensor diagnostics to be disabled. When a sensor does not have a solution ground such as nonadvantage sensors, the diagnostic signal cannot be injected into process liquid. For these situations and applications that are using very pure water, the sensor diagnostics should be disabled.

### *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 and its related procedures.

### *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 second 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 and its related procedures.

## *CONFIGURATION SEQUENCE*

Refer to Figures 8-3, 8-4 and 8-5 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.

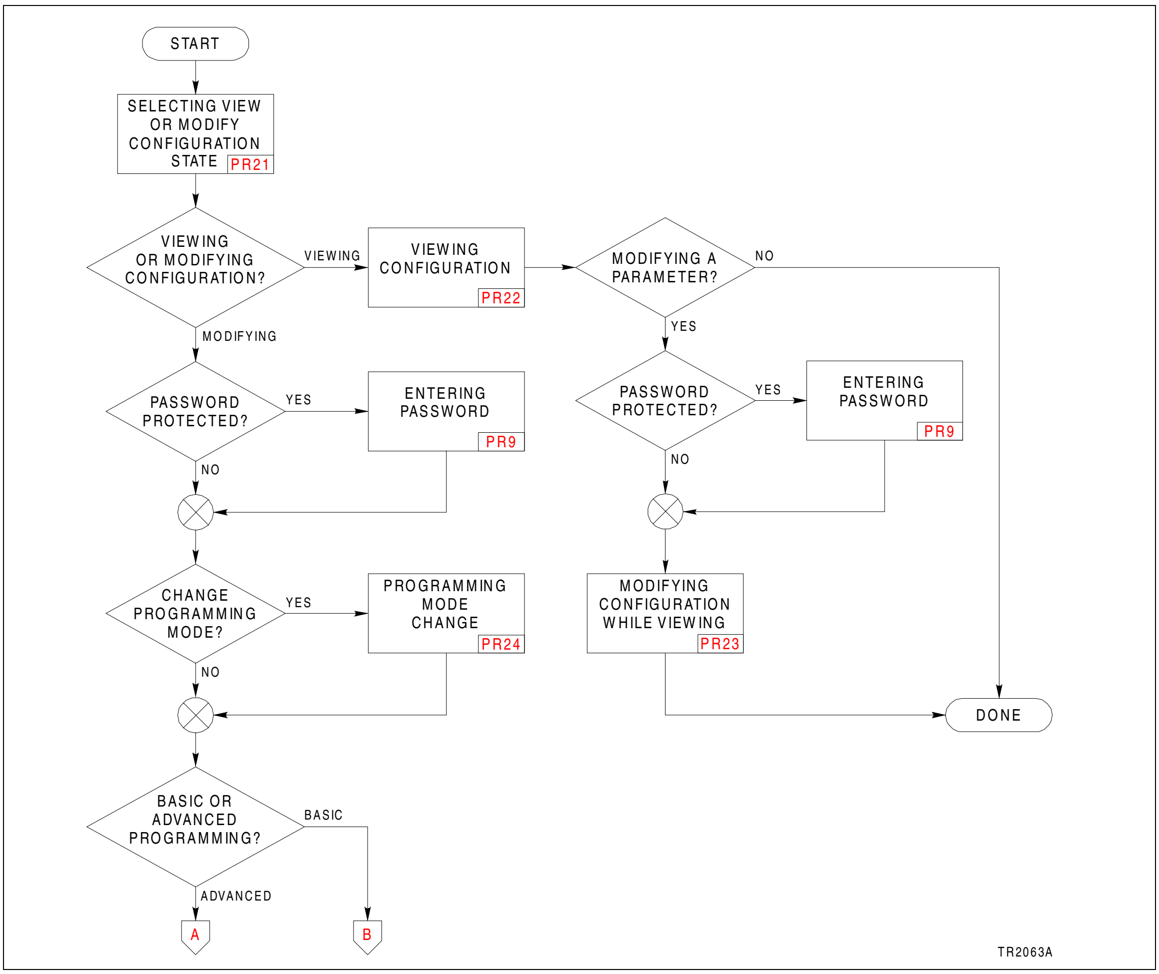


*Figure 8-3. Configuration Sequence*

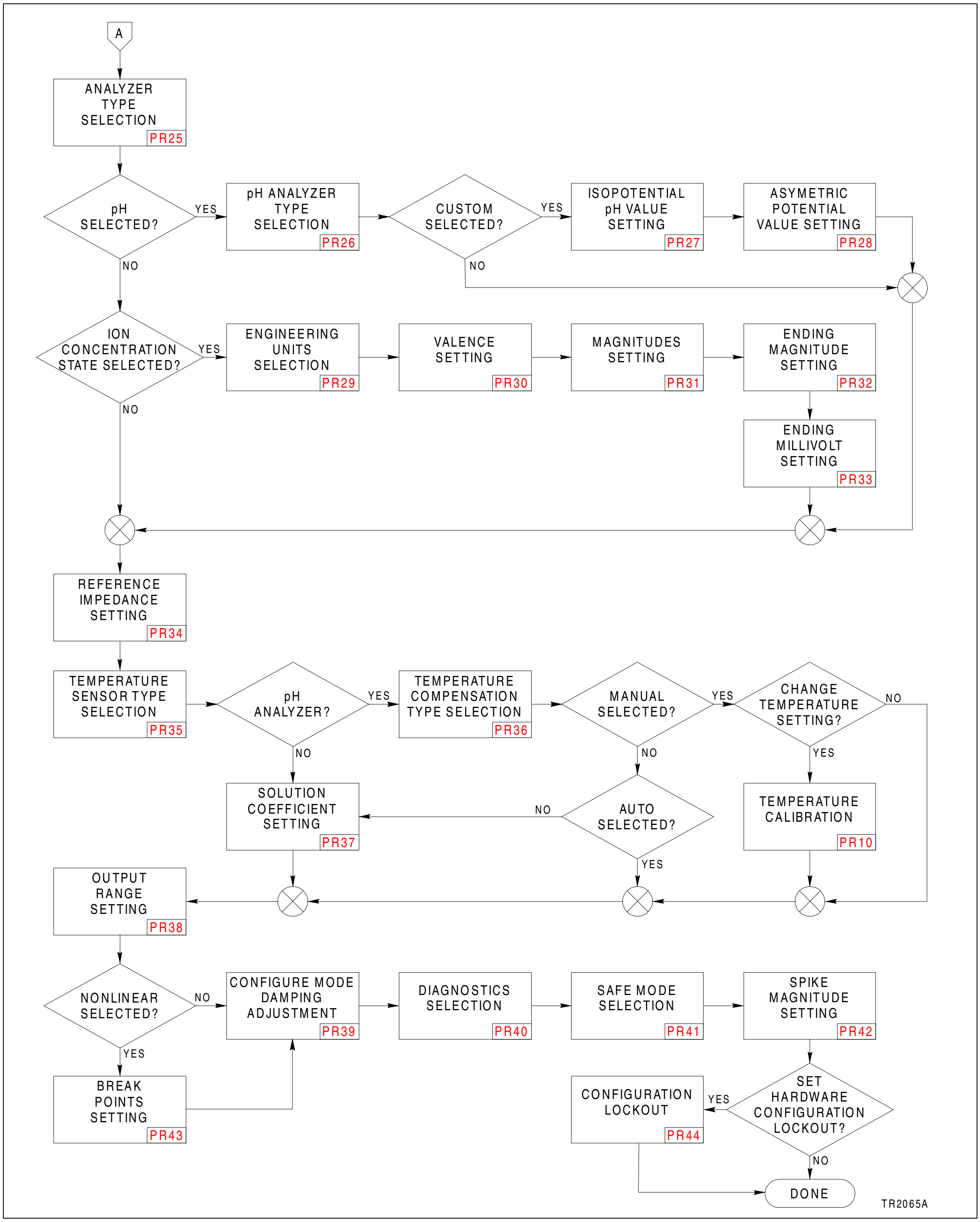


*Figure 8-4. Advanced Configuration Sequence*

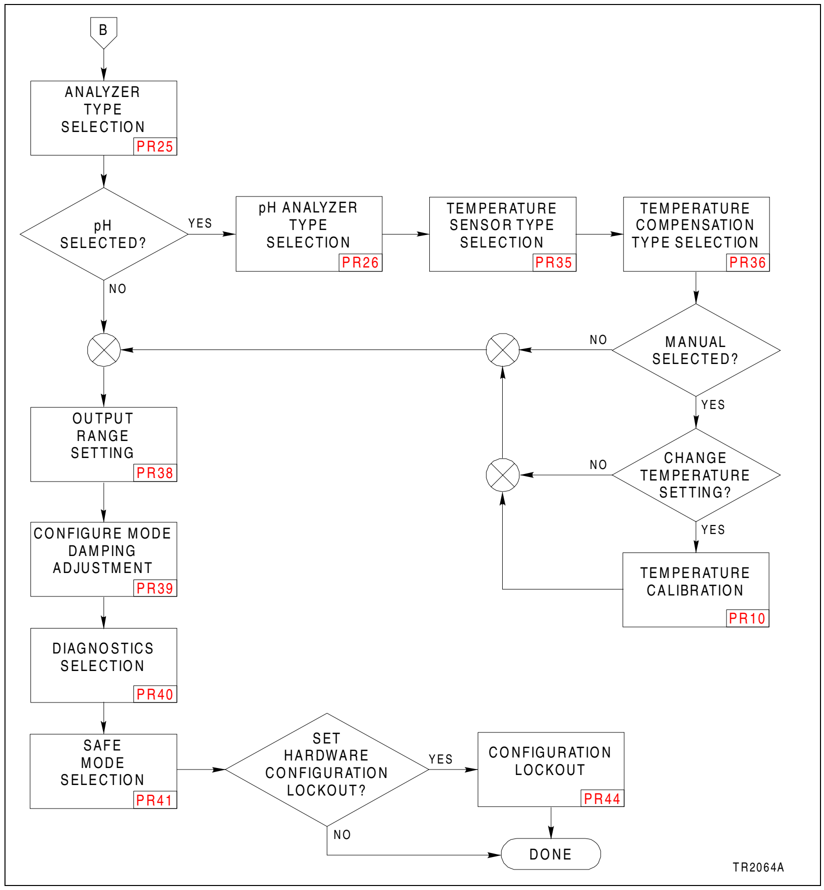


*Figure 8-5. Basic Configuration Sequence*

# 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.

## SECURITY SEQUENCE

There is only one procedure associated with the security mode. Refer to PR45 to set the security states and password.

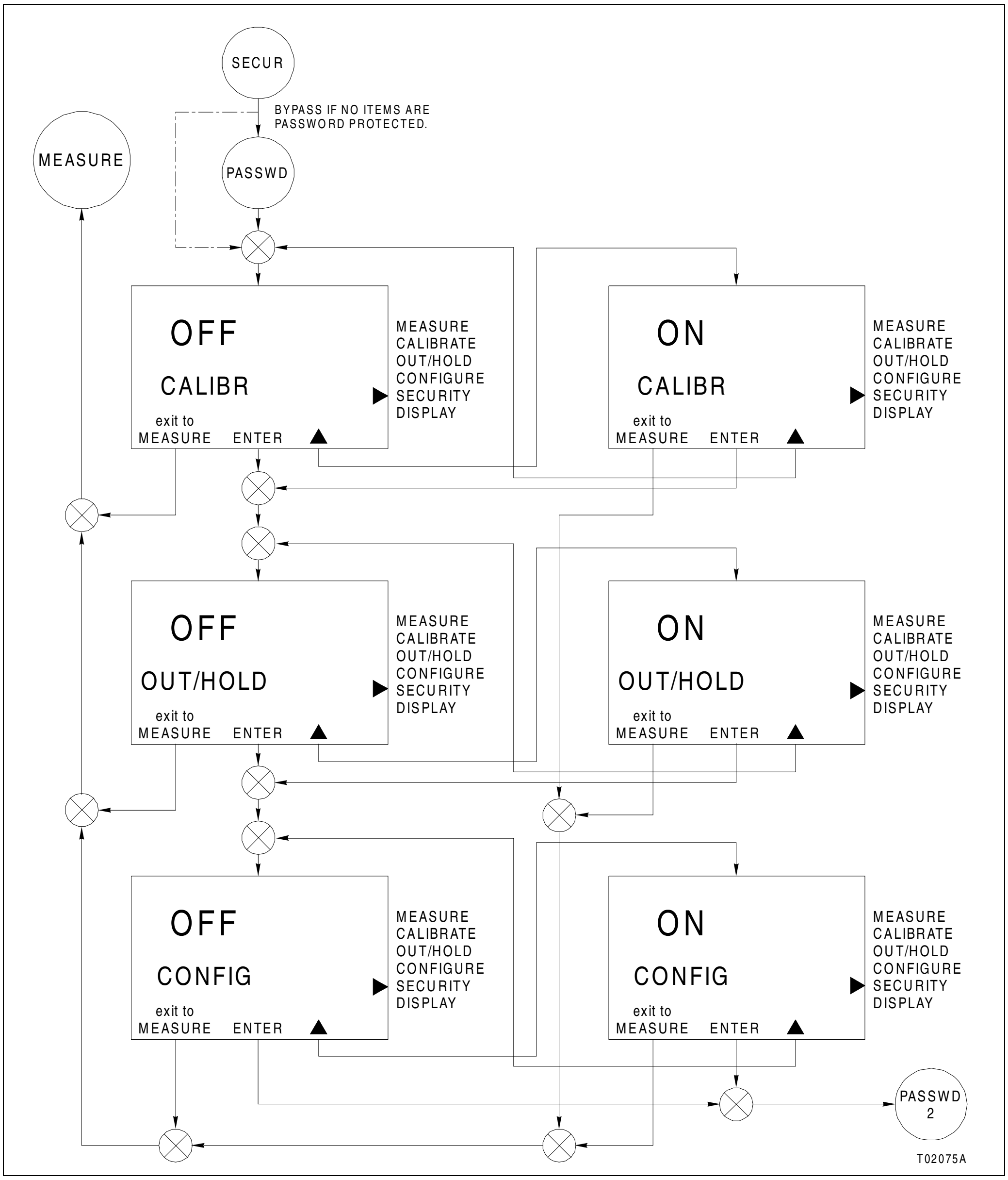


*Figure 9-1. Security State Screen Flow*

# SECTION 10 - SECONDARY DISPLAY MODE

## INTRODUCTION

The Type TB82 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, reference impedance, raw sensor output 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 of operation contains seven states of operation. These provide information on the process temperature, current and sensor output, software revision, and spike 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 SEQUENCE

There is only one procedure associated with the secondary display mode of operation. Refer to PR46 to use the secondary display mode.

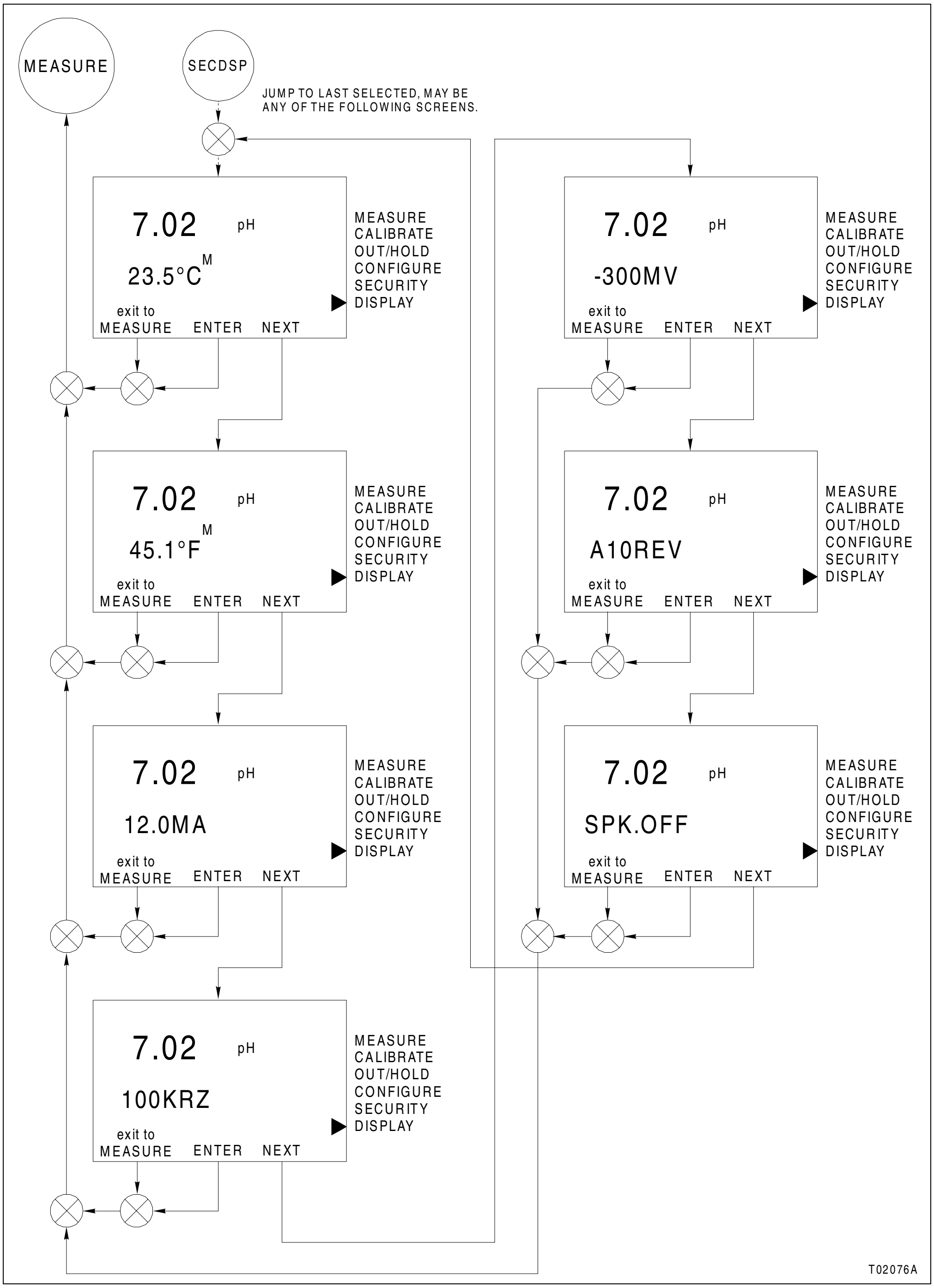


*Figure 10-1. Secondary Display Mode Screen Flow*

# SECTION 11 - UTILITY MODE

## INTRODUCTION

The Type TB82 transmitter has a utility mode of operation that provides access to powerful functions not normally 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 for default values, remove security, reset all parameters to default settings and software reboot.

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

The factory and user states of operation can be accessed 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. Table 11-1 also 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 that can be selected in the modify configure mode of operation. | PR47 |
| Reset configuration | *RST.CON* | Resets configuration to factory defaults. | PR48 |
| Reset security | *RST.SEC* | Resets security to the *OFF* state for all modes. | PR49 |
| Reset all | *RST.ALL* | Resets all programming parameters such as configuration, calibration, output/hold, security and secondary display functions to factory defaults. | PR50 |
| Reset software | *RST.SFT* | Resets transmitter and repeats boot-up and self-test procedures. | PR51 |

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.

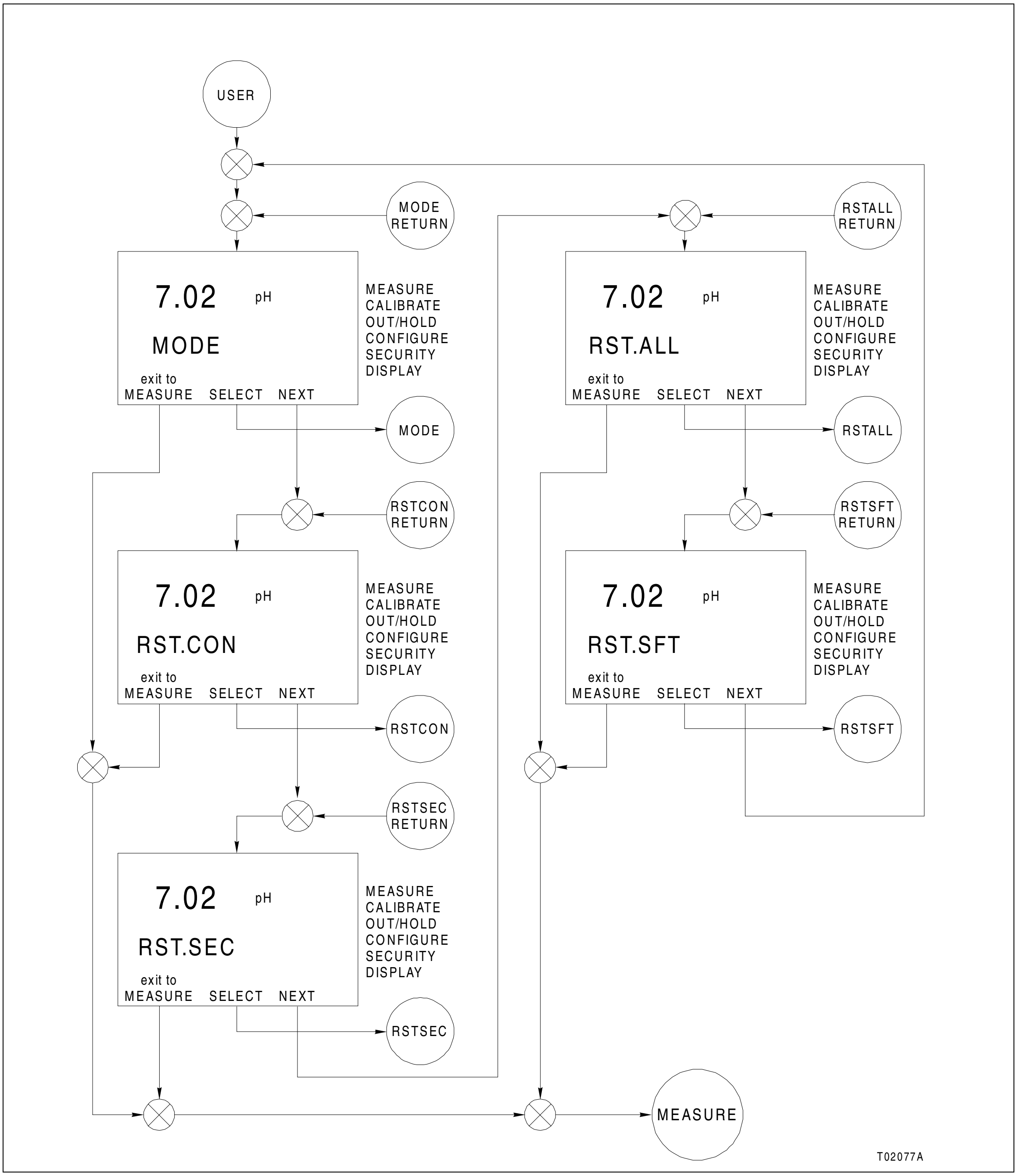


*Figure 11-1. User State Screen Flow*

## *Advanced/Basic Programming Mode User State*

In order to simplify the configuration process for a user who only needs 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 |
|---|---|
| Instrument mode | Basic |
| Analyzer type | pH, glass |
| Temperature sensor | 3-kΩ Balco |
| Temperature compensation | Manual |
| Output range | 0 to 14 pH |
| 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.

## *Reset Security User State*

The reset security user state returns the security of the transmitter back to factory default settings. The factory default is security off for all applicable modes.

## *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 TB82 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. Refer to ***TROUBLE-SHOOTING SEQUENCE*** to find the procedures needed to evaluate the diagnostic messages and troubleshoot the transmitter.

Personnel performing troubleshooting should be familiar with the Type TB82 transmitter.

| 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.** |
|---|---|

## 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 first in, first out (FIFO) 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.

### *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.

## *CALIBRATION DIAGNOSTICS*

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

An efficiency of less than 60 percent or greater than 110 percent indicates a potentially bad process calibration point or poorly performing sensor. Calibration values that yield efficiency values less than 40 percent or greater than 150 percent are not accepted and 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 -180.0 millivolts or greater than +180 millivolts also indicates a potentially bad process calibration or poorly performing sensor. Calibration values that yield offset values less than -1,000 millivolts or greater than +1,000 millivolts are not accepted. The transmitter then 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.

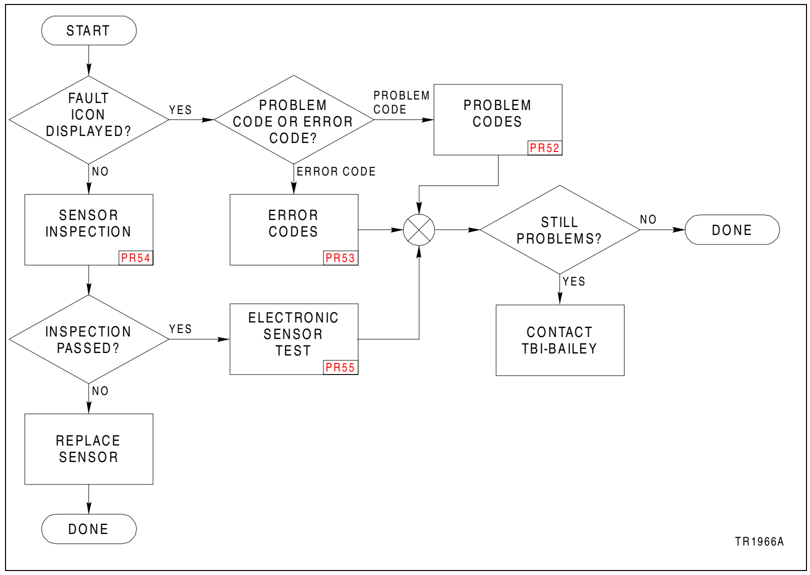


*Figure 12-1. Troubleshooting Sequence*

# SECTION 13 - MAINTENANCE

## INTRODUCTION

This section contains a preventive maintenance schedule for the Type TB82 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 TB82 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. | N/A | 12 |
| Calibrate transmitter output. | PR13 | |
| Inspect sensor. | PR54 | As required |
| Clean sensor. | PR56 | |
| Clean keypad. | PR66 | |
| Calibrate sensor. | Fig. 6-3 | |
| Clean and lubricate all gaskets and O-rings. | N/A | Each time seals are broken |
| Complete all tasks in this table. | N/A | Shutdown |

# SECTION 14 - REPAIR AND REPLACEMENT

## INTRODUCTION

Due to the modular design of the Type TB82 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 provides removal and installation procedures for these assemblies. Use Figure 15-1 as a reference during removal and installation procedures.

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

**WARNING**

**Do not substitute 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.

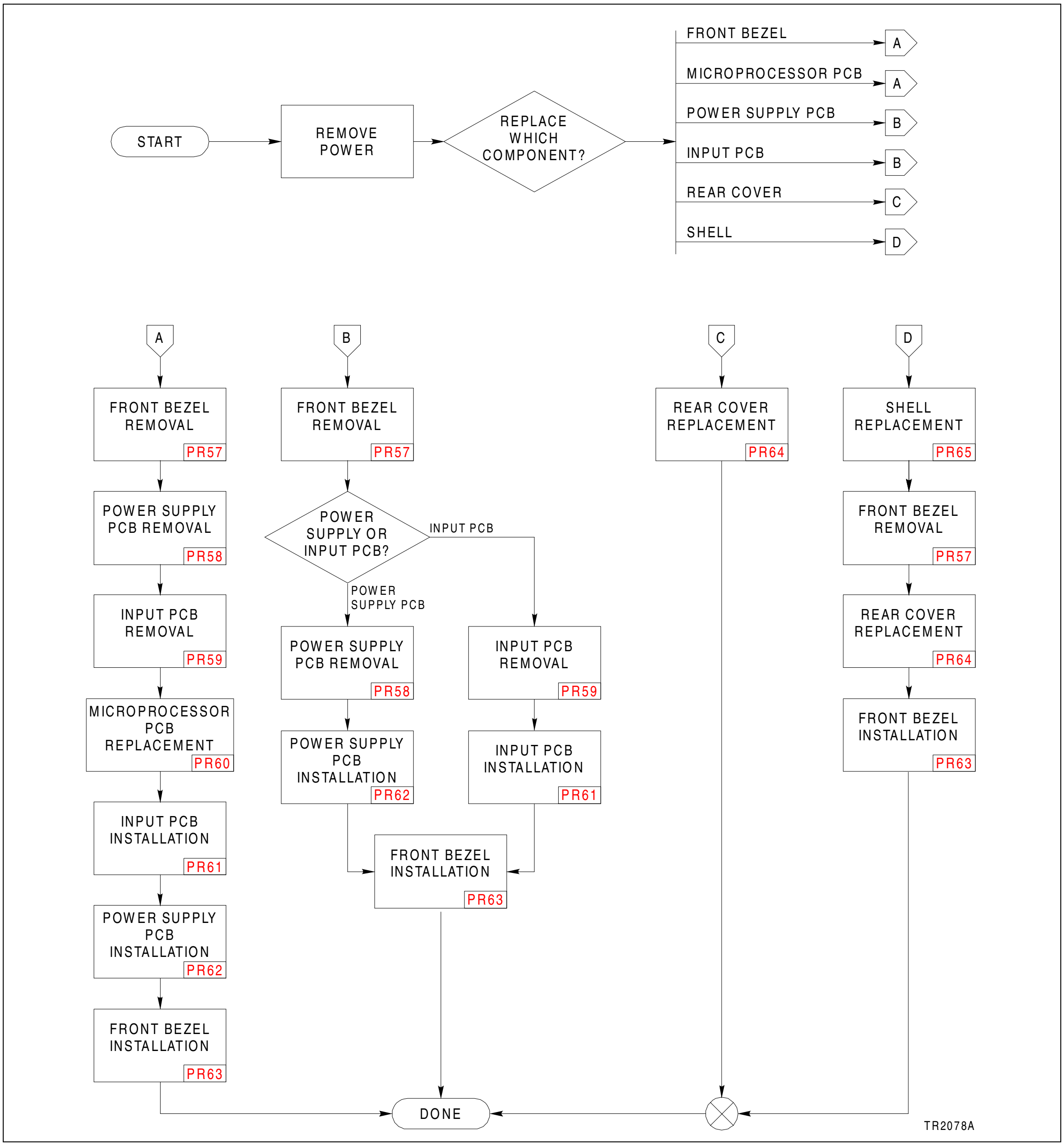


*Figure 14-1. Repair and Replacement Sequence*

# SECTION 15 - SUPPORT SERVICES

## INTRODUCTION

Figure 15-1 is an assembly drawing of the Type TB82 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 TB82 transmitter can be obtained by contacting:

ABB Inc.
9716 S. Virginia St., Ste. E
Reno, Nevada 89511 USA
Tel: +1 (775) 850-4800
FAX: +1 (775) 850-4808

## RETURN MATERIALS PROCEDURES

If any equipment should need to be returned for repair or evaluation, please contact ABB at (702) 883-4366, or your local ABB representative for a return materials authorization (RMA) 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 manual 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.

***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.

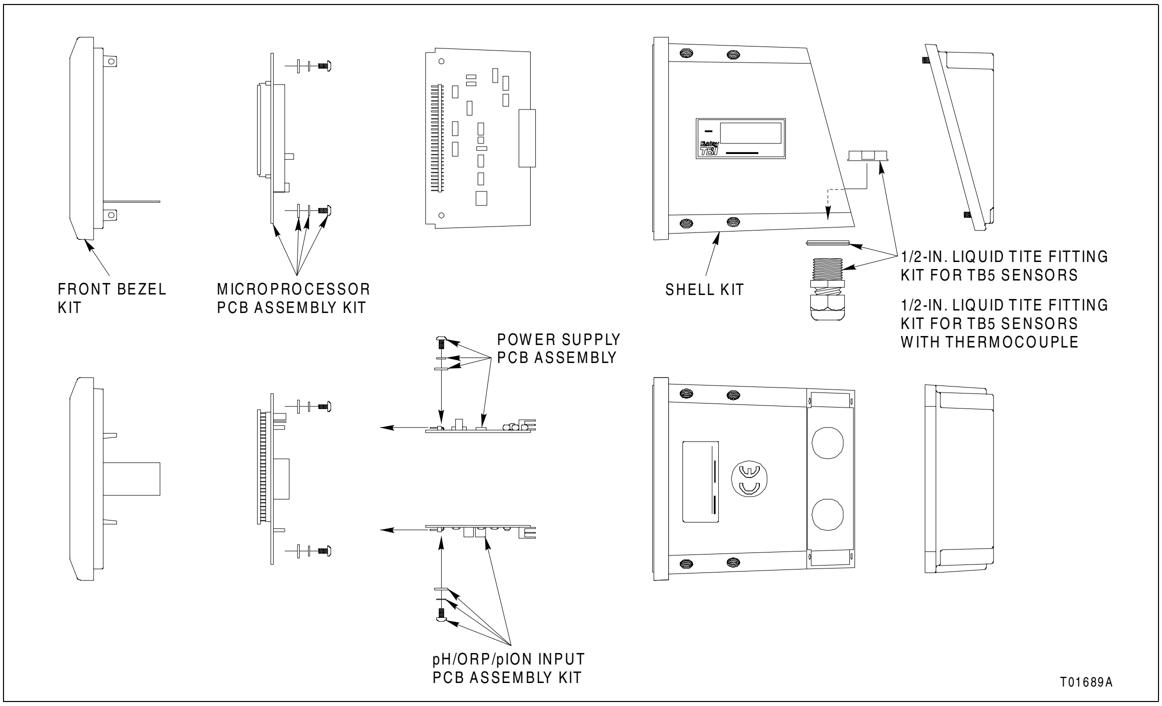


*Figure 15-1. Exploded View*

## RECOMMENDED SPARE PARTS KITS

Table 15-1 lists the recommended spare parts kits.

*Table 15-1. Spare Parts Kits*

| Part Number | Description |
|---|---|
| 4TB9515-0123 | Panel mount kit |
| 4TB9515-0124 | Pipe mount kit |
| 4TB9515-0125 | Hinge mount kit |
| 4TB9515-0153 | Input PCB assembly kit |
| 4TB9515-0154 | Microprocessor PCB assembly kit |
| 4TB9515-0155 | Power supply PCB assembly kit |
| 4TB9515-0156 | Wall mount kit |
| 4TB9515-0157 | Power supply PCB assembly kit for HART compatible transmitters |
| 4TB9515-0158 | Power supply PCB assembly with lightning arrestor kit |
| 4TB9515-0159 | Power supply PCB assembly with lighting arrestor kit for HART compatible transmitters |
| 4TB9515-0160 | Front bezel kit |
| 4TB9515-0161 | Shell kit |

*Table 15-1. Spare Parts Kits (Continued)*

| Part Number | Description |
|---|---|
| 4TB9515-0162 | Rear cover kit |
| 4TB9515-0163 | ½-in. liquid-tite cable grip fitting kit (TBX5 sensors only) |
| 4TB9515-0164 | BNC/TC to TB82PH pin adapter |
| 4TB9515-0165 | ½-in. liquid-tite cable grip fitting kit (TB5 sensors only) |
| 4TB9515-0166 | BNC to TB82PH pin adapter with ½-in. liquid-tite fitting for sensors with BNC (TB5) |

# APPENDIX A - TEMPERATURE COMPENSATION

## GENERAL

The Type TB82 Advantage Series Transmitter has three types of temperature compensation options: manual Nernstian, automatic Nernstian, and automatic Nernstian with solution coefficient.

The temperature effect on ORP sensors is negligible. The effect of temperature on pION sensors is difficult to characterize, except for specific applications. Therefore, only the solution coefficient option can be used to compensate for electrode and process changes with temperature.

## NERNSTIAN TEMPERATURE COMPENSATION

Manual and automatic Nernstian temperature compensation types adjust for the thermodynamic properties of electrochemical half cells. The Nernstian effect is characterized by the mathematical equation:

$$E = E_{reference} + (2.3 \times R \times T_K \times \mathrm{LOG}[a_i] / n \times F)$$

where:

| | |
|---|---|
| *E* | Overall sensor output. |
| *Ereference* | Reference half cell output (typically a constant). |
| *R* | Constant. |
| *TK* | Absolute temperature (Kelvin). |
| *n* | Ion charge. |
| *F* | Constant. |
| *[ai]* | Ion activity. |

The ion activity is nearly equal to the ion concentration for weak solutions containing that particular ion. The Nernst equation is used to adjust the output of an electrochemical sensor to a reference temperature that is typically 25-degrees Celsius.

Temperature effects of pH sensors are well behaved and are characterized by the Nernst equation. The Type TB82 transmitter applies Nernstian compensation to all three temperature compensation options when the transmitter is configured as a pH analyzer. If interested in the uncompensated value, set the transmitter to manual temperature compensation and calibrate the temperature to 25-degrees Celsius. This allows the monitoring of the uncompensated value.

Automatic Nernstian (*AUTO*) temperature compensation provides the most useful information and is recommended in most cases. Since ion dissociation is affected by temperature, the pH value can also be affected. If these processes behave in a repeatable manner, the dissociation can be characterized and a solution coefficient can be used to compensate for these effects.

## SOLUTION COEFFICIENT

The solution coefficient compensates the Nernstian value for pH measurements, and the raw voltage value for ORP or pION measurements, by a fixed value per each 10-degrees Celsius. The temperature compensation factor is derived from the following equations:

$$pH_{indication} = pH_{Nernstian} \pm COEF \times ((T - 25°\mathrm{C})/(10°\mathrm{C}))$$

$$mV_{indication} = mV \pm COEF \times ((T - 25°\mathrm{C})/(10°\mathrm{C}))$$

where:

| | |
|---|---|
| *COEF* | pH or mV change per ten-degrees Celsius. |
| *pHNernstian* | Nernstian pH value referenced at 25-degrees Celsius after applying the factory and process calibration values. |
| *pHindication* | pH value indicated on the transmitter and proportional to the current output value. |
| *mV* | millivolt value of the sensor output after applying the factory and process calibration values. |
| *mVindication* | mV value indicated on the transmitter and proportional to the current output value. |
| *T* | temperature of the solution in degrees Celsius after applying the factory and process calibration values. |

Examples

Solution coefficients for pure water applications are:

$$\text{pure water} = +0.18\ \text{pH}/(10°\text{C})$$

$$\text{pure water with 1 ppm ammonia} = +0.31\ \text{pH}/(10°\text{C})$$

The solution coefficient for the Type TB82 transmitter either adds or subtracts a configured amount of the process variable per 10-degrees Celsius to the Nernstian compensated process variable. Thus, an application having a process liquid that decreases in its pH value as the temperature increases should use a positive solution coefficient correction factor. Conversely, an application having a process liquid that increases in its pH value as the temperature increases should use a negative solution coefficient correction factor. The solution coefficient affects the uncompensated process variable for ORP and pION analyzer types in the same manner as the pH analyzer type.

# APPENDIX B - PROGRAMMING TEXT STRING GLOSSARY

## INTRODUCTION

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

**NOTE:** This instruction covers the standard Type TB82 transmitter. Refer to the ***Type STT Smart Transmitter Terminal Instruction*** for information on the HART version.

## TEXT PROMPTS

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

*Table B-1. Text Prompt Equivalents*

| Text Prompt | Equivalent |
|---|---|
| 1PT.CAL | One-point calibration |
| 20MA.PT | 20-mA point |
| 2PT.CAL | Two-point calibration |
| 3K.BLCO | 3-kΩ Balco (temperature compensation) |
| 4MA.PT | 4-mA point |
| REV.A10 | Software revision A10 |
| ADVNCD | Advanced (programming mode) |
| ANALZR | Analyzer state |
| ANTMNY | Antimony (pH sensor with Antimony measurement electrode) |
| ASY.POT | Asymmetric potential |
| AUT.SOL | Automatic temperature compensation (Nernstian) with solution coefficient |
| AUTO | Automatic temperature compensation (Nernstian) |
| BAD.CAL | Bad calibration - entered value caused calculated values to exceed maximum values |
| BAD.VAL | Bad value - entered value exceeded maximum allowable value for entered parameter |
| CALIBR | Calibrate mode |
| CONFIG | Configure mode |
| DAMPNG | Damping state |
| DIAGS | Diagnostic state |
| DISABL | Disable |
| END.MV | Ending mV point (for pION concentration configuration only) |
| END.MAG | Ending magnitude point (for pION concentration configuration only) |
| FAIL.HI | Fail high (20 mA) |
| FAIL.LO | Fail low (4 mA) |
| HI.VAL | High calibration (buffer or standard) value |
| ION.CAL | pION calibration |

*Table B-1. Text Prompt Equivalents (Continued)*

| Text Prompt | Equivalent |
|---|---|
| ION.CON | pION concentration |
| ISO.PT | Isopotential point |
| ---KRZ | Reference impedance in kΩ where --- is the impedance value |
| LO.VAL | Low calibration (buffer or standard) value |
| MAGS | Magnitudes - number of decades output range covers (for pION concentration configuration only) |
| MV/10C | mV per 10°C (solution coefficient value for automatic Nernstian with solution coefficient temperature compensation) |
| NEW.VAL | New calibration value - the process variable or temperature value expected during a one-point or temperature calibration |
| NON.LIN | Nonlinear output state |
| ORP.CAL | ORP calibration state |
| OUT.CAL | Output calibration state |
| PASSWD | Security password |
| PH.CAL | pH calibration state |
| PH.GLAS | pH glass (pH sensor with glass measurement electrode) |
| PT 100 | Pt 100 RTD |
| REF Z | Reference impedance |
| REL.HLD | Release hold |
| RERANG | Rerange state |
| 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 |
| SEC.DSP | Secondary display mode |
| SECS | Seconds |
| SECUR | Security mode |
| SPK.MAG | Spike output magnitude |
| SPK.OFF | Spike output function set to off (disabled) |
| STABL? | Is the displayed process variable stable? |
| TC.TYPE | Temperature compensation type state |
| TMP.CAL | Temperature calibration state |
| TMP.SNS | Temperature sensor type state |
| TMP°C | Temperature in degrees Celsius |
| VALENC | Ion valence state (for pION concentration configuration only) |
| X-1 | Nonlinear X input point value for break point 1 in percentage input |
| Y-1 | Nonlinear Y output point value for break point 1 in percentage output |

## *FLOW TREE*

Figure B-1 is a function flow tree for the Type TB82 transmitter.

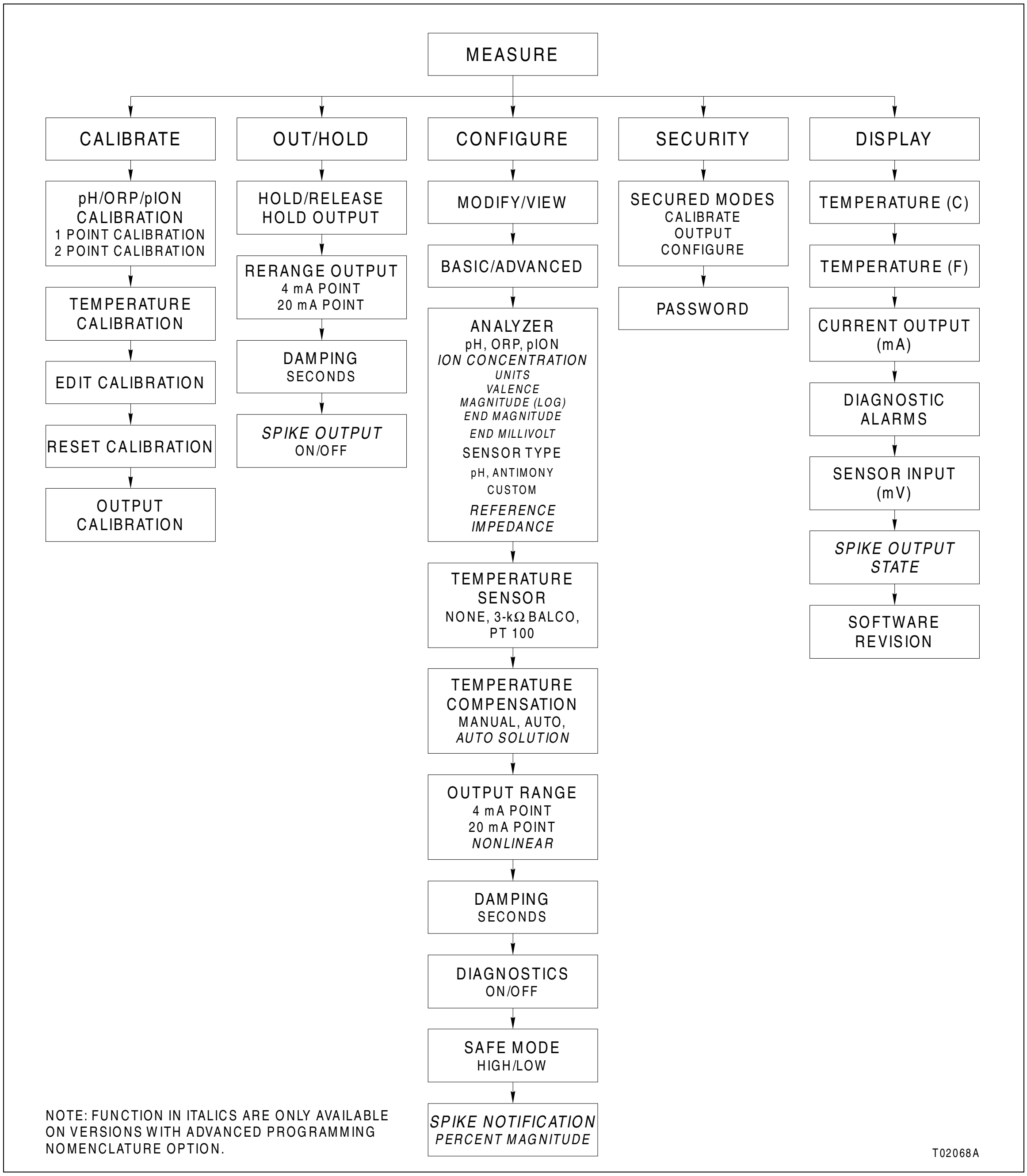


*Figure B-1. Function Flow Tree*

# Type TB82 Advantage Series pH/ORP/pION Transmitter

TAG _______________ DATE _______________

PROGRAMMING MODE ☐ Basic ☐ Advanced

ANALYZER TYPE ______________________

| ☐ pH | ☐ ORP | ☐ pION | ☐ Ion Concentration |
|---|---|---|---|
| ☐ Glass | Ref Z _______kΩ | Ref Z _______kΩ | Unit _______ |
| ☐ Antimony | | | Valence _______ |
| ☐ Custom | | | Mags _______ |
| Iso Pt _______pH | | | End Mag _______ |
| Asy Pot _______mV | | | End mV _______mV |
| Ref Z _______kΩ | | | Ref Z _______kΩ |

TEMPERATURE SENSOR ☐ None ☐ 3 kΩ Balco ☐ Pt 100

TEMPERATURE COMPENSATION TYPE ☐ Manual ☐ Auto ☐ Auto Solution Coefficient _______

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

FACTORY DEFAULT SETTINGS

| Software | | Hardware |
|---|---|---|
| Instrument mode | Basic | Microprocessor and Display PCB Jumper W1[2] |
| Analyzer type | pH, Glass | Position 1-2 disables configuration lockout (default) |
| Temperature sensor type | 3-kΩ Balco | Position 2-3 enables configuration lockout |
| Temperature comp. type | Manual | |
| Output range | 0 to 14 pH | |
| Damping value | 0.5 sec | |
| Sensor diagnostics state | Disable | |
| Safe mode fail output state | Low | |
| Spike output[1] | 0% | |

**NOTES:**

1. Feature only available in Advanced programming.
2. Refer to PR44 for procedure to change jumper position.

# PROCEDURE INDEX

## INTRODUCTION

This index is provided as a quick reference for those with a thorough knowledge of the Type TB82 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.


| Title | Procedure |
|---|---|
| Analyzer type selection | PR25 |
| Asymmetric potential value setting | PR28 |
| Break points setting | PR43 |
| Configuration lockout | PR44 |
| Configuration reset | PR48 |
| Configure mode damping adjustment | PR39 |
| Diagnostics selection | PR40 |
| Edit calibration | PR14 |
| Electronic sensor test | PR55 |
| Ending magnitude setting | PR32 |
| Ending millivolt setting | PR33 |
| Engineering units selection | PR29 |
| Entering password | PR9 |
| Error codes | PR53 |
| Front bezel installation | PR63 |
| Front bezel removal | PR57 |
| Grounding | PR8 |
| Hinge mounting | PR4 |
| Hold output | PR17 |
| Input PCB installation | PR61 |
| Input PCB removal | PR59 |
| Isopotential pH value setting | PR27 |
| Keypad cleaning | PR66 |
| Magnitudes setting | PR31 |
| Microprocessor PCB replacement | PR60 |
| Modifying configuration while viewing | PR23 |
| One-point process sensor calibration | PR11 |
| Output calibration | PR13 |
| Output range setting | PR38 |
| Output spike toggle | PR20 |

| Title | Procedure |
|---|---|
| Output/hold mode damping adjustment | PR16 |
| Panel mounting | PR2 |
| pH analyzer type selection | PR26 |
| Pipe mounting | PR1 |
| Power supply PCB installation | PR62 |
| Power supply PCB removal | PR58 |
| Problem codes | PR52 |
| Programming mode change | PR24 |
| Rear cover replacement | PR64 |
| Reference impedance setting | PR34 |
| Release hold output | PR18 |
| Rerange output | PR19 |
| Reset calibration | PR15 |
| Resetting all parameters | PR50 |
| Safe mode selection | PR41 |
| Secondary display operation | PR46 |
| Security and password assignment | PR45 |
| Security reset | PR49 |
| Selecting view or modify configuration state | PR21 |
| Sensor cleaning | PR56 |
| Sensor inspection | PR54 |
| Shell replacement | PR65 |
| Signal and power wiring | PR5 |
| Solution coefficient setting | PR37 |
| Spike magnitude setting | PR42 |
| Temperature calibration | PR10 |
| Temperature compensation type selection | PR36 |
| Temperature sensor type selection | PR35 |
| Transmitter soft boot | PR51 |
| Two-point process sensor calibration | PR12 |
| Type TB5 sensor wiring | PR6 |
| Type TBX5 sensor wiring | PR7 |
| Utility mode Advanced/Basic programming | PR47 |
| Valence setting | PR30 |
| Viewing configuration | PR22 |
| Wall mounting | PR3 |

# 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 | 2 | 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.

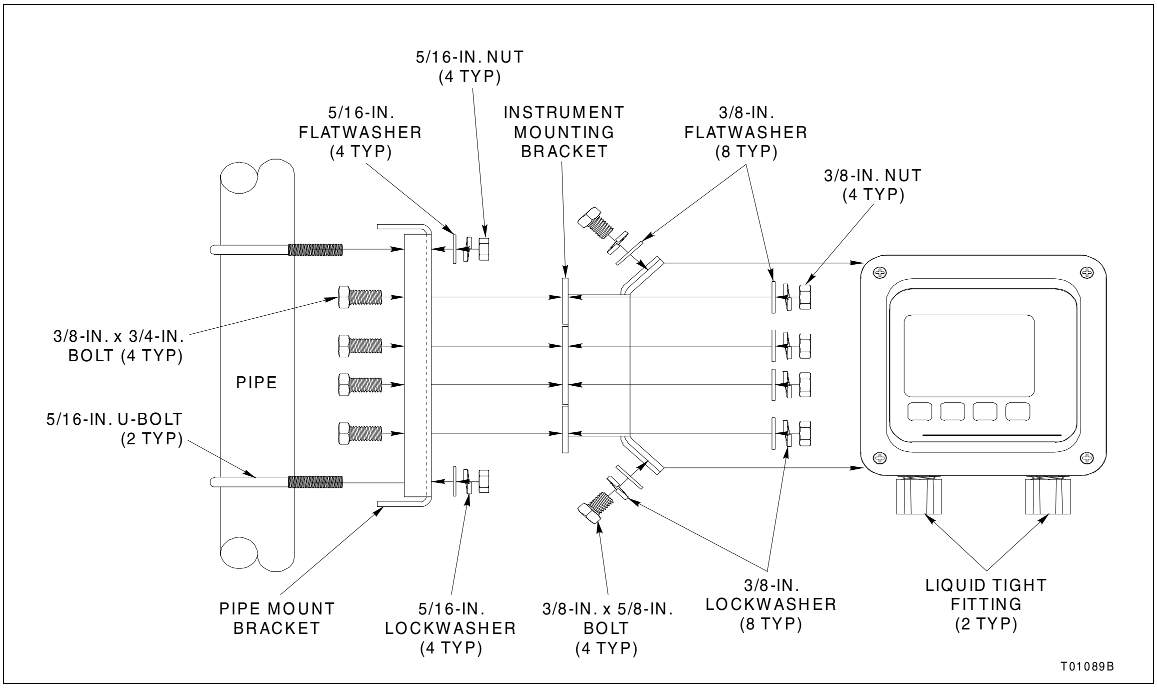


*Figure PR1-1. Pipe Mounting*

☐ 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, 3/8-16 x ½-in. |
| 4TB4704-0118 | 4 | Screw, panel mount |
| 4TB4710-0022 | 4 | Lockwasher, split, 3/8-in. |
| 4TB4904-0131 | 4 | Bumper, rubber |
| 4TB4906-0019 | 1 | Gasket, panel mount |
| 4TB5205-0292 | 4 | Bracket, panel mount |

**Tools**

- Tools for making panel cutout (dependent on installation).
- Bladed screwdriver.

## PROCEDURE

The panel mounting kit contains four panel mount bracket assemblies and a panel mount gasket. The transmitter enclosure conforms to DIN sizing and requires a 138-millimeter by 138-millimeter (5.43-inch by 5.43-inch) cutout. The panel brackets accommodate a panel thickness as large as 9.53 millimeters (0.375 inches).

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

☐ 2. Use suitable tools (dependent on installation) to make a 138-millimeter by 138-millimeter (5.43-inch by 5.43-inch) 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. Attach the panel mount brackets to all four corners of the transmitter.

☐ 6. Use the bladed screwdriver to tighten the adjustment screws on the panel mount bracket until the transmitter sits tightly against the panel.

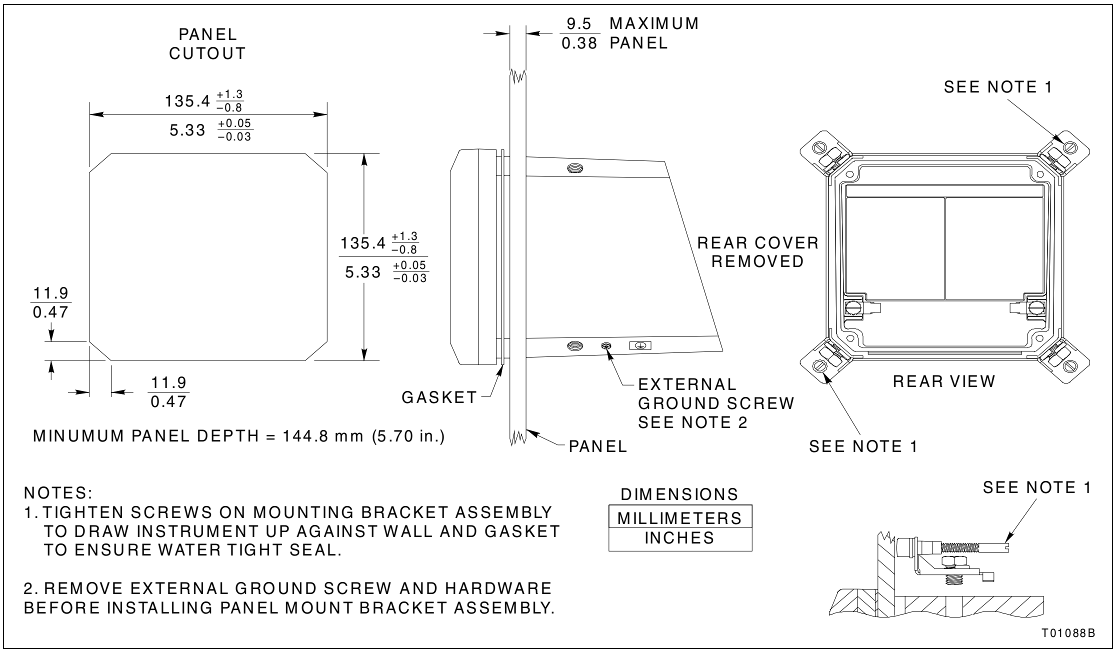


*Figure PR2-1. Panel Mounting*

# 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.

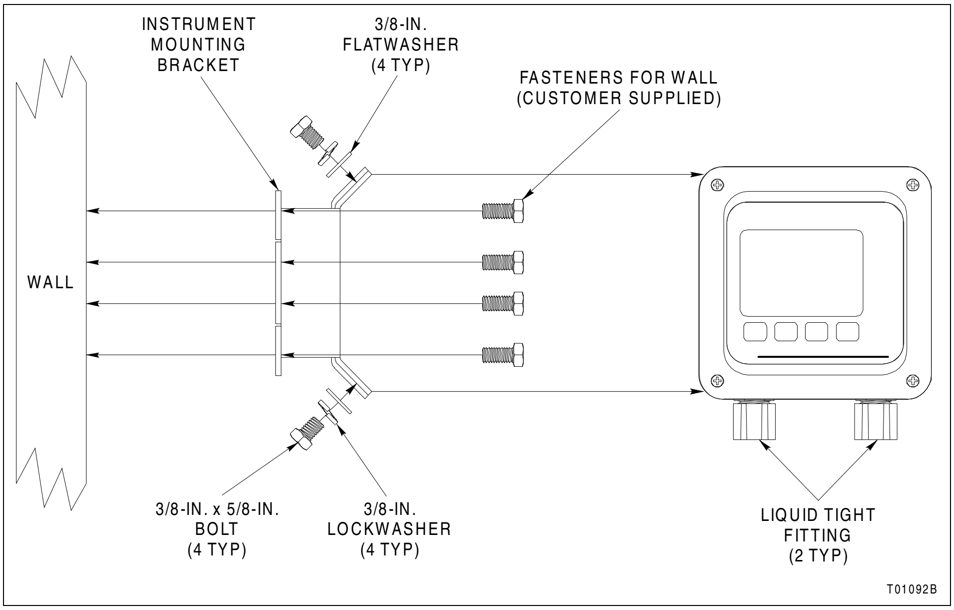


*Figure PR3-1. Wall Mounting*

# 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.

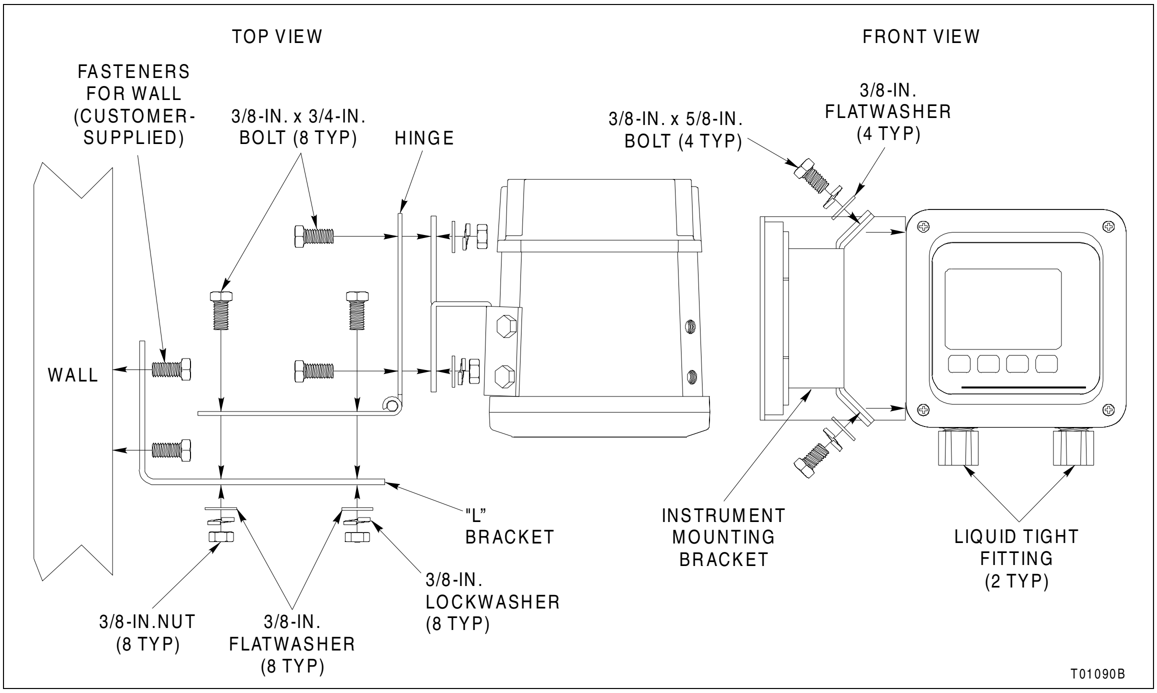


*Figure PR4-1. Hinge Mounting*

☐ 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 AND POWER WIRING

## PURPOSE/SCOPE

10 min.

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

**Parts** None.

**Tools**
- Bladed screwdriver.
- Small bladed screwdriver.

## PROCEDURE

ABB recommends the use of shielded wire and separate conduit for the signal and 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) and other applicable local or international codes.

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 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 ensure 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 via a standard 24-VDC system power supply. 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.

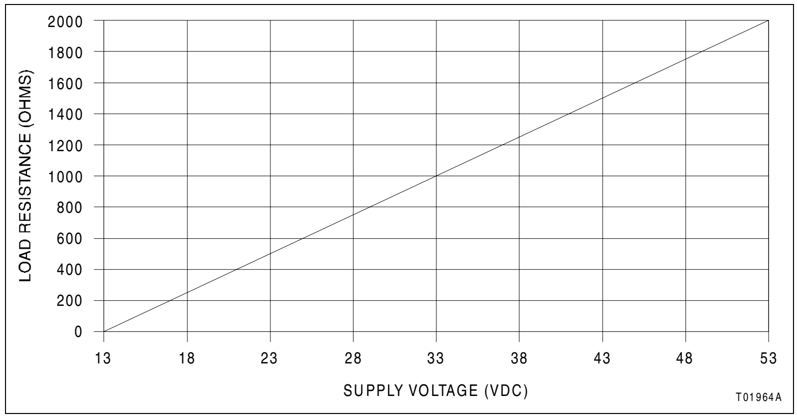


*Figure PR5-1. Load Limits*

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

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

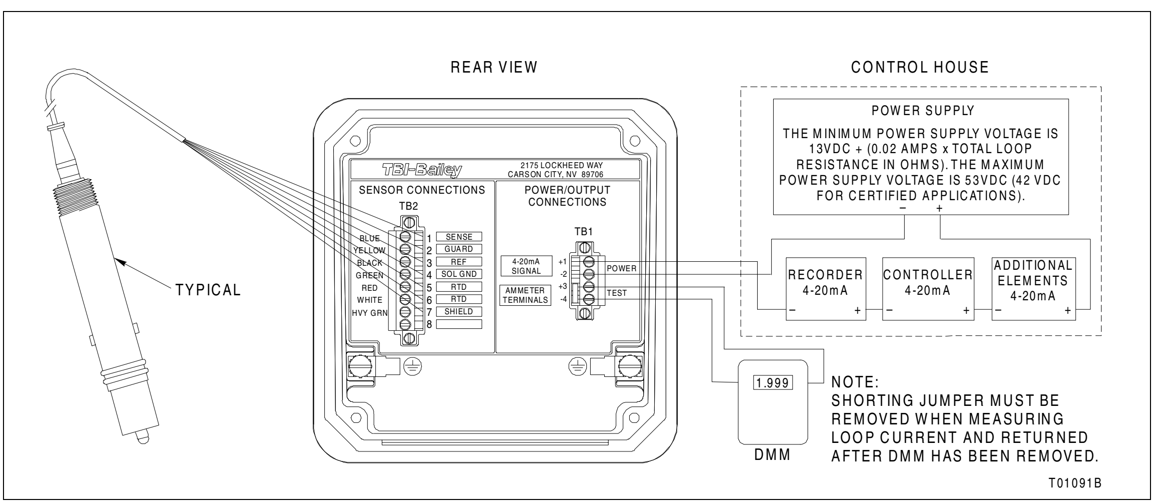


*Figure PR5-2. Signal and Power Wiring*

☐ 3. Install the rear cover and tighten the captive screws with the bladed screwdriver.

# PROCEDURE PR6 - TYPE TB5 SENSOR WIRING

## PURPOSE/SCOPE

10 min.

This procedure describes how to connect a standard ABB (Type TB5) sensor to the transmitter.

**Parts**

| Number | Qty | Description |
|---|---|---|
| 4TB9515-0164 | 1[1] | BNC adapter |
| 4TB9515-0166 | | BNC adapter with fitting |

**NOTE:**
1. Not required if using pin terminal sensor cable option.

**Tools**

- Bladed screwdriver.
- Small bladed screwdriver.

## PROCEDURE

There are two ways to connect standard ABB sensors. A pin terminal sensor cable option is available. Though this cable option is recommended when using a standard sensor, stocking preferences may tend towards the use of one common sensor. If this sensor type requires a BNC adapter to mate with existing instrumentation, a BNC adapter can be used in conjunction with the transmitter.

### *Pin Terminal*

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

☐ 2. Use the small bladed screwdriver to connect the sensor wiring as shown in Table PR6-1 and Figure PR6-1.

*Table PR6-1. Pin Terminal Sensor Connections*

| Terminal | Color Code | Function |
|---|---|---|
| TB2-1 | Blue | Sense |
| TB2-2 | No connection | Guard |
| TB2-3 | Black | Reference |
| TB2-4 | No connection | Solution ground |
| TB2-5 | Red[1] | RTD |
| TB2-6 | White[1] | RTD |
| TB2-7 | No connection | Shield |
| TB2-8 | No connection | No connection |

**NOTE:**
1. Red and white conductors are only present when using a temperature compensator.

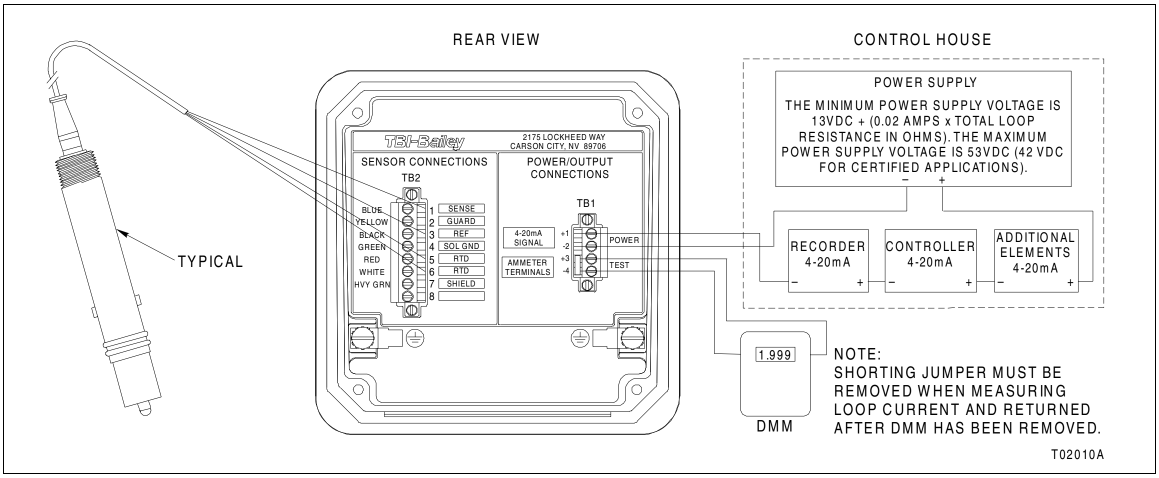


*Figure PR6-1. Pin Terminal Sensor Connections*

☐ 3. Install the rear cover and tighten the captive screws with the bladed screwdriver.

## BNC Adapter

pH/ORP/pION sensor cables generally contain a low-noise conductive layer within the coaxial cable. Complete removal of this layer is extremely important to ensure correct sensor operation. Additionally, most conductors within the sensor cable are small and are not intended for direct connection to the transmitter terminal block. ABB recommends using the BNC adapter as opposed to stripping back each of the individual conductors.

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

☐ 2. Use the bladed screwdriver to remove the earth ground screw and associated hardware located below TB2 (Fig. PR6-2).

☐ 3. Slide the earth ground screw (and associated hardware if desired) through the screw hole on the BNC adapter so that the leads of the adapter and female BNC connector are pointing upwards.

☐ 4. Mount the BNC adapter to the earth ground hole and tighten the screw with the bladed screwdriver.

☐ 5. Connect the BNC adapter pin terminals to TB2 as shown in Figure PR6-2 and Table PR6-2.

> **NOTE:** If the sensor does not have a female connector for the temperature compensator, connect the leads from the sensor directly to TB2-5 (red) and TB2-6 (white). If the sensor does not have a temperature compensator, leave TB2-5 and TB2-6 open.

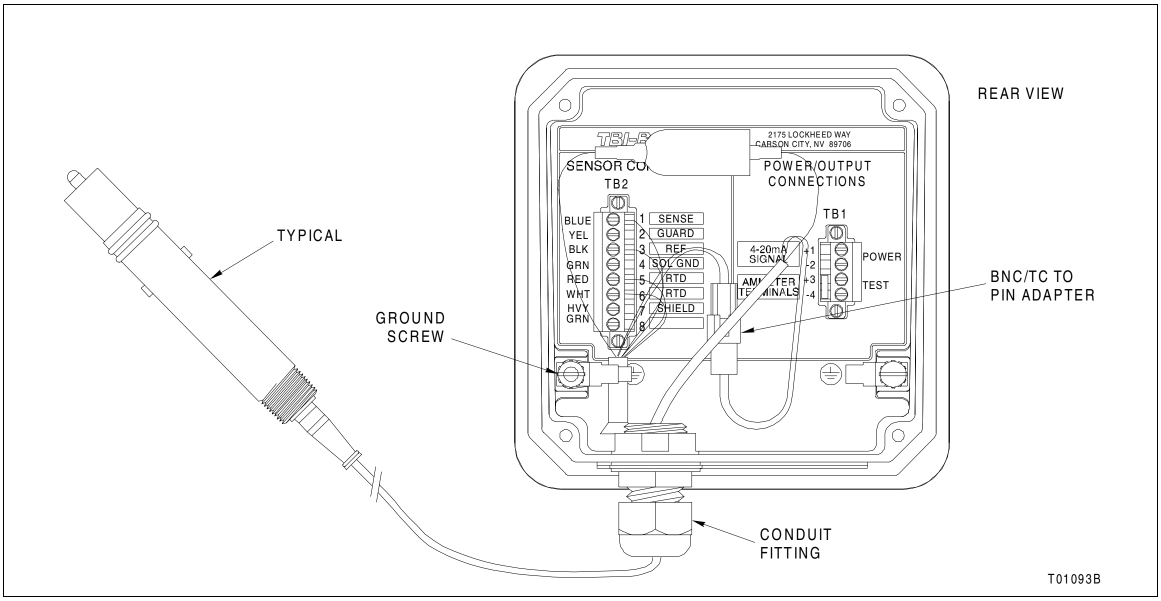


*Figure PR6-2. BNC Adapter Sensor Connections*

*Table PR6-2. BNC Adapter Sensor Connections*

| Terminal | Color Code | Function |
|---|---|---|
| TB2-1 | Blue | Sense |
| TB2-2 | No connection | Guard |
| TB2-3 | Black | Reference |
| TB2-4 | No connection | Solution ground |
| TB2-5 | Red[1] | RTD |
| TB2-6 | White[1] | RTD |
| TB2-7 | No connection | Shield |
| TB2-8 | No connection | No connection |

**NOTE:**

1. Red and white conductors are only present when using a temperature compensator.

☐ 6. Connect the male BNC connector from the sensor to the female BNC connector from the BNC adapter.

☐ 7. Connect the female temperature compensator connector from the sensor to the male temperature compensator connector from the BNC adapter.

☐ 8. Slide the protective boot over the BNC connection.

☐ 9. Install the rear cover and tighten the captive screws with the bladed screwdriver.

# PROCEDURE PR7 - TYPE TBX5 SENSOR WIRING

## PURPOSE/SCOPE

10 min.

This procedure describes how to connect the Advantage Series (Type TBX5) sensor to the transmitter.

**Parts** None.

**Tools**
- Bladed screwdriver.
- Small bladed screwdriver.

## SAFETY CONSIDERATIONS

| | |
|---|---|
| **CAUTION** | **1. Do not allow the blue (sense) and black (reference) leads to short together. Shorting these conductors together will permanently damage the sensor.** |

## PROCEDURE

The sensor wiring connects to TB2 at the rear of the transmitter. ABB recommends running sensor wiring in shielded conduit (or similar) to protect it from the environment. Do not allow the sensor wires to become wet, lay on the ground or over any other equipment. Ensure the cables are not abraded, pinched or bent at installation.

The sensor cable has seven leads with pin terminals that connect to TB2 at the rear of the transmitter. The terminal block accepts wire sizes from 12 to 24 AWG.

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

☐ C1 2. Remove the protective insulator from the blue (sense) and black (reference) leads. The insulators are provided to prevent shorting of the sensor half-cell.

☐ 3. Use the small bladed screwdriver to connect the sensor wiring as shown in Table PR7-1 and Figure PR7-1.

*Table PR7-1. Sensor Connections*

| Terminal | Color Code | Function |
|---|---|---|
| TB2-1 | Blue | Sense |
| TB2-2 | Yellow | Guard |
| TB2-3 | Black | Reference |
| TB2-4 | Green | Solution ground |

*Table PR7-1. Sensor Connections (Continued)*

| Terminal | Color Code | Function |
|---|---|---|
| TB2-5 | Red | RTD |
| TB2-6 | White | RTD |
| TB2-7 | Heavy green | Shield |
| TB2-8 | No connection | No connection |

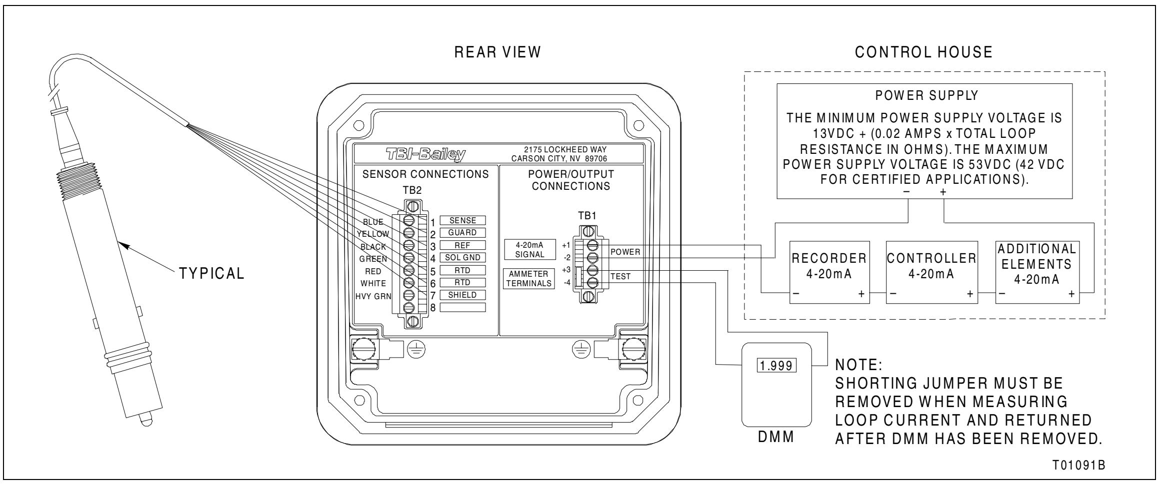


*Figure PR7-1. Sensor Connections*

☐ 4. Install the rear cover and tighten the captive screws with the bladed screwdriver.

## PURPOSE/SCOPE

10 min.

This procedure describes how to properly ground the transmitter.

**Parts** None.

**Tools**

- Bladed screwdriver.

## PROCEDURE

Signal wiring should be grounded at any one point in the signal loop. It may be left ungrounded (floating) if electrical noise is minimal. The transmitter enclosure must be grounded 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 PR8-1.

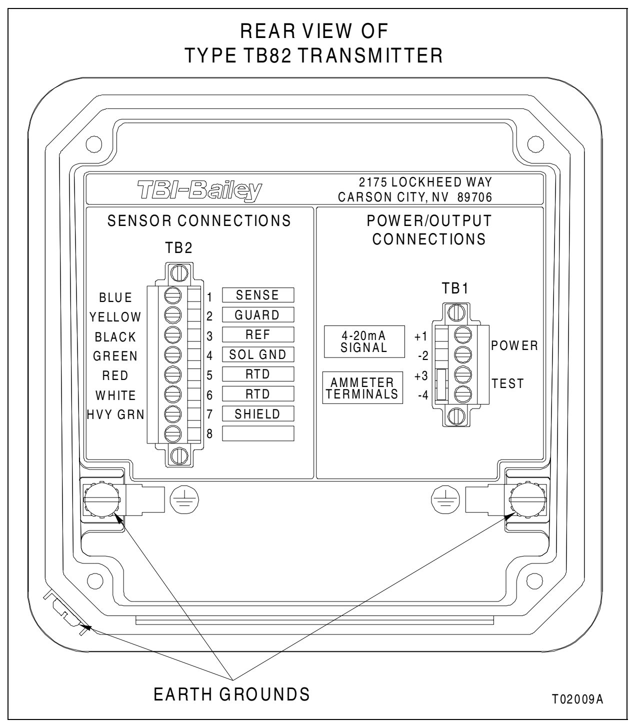


*Figure PR8-1. Earth Grounds*

# PROCEDURE PR9 - ENTERING PASSWORD

## *PURPOSE/SCOPE*

1 min.

This procedure describes how to enter the password.

**Parts** None.

**Tools** None.

## *PROCEDURE*

☐ 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.

# PROCEDURE PR10 - TEMPERATURE CALIBRATION

## PURPOSE/SCOPE

20 min.

This procedure describes how to perform a temperature calibration.

**Parts** None.

**Tools**
- Temperature measuring device.

## PROCEDURE

The temperature calibrate state is a smart calibration routine that allows for both one and two-point calibrations. Calibrating the temperature at two points that are at least 20-degrees Celsius apart causes the transmitter to automatically adjust the offset and slope of the temperature sensor. Since this routine only uses the most recent calibration data, calibration can be conducted throughout the life of the sensor. This ensures that the temperature sensor measures accurately. The reset calibration state restores the calibration to factory settings in the event of bad calibration data. The reset calibrate state is discussed in PR15.

> **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. Allow the sensor to reach ambient temperature before installing it into its final location.

☐ 2. Press the *NEXT* 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 process sensor calibration state. Perform Steps 7 through 9. If *YES* is selected, go to Step 10.

☐ 7. Wait until process liquid composition 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 PR53 for information on error codes.

☐ 10. The transmitter asks for the *NEW VAL*. Enter the ambient temperature as measured by the temperature measuring device.

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. Mount the sensor in its final installed location.

☐ 12. Use the temperature measuring device to measure the temperature of the process fluid.

☐ 13. Repeat steps 4 through 10; however, use the process fluid temperature as the *NEW VAL*.

# PROCEDURE PR11 - ONE-POINT PROCESS SENSOR CALIBRATION

## PURPOSE/SCOPE

10 min.

This procedure describes how to perform a one-point process sensor calibration.

**Parts** None.

**Tools**

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

## PROCEDURE

The process sensor calibrate state contains two calibration procedures: one-point calibration and two-point calibration. This procedure covers the one-point calibration.

As with the calibrate states, use the *NEXT* smart key to toggle from one procedure to the next then select the desired procedure using the *SELECT* smart key. Use the *exit to MEASURE* smart key to escape to the measure mode.

The one-point calibrate state conducts an offset adjustment on the sensor input. Use this calibration procedure when the sensor is in the final installed location. Due to variations in ionic strength between the sensor reference and process liquid, improved accuracy can be realized by conducting a one-point calibration with the sensor in its final location. The transmitter is typically verified against an external validation device using a grab sample.

☐ 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 *NEXT* 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 *1PT.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 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 PR53 for information on 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 process sensor calibrate state or press the *exit to MEASURE* smart key to go to the measure mode.

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

More information on sensor calibration techniques and troubleshooting is contained in ***Calibration and Troubleshooting of pH Loops*** (Table 1-1).

# PROCEDURE PR12 - TWO-POINT PROCESS SENSOR CALIBRATION

## *PURPOSE/SCOPE*

20 min.

This procedure describes how to perform a two-point process sensor calibration.

**Parts** None.

**Tools**

- Temperature measuring device.
- Low and high buffers for pH sensors or low and high standards for pION sensors.

## *PROCEDURE*

The process sensor calibrate state contains two calibration procedures: One-point calibration and two-point calibration. This procedure covers the two-point calibration.

As with the calibrate states, use the *NEXT* smart key to toggle from one procedure to the next then select the desired procedure using the *SELECT* smart key. Use the *exit to MEASURE* smart key to escape to the measure mode.

The two-point calibrate state conducts an offset and slope adjustment on a sensor to determine its response characteristics before installation into its final location. This calibration procedure uses buffers for pH sensors or standards for pION sensors.

☐ 1. Prepare the buffer solutions or standards.

☐ 2. Remove the sensor from the process piping if required.

☐ 3. Press the *NEXT* smart key until *CALIBRATE* is highlighted on the display.

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

☐ 5. Press the *NEXT* smart key until *2PT.CAL* appears on the display.

☐ 6. Press the *SELECT* smart key to start the two-point calibration procedure.

☐ 7. The transmitter displays the current temperature in degrees Celsius and *TMP°C*. Use the temperature measuring device to measure the temperature of the buffer or standard and enter that number into the transmitter.

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.

☐ 8. The transmitter asks for the *LO VAL*. Enter the value of the low buffer or standard.

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.

☐ 9. Place the sensor in the low buffer or standard solution.

☐ 10. Stir the solution with the sensor in a slow, circular motion.

☐ 11. 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 12 through 14. If *YES* is selected, go to Step 15.

☐ 12. Wait until process liquid composition stabilizes.

☐ 13. 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.

☐ 14. Refer to PR53 for information on error codes.

☐ 15. The transmitter asks for the *HI VAL*. Enter the value of the high buffer or standard.

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 15a and 15b for each digit.

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

☐ 16. Remove the sensor from the low buffer or standard solution.

☐ 17. Rinse the sensor.

☐ 18. Place the sensor in the high buffer or standard solution.

☐ 19. Stir the solution with the sensor in a slow, circular motion.

☐ 20. 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 21 through 23. If *YES* is selected, go to Step 24.

☐ 21. Wait until process liquid composition stabilizes.

☐ 22. 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.

☐ 23. Refer to PR53 for information on error codes.

☐ 24. 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.

☐ 25. Press the *NEXT* smart key to return to the process sensor calibrate state or press the *exit to MEASURE* smart key to go to the measure mode.

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

More information on sensor calibration techniques and troubleshooting is contained in ***Calibration and Troubleshooting of pH Loops***.

# PROCEDURE PR13 - 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).
- Bladed screwdriver.
- Small bladed 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 bladed screwdriver to loosen the four captive screws that secure the rear cover to the transmitter.

☐ 2. Use the small bladed screwdriver to remove the shorting jumper from the test terminals, TB1-3 (+) and TB1-4 (-), as shown in Figure PR13-1.

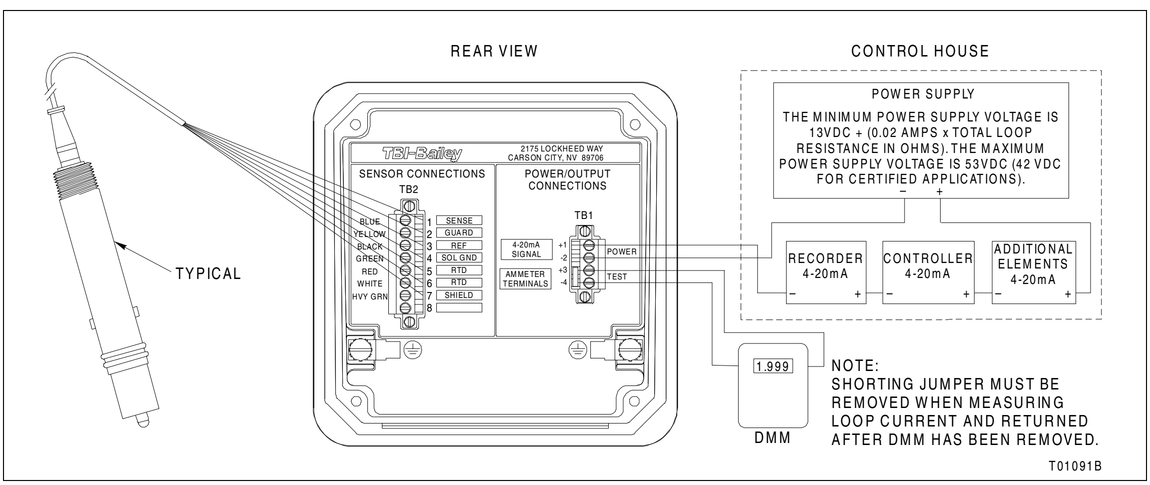


*Figure PR13-1. Output Calibration Setup*

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

☐ 4. Press the *NEXT* 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 calibrate 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 PR14 - EDIT CALIBRATION

## *PURPOSE/SCOPE*

5 min.

This procedure describes how to edit the process sensor offset and slope (efficiency) values, and the temperature sensor offset and slope values.

**Parts** None.

**Tools** None.

## *PROCEDURE*

The edit calibrate state allows manual adjustment of the sensor and temperature 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 *NEXT* 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 sensor slope. Valid slope values range from 40% to 150%.

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 go on to edit the sensor offset. To continue, go on to Step 6. To end the procedure, press the *exit to MEASURE* smart key.

☐ 6. The transmitter displays the sensor offset. Valid offset values range from -1,000 to +1,000 mV.

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 go on to edit the temperature slope. To continue, go on to Step 7. To end the procedure, press the *exit to MEASURE* smart key.

☐ 7. The transmitter displays the temperature 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 go on to edit the temperature offset. To continue, go on to Step 8. To end the procedure, press the *exit to MEASURE* smart key.

☐ 8. The transmitter displays the temperature offset. Valid offset values range from -40° 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 calibrate state. To end the procedure, press the *exit to MEASURE* smart key.

# PROCEDURE PR15 - 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 calibrate 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 sensor slope to 100 percent, the sensor offset to zero millivolts, the temperature slope to 1.000, and the temperature offset to zero-degrees Celsius.

☐ 1. Press the *NEXT* 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 PR16 - OUTPUT/HOLD MODE DAMPING ADJUSTMENT

## *PURPOSE/SCOPE*

1 min.

This procedure describes how to change the damping on the transmitter output.

**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.

☐ 1. Press the *NEXT* 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. Press the *exit to MEASURE* smart key to escape to the measure mode.

# PROCEDURE PR17 - 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 milliamperes).

☐ 1. Press the *NEXT* 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 go to Step10. 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. Press the *exit to MEASURE* smart key to escape to the measure mode.

# PROCEDURE PR18 - 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 *NEXT* 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. Press the *exit to MEASURE* smart key to escape to the measure mode.

# PROCEDURE PR19 - 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 end point values to any value or range of values that are within those listed in Table PR19-1.

*Table PR19-1. Output Ranges*[1]

| Input Type | Output Range |
|---|---|
| pH | -2 to +16.00 pH |
| ORP | -1,999 to +1,999 mV |
| Temperature | -20° to +300°C (-4° to +572°F) |

**NOTE:**

1. The rerange state does not apply if the transmitter is configured for pION inputs.

If the transmitter is configured for a nonlinear output, reranging the end point values affects the nonlinear relationship. Since this relationship is set as a percentage input against a percentage output, changing the end point values should accompany a review of the break points for the nonlinear relationship.

☐ 1. Press the *NEXT* 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 by pressing the ▲ smart key to increment the blinking digit to the desired value.

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

☐ 7. Repeat Steps 5 and 6 for each digit.

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

☐ 9. 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 PR19-1, 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.

☐ 10. Edit the process variable value for the 20-mA point by pressing the ▲ smart key to increment the blinking digit to the desired value.

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

☐ 12. Repeat Steps 10 and 11 for each digit.

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

☐ 14. Press the *exit to MEASURE* smart key to escape to the measure mode.

# PROCEDURE PR20 - 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 *NEXT* 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. Press the *exit to MEASURE* smart key to return to the measure mode.

**NOTE:** If the spike state in the output/hold mode has not been used, setting or changing the spike output level to zero in the configure mode automatically turns off the spike output. Setting or changing the spike output level to a nonzero value in the configure mode automatically turns on the spike output. However, changing the spike state in the output/hold mode from off to on, or vice versa, overrides the configured value. The spike state in the output/hold mode must be used to turn the spike output on or off before the configuration change can take effect.

# PROCEDURE PR21 - 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 *NEXT* 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 on 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.

# PROCEDURE PR22 - VIEWING CONFIGURATION

## *PURPOSE/SCOPE*

1 min.

This procedure describes how to view the configuration.

**Parts** None.

**Tools** None.

## *PROCEDURE*

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

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

# PROCEDURE PR23 - 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* key to abort the change. In either case, the transmitter goes to the measure mode.

# PROCEDURE PR24 - 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 a 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 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. The *BASIC* screen appears. Press the *ENTER* smart key to set the programming to Basic and advance to the modify configure states. 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 PR25 - 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 type of process variable being measured. It must coincide with the type of sensor being used. Table PR25-1 describes the function and programming mode of each state.

*Table PR25-1. Analyzer States*

| State | Display | Programming Mode | Function |
|---|---|---|---|
| pH | *PH* | Basic and Advanced | Used to measure pH of a solution. Process variable engineering units are pH. |
| ORP | *ORP* | | Used to measure oxidation reduction potential (ORP) of a solution. Process variable engineering units are mV. |
| pION | *PION* | | Used to measure specific ion of a solution. Sensor must use measurement electrode specific to ion of interest. Process variable engineering units are mV. |
| pION concentration | *ION.CON* | Advanced | Used to measure specific ion of a solution. Sensor must use measurement electrode specific to ion of interest. Process variable engineering units are set by user. Output is directly proportional to those units and is set by number of concentration decades. |

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

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

☐ 3. 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 PR26 - pH ANALYZER TYPE SELECTION

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the pH analyzer state. This setting is available in both the Basic and Advanced programming modes.

**Parts** None.

**Tools** None.

## PROCEDURE

The pH analyzer state coincides with the type of pH sensor being used. Table PR26-1 describes the function and programming mode of each state.

*Table PR26-1. pH Analyzer States*

| State | Display | Programming Mode | Function |
|---|---|---|---|
| pH glass | *PH.GLAS* | Basic and Advanced | Used when associated sensor uses standard glass measuring electrode. |
| Antimony | *ANTMNY* | | Used when associated sensor uses Antimony measuring electrode. |
| Custom | *CUSTOM* | Advanced | Used when associated sensor uses measuring electrode having unique isopotential point and asymmetric potential. |

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

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

☐ 3. 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 PR27 - ISOPOTENTIAL pH VALUE SETTING

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the isopotential pH value state. This setting is available in the Advanced programming mode and applies to the Custom pH analyzer state.

**Parts** None.

**Tools** None.

## PROCEDURE

The isopotential point is the potential of the sensor that is not affected by sample fluid temperature changes.

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

☐ 2. The transmitter displays the current 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 *NEXT* key to go on to the next configuration parameter.

# PROCEDURE PR28 - ASYMMETRIC POTENTIAL VALUE SETTING

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the asymmetric potential value state. This setting is available in the Advanced programming mode and applies to the Custom pH analyzer state.

**Parts** None.

**Tools** None.

## PROCEDURE

The asymmetric potential value is the electrical potential across the measuring and reference half-cell of the sensor at the isopotential point.

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

☐ 2. The transmitter displays the current 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 *NEXT* key to go on to the next configuration parameter.

# PROCEDURE PR29 - ENGINEERING UNITS SELECTION

## *PURPOSE/SCOPE*

1 min.

This procedure describes how to configure the engineering units state. This setting is available in the Advanced programming mode and applies to the ion concentration state.

**Parts** None.

**Tools** None.

## *PROCEDURE*

The ion concentration state allows for conversion of pION sensor inputs to concentration units such as parts per million (ppm) and parts per billion (ppb). The engineering units state allows display of the selected engineering units.

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

☐ 2. Press the *NEXT* smart key until the desired engineering units appear.

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

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

# PROCEDURE PR30 - VALENCE SETTING

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the valence state. This setting is available in the Advanced programming mode and applies to the ion concentration state.

**Parts** None.

**Tools** None.

## PROCEDURE

The ion concentration state functions by associating an end millivolt value to an end magnitude value. The valence determines the millivolt change per decade of concentration. It is defined by the Nernst equation:

- 59.16-millivolt per decade for a valence equal to one.
- 29.58-millivolt per decade for a valence equal to two.
- 19.72-millivolt per decade for a valence equal to three.

If the valence is negative, the millivolt per concentration relationship has a negative slope. The allowable valence values range from -3 to +3.

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

☐ 2. Use the ▲ smart key to increment the displayed value or the ▼ smart key to decrement the displayed value.

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

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

# PROCEDURE PR31 - MAGNITUDES SETTING

## *PURPOSE/SCOPE*

1 min.

This procedure describes how to configure the magnitudes state. This setting is available in the Advanced programming mode and applies to the ion concentration state.

**Parts** None.

**Tools** None.

## *PROCEDURE*

The number of magnitudes defines the transmitter output. Two magnitudes would set the output to zero to ten percent for the first magnitude and ten to 100 percent for the second magnitude.

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

☐ 2. Use the ▲ smart key to increment the displayed value or the ▼ smart key to decrement the displayed value.

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

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

# PROCEDURE PR32 - ENDING MAGNITUDE SETTING

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the end magnitude state. This setting is available in the Advanced programming mode and applies to the ion concentration state.

**Parts** None.

**Tools** None.

## PROCEDURE

The ion concentration state functions by associating an end millivolt value to an end magnitude value. The end magnitude value can be set to 10, 100 or 1,000.

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

☐ 2. Use the ▲ smart key to increment the displayed value or the ▼ smart key to decrement the displayed value.

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

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

# PROCEDURE PR33 - ENDING MILLIVOLT SETTING

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the end millivolt state. This setting is available in the Advanced programming mode and applies to the ion concentration state.

**Parts** None.

**Tools** None.

## PROCEDURE

The ion concentration state functions by associating an end millivolt value to an end magnitude value.

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

☐ 2. Use the ▲ smart key to increment the displayed value or the ▼ smart key to decrement the displayed value.

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

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

# PROCEDURE PR34 - REFERENCE IMPEDANCE SETTING

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the reference impedance state. This setting is available in the Advanced programming mode and applies to the glass, Antimony and Custom pH states, the ORP and pION states, and the ion concentration state.

**Parts** None.

**Tools** None.

## PROCEDURE

The reference impedance (*REF Z*) is the reference electrode impedance that triggers a diagnostic condition. The REF Z value can be manually set or accepted at the default value of 100 kilohms. More information about diagnostic reporting is contained in Section 12.

The reference impedance of a new ABB pH sensor is typically one to two kilohms as measured by the diagnostic circuit of the transmitter. Performance of the reference electrode is unaffected up to 100 kilohms (the default value). Adjustment to higher resistance values is allowed; however, acceptable performance of the sensor must be determined by the customer.

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

☐ 2. The transmitter displays the current reference impedance setting.

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.

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

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

# PROCEDURE PR35 - 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 or three-kilohm Balco RTD, 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* (no temperature sensor), *3K.BLCO* (three-kilohm BALCO RTD) and *PT100* (Pt 100 RTD).

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

# PROCEDURE PR36 - TEMPERATURE COMPENSATION TYPE SELECTION

## PURPOSE/SCOPE

1 min.

This procedure describes how to configure the temperature compensation state. This setting is available in both the Basic and Advanced programming modes.

**Parts** None.

**Tools** None.

## PROCEDURE

Temperature has two effects on electrochemical sensors. The Nernstian effect causes the sensor output to increase with increasing temperature. A pH sensor exhibits an increase of approximately:

$$\frac{0.03\ pH}{pH\ unit}\ from\ \frac{7.00\ pH}{10^\circ C}$$

Since ABB sensors use a Silver/Silver Chloride measurement and reference half cell, the pH value where the sensor output is not affected by temperature (isopotential point) is 7.00 pH.

The second effect of temperature is on the actual chemistry of the solution. Since ion disassociation is a function of temperature, measured ion properties such as pH, ORP and pION are affected by changes in process temperature. This effect cannot be predicted due to differences between solution chemistries.

The temperature compensation state sets the compensation method to reflect these temperature effects. The three states of temperature compensation are: Manual Nernstian, automatic Nernstian and automatic Nernstian with solution coefficient. Table PR36-1 describes the function and programming mode of each state.

*Table PR36-1. Temperature Compensation States*

| State | Display | Programming Mode | Function |
|---|---|---|---|
| Manual Nernstian | *MANUAL* | Basic and Advanced | Used when fixed temperature value can be used instead of measured value. Initial value is 25°C. Use temperature calibrate state to change fixed temperature value. Nernstian compensation applied using fixed temperature value. |
| Automatic Nernstian | *AUTO* | Basic and Advanced | Used when measured temperature value is being provided by temperature sensor. Nernstian compensation applied using measured value. |

*Table PR36-1. Temperature Compensation States (Continued)*

| State | Display | Programming Mode | Function |
|---|---|---|---|
| Automatic Nernstian with solution coefficient | *AUT.SOL* | Advanced | Used when measured temperature value is being provided by temperature sensor. Nernstian compensation and solution coefficient applied using measured value. |

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

☐ 2. The currently configured temperature compensation state appears first. Press the *NEXT* smart key until the desired temperature compensation state appears.

**NOTE:** If the desired temperature compensation type is automatic Nernstian with solution coefficient (*AUT.SOL*), the transmitter must first be configured for automatic Nernstian (*AUTO*). When the tests on the representative sample of the process are completed (refer to PR37), the transmitter must then be configured for *AUT.SOL* and the solution coefficient must be entered.

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

☐ 4. If the desired compensation type is *MANUAL* or *AUTO*, press the *NEXT* smart key to go on to the next configuration parameter. If the desired compensation type is *AUT.SOL*, go on to Step 5.

☐ 5. At this point, the transmitter should be configured for *AUTO*. Press the *exit to MEASURE* smart key.

☐ 6. When the *SAVE?* screen comes up, press the *YES* smart key and the transmitter goes to the measure mode. Go on to PR37.

# PROCEDURE PR37 - SOLUTION COEFFICIENT SETTING

## PURPOSE/SCOPE

20 min.

This procedure describes how to configure the solution coefficient. This setting is available in the Advanced programming mode.

**Parts** None.

**Tools**

- Type TB82 transmitter set for automatic Nernstian temperature compensation, and associated sensor with temperature sensing device.
- Representative sample of the process solution.
- Means to raise or lower the temperature of the sample to represent the range of temperature expected in the process solution at the final installed location.

## PROCEDURE

**NOTE:** Automatic Nernstian with solution coefficient compensation can only be used for processes that are extremely repeatable with regards to the adjusted parameter (pH, ORP or pION).

The automatic Nernstian with solution coefficient state compensates the sensor output to a standard temperature value of 25-degrees Celsius using the Nernst equation and a solution coefficient.

The solution coefficient is in terms of pH units per ten-degrees Celsius for the pH analyzer state and has a range of ±1.999 pH units per ten-degrees Celsius. The solution coefficient is in terms of millivolts per ten-degrees Celsius for the ORP, pION and ion concentration states and has a range of ±19.99 millivolts per ten-degrees Celsius.

This compensation method also requires an input from a temperature sensing device. This input can be either from a Pt 100 or three-kilohm Balco RTD. It must be set to the appropriate temperature sensor in the temperature sensor state. The allowable temperature range is zero to 140-degrees Celsius.

This compensation method adjusts for Nernst and solution effects. The standardized displayed process variable complies with the following formulas:

$$pH_{indication} = pH_{Nernstian} \pm COEF \times ((T - 25^\circ C) / (10^\circ C))$$

$$mV_{indication} = mV \pm COEF \times ((T - 25^\circ C) / (10^\circ C))$$

where:

| | |
|---|---|
| *COEF* | pH or mV change per ten-degrees Celsius. |
| *pHNernstian* | Nernstian pH value referenced at 25-degrees Celsius after applying the factory and process calibration values. |
| *pHindication* | pH value indicated on the transmitter and proportional to the current output value. |
| *mV* | millivolt value of the sensor output after applying the factory and process calibration values. |
| *mVindication* | mV value indicated on the transmitter and proportional to the current output value. |
| *T* | temperature of the solution in degrees Celsius after applying the factory and process calibration values. |

**NOTE:** The transmitter must be set for automatic Nernstian temperature compensation before beginning this procedure.

☐ 1. Obtain a representative sample of the process solution.

☐ 2. Heat or cool the sample to the lowest point in the temperature range expected in the process solution in the final installed location.

☐ 3. Record the value as $T_L$ in Table PR37-1.

*Table PR37-1. Solution Coefficient Values*

| Parameter | Value |
|---|---|
| $T_L$ | |
| $PV_L$ | |
| $T_H$ | |
| $PV_H$ | |
| COEF | |

☐ 4. Use the Type TB82 transmitter and associated sensor with temperature sensing device to measure the process variable.

☐ 5. Record the value as $PV_L$ in Table PR37-1.

☐ 6. Heat the sample to the highest point in the temperature range expected in the process solution in the final installed location.

☐ 7. Record the value as $T_H$ in Table PR37-1.

☐ 8. Use the Type TB82 transmitter and associated sensor with temperature sensing device to measure the process variable.

☐ 9. Record the value as $PV_H$ in Table PR37-1.

☐ 10. Use the values in Table PR37-1 to calculate the coefficient using the following formula:

$$COEF = ((PV_L - PV_H)/(T_H - T_L)) \times 10$$

where:

| | |
|---|---|
| $COEF$ | solution coefficient to be entered into transmitter. |
| $PV_L$ | process variable value at low end of temperature range ($T_L$). |
| $PV_H$ | process variable value at high end of temperature range ($T_H$). |
| $T_L$ | temperature at low end of range. |
| $T_H$ | temperature at high end of range. |

11. Record the value as COEF in Table PR37-1. If the process variable decreased as temperature increased, the coefficient must be positive. If the process variable increased as temperature increased, the coefficient must be negative.

☐ 12. Press the *NEXT* smart key until *CONFIGURE* is highlighted on the display.

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

☐ 14. The *MODIFY* screen appears. Press the *YES* smart key to modify the configuration.

☐ 15. If the configure mode is password protected, perform this step and then go on to Step 16. If it is not password protected, go on to Step 16. 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 15a and 15b for each digit.

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

☐ 16. Press the *NEXT* smart key to scroll through the configuration states until *TC.TYPE* appears.

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

☐ 18. The currently configured temperature compensation state appears first (*AUTO*). Press the *NEXT* smart key until *AUT.SOL* appears.

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

☐ 20. The transmitter displays the current solution coefficient value. Enter the value recorded for COEF in Table PR37-1.

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 20a and 20b for each digit.

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

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

# PROCEDURE PR38 - 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. Transmitters with the Basic programming option have a linear output type and require configuration of the process variable lower and upper values. Transmitters with the Advanced programming option can have either a linear or nonlinear output type. The linear output state in the Advanced configuration is the same as for the Basic configuration. The nonlinear output state is available only in the Advanced configuration and five break points, expressed in terms of percent input against percent output, must be configured.

The linear output state sets the process variable lower and upper values for the linear output range. The default values for the output represent the full scale process variable range (zero to 14 pH). If requiring a reverse acting output, reverse the four and 20-milliampere process variable values by using, for instance, 14 pH for the four-milliampere value and zero pH for the 20-milliampere value.

☐ 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. If using Basic programming, press the *NEXT* smart key to go on to the next configuration parameter. If using Advanced programming, go on to Step 5.

☐ 5. If using a linear output, press the *SELECT* smart key to choose the *LINEAR* output state and go on to Step 6. If using a nonlinear output, go to Step 7.

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

☐ 7. Press the *NEXT* smart key to change the output state from *LINEAR* to *NON.LIN*.

☐ 8. Press the *SELECT* smart key to accept the nonlinear output state. Go to PR43 to set the break points.

# PROCEDURE PR39 - CONFIGURE MODE DAMPING ADJUSTMENT

## *PURPOSE/SCOPE*

1 min.

This procedure describes how to configure the damping on the transmitter output through the damping state. This setting is available in both the Basic and Advanced programming modes.

**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.

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

# PROCEDURE PR40 - 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. When a sensor does not have a solution ground, such as sensors that are not Advantage Series sensors (Type TB5 sensors), the diagnostic signal cannot be injected into the process liquid. The diagnostics should be disabled for these situations and for applications using very pure water.

☐ 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 PR41 - 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 PR42 - 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-milliampere output range. A ten-percent spike magnitude generates a 1.6-milliampere spike, a 20-percent spike magnitude generates a 3.2-milliampere spike, etc.

☐ 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.

**NOTE:** If the spike state in the output/hold mode has not been used, setting or changing the spike output level to zero in the configure mode automatically turns off the spike output. Setting or changing the spike output level to a nonzero value in the configure mode automatically turns on the spike output. However, changing the spike state in the output/hold mode from off to on, or vice versa, overrides the configured value. The spike state in the output/hold mode must be used to turn the spike output on or off before the configuration change can take effect.

☐ 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 PR43 - BREAK POINTS SETTING

## PURPOSE/SCOPE

5 min.

This procedure describes how to configure the break points when choosing nonlinear in the output state. This setting is available in the Advanced programming mode.

**Parts** None.

**Tools** None.

## PROCEDURE

The nonlinear output state sets the end point values and break points of the desired nonlinear output response. The default values for the output represent the full scale process variable range of -1,999 to +1,999 millivolts and the break points are set for a linear output (e.g., 20-percent input equals 20-percent output).

To define the break points, a plot of the process variable against the desired output (or variable that represents the output value) must be segmented into six linear regions. The points where the linear regions intersect should fall on the nonlinear function and represent the break points that are entered into the nonlinear output state.

As with the linear output state, the output range must be set to represent the zero-percent input and zero-percent output, and 100-percent input and 100-percent output points. Since the zero-percent and 100-percent points are defined, the break point information (e.g., $X_1$ and $Y_1$, $X_2$ and $Y_2$, etc. values) do not include the zero-percent input and zero-percent output, and 100-percent input and 100-percent output values. Also, a reverse acting output can be implemented by reversing the four-milliampere process variable value and the 20-milliampere process variable value.

Table PR43-1 and Figure PR43-1 illustrate the use of the nonlinear output function. This information is for illustration purposes only and does not characterize any specific application.

*Table PR43-1. Nonlinear Output Example*

| Break Point | ORP Signal (mV) | Output Range (mA) | Percent Input (%) | Percent Output (%) |
|---|---|---|---|---|
| N/A[1] | 0 | 4.0 | 0 | 0 |
| 1 | 120 | 5.6 | $X_1$ = 20 | $Y_1$ = 10 |

*Table PR43-1. Nonlinear Output Example (Continued)*

| Break Point | ORP Signal (mV) | Output Range (mA) | Percent Input (%) | Percent Output (%) |
|---|---|---|---|---|
| 2 | 270 | 8.8 | $X_2 = 45$ | $Y_2 = 30$ |
| 3 | 360 | 12.0 | $X_3 = 60$ | $Y_3 = 50$ |
| 4 | 420 | 15.2 | $X_4 = 70$ | $Y_4 = 70$ |
| 5 | 540 | 19.2 | $X_5 = 90$ | $Y_5 = 95$ |
| N/A[1] | 600 | 20.0 | 100 | 100 |

**NOTE:**

1. The end point values were previously set in the output range state.

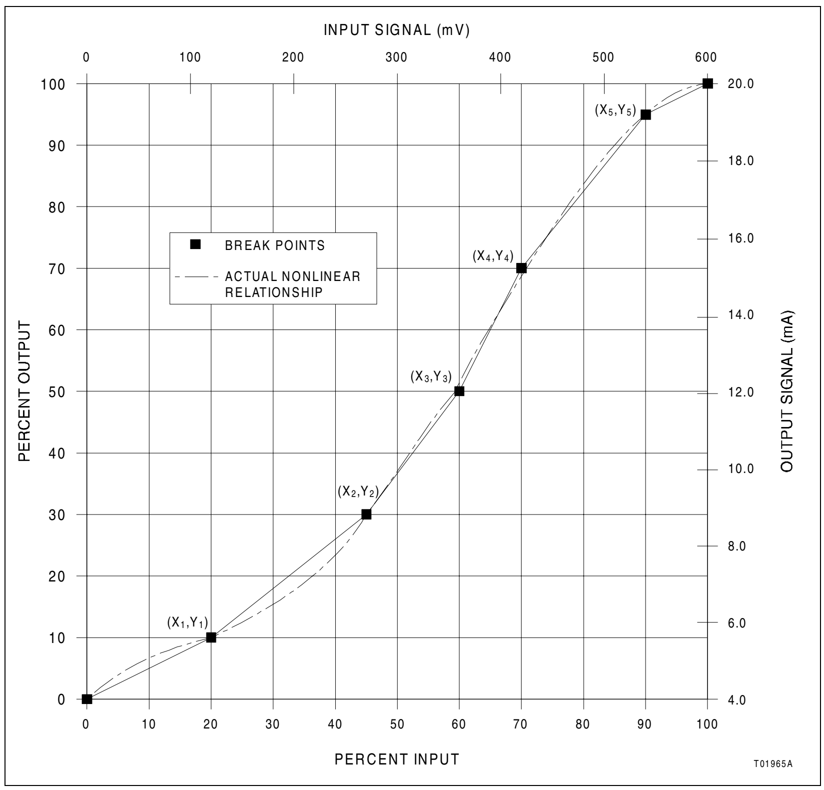


*Figure PR43-1. Break Point Determination*

☐ 1. Set the input percentage for the first break point ($X_1$).

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 1a and 1b for each digit.

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

☐ 2. Set the output percentage for the first break point ($Y_1$).

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. Repeat Steps 1 and 2 for the remaining four break points.

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

# PROCEDURE PR44 - CONFIGURATION LOCKOUT

## PURPOSE/SCOPE

5 min.

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

**Parts** None.

**Tools**

- Bladed 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 bladed 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 PR44-1 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.

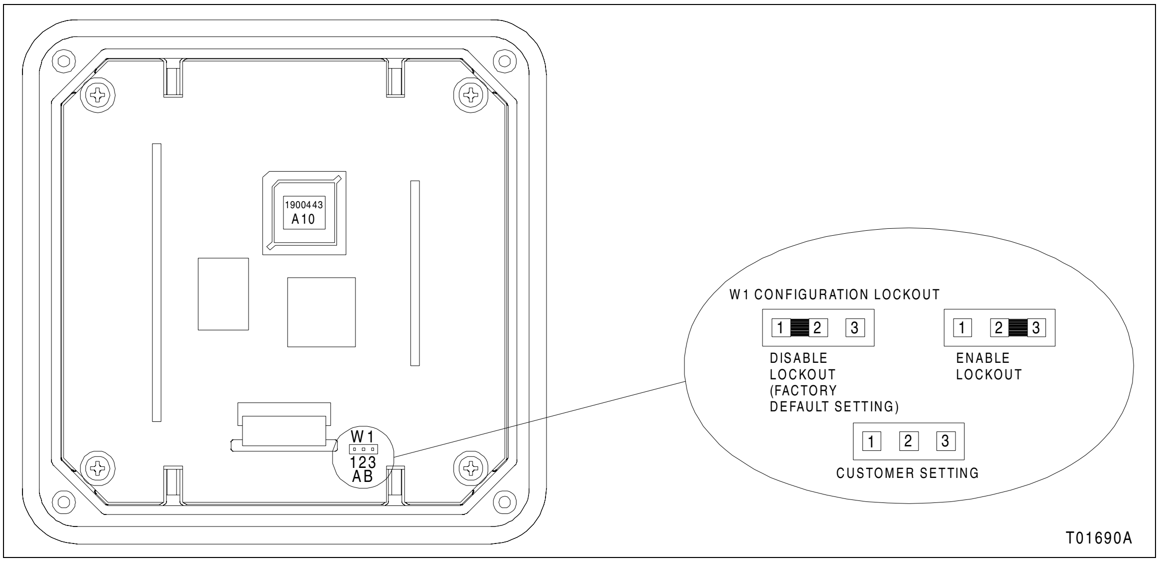


*Figure PR44-1.  Configuration Lockout Jumper*

# PROCEDURE PR45 - 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 PR49 for the reset security procedure.

### *Setting Security and Password*

☐ 1. Press the *NEXT* 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 *NEXT* 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. Press the ▲ smart key to change the security from *ON* to *OFF*.

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

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

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

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

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

### *Changing Security or Password*

☐ 1. Press the *NEXT* 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 change the security, press the ▲ smart key to toggle the security between *OFF* and *ON* and continue with Step 4. To leave the security unchanged, 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 change the security, press the ▲ smart key to toggle the security between *OFF* and *ON* and continue with Step 6. To leave the security unchanged, 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 change the security, press the ▲ smart key to toggle the security between *OFF* and *ON* and continue with Step 8. To leave the security unchanged, 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. 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 9a and 9b for each digit.

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

☐ 10. 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 10a and 10b for each digit.

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

# PROCEDURE PR46 - SECONDARY DISPLAY OPERATION

## *PURPOSE/SCOPE*

1 min.

This procedure describes how to use the secondary display mode and states of operation.

**Parts** None.

**Tools** None.

## *PROCEDURE*

☐ 1. Press the *NEXT* 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.

# PROCEDURE PR47 - 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 reduce 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 a 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 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 PR48 - 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 PR48-1 lists the factory software default configuration settings.

*Table PR48-1. Factory Software Defaults*

| Parameter | Default |
|---|---|
| Instrument mode | Basic |
| Analyzer type | pH, glass |
| Temperature sensor | 3-kΩ Balco |
| Temperature compensation | Manual |
| Output range | 0 to 14 pH |
| 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 PR49 - 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:

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

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

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

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

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

j. 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 PR50 - 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 PR51 - TRANSMITTER SOFT BOOT

## PURPOSE/SCOPE

1 min.

This procedure describes how to perform a transmitter reboot without affecting existing parameters.

**Parts** None.

**Tools** None.

## PROCEDURE

The soft boot user state initiates a hardware reset. This reset is identical to cycling power and 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 reboot operation.

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

# PROCEDURE PR52 - PROBLEM CODES

## PURPOSE/SCOPE

1 min.

This procedure contains a table listing the problem codes, their associated text strings, a brief description of the problems and corrective action necessary to solve them.

**Parts** None.

**Tools** None.

## PROCEDURE

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 PR52-1 lists common problem codes and Table PR52-2 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 PR52-3 lists the HART problem messages that can appear on the Type STT terminal. Refer to the ***Type STT Smart Transmitter Terminal Instruction*** for more information on HART transmitters.

*Table PR52-1. Common Problem Codes*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC1 | LO.GLS.Z | Low pH measuring electrode impedance | Verify sensor wiring connections. |
| | | | Verify glass electrode is intact. If broken, replace sensor. |
| | | | Remove any liquids, oils, scales or corrosion from transmitter terminal block or extension cable junction box terminals. |
| | | | Verify sensor responds to pH buffers. Replace sensor if it does not respond. |
| | | | Change configuration to proper analyzer type if sensor is not a glass pH sensor. |

*Table PR52-1. Common Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC2 | HI.REF.Z | High reference electrode impedance | Verify sensor wiring connections. |
| | | | Verify reference is clean. Remove any foreign material. |
| | | | Clean sensor and verify it responds to pH buffer. Replace sensor if it does not respond. |
| | | | Change configuration to increase reference impedance limit if sensor is functioning properly in buffers and is in final installed location. |
| 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 pH buffers. Replace sensor and/or sensor extension cable (if present) if sensor does not respond. |
| | | | Electronically test sensor (PR55). Replace if it does not meet requirements. |
| PC5 | OPEN | Open sensor cable or sensor out of solution | 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 pH buffers. Replace sensor and/or sensor extension cable (if present) if sensor does not respond. |
| | | | Electronically test sensor (PR55). 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 sensor wiring connections. |
| | | | Remove any liquids, oils, scales or corrosion from transmitter terminal block or extension cable junction box terminals. |
| | | | Clean sensor and perform a buffer and process calibration. |
| | | | Conduct a temperature calibration. If not using temperature sensor, verify configuration for TMP.SNS is NONE. |
| | | | Electronically test the sensor and temperature compensator (PR55). Replace sensor if it does not meet requirements. |
| 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 sensor wiring connections. |
| | | | Remove any liquids, oils, scales or corrosion from transmitter terminal block or extension cable junction box terminals. |
| | | | Clean sensor and perform a buffer and process calibration. |
| | | | Conduct a temperature calibration. If not using temperature sensor, verify configuration for TMP.SNS is NONE. |
| | | | Electronically test the sensor and temperature compensator (PR55). Replace sensor if it does not meet requirements. |

*Table PR52-1. Common Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| 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, scales or corrosion from transmitter terminal block or extension cable junction box terminals. |
| | | | Verify sensor responds to pH buffers. Replace sensor and/or sensor extension cable (if present) if sensor does not respond. |
| | | | Electronically test sensor (PR55). 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 pH buffers. Replace sensor and/or sensor extension cable (if present) if sensor does not respond. |
| | | | Electronically test sensor (PR55). Replace if it does not meet requirements. |
| PC10 | HI.TEMP | Temperature above transmitter range | Verify process conditions are within transmitter range. PV must be within transmitter range. |
| | | | Verify process conditions are within configured output range. If PV is outside configured range, increase output 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 a buffer and process calibration. |
| | | | Conduct a temperature calibration. If not using temperature sensor, verify configuration for TMP.SNS is NONE. |
| | | | Electronically test the sensor and temperature compensator (PR55). 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 process conditions are within configured output range. If PV is outside configured range, increase output 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 a buffer and process calibration. |
| | | | Conduct a temperature calibration. If not using temperature sensor, verify configuration for TMP.SNS is NONE. |
| | | | Electronically test sensor and temperature compensator (PR55). Replace sensor if it does not meet requirements. |

*Table PR52-1. Common Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC12 | HI.T.AD | Open or missing temperature sensor | Verify process conditions are within transmitter range. PV must be within transmitter range. |
| | | | Verify process conditions are within configured output range. If PV is outside configured range, increase output 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 a buffer and process calibration. |
| | | | Conduct temperature calibration. If not using temperature sensor, verify configuration for TMP.SNS is NONE. |
| | | | Electronically test sensor and temperature compensator (PR55). Replace sensor if it does not meet requirements. |
| | | | Replace pH/ORP/pION input PCB assembly. |
| PC13 | LO.T.AD | Shorted temperature sensor | Verify process conditions are within transmitter range. PV must be within transmitter range. |
| | | | Verify process conditions are within configured output range. If PV is outside configured range, increase output 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 buffer and process calibration. |
| | | | Conduct temperature calibration. If not using temperature sensor, verify configuration for TMP.SNS is NONE. |
| | | | Electronically test sensor and temperature compensator (PR55). Replace sensor if it does not meet requirements. |
| | | | Replace pH/ORP/pION input PCB assembly. |
| PC14 | +HI.OFF | Large positive sensor offset (>180 mV) | Clean sensor and perform buffer and process calibration. |
| | | | Inspect sensor and cabling for shorts. Remove all potential shorts to ground, conduit or metals. |
| | | | If sensor is functioning properly, order spare sensor to replace existing sensor. Replace existing sensor with spare when transmitter does not accept calibration values. |
| PC15 | -HI.OFF | Large negative sensor offset (<-180 mV) | Clean sensor and perform buffer and process calibration. |
| | | | Inspect sensor and cabling for shorts. Remove all potential shorts to ground, conduit or metals. |
| | | | If sensor is functioning properly, order spare sensor to replace existing sensor. Replace existing sensor with spare when transmitter does not accept calibration values. |
| PC16 | HI.EFF | High sensor efficiency (>110%) | Verify proper buffer values were used for calibration and repeat buffer calibration. |
| | | | Clean sensor and repeat buffer calibration. |

*Table PR52-1. Common Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC17 | LO.EFF | Low sensor efficiency (<60%) | Verify proper buffer values were used for calibration and repeat buffer calibration. |
| | | | Clean sensor and repeat buffer calibration. |
| | | | Look for shorts in sensor and extension cable. Remove all potential shorts. Remove any liquids, oils, scales or corrosion from transmitter terminal block or junction box terminals. |
| | | | If sensor is functioning properly, order new sensor to replace existing sensor once transmitter does not accept calibration values. |

*Table PR52-2. Uncommon Problem Codes*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC20 | BAD.SEE | Bad SEEPROM or pH/ORP/pION input PCB assembly | Input PCB assembly factory calibration constants can not be loaded. Calibrate sensor and order replacement pH/ORP/pION 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 can be performed. |
| PC22 | BLNK.uP | Blank microprocessor EEPROM | Cycle transmitter power. |
| | | | Contact ABB. |
| PC23 | SEE.EMI | Unverifiable SEEPROM bus read operation | Cycle transmitter power. |
| | | | Contact ABB. |
| PC24 | ROM.EMI | Unverifiable EEPROM/ROM bus read operation | Cycle transmitter power. |
| | | | Contact ABB. |
| PC25 | ROM.SUM | Incorrect EPROM checksum | Cycle transmitter power. |
| | | | Contact ABB. |
| PC30 | PV.F.CAL | Out of range or missing factory calibration for PV | Contact ABB for factory calibration procedure. Calibrate sensor for short-term usage until factory calibration can be performed. |
| PC31 | BA.F.CAL | Out of range or missing factory calibration for 3-kΩ Balco temperature sensor | Contact ABB for factory calibration procedure. Calibrate temperature sensor for short-term usage until factory calibration can be performed. |
| PC32 | PT.F.CAL | Out of range or missing factory calibration for Pt 100 temperature sensor | Contact ABB for factory calibration procedure. Calibrate temperature sensor for short-term usage until factory calibration can be performed. |
| PC33 | RZ.F.CAL | Out of range or missing factory calibration for reference impedance measurement | Contact ABB for factory calibration procedure. Reference impedance diagnostic will not be operational until factory calibration is performed. Disable diagnostics until factory calibration can be performed. |

*Table PR52-2. Uncommon Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC34 | PV.CHKS | Incorrect or missing PV checksum | Cycle transmitter power. |
| | | | Remove transmitter from installed location and relocate to noise-free environment. If problem does not appear, transmitter needs new final location or additional shielding on transmitter and/or wiring. |
| | | | Contact ABB. |
| PC35 | BA.CHKS | Incorrect or missing 3-kΩ Balco temperature sensor checksum | Cycle transmitter power. |
| | | | Remove transmitter from installed location and relocate to noise-free environment. If problem does not appear, transmitter needs new final location or additional shielding on transmitter and/or wiring. |
| | | | Contact ABB. |
| PC36 | PT.CHKS | Incorrect or missing Pt 100 temperature sensor checksum | Cycle transmitter power. |
| | | | Remove transmitter from installed location and relocate to noise-free environment. If problem does not appear, transmitter needs new final location or additional shielding on transmitter and/or wiring. |
| | | | Contact ABB. |
| PC37 | PZ.CHKS | Incorrect or missing reference impedance measurement checksum | Cycle transmitter power. |
| | | | Remove transmitter from installed location and relocate to noise-free environment. If problem does not appear, transmitter needs new final location or additional shielding on transmitter and/or wiring. |
| | | | Contact ABB. |
| PC40 | HI.R.CKT | Reference impedance circuit failure - high range error | Verify sensor wiring connections. |
| | | | Verify reference is clean. Remove any foreign material. |
| | | | Clean sensor and verify it responds to pH buffer. Replace sensor if it does not respond. |
| | | | Change configuration to increase reference impedance limit if sensor is functioning properly in buffers and is in final installed location. |
| | | | Input PCB reference impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |

*Table PR52-2. Uncommon Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC41 | LO.R.CKT | Reference impedance circuit failure - low range error | Verify sensor wiring connections. |
| | | | Electronically test sensor. Replace if it does not meet requirements. |
| | | | Input PCB reference impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC42 | HI.RZ.AD | Reference impedance above transmitter A/D range | Input PCB reference impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC43 | LO.RZ.AD | Reference impedance below transmitter A/D range | Input PCB reference impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC44 | HI.G.CKT | pH measuring electrode impedance circuit failure - high range error | 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 pH buffers. Replace sensor and/or sensor extension cable (if present) if sensor does not respond. |
| | | | Electronically test sensor (PR55). Replace if it does not meet requirements. |
| | | | Input PCB assembly glass pH impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |

*Table PR52-2. Uncommon Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC45 | LO.G.CKT | pH measuring electrode impedance circuit failure - low range error | Verify sensor wiring connections. |
| | | | Verify glass electrode is intact. If broken, replace sensor. |
| | | | Remove any liquids, oils, scales or corrosion from transmitter terminal block or extension cable junction box terminals. |
| | | | Verify sensor responds to pH buffers. Replace sensor if it does not respond. |
| | | | Change configuration to proper analyzer type if sensor is not a glass pH sensor. |
| | | | Input PCB assembly glass pH impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC46 | HI.GL.DA | pH measuring electrode impedance above transmitter A/D range | Input PCB assembly glass pH impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC47 | LO.GL.AD | pH measuring electrode impedance below transmitter A/D range | Input PCB assembly glass pH impedance circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC48 | HI.C.CKT | Cable diagnostic circuit failure - high range error | Verify sensor wiring connections. |
| | | | Remove any liquids, oils, scales or corrosion from transmitter terminal block or extension cable junction box terminals. |
| | | | Electronically test sensor (PR55). Replace if it does not meet requirements. |
| | | | Input PCB assembly diagnostic circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC49 | LO.C.CKT | Cable diagnostic circuit failure - low range error | Verify sensor wiring connections. |
| | | | Remove any liquids, oils, scales or corrosion from transmitter terminal block or extension cable junction box terminals. |
| | | | Electronically test sensor (PR55). Replace if it does not meet requirements. |
| | | | Input PCB assembly diagnostic circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |

*Table PR52-2. Uncommon Problem Codes (Continued)*

| Code | Text String | Description | Corrective Action |
|---|---|---|---|
| PC50 | HI.CA.AD | Cable diagnostic signal above transmitter A/D range | Input PCB assembly diagnostic circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |
| PC51 | LO.CA.AD | Cable diagnostic signal below transmitter A/D range | Input PCB assembly diagnostic circuit failure exists. Disable diagnostics and order replacement input PCB assembly. Existing input PCB assembly should properly function until new assembly is received. |

*Table PR52-3. HART Problem Messages*

| Message | Description | Corrective Action |
|---|---|---|
| CAL OFFSET WARNING | Large positive sensor offset (>180 mV) or large negative sensor offset (<-180 mV) | Clean sensor and perform buffer and process calibration. |
| | | Inspect sensor and cabling for shorts. Remove all potential shorts to ground, conduit or metals. |
| | | If sensor is functioning properly, order spare sensor to replace existing sensor. Replace existing sensor with spare when transmitter does not accept calibration values. |
| CAL SLOPE WARNING | High sensor slope (>110%) or low sensor slope (<60%) | Verify proper buffer values were used for calibration and repeat buffer calibration. |
| | | Clean sensor and repeat buffer calibration. |
| | | Look for shorts in sensor and extension cable. Remove all potential shorts. Remove any liquids, oils, scales or corrosion from transmitter terminal block or junction box terminals. |
| | | If sensor is functioning properly, order new sensor to replace existing sensor once transmitter does not accept calibration values. |
| TEMP OFFSET WARNING | High or low temperature offset | Verify sensor wiring connections and inspect cable for shorts. Remove all potential shorts to ground, conduit or metals. |
| | | Verify that sensor had 10 to 15 min. to acclimate to temperature environment to which it was calibrated. |
| | | Disconnect temperature compensator leads from transmitter and measure resistance according to PR55. |
| | | Replace sensor with spare when transmitter does not accept calibration values. |

*Table PR52-3. HART Problem Messages (Continued)*

| Message | Description | Corrective Action |
|---|---|---|
| TEMP SLOPE WARNING | High or low temperature slope | Verify sensor wiring connections and inspect cable for shorts. Remove all potential shorts to ground, conduit or metals. |
| | | Verify that sensor had 10 to 15 min. to acclimate to temperature environment to which it was calibrated. |
| | | Disconnect temperature compensator leads from transmitter and measure resistance according to PR55. |
| | | Replace sensor with spare when transmitter does not accept calibration values. |

# PROCEDURE PR53 - ERROR CODES

## PURPOSE/SCOPE

1 min.

This procedure contains a table listing the error codes, their associated text strings and brief descriptions of the errors.

**Parts** None.

**Tools** None.

## SAFETY CONSIDERATIONS

**WARNING**

**1. 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.**

## PROCEDURE

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 PR53-1 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.

☐ W1 1. 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 instruction.

*Table PR53-1. Error Codes*

| Error Code | Text String | Description |
|---|---|---|
| EC1 | *HI.PV.AD* | Overrange PV A/D |
| EC2 | *LO.PV.AD* | Underrange PV A/D |
| EC3 | *FC.PCB* | 4-wire conductivity board with pH/ORP/pION firmware |
| EC4 | *TC.PCB* | Toroidal conductivity board with pH/ORP/pION firmware |

# PROCEDURE PR54 - SENSOR INSPECTION

## *PURPOSE/SCOPE*

10 min.

This procedure describes how to visually inspect the sensor.

**Parts** None.

**Tools** None.

## *SAFETY CONSIDERATIONS*

| CAUTION | **1. When mechanically cleaning the sensor, always use a soft bristle brush in order to avoid damage to the insulating coating on the solution ground (the metallic collar around the measuring electrode). Damage to this coating will cause the reference diagnostics to malfunction.** |
|---|---|

## *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 due to their high impedance.

☐ 3. If using a BNC connector, check to see that it is dry and not shorting against any metal, earth grounds or conduit.

### *Measuring Electrode*

☐ 1. Remove the sensor from the process.

☐ 2. Inspect the glass measuring electrode for breaks or cracks.

☐ 3. If breaks or cracks exist, contact ABB for alternative electrode choices or suggestions regarding alternate sensor mounting locations.

☐ 4. If no breaks or cracks exist, use a tissue to dry the measuring electrode.

☐ 5. Hold the sensor up to a bright light.

☐ 6. Scaling appears as a whitish, textured material on the surface of the measuring electrode. Films usually have a streaky, multicolored appearance.

☐ 7. If scales or film exists, clean the sensor using the procedures presented in PR56.

### *Reference Junction*

The reference junction is the area between the measuring electrode and the sensor body.

☐ 1. Inspect the reference junction for heavy foulants or scaling.

☐ C1 2. If heavy fouling or scaling exists, clean the sensor using the procedures presented in PR56.

☐ 3. If the reference junction, especially if it is made of wood, has been attacked by process chemicals, contact ABB for alternate reference junction materials.

### *Solution Ground and O-Ring Seals*

The solution ground on Type TBX5 sensors is the metallic collar around the measuring electrode.

☐ 1. If using a Type TBX5 sensor, inspect the solution ground and sealing O-rings for attack by the process liquid.

☐ 2. If the solution ground shows evidence of corrosion or deterioration or the O-rings appear distorted or swollen, contact ABB for alternate material choices.

# PROCEDURE PR55 - 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.
- Temperature measuring device.

## PROCEDURE

There is an electronic sensor test to verify the integrity of pH/ORP/pION sensor elements and associated cable.

☐ 1. The sensor must remain wet at all times. Place the sensor in a container filled with buffer solution.

☐ 2. Disconnect the sensor leads and automatic temperature compensator leads from the transmitter.

**NOTE:** If the sensor is a standard ABB sensor (Type TB5 sensor) that does not have a solution ground and does have a BNC connector, the center conductor will be equivalent to the blue lead (sense) and the shell will be equivalent to the black lead (reference) as specified in this procedure.

☐ 3. Check the resistance of the temperature compensator.

a. If using a three-kΩ Balco RTD, the expected resistance can be calculated from:

$$R_{TC} = (((T - 25°C) \times 0.0045) + 1) \times 3,000$$

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:

$$R_{TC} = 100 + ((T - 25°C) \times 0.385)$$

where T is the temperature in degrees Celsius. The measured resistance should be within the expected value by ±5%.

☐ 4. Check the conductance between the red temperature compensator lead and each of the other sensor leads (blue, yellow, black, green, white and heavy green). The reading must be less than 0.05 nS.

☐ 5. Check the conductance between the yellow guard lead and each of the other sensor leads (blue, black, green, red, white 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.

☐ 7. Check the conductance between the sensor measurement electrode by measuring across the blue and green leads. The reading must be between one and 10 nS when the sensor and the solution that the sensor is in contact with are at 25°C. If the sensor and solution are above or below 25°C, the conductance value can be estimated at half the conductance for every 8°C above 25°C or double the conductance for every 8°C below 25°C.

☐ 8. Check the voltage of the sensor reference electrode by measuring across the black lead for the sensor under test and the black lead of a known good sensor. When performing this test, the sensor must be removed from the process and placed into a buffer solution. The known good sensor must also be placed in the same buffer solution. The voltage must be between -180 and +180 mV.

# PROCEDURE PR56 - SENSOR CLEANING

## PURPOSE/SCOPE

20 min.

This procedure describes how to clean the sensor.

**Parts** None.

**Tools**

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

## SAFETY CONSIDERATIONS

**WARNING**

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

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

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

## PROCEDURE

ABB pH/ORP/pION 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 not incompatible with HCl.

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

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

☐ 4. Rinse the sensor with water.

## Solvent Dip

This method removes organic coatings.

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

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

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

☐ 4. Remove the solvent using a clean cloth.

☐ 5. Rinse the sensor with soap and water.

## Physical Cleaning

This method removes especially thick scales and accumulations. When mechanically cleaning the sensor, always use a soft bristle brush in order to avoid damaging the insulative coating on the solution ground (the metallic collar around the measuring electrode). This coating is only present on the outer diameter next to the reference junction and must be intact for the reference diagnostics to function properly.

☐ 1. Use a rag, acid brush or tooth brush to clean the sensor. Observe caution in cleaning the glass pH electrode, if present, to prevent glass breakage.

# PROCEDURE PR57 - FRONT BEZEL REMOVAL

## *PURPOSE/SCOPE*

2 min.

This procedure describes how to remove the front bezel.

**Parts** None.

**Tools**

- Bladed 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 bladed 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 PR58 - POWER SUPPLY PCB REMOVAL

## PURPOSE/SCOPE

2 min.

This procedure describes how to remove the power supply PCB.

**Parts** None.

**Tools**

- Phillips head screwdriver.

## PROCEDURE

**NOTE:** Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Use the Phillips head screwdriver to remove the two screws that retain the power supply PCB (Fig. PR58-1).

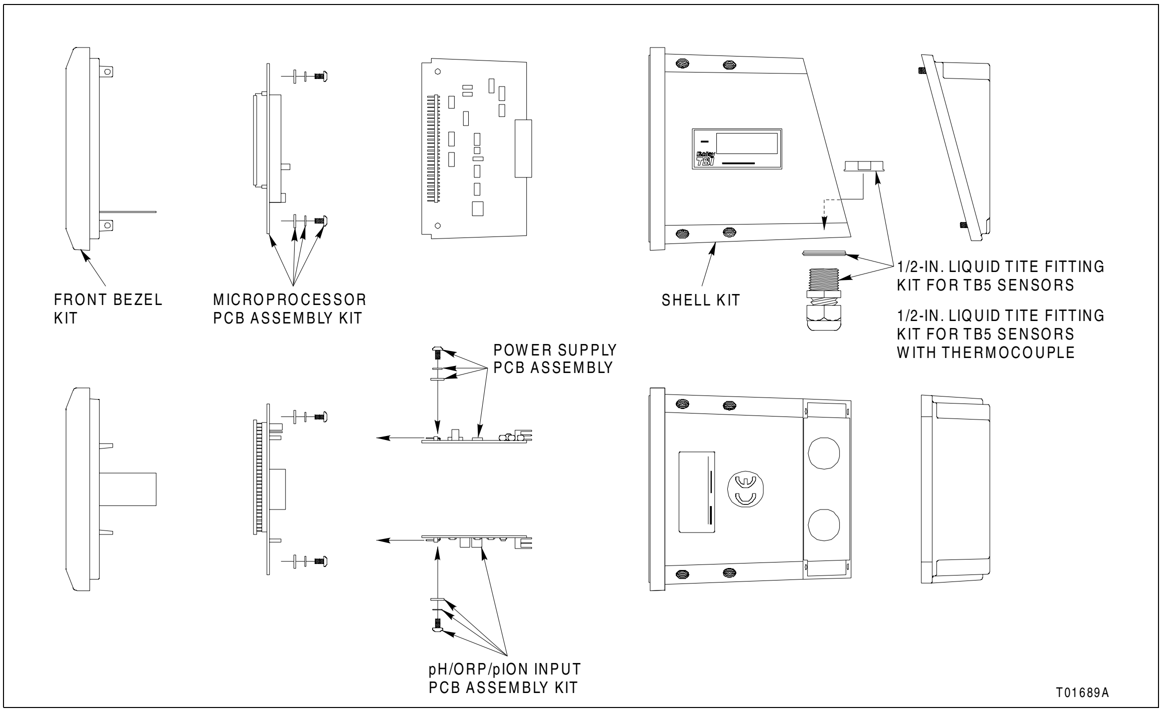


*Figure PR58-1. Power Supply PCB Removal*

☐ 2. Gently pull on the power supply PCB to disengage it from the microprocessor PCB.

# PROCEDURE PR59 - INPUT PCB REMOVAL

## *PURPOSE/SCOPE*

2 min.

This procedure describes how to remove the input PCB.

**Parts** None.

**Tools**

- Phillips head screwdriver.

## *PROCEDURE*

**NOTE:** Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Use the Phillips head screwdriver to remove the two screws that retain the input PCB (Fig. PR59-1).

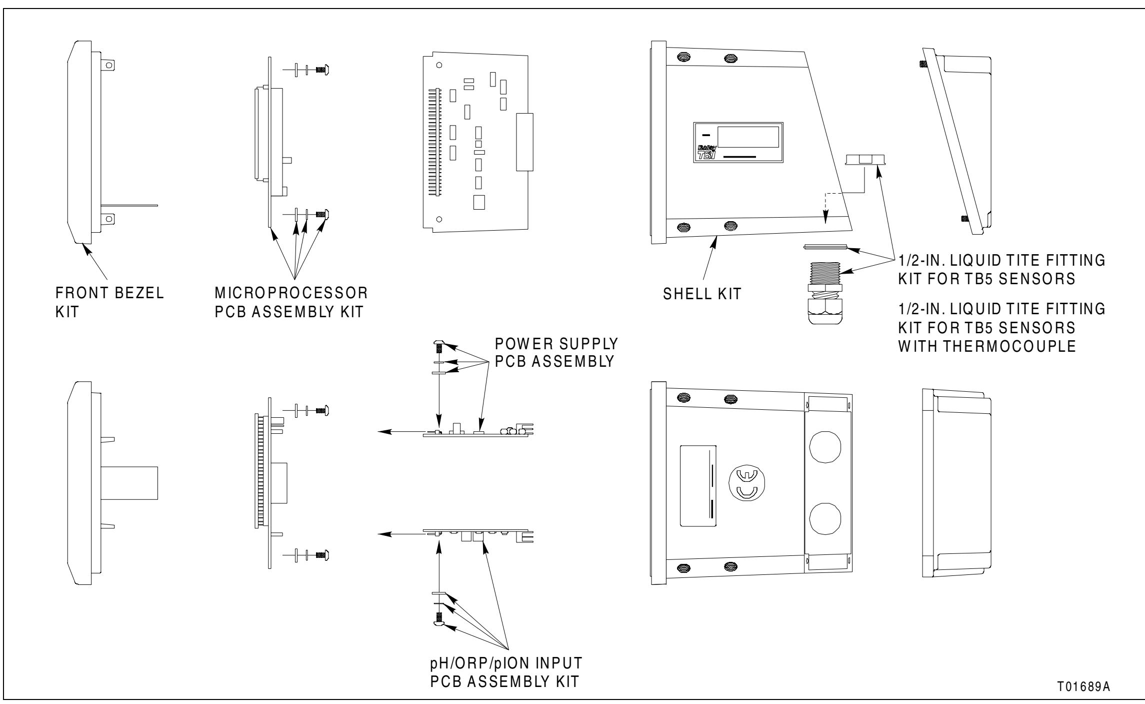


*Figure PR59-1. Input PCB Removal*

☐ 2. Gently pull on the input PCB to disengage it from the microprocessor PCB.

# PROCEDURE PR60 - MICROPROCESSOR PCB REPLACEMENT

## PURPOSE/SCOPE

2 min.

This procedure describes how to replace the microprocessor PCB.

**Parts**

| Number | Qty | Description |
|---|---|---|
| 4TB9515-0154 | 1 | Microprocessor PCB |

**Tools**

- Phillips head 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 head screwdriver to remove the two screws that secure the microprocessor PCB to the front bezel (Fig. PR60-1).

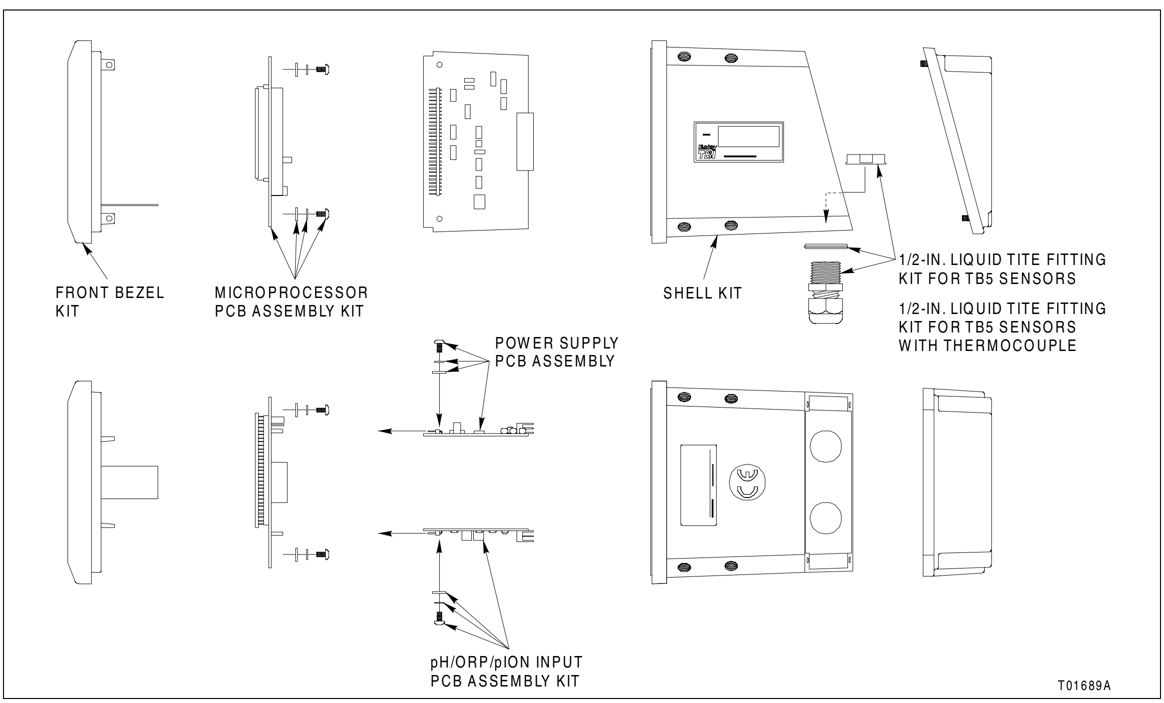


*Figure PR60-1. Microprocessor PCB Replacement*

☐ 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 head screwdriver.

☐ 6. Attach the keypad ribbon cable connector.

# PROCEDURE PR61 - INPUT PCB INSTALLATION

## PURPOSE/SCOPE

2 min.

This procedure describes how to install the input PCB.

**Parts**

| Number | Qty | Description |
|---|---|---|
| 4TB9515-0153 | 1 | Input PCB |

**Tools**

- Phillips head screwdriver.

## PROCEDURE

**NOTE:** Refer to ***SPECIAL HANDLING*** in Section 3 before performing this procedure.

☐ 1. Insert the header on the input PCB into the proper connector on the microprocessor PCB.

☐ 2. Install the two screws to retain the input PCB and tighten them with the Phillips head screwdriver.

# PROCEDURE PR62 - 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 head 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 head screwdriver.

# PROCEDURE PR63 - 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**

- Bladed 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.

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

# PROCEDURE PR64 - 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**

- Bladed 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 bladed 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 bladed screwdriver to tighten the four captive screws.

# PROCEDURE PR65 - 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 |
|---|---|---|
| 4TB9515-0161 | 1 | Shell |

**Tools** None.

# PROCEDURE PR66 - 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.

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# Products and customer support

## Automation Systems
For the following industries:
- Chemical & Pharmaceutical
- Food & Beverage
- Manufacturing
- Metals and Minerals
- Oil, Gas & Petrochemical
- Pulp and Paper

## Drives and Motors
- AC and DC Drives, AC and DC Machines, AC Motors to 1kV
- Drive Systems
- Force Measurement
- Servo Drives

## Controllers & Recorders
- Single and Multi-loop Controllers
- Circular Chart and Strip Chart Recorders
- Paperless Recorders
- Process Indicators

## Flexible Automation
- Industrial Robots and Robot Systems

## Flow Measurement
- Electromagnetic Flowmeters
- Mass Flowmeters
- Turbine Flowmeters
- Wedge Flow Elements

## Marine Systems & Turbochargers
- Electrical Systems
- Marine Equipment
- Offshore Retrofit and Refurbishment

## Process Analytics
- Process Gas Analysis
- Systems Integration

## Transmitters
- Pressure
- Temperature
- Level
- Interface Modules

## Valves, Actuators and Positioners
- Control Valves
- Actuators
- Positioners

## Water, Gas & Industrial Analytics Instrumentation
- pH, Conductivity and Dissolved Oxygen Transmitters and Sensors
- Ammonia, Nitrate, Phosphate, Silica, Sodium, Chloride, Fluoride, Dissolved Oxygen and Hydrazine Analyzers
- Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity

## 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.


### USA
ABB Inc.
Tel: +1 800 HELP 365 (435 7365)
Fax: +1 860 298 7669

### UK
ABB Limited
Tel: +44 (0)1453 826661
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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